Taylor Wimpey UK Ltd

Land South of Jacqueline Road, Markfield

Geo-environmental site assessment

Project no. 301538

AUGUST 2015

RSK GENERAL NOTES

Project No.: 301538 R01 (02)

Title: Geo-environmental site assessment: Land South of Jacqueline Road, Markfield

Client: Taylor Wimpey UK Ltd

Date: August 2015

Office: RSK Environment Ltd, Unit 12, Royal Scot Road, Pride Park, Derby, Derbyshire, DE24 8AJ

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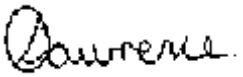
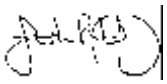
Signature		Signature	
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EXECUTIVE SUMMARY

Site description and proposed development	The site is located off Ratby Lane to the east of Markfield at Fieldhead, in north west Leicestershire. The site covers 5.38 hectares with a small parcel of land to the south that may be used for access purposes. The proposed development is to include up 140 residential properties.
Purpose of assessment	In accordance with the tender documentation, this assessment was undertaken to support outline planning consent for residential development for up to 140 dwellings including means of access, open space and associated development.
PRELIMINARY RISK ASSESSMENT	
Site walkover	A site walkover was carried out in January 2015. The walkover highlighted suspected asbestos containing materials along the northern boundary. An animal water trough was noted in the east of the site. The site is undulating and dips towards the south towards a copse of trees and a public footpath. The site is bounded to the north by residential properties, to the east and south by trees and to the west by Ratby Lane with residential properties beyond. Surface water ponding was noted at this time.
History of site and surrounding area	The site has remained undeveloped since the first available historical map. A small pond was noted on the western boundary although it has since been infilled. The surrounding area had an increase in residential properties since the late 1950s. There is a quarry and brick pits within 1km of the site.
Geology, hydrogeology and hydrology	The site is underlain by superficial deposits of the Oadby Member (unproductive stratum) and bedrock of the South Charnwood Diorites (Secondary B aquifer). There are no public water boreholes within a 2km radius of the site. The site is not located within a groundwater source protection zone (SPZ). The nearest identified surface water feature is a drainage ditch located approximately 160m to the northwest. The site is not located within a flood plain.
Potentially contaminative uses on site and in surrounding area	No potentially contaminative current activities have been identified on and in the area surrounding the site.
Conceptual model	There are no potentially complete pollutant linkages identified with the site.
SITE ASSESSMENT	
Site investigation	The investigation included the excavation of fourteen trial pits, and three soakaway test pits. The investigation revealed variable ground conditions comprising the Oadby Member and the South Charnwood Diorite both directly beneath the topsoil and below the Oadby Member in

	localised areas. The soakaway tests were undertaken in both the South Charnwood Diorites and Oadby Member.
Refined conceptual site model	The laboratory data were compared to generic assessment criteria to evaluate whether the materials were suitable for use on site. The results indicated that the topsoil and subsoil were suitable for use in private gardens.
CONCLUSIONS AND RECOMMENDATIONS	
Environmental assessment	The results of the environmental assessment concluded that the site and the site material are suitable for use within the building development.
Geotechnical assessment	The use of strip foundations are deemed suitable extended to a minimum of 1.00m (within clay) or a minimum of 0.60m (within granular/rock) below existing or finished ground level (whichever is lower) and at least 0.10m into the founding stratum. Deepening and reinforcement of the foundation will be required if the interface of the geologies is encountered. The foundations should be designed for allow for high volume change potential. Ground bearing floor slabs are deemed suitable for use on this site, with suspended floor slabs in areas affected by trees and where made ground is in excess of 0.60m in thickness. The buried concrete specification is DS-1 AC-2z. A CBR of 3% within clay materials and 20% within granular material is recommended for road and pavement design.
Recommendations including issues for further assessment	During the groundwork stage of construction if unexpected contamination is encountered, please contact RSK or an alternative suitably qualified environmental consultant who can advise of an appropriate course of action.
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.	

1 INTRODUCTION

RSK Environment Limited (RSK) was commissioned by Taylor Wimpey UK Ltd to carry out a geo-environmental assessment of the land south of Jacqueline Road, Markfield. This assessment was undertaken to support outline planning consent for residential development for up to 140 dwellings including means of access, open space and associated development.

This report is subject to the RSK service constraints given in Appendix A.

1.1 Background

The site is located to the south of Jacqueline Road, Markfield approximately 8 miles north west of the city of Leicester and occupies 5.38 hectares. It is presently occupied by an open field, with hedgerows and mature trees present along the southern, eastern and western boundaries of the site. Access to the site would be from Ratby Lane to the west of the site. The site setting to the north and west is principally residential with open farmland and woodland to the south and east.

1.2 Objective

The objective of the work is to support a planning application for the site.

1.3 Scope

The scope of the investigation and layout of this report has been designed with consideration of CLR11 (Environment Agency, 2004a) and BS 10175: 2011 (BSI, 2011) and guidance on land contamination reports issued by the Environment Agency (EA) (2010a), a summary of which is presented as Appendix B.

The project was carried out to an agreed brief as set out in RSK's proposal (T301538/L01/mr, dated 21 November 2014). The scope of works for the assessment included:

- a preliminary risk assessment (PRA) to include a review of geological, hydrogeological and hydrological information, a commercially available environmental database, and historical plans; a coal mining search/solution features search/cavities search, a site walkover; and correspondence with regulatory authorities (if necessary); – this information is used to develop an initial conceptual site model to consider any potentially complete pollutant linkages
- an intrusive investigation consisting of 12-16 trial pits with laboratory analysis, with soakaway testing to BRE Digest 365
- development of a refined conceptual site model followed by generic quantitative risk assessment (GQRA) to assess complete pollutant linkages that may require the implementation of mitigation measures to facilitate redevelopment
- identification of outline mitigation measures for complete pollutant linkages or recommendations for further work

- interpretation of ground conditions and geotechnical data to provide recommendations with respect to foundations and infrastructure design
- a factual and interpretative report with recommendations for further works (i.e. undertake a remedial options appraisal to identify appropriate mitigation measures/produce a remedial implementation and verification plan) and/or remediation as necessary
- an assessment of the potential waste classification implications of soil arisings.

1.4 Existing reports

RSK have not been provided with any third party assessments/documents pertaining to the site prior to the preparation of this report.

1.5 Limitations

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.

Suspected asbestos containing materials were identified during the site walkover, but were not observed further into the site within fieldworks and supporting laboratory analysis. Asbestos is often present in discrete areas, thus, although not encountered during the site investigation, may be found during more extensive ground works.

2 THE SITE

2.1 Site location and description

The site is located to the south of Jacqueline Road, Markfield at National Grid reference 449760, 309490, as shown on Figure 1.

The area around the site is a combination of residential, woodlands and open fields as detailed in Table 1.

Table 1: Site setting

To the north:	Residential properties of Jacqueline Road
To the east:	Woodland
To the south:	Public footpath with a narrow band of woodland, with agricultural land beyond
To the west:	Residential properties

The site covers 5.38 hectares at an elevation of approximately 175m above Ordnance Datum (AOD). The highest point of the site is approximately 180m AOD located at the north and centre of the site, and descending towards the south west corner to approximately 173m AOD.

2.2 Proposed development

The subject site is being considered for residential development. A proposed site layout plan had not been provided at the time of reporting, however, it is likely that development will be a combination of two and three storey; two, three and four bedroom houses with associated private gardens, parking, public open space, and infrastructure.

3 PRELIMINARY RISK ASSESSMENT (PRA)

3.1 Site walkover

The site was visited on 13 January 2015 to undertake a site walkover. Photographs and the site walkover checklist are provided in Appendix C. Potentially significant environmental and geotechnical issues arising from the survey are summarised below.

The site comprises a large approximately rectangular undulating grass. There is a ridge approximately in the centre of the site running in a north-south direction. The site has been used for animal grazing and an animal track is present running generally east-west. This track is waterlogged and contains algae in some areas. The area to the far south west of the site is heavily waterlogged.

A water trough is present in the east of the site. The water supply is not included within the services plans provided, however discussions with the land owner suggests that the supply runs from the farmyard off site to the south west.

An overhead power line is highlighted on the service plans and was noted on the site walkover in the field to the south of the site.

A public footpath is noted to the south of the site however, the site itself has also been used for dog walking by local residents.

Large cobbles and small boulders of diorite were noted across the site, particularly along the boundaries, indicating that the bedrock may be encountered at shallow depths.

Recycled road chippings have been used to provide hard standing at the entrance to the site.

Suspected asbestos containing materials (ACM) were noted in the form of cement board on the northern boundary between the residential rear garden fence and the dual barbed wire fence surrounding the site. There is no evidence of ACM further into the field although its absence elsewhere cannot be discounted.

Japanese knotweed is a non-native, highly invasive species and spreads via rhizomes (underground ‘stems’) rather than seeds in the UK. It is found in a range of habitats across the UK including roadsides, riverbanks and derelict land.

Japanese knotweed was not identified during the site visit. However, Japanese knotweed is difficult to identify outside the growing season (March to September/October). As the site visit was conducted in January, it is unlikely that any Japanese knotweed present could be identified accurately and, as such, we recommend that the site be resurveyed during the growing season.

3.2 Ground conditions

3.2.1 Geology

Published records (British Geological Survey website, 2014) for the area indicated the geology of the site to be characterised by the succession recorded in Table 2.

Table 2: Geology at the site

Geological unit	Description	Estimated thickness (m)
Oadby Member (superficial)	Diamicton, grey, weathering brown, characterised by Cretaceous and Jurassic rock fragments; subordinate lenses of sand and gravel, clay and silt. Clay, brown to grey, and silty clay, with chalk and flint fragments	Up to 20m, but typically 1-7m
South Charnwood Diorites (Bedrock)	A grey to pink, medium- to coarse-grained granophyric diorite with a distinctive "mottled" appearance caused by the clumping together of dark grey ferromagnesian minerals (mainly hornblende and chlorite) and grey-green hypidiomorphic plagioclase crystals. Both components are surrounded by a pink to grey granophyric mesostasis. The texture coarsens in places, but true pegmatites are rarely developed; green-grey aplite sheets cross the diorite in some quarries.	~1100m
Source: The British Geological Survey Lexicon of Named Rock Units		
Notes: It is possible that the topsoil on the site has been reworked during agricultural land uses, therefore some anthropogenic material may exist on the site		

There are no borehole records within the vicinity of the site that could provide information on the ground conditions expected beneath the site.

3.2.2 Radon

The environmental database report (Envirocheck report, December 2014), presented as Appendix D, provides an assessment of radon risk equivalent to a stage 2 assessment undertaken by the British Geological Survey. This indicates that between 1% and 3% of homes in the area are above the radon Action Level as defined by the Documents of the National Radiological Protection Board (Radon Atlas of England and Wales, NRPB-W26-2002) although no radon protective measures are required within new dwellings at the site.

3.2.3 Mining and quarrying

Evidence has been sought to identify any mining and quarrying operations, past and present, which have taken place in the vicinity of the site. The sources of information referenced in this element of the desk study include:

- Envirocheck report
- old Ordnance Survey maps and plans
- geological maps

With reference to the above data there are no recorded mines or quarries within a 250m radius of the site. A former opencast mineral site is recorded at approximately 500m to the south east of the site, for common clay and shale of the Mercia Mudstone Formation.

3.2.4 Landfilling and land reclamation

Evidence has been sought to identify any landfilling or land reclamation operations, past and present, which have taken place in the vicinity of the site. The sources of information referenced in this element of the desk study include:

- Envirocheck report
- old Ordnance Survey maps and plans
- geological maps

There are no records of landfill sites (former or current) within a 250m radius of the site (i.e. within the planning consultation zone). A landfill boundary for a licensed waste management facility is noted at approximately 360m to the east of the site. The landfill is operated by Waste Recycling Group Ltd and the accepted deposits include household, commercial and industrial wastes. The landfill is not considered to represent a significant risk of ground gases at the proposed development.

3.2.5 Ground gas

Given the anticipated ground conditions, the risk associated with ground gas is considered very low in accordance with BS8576.

3.3 Hydrogeology

3.3.1 Aquifer characteristics

The presence of low permeability clay at relatively shallow depths beneath the site, while restricting downwards migration, may increase the potential for lateral migration of shallow groundwater (and therefore mobile contamination, if present).

It is also possible that localised perched water may also be present within granular pockets of the Oadby Member.

3.3.2 Vulnerability of groundwater resources

The site has been classified by the EA to overlie a:

- secondary B aquifer: predominantly lower permeability layers that may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering; and an
- 'unproductive' strata: low permeability with negligible significance for water supply or river base flow.

The soils beneath the site are 'unclassified' with reference to the leaching potential, indicating that any pollutants (if present) on site are highly unlikely to penetrate the soil layer either as a result of largely horizontal water movement or because the soil has the ability to attenuate diffuse pollutants. Lateral flow in these soils may contribute to groundwater recharge elsewhere in the catchment and generally have a high clay content.

3.3.3 Licensed groundwater abstraction

The Envirocheck report indicates that there are four current licensed groundwater abstractions (none of which are public water supply boreholes) within a 2km radius of the site as summarised in Table 3. The nearest is located approximately 1150m to the south. It is operated by Groby Lodge Estate Ltd for general farming and domestic purposes.

Table 3: Groundwater abstractions

Reference	As reported distance and orientation from site	Comment
03/28/56/0019/G	1150m S	Operator: Groby Lodge Estate Ltd Details: Groby Lodge Farm - 3 wells Purpose: General farming and domestic
03/28/56/00101	1307m NW	Operator: Tarmac Quarry Products Ltd Details: Not supplied Purpose: Industrial processing
03/28/56/0019/G	1551m S	Operator: Groby Lodge Estate Ltd Details: Groby Lodge Farm - 3 wells Purpose: General farming and domestic
03/28/56/0019/G	1677m S	Operator: Groby Lodge Estate Ltd Details: Groby Lodge Farm - 3 wells Purpose: General farming and domestic

In terms of aquifer protection, the EA generally adopts a three-fold classification of source protection zones (SPZ) for public supply abstraction wells. Information available on the EA website indicates that the site does not lie within a currently designated groundwater SPZ.

3.4 Hydrology

3.4.1 Surface watercourses

There are no ponds, streams or drainage ditches on or adjacent to the site, although a pond was present in the south west corner of the site until the late 1950s. The nearest identified surface water feature to the site is a drainage ditch located approximately 160m to the north west of the site.

There is one entry for pollution to controlled waters 2m to the northwest of the site relating to water used to treat a fire in July 1997. The incident was categorised as a Category 3-minor incident.

3.4.2 Surface water abstractions

Surface water abstractions identified in the Envirocheck report, within a 2km radius of the site are detailed in Table 4.

Table 4: Surface water abstractions

Reference	As reported distance and orientation from site	Comment
03/28/57/0009	1270m N	Operator: Mr D F Thorpe Details: Chilterman Hill Farm Purpose: General farming and domestic
03/28/56/0019/S	1712m SE	Operator: Groby Lodge Estate Ltd Details: Groby Lodge Farm (lake) Purpose: General farming and domestic

3.4.3 Site drainage

Surface drainage from the site appears to discharge into the ground surface and is likely to flow in a south westerly direction, following the topography of the site.

3.4.4 Preliminary flood risk assessment

The indicative floodplain map for the area, published by the EA, shows that the site is not at risk from flooding by rivers or reservoirs.

3.5 History of site and surrounding area

The history of the land-use and development of the site and surrounding area has been assessed based on the following sources:

- historical maps within the Envirocheck report from 1884 to 2014
- town plans
- internet search
- information from the local planning authority

Copies of OS and County Series maps are included in the Envirocheck report in Appendix D. Other details of the development history of the site are also included in Appendix D.

Reference to 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.

There are no available planning records held by Hinckley and Bosworth Borough Council pertaining to the site.

The development history of the site and surrounding area from the above sources is detailed in Table 5.

Table 5: Summary of historical development

Date	Land use/features on site	Land use/features in vicinity of site (of relevance to the assessment)
1884-1929	The site is undeveloped and split into two fields (east and west). There are trees sporadically spread along the boundaries of the fields A footpath is located on the southern boundary A small pond is located in the south west corner of the site	Surrounding area is agricultural fields Ratby Lane bounds the site to the west A well and a small pit ~250m south Several woods towards the NE to SE Groby Slate Works ~1250m SE Markfield Quarry ~1200m NW (disused post 1904)
1930	No change on site	Brick & stone works ~400m SE
1957-1959		Construction of residential properties along Leicester Road (A50) Quarry ~500m E
1964-1968		Sewage works~800m S
1980-1985	Site is now one large field	Residential development along Jacqueline Road, adjacent to the site Gradual spread of development to the east from Markfield towards Field Head Sewage works are now disused
1992-2014	No change on site	Continued spread of development towards Field Head

3.6 Sensitive land uses

No national or internationally designated sensitive land uses such as sites of special scientific interest (SSSI) were identified in the vicinity of the site, however the site is located within 'The National Forest'. The site is also located within a nitrate vulnerable zone.

3.7 Initial conceptual site model

The information presented in Sections 2 and 3.1 to 3.6, has been used to compile an initial conceptual site model (CSM). There are no identified sources of potential contamination associated with the site or the surrounding area. A site investigation is recommended to determine the ground conditions beneath the site, to undertake geotechnical testing and to test the topsoil for re-use on site and on other Taylor Wimpey sites under the CL:AIRE guidelines.

4 SITE INVESTIGATION METHODOLOGY

RSK carried out intrusive investigation work between 22-23 January 2015 to determine the ground conditions, to collect samples for environmental and geotechnical testing and to confirm that no potential complete pollutant linkages exist on the site.

4.1 Sampling strategy and methodology

The techniques adopted for the investigation have been chosen considering the anticipated ground conditions, existing land use and the proposed development.

An 8-tonne 360º tracked excavator was chosen to excavate the trial pits due to the recent rainfall and subsequent wet surface conditions and to avoid creating deep ruts on the surface that a wheeled excavator may have caused. The excavator also has a comparable digging power to that of a JCB-3CX.

Soakaway pits were constructed to provide a suitable spread across the site to determine a drainage strategy. The pits were excavated to depths between 1.50m to 2.20m, installed with a full length slotted monitoring pipe and filled with 20mm gravel. The pit was filled with water to the top of the gravel (approximately 0.50m bgl) and the fall in water was monitored over time to allow an infiltration rate to be calculated.

4.1.1 Health and safety considerations

Service plans of the site and surrounding area were provided prior to mobilisation to site. The plans indicated that there were no buried services on the site apart from a water supply to an animal trough. Overhead power cables were present in the field to the south of the site. A small area in the west of this field may be used for access purposes.

A safety, health and environment plan was written prior to the site works that identified site specific hazards in addition to generic hazards associated with site works. The route to the nearest hospital, first aid contact, service distribution operator contact details and details of emergency muster points were included in the plan. The details within the plan were communicated to all site operatives prior to the start of the intrusive works.

During the investigative works, a member of the public informed the supervising engineer that the site was the subject of a WWII bomb strike. The engineer contacted the land owner to confirm the validity of the claim. The site owner confirmed that a bomb had landed however, it had landed in the north east corner of the field to the south of the site being investigated. With respect to this information a BACTEC unexploded ordnance (UXO) report was ordered to quantify the risk associated with the intrusive investigation. The report, presented in Appendix E indicates that the site is at low to negligible risk from UXOs.

4.1.2 Investigation locations

The following site works were carried out between 22-23 January 2015:

- Fourteen machine excavated trial pits designated TP101 to TP114
- Three trial pit soakaways in general accordance with BRE Digest 365

The investigation and the soil descriptions were carried out in general accordance with 'BS 5930:1999. Code of Practice for Site Investigations' (BSI, 1999). The exploratory hole records are presented in Appendix E.

The locations of the trial pits are shown in Figure 2. The positions were chosen to provide a representative spread across the site. The investigation points were located using a GPS tracking device at the time of investigation.

4.1.3 Soil sampling, in-situ testing and laboratory analysis

A selection of samples were taken from each location. Environmental samples were taken for the analysis of the topsoil for re-use. Small disturbed samples were also taken between 0.70m to 1.50m for concrete classification. Samples of clay soils were taken to determine the volume change potential for foundation design. Bulk samples were taken of granular materials for particle size distribution analyses.

Forty four samples were taken and are recorded together with their depths on the trial pit records in Appendix F. The samples were transported to the laboratory in chilled cool boxes. Laboratory chain of custody forms can be provided if required. The rationale for soil sample chemical analysis is presented in Table 6.

Table 6: Scheduled analysis – soil

Exploratory hole no. and sample depth (m bgl)	Analyte	Rationale
TP102 @ 0.20m TP102 @ 0.70m TP104 @ 0.15m TP105 @ 0.45m TP106 @ 0.50m TP107 @ 0.15m TP113 @ 0.50m TP114 @ 0.30m	Metals, PAH, TPH, pH, WS Sulphate, BTEX & MTBE	Provides information to allow topsoil and subsoil to be used on site and to be transported to other Taylor Wimpey sites if necessary.
TP101 @ 0.15m TP105 @ 0.15m TP108 @ 0.20m TP109 @ 0.15m TP109 @ 0.50m TP110 @ 0.20m TP111 @ 0.45m TP112 @ 0.50m	Metals	Provides information to allow topsoil and subsoil to be used on site and to be transported to other Taylor Wimpey sites if necessary.

TP107 @ 0.15m TP111 @ 0.45m	Asbestos screen	TP107 was located near to the area where suspected ACM was noted on the boundary of the site. The screen within the topsoil was to determine if fragments had been spread locally.
TP102 @ 0.20m TP105 @ 0.45m TP106 @ 0.50m TP107 @ 0.15m TP109 @ 0.50m TP114 @ 0.30m	TOC	Allows for the calculation for soil organic matter (SOM) to determine the mobility of contaminants (if present).
TP102 @ 0.70m TP102 @ 1.30m TP104 @ 0.90m TP105 @1.20m TP107 @ 1.40m TP108 @ 1.20m TP108 @ 1.80m TP109 @ 1.20m TP111 @ 1.35m	BRE Suite 5	The determine the concrete classification for foundation design.
Notes: Metals suite = arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc. PAH = polyaromatic hydrocarbons TPH = total petroleum hydrocarbons BTEX = Benzene, toluene, ethyl benzene & xylenes MTBE = methyl tertiary-butyl ether TOC = total organic content		

The laboratory results of the chemical analysis are presented in Appendix G. The topsoil analysis was completed separately to the subsoil to aid materials re-use.

4.1.4 In-situ hydraulic conductivity/infiltration testing

Soakaway tests were carried out trial pits, TP101 – 103 to establish the infiltration characteristics of the strata encountered. The tests were carried out generally in accordance with the method described in BRE Digest 365 (BRE, 2007). This involved filling the pits with water from a tanker and recording the drop in water level with time as the water soaked into the ground. The tests were carried out three times within TP101 and TP103. TP102 recorded a rise in water level, possibly due to groundwater infiltration that was not noted during the excavation of the pit. The test was therefore aborted. The data are presented in Appendix H including the calculations in accordance with BS 5930 (BSI, 1999).

5 GROUND CONDITIONS

The results of the intrusive investigation and subsequent laboratory analysis undertaken are detailed below. 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 are included on the trial pit records presented in Appendix F.

5.1 Soil

The trial pits revealed that the site is underlain by a variable thickness of topsoil over the Oadby Member and/or the Lower Charnwood Diorites. This appears to confirm the stratigraphical succession described within the initial conceptual site model. For the purpose of discussion, the ground conditions are summarised in Table 7 and the strata discussed in subsequent subsections

Table 7: General succession of strata encountered

Strata	Exploratory holes encountered	Depth to top of stratum m bgl	Thickness (m)
Topsoil	All positions	Ground level	Between 0.25m and 0.60m. Predominantly approximately 0.30m
Oadby Member	TP102-TP108, TP110-TP114	0.25-0.60m	0.35m-3.40m*
South Charnwood Diorites	TP101, TP103, TP106, TP108, TP109	0.30m – 2.55m	0.05m* - 1.90m*
Notes: *To full depth of the investigation			

5.1.1 Topsoil

The made ground generally comprised a friable dark drown sandy clay with gravels and cobbles of diorite and ranged in thickness from 0.25m to 0.60m, however the thickness was predominantly in the region of 0.30m.

5.1.2 Oadby Member

This stratum was encountered beneath the topsoil in twelve of the fourteen positions and comprised four distinct facies, not all of which were noted in every trial pit:

- Firm light orangish brown slightly sandy CLAY to clayey SAND
- Stiff dark reddish brown mottled light grey slightly sandy CLAY
- Light yellowish brown gravelly SAND
- Dark reddish brown clayey SAND

A summary of the laboratory test results in this stratum is presented in Table 8. The full laboratory test results are presented in Appendix I.

Table 8: Summary of in-situ and laboratory test results for Oadby Member

Soil parameters	Range	Reference
Liquid limit (%)	47-67%	Appendix I
Plastic limit (%)	15-21%	
Plasticity index (%)	30-46%	
Plasticity term	Intermediate to high	
Moisture content (%)	21-33%	
Undrained shear strength (kN/m^2) from shear vane	32-108	Appendix F
Stiffness term	Firm to stiff	

5.1.3 South Charnwood Diorites

This stratum was encountered at a depth of between 0.30m and 2.55m below either the topsoil or Oadby Member and was found to the full depth of the investigation of 2.55m. The stratum was a combination of sand, gravels, cobbles and boulders of dark pinkish black crystalline diorite. In trial pits TP103, TP108 and TP109, the diorite encountered was massive and crystalline, as such the excavator was unable to penetrate the layer and excavation was terminated.

5.1.4 Groundwater

Groundwater was encountered in four positions (TP106, TP107, TP111 and TP112) between depths of 0.75m and 2.30m bgl as detailed in Table 9. Depths to groundwater and water seepages are given on the trial pit records in Appendix F.

Table 9: Groundwater results during investigation

TP	Stratum	Strike (m bgl)	Rise (m)
TP106	SCD	1.80m	Equilibrium not reached
TP107	OM	2.30m	
TP111	OM	0.80m and 2.10m	
TP112	OM	1.70m	
Notes: SCD = South Charnwood Diorites OM = Oadby Member			

5.1.5 Results of soakaway testing

The results of soakaway testing are summarised in Table 10.

Table 10: Soakaway test results

Trial pit	Geological unit	Test result (m/s)
TP101	South Charnwood Diorites	8.98×10^{-5} – 4.19×10^{-5}
TP102	Oadby Member	*Recorded a rise in water level**
TP103	South Charnwood Diorites	2.68×10^{-4} - 2.23×10^{-4}
Notes: *TP102 recorded a rise in water level possibly due to groundwater infiltration that was not observed during the excavation of the pit. The test was subsequently aborted.		

5.1.6 Visual/olfactory evidence of soil and groundwater contamination

No visual or olfactory evidence of soil or groundwater contamination were observed during the investigation.

5.2 Refinement of the initial conceptual site model

The investigation did not highlight any sources of potential contamination on the site, therefore the initial conceptual model remains valid.

5.2.1 Limitations

The historical maps indicate that a pond was present at the current entrance to the site. The pond has been filled with unknown material and the current surface appears to be recycled road chippings. The pond area was not investigated due to the disruption that an excavation in that area would cause including the removal of hard standing. During enabling works a watching brief should be present in order that any deleterious material if encountered can be removed.

6 QUANTITATIVE RISK ASSESSMENT

In line with CLR11 (EA, 2004a), there are two stages of quantitative risk assessment, generic and detailed. The GQRA comprises the comparison of soil 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.

6.1 Linkages for assessment

Section 5.2 presents the refined conceptual model which identified that there are no linkages that require assessment after the findings of the site investigation had been considered.

For the purposes of the re-use of material on the site and for the material management plan for the re-use of materials on other Taylor Wimpey sites, the results of the chemical analysis were compared with the generic assessment criteria (GAC) for a residential end use with private gardens (Appendix J). The results for the topsoil and subsoil were predominantly below the laboratory method detection limit and all of the results were below the corresponding GAC. Therefore, the topsoil and subsoil are deemed suitable for use in private gardens.

6.1.1 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 K 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 unlikely to exist associated with organic contaminants and therefore polyvinyl chloride (PVC) water supply pipes are expected to be suitable for use on the development.

It should be noted that at the time of this investigation the future routes of water supply pipes had not been established, hence the investigation and sampling strategy may not be fully compliant with UKWIR recommendations. Consequently, a targeted investigation and specific sampling/analytical strategy may be required at a later date once the routes of the supply pipes are known. In addition, it is recommended that the relevant water supply company be contacted at an early stage to confirm its requirements for assessment, which may not necessarily be the same as those recommended by UKWIR.

7 GEOTECHNICAL SITE ASSESSMENT

7.1 Engineering considerations

It is understood that the proposed development is to involve the construction of up to 150 residential properties and associated infrastructure. A proposed development plan had not been provided at the time of preparation of this report, however similar projects have included a combination of two, three and four bedroom, two and three storey houses with off road parking and private gardens.

7.2 Geotechnical hazards

A summary of commonly occurring geotechnical hazards is given in Table 11 together with an assessment of whether the site may be affected by each of the stated hazards.

Table 11: Summary of main potential geotechnical hazards that may affect site

Hazard category (excluding contamination issues)	Hazard status based on investigation findings and proposed development			Engineering considerations if hazard affects site
	Found to be present on site	Could be present but not found	Unlikely to be present and/or affect site	
Sudden lateral changes in ground conditions	✓	Changes between the South Charnwood Diorites and the Oadby Member		Likely to affect ground engineering and foundation design and construction
Shrinkable clay soils	✓	Medium to high volume change potential		Design to NHBC Standards Chapter 4 or similar
Highly compressible and low bearing capacity soils, (including peat and soft clay)			✓	Likely to affect ground engineering and foundation design and construction
Silt-rich soils susceptible to rapid loss of strength in wet conditions			✓	Likely to affect ground engineering and foundation design and construction
Running sand at and below water table	✓	Running sands observed within trial pits with Oadby Member geology with seepage and groundwater strikes		Likely to affect ground engineering and foundation design and construction
Karstic dissolution features (including 'swallow holes' in Chalk terrain)			✓	May affect ground engineering and foundation design and construction – refer to Section 4.1.2

Hazard category (excluding contamination issues)	Hazard status based on investigation findings and proposed development			Engineering considerations if hazard affects site
	Found to be present on site	Could be present but not found	Unlikely to be present and/or affect site	
Evaporite dissolution features and/or subsidence			✓	May affect ground engineering and foundation design and construction
Ground subject to or at risk from landslides			✓	Likely to require special stabilisation measures
Ground subject to peri-glacial valley cambering with gulls possibly present			✓	Likely to affect ground engineering and foundation design and construction
Ground subject to or at risk from coastal or river erosion			✓	Likely to require special protection/stabilisation measures
High groundwater table (including waterlogged ground)	✓	Waterlogged area in the south west of the site and wet surface in localised areas across the site		May affect temporary and permanent works
Rising groundwater table due to diminishing abstraction in urban area			✓	May affect deep foundations, basements and tunnels
Underground mining			✓	Likely to require special stabilisation measures
Existing sub-structures (e.g. tunnels, foundations, basements, and adjacent sub-structures)			✓	Likely to affect ground engineering and foundation design and construction
Filled and made ground (including embankments, infilled ponds and quarries)	✓	Historical maps indicate a pond at the site entrance.		Likely to affect ground engineering and foundation design and construction
Adverse ground chemistry (including expansive slags and weathering of sulphides to sulphates)			✓	May affect ground engineering and foundation design and construction
Note: Seismicity is not included in the above table as this is not normally a design consideration in the UK.				

7.3 Foundations

7.3.1 General suitability

Given the presence of competent natural soils at a relatively shallow depth it is considered that traditional spread footings will be suitable for the proposed development.

7.3.2 Spread foundations

The recommendations for the design and construction of spread foundations in relation to the ground conditions are set out in Table 12.

Table 12: Design and construction of spread foundations

Design/construction considerations	Design/construction recommendations
Founding stratum	South Charnwood Diorites (weathered rock) or Oadby Member (Clay)
Depth	**Oadby Member (Clay):** Foundations should be taken to a minimum depth of 1.00m below existing or finished ground level (whichever is lower) and at least 0.1m into the founding stratum and below any overlying topsoil or to any greater depth required in respect of the special design considerations given below. **South Charnwood Diorites:** Foundations should be taken to a minimum depth of 0.60m below finished ground level or final ground level (whichever is lower) and at least 0.10m into the founding stratum.
Special design considerations	Owing to the presence of shrinkable clay soils (high volume shrinkage potential), foundations should be designed taking into account all the normal precautions, including minimum founding depths, to minimise the risk of future foundation movements in accordance with NHBC standards. Within influencing distance of trees, foundation depths will need to be increased in line with NHBC Standards, Chapter 4.2, 'Building near trees'. Should granular strata or rock be encountered before the specified depth then the foundation may be terminated sooner. Where possible, foundations should be constructed entirely in the clay or on diorite. Owing to the lateral and vertical variability of the ground conditions, foundation may be terminated in both the clay and diorite however nominal mesh reinforcement should be incorporated into foundations to minimise the risk of future differential foundation movements.
Bearing capacity	Spread foundations with a width of up to 0.60m are considered suitable founded at a minimum depth of 1.00m below existing or final level whichever is lower. A net allowable bearing pressure of approximately 100kN/m^2 can be assumed for design purposes rising to 200kN/m^2 for the weathered diorite. The allowable bearing capacity includes an overall factor of safety of 3 against bearing capacity failure and with total settlements associated with the bearing pressure estimated to be less than 25mm.
Stability of excavations	Some of the trial pits became unstable during excavation. It is therefore recommended that excavation support systems are made available during the groundwork stage of the development.

Design/construction considerations	Design/construction recommendations
Dewatering	Groundwater was encountered in some of the trial pits. Dewatering may therefore be required to facilitate foundation excavation.
Construction considerations	All foundation excavations should be inspected, and any made ground and soft, organic or otherwise unsuitable materials removed and replaced with mass concrete. With respect to a backfilled pond located close to the site entrance, foundations here will need to be extended below any infill materials

7.3.3 Foundation works risk assessment

It is anticipated that a foundation works risk assessment report will not be required for the development because no free-phase product was identified at the site and concentrations of chemicals of potential concern (COPC) within the natural soils were below their corresponding GAC.

7.3.4 Floor slabs

The nature of the soils encountered during the investigation indicates that ground bearing floor slabs may be adopted with a suitable sub-base layer for the proposed development.

All formation levels should be proof-rolled and all topsoil and any other loose, soft, organic or otherwise unsuitable materials should be removed and replaced with well-compacted, suitable granular fill.

Suspended floor slabs will be required on clay soils within influencing distance of trees and where remaining made ground is in excess of 0.60m in thickness.

7.3.5 Roads, hardstanding and drainage

In the 1m to 1.5m below the proposed finished ground level, the exploratory holes have revealed a soil profile comprising firm to stiff sandy clay, clayey sand, and sandy gravels & cobbles.

In pavement design terms, the groundwater conditions are anticipated to comprise a low water table, i.e. at least 1m below the pavement formation level.

The estimated minimum, equilibrium soil-suction, California bearing ratio (CBR) value for the soils and groundwater conditions described above under a completed pavement is 3%, based upon Table C1 in TRRL (1984) Report LR1132.

The results of in-situ testing indicate that the near surface soils have a CBR value that ranges from between 3-6%, the results are summarised in Table 13.

Table 13: Summary of CBR values derived from in-situ Clegg Hammer tests

Test location	Material type	Minimum CBR value (%) determined at or just below anticipated formation level
TP105	Firm to stiff gravelly clay	3,4,4,4,4

TP106	Clayey sand	5,6,6,6,6

The more granular sub-base materials can be improved by rolling with conventional compaction plant.

The recommended CBR value for clayey subgrade materials has been assessed to be 3%. This value assumes that during construction, the formation level will be carefully compacted and any soft spots removed and replaced with well-compacted granular fill. For granular subgrade materials, a CBR of 20% can be assumed

The sub-grade soils can be regarded as non-frost-susceptible, based upon the criteria given in Appendix 1 of TRRL (1970) Report Road Note 29.

7.3.6 Chemical attack on buried concrete

This assessment of the potential for chemical attack on buried concrete is based on current BRE guidance. The desk study and site walkover indicate that, for the purposes of this assessment of the aggressive chemical environment, the site should be considered as a site where disturbance of pyrite-bearing ground could result in additional sulphate. A suite of chemical analyses appropriate to this site classification was carried out on soil samples.

“Characteristic value” is the highest result, mean of the two highest if 5 to 9 readings from one area are available, or the mean of the highest 20% if 10 or more readings from one area are available. The maximum water-soluble sulphate content in soil of 0.06g/l has been taken as the characteristic value. As this value is below the limiting value of 3.0g/l, consideration of magnesium is not required. Based on Table C1 in the BRE guidance, Result one for Design Sulphate Class for the site is DS-1.

Because of the possible presence of sulphides in the Oadby Member, a calculation was made using the measured concentrations of Total Sulphur and Acid Soluble Sulphate of the amount of Oxidisable Sulphide present. A maximum Oxidisable Sulphide content of 0.01% was calculated. Since this value is less than 0.3%, no third result for Design Sulphate Class is required. Based on this value, result two for Design Sulphate Class for the site is DS-1.

From consideration of the results a Design Sulphate Class of DS-1, may be adopted for the site. Based on the combination of both permeable and impermeable ground conditions, a worst-case scenario has been adopted, therefore it has been assumed that groundwater conditions are mobile. From consideration of the characteristic pH value, an Aggressive Chemical Environment for Concrete classification of AC-2z may be assumed for design purposes.

7.3.7 Soakaways

Based upon the results of the soakaway tests presented in Section 7.3.5 above; the ground conditions are variable in their suitability from a geotechnical viewpoint for the use of pit soakaways to discharge surface run-off. The pits constructed within the South Charnwood Diorites appeared to be suitable to discharge surface run off, however pit soakaways constructed within the Oadby Member would not be suitable. For

environmental reasons, careful consideration will have to be given to selecting their locations and design details.

The EA should be contacted at the design stage in order to obtain a 'consent to discharge'. This may not be forthcoming where soakage will be into or just above the water table. In addition, planning approval will have to be sought for their use.

8 REUSE OF MATERIALS AND WASTE

8.1 Reuse of suitable materials

In accordance with the CL:AIRE Code of Practice (2011) (CoP), materials are only considered waste if 'they are discarded, intended to be discarded or required to be discarded, by the holder'. Thus contaminated material does not become waste until the aforementioned criteria are met.

Under the CoP, soil may be re-used on site where they were produced provided they are:

- Certain to be used
- Are suitable for use both chemically and geotechnically
- Only the required quantity is used.

The CoP requires the preparation of a materials management plan (MMP) that confirms the above factors will be met. This plan needs to be reviewed by a 'Qualified Person' (QP) who will then issue a declaration form to the EA. RSK has qualified persons to enable compliance with the CoP.

8.2 Treatment to meet suitable-for-use criteria

Where materials do not meet the suitable for use criteria it may be possible to treat them under an environmental permit (mobile treatment licence) to enable them to be reused onsite.

To enable the treatment options to be determined, an options appraisal and a remediation strategy document will be necessary to support discussion of the issues with regulators and third parties.

8.3 Reuse of waste materials

If material is discarded as waste then its reuse on site may still be possible. Waste soils and recycled aggregate can be reused on site under a standard rules environmental permit or a U1 waste exemption from the Environmental Permitting (England and Wales) Regulations 2010 provided that they are suitable for the proposed use, i.e. not cause harm to human health or the environment. However, it should be noted that these have strict limits on the quantity of material that can be reused.

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 Environmental

Based on the information gathered from the PRA and site investigation, there are no identified contaminant linkages associated with the site. Therefore, the site is considered to be suitable for residential use.

Should visual or olfactory material indicative of contamination be encountered during the groundworks stage of construction, contact should be made with RSK or an alternative suitably qualified consultant.

9.2 Geotechnical

Spread foundations are considered suitable for the majority of the site at a minimum depth of 0.60m in the diorite and a minimum depth of 1.00m in the clay below final or existing level (whichever is lower). Foundations should be taken down through any made ground and founded with the underlying natural strata. A maximum net allowable bearing pressure of 100kN/m^2 is recommended for clay soils rising to 200kN/m^2 for foundation constructed directly on weathered rock (diorite).

Nominal mesh reinforcement is recommended for foundations constructed upon variable ground conditions.

Foundations constructed within clay soils close to trees and shrubs must be deepened in line with NHBC Standards. Foundations may be terminated before the specified depth if granular materials or rock are encountered sooner. Although unlikely, should foundations in excess of 2.50m deep be required, then piled foundations may prove to be an economic proposition.

Ground bearing floor slabs are considered to be suitable for use on this site. Suspended floor slabs will be required on clay soils within influencing distance of trees.

For preliminary pavement design purposes, it is recommended that a –sub-grade CBR value of 3% be assumed for clayey subgrade materials rising to 20% for granular subgrade. It is recommended that the final formation be tested to confirm the design CBR values.

The ground conditions are variable, however the use of pit soakaways constructed within the South Charnwood Diorites are considered to be suitable.

It is recommended that the buried concrete be designed in accordance with Design Sulphate Class DS-1 and Aggressive Chemical Environment for Concrete Class AC-2z.

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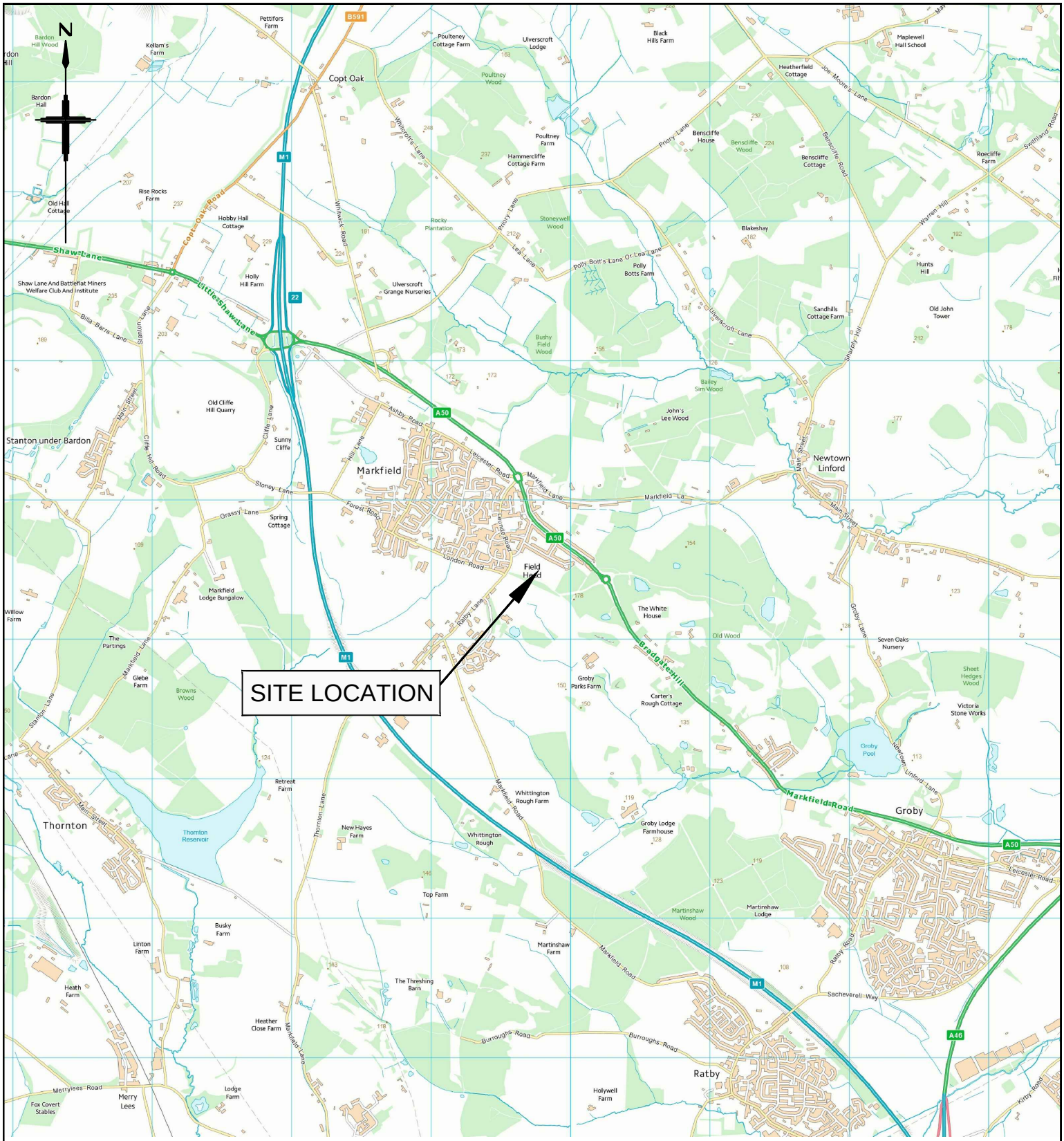
FIGURES



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Client	TAYLOR WIMPEY UK Ltd
Project Title	MARKFIELD
Drawing Title	SITE LOCATION PLAN

Drawn	Date	Checked	Date	Approved	Date	Project No.	Drawing File
HD	26.01.15	PT	26.01.15	PT	26.01.15	301538	301538- R1(02)D001A

Scale	Orig Size	Dimensions	Drawing No.	Rev.
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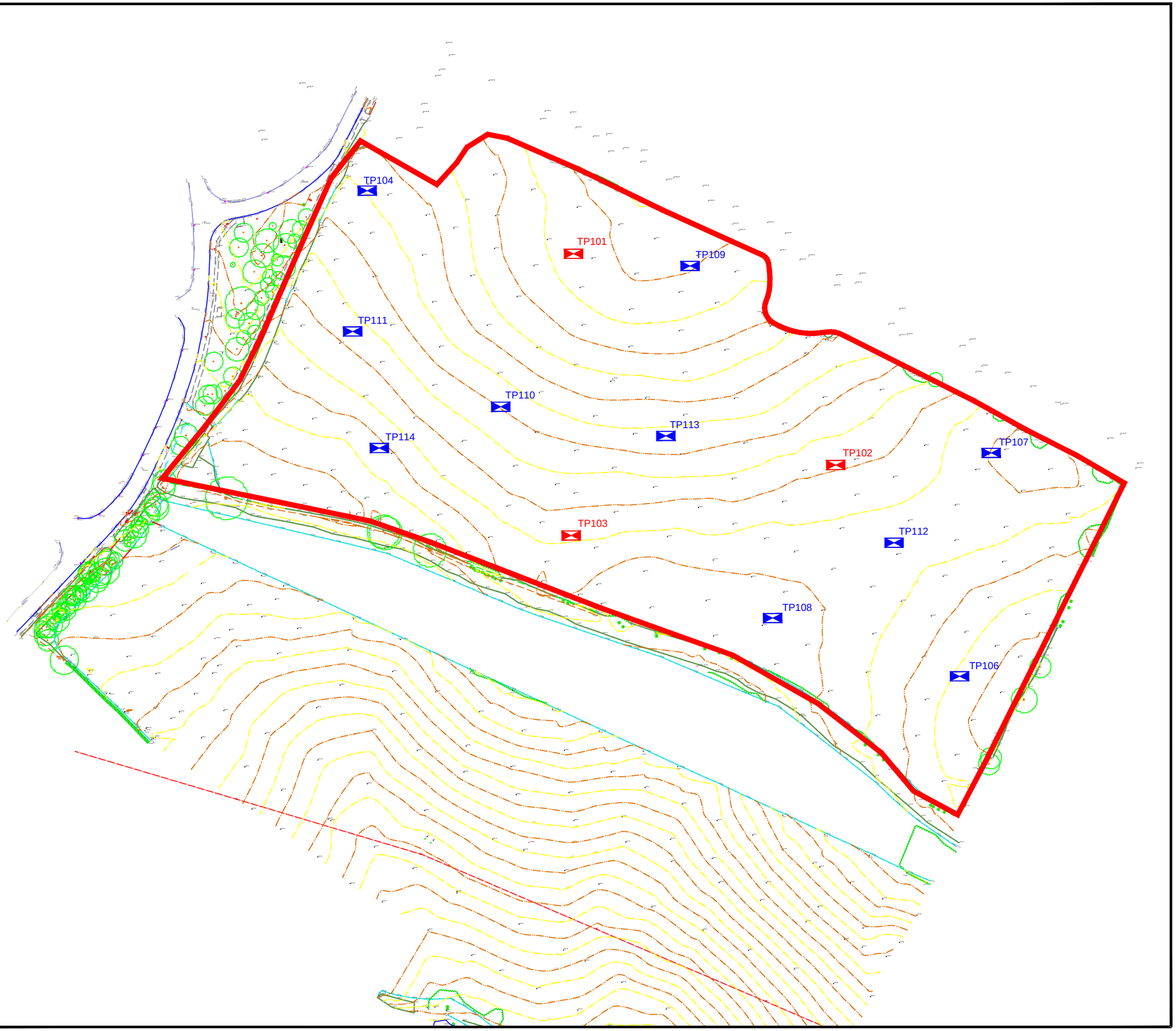

LEGEND:

- Site boundary
- Soakaway trial pit locations
- Trial pit locations

N

REV	DATE	DESCRIPTION	BY	CHD.	APR.
A	27.01.15	FIRST ISSUE	HD	PT	PT

Dimensions	Projection	Scale	Orig Size
m		AS SHOWN	A3

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CLIENT
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PROJECT
MARKFIELD

TITLE
EXPLORATORY POSITION PLAN

JOB No.:	DRAWING FILE:
301538	301538-R1(02)D002A

BY:	DATE:	CONTRACT NO.		REV:
HD	27.01.15		FIGURE 2	A

Scale bar
0 12.5 25 37.5 50m

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 Taylor Wimpey Strategic Land (the "client") in accordance with the terms of a contract between RSK and the "client", dated 21 November 2014. 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.

2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.

3. Unless otherwise agreed in writing the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.**

4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date of this report, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.

5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.

6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.

7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey 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. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and 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 is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the 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 soil and groundwater conditions, together with the position of any current structures and underground 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 contract 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 (boreholes, trial pits 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.

APPENDIX B
SUMMARY OF LEGISLATION AND POLICY RELATING TO CONTAMINATED LAND

Part IIA of the Environmental Protection Act 1990 (EPA) 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 of the EPA 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).

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.

Environmental Permitting Regulations (EPR)

The Environmental Permitting (England and Wales) Regulations 2010 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 2010 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.'

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.

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.

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).

The new framework has only limited guidance on contaminated land, as follows:

- *"planning policies and decisions should also ensure that:*
    - *the site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation;*

- *after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and*
- *adequate site investigation information, prepared by a competent person, is presented".*

APPENDIX C
SITE PHOTOGRAPHS AND WALKOVER CHECKLIST

PHOTOGRAPHIC LOG		
Photo no. 1	**Date:** 13/01/15	
Direction photo taken: W		
Description: Overview of site		

Photo No. 2	**Date:** 13/01/15	
Direction photo taken: NE		
Description: Water filled animal track		

Photo No.	Date:	
3	13/01/15	
Direction Photo Taken: SW		
Description: Waterlogged area in the south west corner of the site		

Photo No.	Date:	
4	13/01/15	
Direction Photo Taken: N/A		
Description: Suspected asbestos containing material on northern boundary		

Photo No.	Date:	
5	13/01/15	
Direction Photo Taken: N		
Description: Surface runoff pipe from residential property on the northern boundary extends onto the site		

WALKOVER SURVEY CHECKLIST

SITE NAME	SITE REFERENCE	NGR
Markfield	301538	449760, 309490

These inspections can provide useful information on:

- Potential geotechnical hazards
- Suitable and appropriate locations for investigation
- The groundwater and surface water environments
- Potentially sensitive receptors (targets) including issues that require further investigation, e.g. ecology surveys
- Potential sources of contaminants
- Nature of contamination
- Potential migration routes (pathways)

Mark locations of features described on a map and give them a reference number.

Describe features in as much detail as possible. Continue on the back of the checklist if necessary, using the feature letter for reference. Take photos of site and relevant features in immediate surrounding area.

The walkover survey can also provide information for the environmental consultant in planning the site investigation.

Points that should be addressed in a walkover survey are as follows:

Features	Description	Photo no.	Map ref.
a) Describe materials exposed in nearby road or railway cuttings, in pits and quarries and natural exposures of soils and rocks near to the site. *This will give an indication of the geology beneath the site*	Large diorite boulder located off site and several smaller boulders located adjacent to site boundaries		
b) Describe the site in terms of ground slopes and changes in slope. *Old scarps or hummocky ground may be evidence of previous landslips that could be reactivated. A terraced appearance may be indicative of superficial solifluction movement or cambering.*	Site dips generally to the south with a crest in the centre		
c) Note any abrupt changes in ground level. *May indicate that minerals have been worked in surface excavations.*	None observed		

d) Note any surface hollows. *Which may indicate the presence of solution features or swallow holes in rocks such as chalk limestone, gypsum and salt, or collapsed underground workings in these materials. May also indicate badger setts or other wildlife activity.*	None observed		
e) In areas of country underlain by coal or other minerals note any hummocky ground. *Which may be the remnants of spoil tips and surface depressions that may indicate collapsed shallow workings. Areas of general unevenness may be evidence of waste disposal activities.*	N/A		
f) Describe the types and condition of surface vegetation. *Nettles may indicate an old cesspit for example or unhealthy vegetation may indicate the presence of phytotoxic fill or landfill gas. Note invasive weeds, e.g. Japanese knotweed.*	Open grassland in good condition. Nettles observed on northern boundary outside one house. Died back vegetation with hollow stems (1.20m in height)		
g) Note the number, location, height and species of trees and hedges. *This is important in terms of shrinking and swelling ground. Trees that are leaning may indicate instability or general slope movement. Trees and hedgerows may be protected; their condition should be noted along with any restrictions they will impose for site access.* *It is important to note any areas with the potential for nesting birds, roosting bats, water voles and badger setts.*	Topo provides these details Abundant hawthorn bushes, holly and mature trees on boundaries. Two nest observed on one tree on the eastern boundary Some coniferous trees		
h) Describe any evidence of animal activity. *For example obvious animal paths or areas of excavations and burrows.*	Few areas where slight burrowing to get beneath the fence. Evidence of dogs on site.		
i) Note the location of streams, culverts, ponds, seepages and sinks and signs of previous flooding. Note direction of flow. Note where the stream is accessible for sampling. May need to take dimensions of stream. *If ponds are present on site they may contain great crested newts. Ditches, streams and rivers that border or run through a site may contain water voles, otters or white-clawed crayfish. Presence of water features on site may prompt the need for a survey during a site investigation.*	SW corner very flooded. Animal track across the site with water collecting in it		
j) Describe present land use *Especially crops, for consideration of appropriate timing for further investigation, compensation and reinstatement. Also note hardstanding, obstructions etc. Note any old buildings/ivy covered trees as these may be used by owls or bats*	Open grassland		

WALKOVER SURVEY CHECKLIST Continued

Features	Description	Photo no.	Map ref.
k) Describe surrounding properties/land use *This will identify any potential sources of contamination from adjacent sites and any sensitive receptors*	Bungalows adjacent to the north – gardens over look the site		
l) Description of buildings on site. Is there any evidence of asbestos construction materials, e.g. roofing, insulation materials. Do any of the buildings have basements? Do any of the buildings have a boiler room? (if yes describe fuel type and storage arrangements)	No buildings ACM was noted adjacent to the fence of one of the properties		
m) Describe any damage to existing structures on site or adjacent to the site *For example, cracks in buildings both on the site and in the neighbourhood, and other evidence of settlement or differential settlement.* *Note presence of any suspected asbestos-containing materials (ACM)*	N/A		
n) Note the remains of structures that have been demolished. Look for evidence of remnants of any historical structures. *This will provide valuable information on the location of previous foundations, processes etc.* *Note presence of any suspected asbestos-containing materials (ACM)*	N/A		
o) Identify any old structures, pipework etc. wherever possible and, if safe, inspect for evidence of stored waste. *Old tanks may contain oil. Old electricity transformers should be noted.* *Asbestos risk should be assessed together with the need for a specialist hazardous materials survey.*	N/A		

WALKOVER SURVEY CHECKLIST Continued

Features	Description	Photo no.	Map ref.
p) Evidence of buried services (water, gas, electricity, telephone, cable, television, pipelines) *Both for safety considerations and in the case of water as supply for further investigation. As well as danger, there is the question of considerable expense, which can arise from an inadequate knowledge of the location of buried services. The locations and heights of overhead cables may be important when considering the movement of site equipment.*	Water tub on eastern boundary with underground feed		
q) Note the presence of any underground structures, services, mine workings, tunnels etc *From a safety point of view for development of the site and also as they may provide contaminant migration routes.*	N/A		
r) Are there any evidence of gas protection measures (gas membrane, gravel filled trenches, venting pipes, cowls etc)	N/A		
s) Note site drainage. Are there any drain covers/soakaways (if yes describe locations). Are there any outfalls to surface watercourses? Are there any interceptors/lagoons/effluent treatment plants?	Site is generally very wet under foot with flooded areas in the SW and NE		
t) Note any discoloured ground. *This may provide evidence of contamination*	None observed		
u) Examine surrounding areas for evidence of contamination which could migrate onto the site. *For example a leaking oil tank on an adjacent site.*	None observed		
v) All surface waters should be examined for evidence of contamination. *For example, oil sheen, silt, solid matter, discoloured sediment.*	None observed		

WALKOVER SURVEY CHECKLIST Continued

Features	Description	Photo no.	Map ref
w) Note any evidence of gas from nearby landfill sites *Can be indicated for example by poor vegetation or gas bubbles in water-filled trenches.*	None observed		
x) Describe storage of fuels and chemicals. Are there any drums/containers (if yes, describe quantity, full/empty, stored on hardstanding/softstanding, bunded?) *Is there evidence of underground fuel tanks (if yes, describe locations, how many, volumes, bunding, used/disused, condition)?*	N/A		
y) Are there any electricity substations on or adjacent to site?	None observed		
z) Accidents: In the event of a large spillage would runoff affect any vulnerable watercourses/culverts *Are emergency procedures/equipment in place?*	None observed		
aa) Waste: Are there any waste skips on site? Are waste storage facilities adequate? Is there any litter/fly-tipped material?	None observed		
bb) Note any anecdotal information in past uses of the site. *Local street names etc. can provide indicators of past industry or ground problems*	None observed		
cc) Identify potential access routes to the site for plant for the site investigation *Excavators and drilling rigs may be required for the next stage of the investigation, or if the access is limited window sampling techniques may need to be specified. Note any specific obstructions such as unsafe/unstable ground, protected trees or hedgerows, or protected buildings*	Site access off Ratby Lane – hard standing to field		

Walkover survey completed: 13/01/15 Date

Lawrence Signature

Claire Lawrence Name

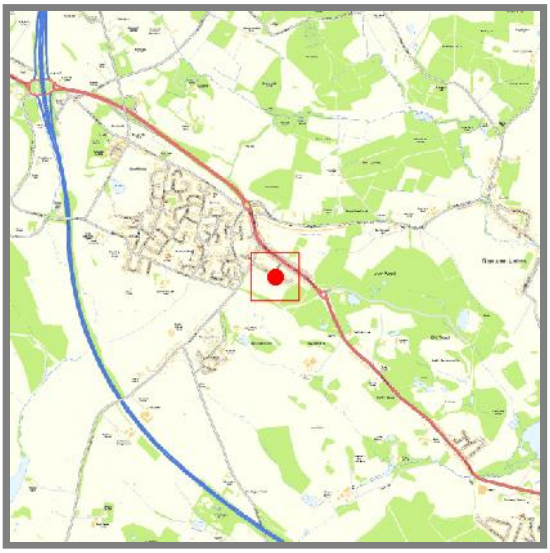
APPENDIX D
ENVIRONMENTAL DATABASE REPORT

N.b - can be provided upon request

APPENDIX E
BACTEC UXO REPORT

BombRisk.com BACTEC | Globally Trusted Locally Dependable

Preliminary Unexploded Ordnance Risk Assessment



Project: **LE67 9RB**

FIND
PROFESSIONAL MAPPING INTELLIGENCE

BACTEC
a Dynasafe Group Company

Report prepared by BACTEC International Limited and FIND Mapping Limited

Report reference: 500754

Preliminary Unexploded Ordnance Risk Assessment

in respect of

LE67 9RB

Contents

1. Introduction

Established in 1991, BACTEC International Limited supports the UK construction industry by assessing the risk of encountering items of unexploded ordnance (UXO) during intrusive works. BACTEC's specialist advice provides essential information for risk assessment, improves safety, enhances reputation and helps contractors to avoid costly delays.

The risk of encountering UXO on most sites in the UK is low. However, where a site is at increased risk it will be necessary to take measures to mitigate that risk. The factors affecting risk assessment are based upon the history and previous usage of a site and its surroundings.

In 2009, the Construction Industry Research and Information Association (CIRIA) established a set of guidelines to assist industry professionals. CIRIA recommends a four stage risk management process:

- Preliminary risk assessment
- Detailed risk assessment
- Risk mitigation
- Implementation

The preliminary risk assessment enables a non-UXO specialist to place a site in context and to identify where a more detailed assessment is necessary. The assessment is based upon data obtained from desktop reviews of the site's history and its proximity to potential indicators for UXO contamination.

There are two principal sources of UXO risk within the UK:

- Ministry of Defence (MoD) activities
- Bombs and projectiles from WWI and WWII

MoD activities include munitions deposited during training exercises, munitions dumped or disposed of ineffectively, Allied wartime activities, defensive installations etc.

- Abandoned Bombs
- Historic Army Camps
- Army Explosive Ordnance Clearance Tasks/Recces
- Bombing Decoy Sites
- Heavy Anti-Aircraft Batteries
- Military Airfield Sites

- Press Articles regarding UXO Finds
- Military Training Areas and Firing Ranges
- BACTEC Desk-top Threat Assessments
- Prisoner of War Camps
- Sites related to the Manufacture of Explosives and Explosive Ordnance
- BACTEC Unexploded Ordnance
- WWII Bombing Density
- WWII Defence Related Positions & Pillboxes
- Pipe Mined WWII Airfields
- Miscellaneous WWII Pipe Mined Locations
- BACTEC On-Site Support Services

Established in 2006, FIND Maps Limited is a pioneering web mapping and spatial data technology company offering online mapping and consultancy services.

www.findmaps.co.uk is an excellent example of what FIND can deliver. The portal currently provides detailed mapping and a wealth of data sets to hundreds of the UK's top property, environmental and design/build companies.

FIND's consultancy services provide bespoke internet mapping solutions to a range of businesses, enabling them to manage their spatial data more effectively.

While working closely with a wide range of reputable data providers including Ordnance Survey and the Environment Agency, FIND works independently of these organisations. A similar arm's-length relationship is maintained in terms of software and hardware providers. This enables the team at FIND to offer truly independent advice.

Methodology

BACTEC and FIND have compiled a geo-referenced database of potential sources of UXO risk within the UK. From this information a range of risk zones have been defined. The weighting of these zones is based upon the influence of all relevant factors. An airfield, for example, has a far greater zone of influence than a single anti-aircraft battery.

An online preliminary automated UXO risk assessment will determine the potential level of UXO risk relating to a site. The assessment will list all factors contributing to this weighting. Importantly, it will also give appropriate recommendations for further action where this is indicated.

2. Search Results

Within 10km of the site the following potential sources of explosive ordnance have been recorded:

Source	Number within 10km
Military Airfield Sites	2
Abandoned Bombs	2
WWII Defence Related Positions & Pillboxes	2
Historic Army Camps	4
Prisoner of War Camps	3
Heavy Anti-Aircraft Batteries	1
Army Explosive Ordnance Clearance Tasks/Reccess	4
Bombing Decoy Sites	None recorded
Press Articles regarding UXO Finds	None recorded
Military Training Areas and Firing Ranges	None recorded
Pipe Mined WWII Airfields	None recorded
Miscellaneous WWII Pipe Mined Locations	None recorded
Sites Related to the Manufacture of Explosives and Explosive Ordnance	None recorded
BACTEC Unexploded Ordnance Finds	None recorded
BACTEC Desk-top Threat Assessments	None recorded
BACTEC On-Site Support Services	None recorded

None of these sources are deemed significant enough to be a risk and therefore do not warrant further research.

3. Conclusions

Risk levels - British unexploded ordnance

Negligible

There are no potential sources of UXO recorded in BACTEC's historical database in close proximity to the site. If there is any empirical evidence of actual or potential contamination, BACTEC should be contacted for advice. Otherwise, the risk on site from UXO is considered to be Negligible.

Risk levels – UXB based on bombing density

Low

Historical records indicate that the area was subjected to a low level of bombing density. If there is empirical evidence of UXB risk (i.e. anecdotal evidence) then please contact BACTEC for further advice.

This preliminary assessment has identified a Low risk from air-delivered unexploded bombs at this site.

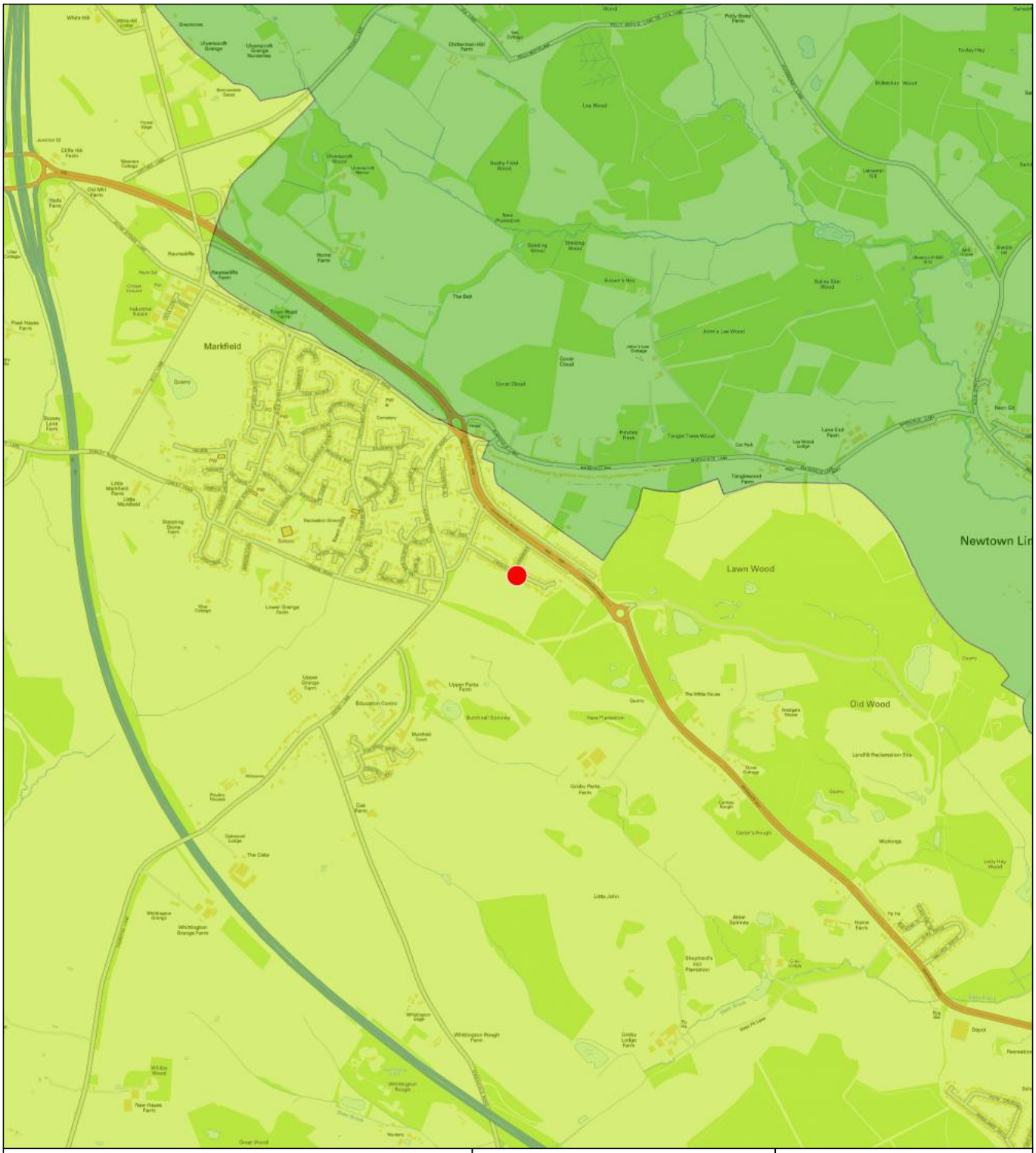
Highest overall risk and recommendation

Low

This preliminary assessment has resulted in an overall Low risk from UXO. Unless any empirical evidence of actual or potential UXO contamination is available, BACTEC do not consider a full Explosive Ordnance Desktop Study necessary for this site. It is recommended that an Explosive Ordnance Safety Awareness briefing is provided by a suitably experienced UXO Specialist.

Risk of UXO based on bombing density

LE67 9RB



Negligible
Low
Medium
High

Report reference: 500754

1:20000

0 400 800

Metres

BombRisk.com

APPENDIX F
EXPLORATORY HOLE RECORDS

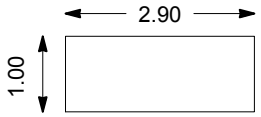
FINAL
TRIAL PIT LOG

Contract:	Client:	Trial Pit:
Jacqueline Road, Markfield	**Taylor Wimpey UK Ltd**	**TP101**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
301538	**22.01.15**	**---**	**E:449728.0 N:309581.0**	**1** of **1**
	End: **22.01.15**			

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results					
0.15	1.0	ES				TOPSOIL: dark brown friable gravelly sandy CLAY with a medium cobble content. Cobbles are subangular diorite. Gravel is angular to subangular medium to coarse diorite. Frequent rootlets.	(0.30)	
							0.30	
1.00	2.0	D				Light orangish brown sandy GRAVEL COBBLES & BOULDERS of diorite. (SOUTH CHARNWOOD DIORITES)	(1.90)	
							2.20	
						Trial pit terminated at 2.20m depth.		

Plan (Not to Scale)



General Remarks

1. Sides unstable below 0.30m
2. No groundwater encountered
3. Installed with slotted pipe 20mm gravel for soakaway testing
4. Backfilled with arisings above gravel layer

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**Tracked excavator**	**CLawrence**	

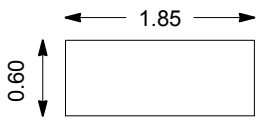
FINAL
TRIAL PIT LOG

Contract:	Client:	Trial Pit:
Jacqueline Road, Markfield	**Taylor Wimpey UK Ltd**	**TP102**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
301538	**22.01.15**	**---**	**E:449836.0 N:309494.0**	**1** of **1**
	End: **22.01.15**			

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results					
0.20	1.0	ES				TOPSOIL: dark brown friable gravelly sandy CLAY with a medium cobble content. Cobbles are subangular diorite. Gravel is angular to subangular medium to coarse diorite. Frequent rootlets.	(0.34) 0.34	
0.70	2.0	ES				Firm light orangish brown slightly sandy CLAY. With rare diorite boulder. (OADBY MEMBER)	(0.46) 0.80	
0.70 0.70 0.70	3.0	D V V	c_u=>42/>48 >/>			Stiff dark reddish brown mottled light grey slightly sandy CLAY. (OADBY MEMBER)	(0.70) 1.50	
1.30 1.30 1.30	4.0	D V V	c_u=>9 >			Light yellowish brown gravelly fine to coarse grained SAND. Gravel is subangular to subrounded fine to coarse sandstone. (OADBY MEMBER)	(0.30) 1.80	
1.70	5.0	B				Trial pit terminated at 1.80m depth.		

Plan (Not to Scale)



General Remarks

1. Sides unstable between 0.40-0.90m
2. No groundwater encountered
3. Installed with slotted pipe 20mm gravel for soakaway testing
4. Backfilled with arisings above gravel layer

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**Tracked excavator**	**CLawrence**	

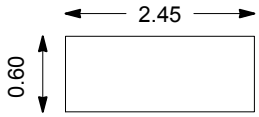
FINAL
TRIAL PIT LOG

Contract:	Client:	Trial Pit:
Jacqueline Road, Markfield	**Taylor Wimpey UK Ltd**	**TP103**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
301538	**22.01.15**	**---**	**E:449727.0 N:309465.0**	**1** of **1**
	End: **22.01.15**			

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results					
						TOPSOIL: dark brown friable slightly gravelly slightly sandy CLAY. Gravel is subangular to rounded Flint and diorite. Sand is fine to medium grained.	(0.30)	
							0.30	
						Light orangish brown slightly clayey SAND. (OADBY MEMBER)	(0.55)	
							0.85	
1.00	1.0	D				Light orangish brown slightly clayey sandy GRAVEL COBBLES & BOULDERS of diorite. (SOUTH CHARNWOOD DIORITES)	(0.60)	
							1.45	
						Massive dark pinkish black crystalline DIORITE. (SOUTH CHARNWOOD DIORITES)	1.50	
						Trial pit terminated at 1.50m depth due to excavator unable to penetrate diorite.		

Plan (Not to Scale)



General Remarks

1. Hard digging below 0.85m
2. No groundwater encountered
3. Installed with slotted pipe 20mm gravel for soakaway testing
4. Backfilled with arisings above gravel layer

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**Tracked excavator**	**CLawrence**	

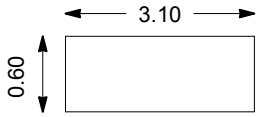
FINAL
TRIAL PIT LOG

Contract:	Client:	Trial Pit:
Jacqueline Road, Markfield	**Taylor Wimpey UK Ltd**	**TP104**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
301538	**22.01.15**	**---**	**E:449643.0 N:309607.0**	**1** of **1**
	End: **22.01.15**			

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
0.15	1.0	ES				TOPSOIL: dark brown friable gravelly sandy CLAY with a medium cobble content. Cobbles are subangular diorite. Gravel is angular to subangular medium to coarse diorite. Frequent rootlets.	(0.30) 0.30	
0.75		V	c_u=>49/>52			Firm orangish brown mottled light grey gravelly CLAY. Gravel is angular to subrounded medium to coarse Sandstone. (OADBY MEMBER)		
0.75		V	>/>					
0.90	2.0	D						
1.00		V	c_u=>40/>36				(1.40)	
1.00		V	>/>					
1.30	3.0	D					1.70	
1.90	4.0	B				light orangish brown gravelly SAND. Gravel is subangular to subrounded fine to coarse Sandstone. (OADBY MEMBER)	(0.40) 2.10	
2.10	5.0	D				Firm to stiff dark reddish brown slightly sandy CLAY. Locally mottled greenish grey. Occasional black organic fragments. Locally soft to firm light grey sandy clay. (OADBY MEMBER)		
2.10		V	c_u=>52/>50					
2.10		V	>/>				(1.60)	
							3.70	
						Trial pit terminated at 3.70m depth.		

Plan (Not to Scale)



General Remarks

1. Sides remained stable during excavation
2. No groundwater encountered
3. Backfilled with arisings

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**Tracked excavator**	**CLawrence**	

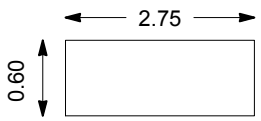
FINAL
TRIAL PIT LOG

Contract:	Client:	Trial Pit:
Jacqueline Road, Markfield	**Taylor Wimpey UK Ltd**	**TP105**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
301538	**23.01.15** End: **23.01.15**	**---**	**E:449562.0 N:309459.0**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
0.15	1.0	ES				TOPSOIL: dark brown friable gravelly sandy CLAY with a medium cobble content. Cobbles are subangular diorite. Gravel is angular to subangular medium to coarse diorite. Frequent rootlets.	(0.30)	
							0.30	
0.45	2.0	ES				Firm to stiff dark reddish brown mottled light grey sandy gravelly CLAY. Gravel is subrounded to rounded fine to coarse chert. With occasional black organic fragments. (OADBY MEMBER)		
0.45		V	c_u=>52/54/68					
0.45		V	>					
1.20	3.0	D						
1.20		V	c_u=54/62/54				(2.20)	
							2.50	
2.50	4.0	D				Trial pit terminated at 2.50m depth.		
2.50		V	c_u=61/72					

Plan (Not to Scale)



General Remarks

1. CBR results at 0.45m (%): 3,4,4,4,4
2. Sides remained stable during excavation
3. No groundwater encountered
4. Backfilled with arisings

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**Tracked excavator**	**CLawrence**	

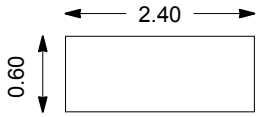
FINAL
TRIAL PIT LOG

Contract:	Client:	Trial Pit:
Jacqueline Road, Markfield	**Taylor Wimpey UK Ltd**	**TP106**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
301538	**23.01.15**	**---**	**E:449887.0 N:309407.0**	**1** of **1**
	End: **23.01.15**			

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
						TOPSOIL: dark brown friable gravelly sandy CLAY with a medium cobble content. Cobbles are subangular diorite. Gravel is angular to subangular medium to coarse diorite. Frequent rootlets.	0.25	
						Light orangish brown clayey SAND. (OADBY MEMBER)	(0.35)	
0.50	1.0	ES					0.60	
						Dark orangish brown clayey sandy GRAVEL COBBLES & BOULDERS of diorite. (SOUTH CHARNWOOD DIORITES)		
1.20	2.0	D		1			(1.20)	
							1.80	
						Trial pit terminated at 1.80m depth.		

Plan (Not to Scale)



General Remarks

1. CBR results at 0.50m (%): 5,6,6,6,6
2. Sides unstable below 0.60m
3. Hard digging below 0.60m
4. Water strike at 1.80m
5. Backfilled with arisings

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**Tracked excavator**	**CLawrence**	

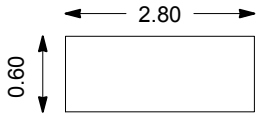
FINAL
TRIAL PIT LOG

Contract:	Client:	Trial Pit:
Jacqueline Road, Markfield	**Taylor Wimpey UK Ltd**	**TP107**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
301538	**23.01.15** End: **23.01.15**	**---**	**E:449900.0 N:309499.0**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
0.15	1.0	ES				TOPSOIL: dark brown friable gravelly sandy CLAY with a medium cobble content. Cobbles are subangular diorite. Gravel is angular to subangular medium to coarse diorite. Frequent rootlets.	0.25	
						Firm light orangish brown mottled light grey sandy CLAY. (OADBY MEMBER)	(0.40)	
0.55		V	c_u=32/38/38				0.65	
0.70		V	c_u=38/46			Firm dark reddish brown sandy CLAY. With pockets of light grey sandy clay and dark orange sand. (OADBY MEMBER)		
0.90	2.0	D						
1.40	3.0	D		1			(1.95)	
							2.60	
2.70	4.0	B				Trial pit terminated at 2.60m depth.		

Plan (Not to Scale)



General Remarks

1. Sides unstable below 2.30m
2. Groundwater encountered at 2.30m
3. Backfilled with arisings

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**Tracked excavator**	**CLawrence**	

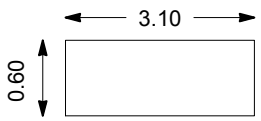
FINAL
TRIAL PIT LOG

Contract:	Client:	Trial Pit:
Jacqueline Road, Markfield	**Taylor Wimpey UK Ltd**	**TP108**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
301538	**23.01.15** End: **23.01.15**	**---**	**E:449810.0 N:309431.0**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
0.20	1.0	ES				TOPSOIL: dark brown friable slightly gravelly clayey SAND. Gravel is subrounded to rounded medium to coarse Flint and rare brick. With frequent rootlets. . . . Below 0.40m at north side of the pit, abundant cobbles and boulders of diorite	(0.60)	
0.60		V	c_u=48/61/60			Stiff dark reddish brown mottled light grey sandy CLAY. (OADBY MEMBER)	0.60	
1.20	2.0	D		≈			(1.25)	
1.60	3.0	D						
1.80	4.0	D					1.85	
2.10	5.0	B				Dark reddish brown clayey SAND. (OADBY MEMBER)	(0.70)	
						Massive dark pinkish black crystalline DIORITE. (SOUTH CHARNWOOD DIORITES)	2.55 2.60	
						Trial pit terminated at 2.60m depth due to excavator unable to penetrate diorite		

Plan (Not to Scale)



General Remarks

1. Sides remained stable during excavation
2. Seepage noted at 1.80m
3. Backfilled with arisings

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**Tracked excavator**	**CLawrence**	

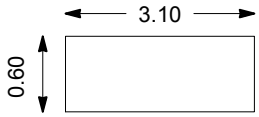
FINAL
TRIAL PIT LOG

Contract:	Client:	Trial Pit:
Jacqueline Road, Markfield	**Taylor Wimpey UK Ltd**	**TP109**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
301538	**23.01.15** End: **23.01.15**	**---**	**E:449776.0 N:309576.0**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
0.15	1.0	ES				TOPSOIL: dark brown friable gravelly sandy CLAY with a medium cobble content. Cobbles are subangular diorite. Gravel is angular to subangular medium to coarse diorite. Frequent rootlets.	(0.35)	
							0.35	
0.50	2.0	ES				Light orangish brown slightly clayey sandy GRAVEL COBBLES & BOULDERS of diorite. (SOUTH CHARNWOOD DIORITES)		
0.60	3.0	D					(0.85)	
1.20	4.0	D					1.20	
1.20	5.0	B				Massive dark pinkish black crystalline DIORITE. (SOUTH CHARNWOOD DIORITES)	1.25	
						Trial pit terminated at 1.25m depth due to excavator unable to penetrate diorite.		

Plan (Not to Scale)



General Remarks

1. Sides remained stable during excavation
2. No groundwater encountered
3. Backfilled with arisings

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**Tracked excavator**	**CLawrence**	

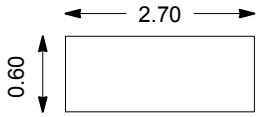
FINAL
TRIAL PIT LOG

Contract:	Client:	Trial Pit:
Jacqueline Road, Markfield	**Taylor Wimpey UK Ltd**	**TP110**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
301538	**23.01.15**	**---**	**E:449698.0 N:309518.0**	**1** of **1**
	End: **23.01.15**			

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
0.20	1.0	ES				TOPSOIL: dark brown friable gravelly sandy CLAY with a medium cobble content. Cobbles are subangular diorite. Gravel is angular to subangular medium to coarse diorite. Frequent rootlets.	(0.30) 0.30	
0.50	2.0	B				Light orangish brown slightly clayey SAND. Localised pockets of firm light grey sandy clay. (OADBY MEMBER)	(0.30) 0.60	
0.60	3.0	D				Very stiff dark reddish brown mottled light grey CLAY. Locally sandy. (OADBY MEMBER)		
0.60		V	c_u=>120/108					
0.60		V	>			. . . Becoming more weathered/mottled bew 1.50m	(2.20)	
							2.80	
						Trial pit terminated at 2.80m depth.		

Plan (Not to Scale)



General Remarks

1. Sides remained stable during excavation
2. No groundwater encountered
3. Backfilled with arisings

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**Tracked excavator**	**CLawrence**	

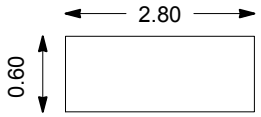
FINAL
TRIAL PIT LOG

Contract:	Client:	Trial Pit:
Jacqueline Road, Markfield	**Taylor Wimpey UK Ltd**	**TP111**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
301538	**23.01.15**	**---**	**E:449637.0 N:309549.0**	**1** of **1**
	End: **23.01.15**			

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
						TOPSOIL: dark brown friable gravelly sandy CLAY with a medium cobble content. Cobbles are subangular diorite. Gravel is angular to subangular medium to coarse diorite. Frequent rootlets.	(0.30)	
							0.30	
						Light orangish brown mottled light grey slightly clayey SAND. (OADBY MEMBER)	(0.30)	
0.45	1.0	ES					0.60	
				1		Firm light orangish brown mottled light grey sandy CLAY. Becoming more sandy with depth. (OADBY MEMBER)		
0.90	2.0	D						
0.90		V	c_u=44/39			. . . At 1.00m diorite boulder	(1.20)	
1.35	3.0	D						
							1.80	
1.90	4.0	B		2		Light orangish brown gravelly SAND. Gravel is subangular to subrounded fine to medium sandstone. Locally clayey. Occasional coarse gravels and cobbles of diorite. (OADBY MEMBER)	(0.90)	
							2.70	
						Trial pit terminated at 2.70m depth.		

Plan (Not to Scale)



General Remarks

1. Sides remained stable during excavation
2. Groundwater encountered at 0.80m and 2.10m
3. Backfilled with arisings

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**Tracked excavator**	**CLawrence**	

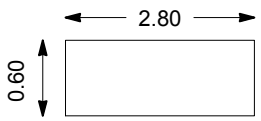
FINAL
TRIAL PIT LOG

Contract:	Client:	Trial Pit:
Jacqueline Road, Markfield	**Taylor Wimpey UK Ltd**	**TP112**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
301538	**23.01.15** End: **23.01.15**	**---**	**E:449860.0 N:309462.0**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
						TOPSOIL: dark brown friable gravelly sandy CLAY with a medium cobble content. Cobbles are subangular diorite. Gravel is angular to subangular medium to coarse diorite. Frequent rootlets.	(0.30) 0.30	
0.50 0.50 0.50	1.0 2.0	ES D V	c_u=42/40			Firm light orangish brown CLAY. Pockets of light grey fine grained sand. (OADBY MEMBER)	(0.90) 1.20	
				1		Dark orangish brown mottled light grey gravelly SAND. Gravel is subangular to subrounded fine and coarse sandstone. (OADBY MEMBER)	(0.80) 2.00	
2.20		V	c_u=56/56			Firm dark reddish brown sandy CLAY. With pockets of firm light grey sandy clay. (OADBY MEMBER)	(0.80) 2.80	
						Trial pit terminated at 2.80m depth.		

Plan (Not to Scale)



General Remarks

1. Perched water on ground surface entered pit resulting in top 0.50m becoming unstable
2. Pit unstable within sand pockets below 1.70m
3. Groundwater encountered at 1.70m
4. Backfilled with arisings

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**Tracked excavator**	**CLawrence**	

AGS

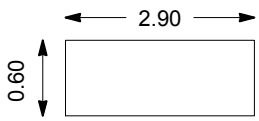
FINAL
TRIAL PIT LOG

Contract:	Client:	Trial Pit:
Jacqueline Road, Markfield	**Taylor Wimpey UK Ltd**	**TP113**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
301538	**23.01.15**	**---**	**E:449766.0 N:309506.0**	**1** of **1**
	End: **23.01.15**			

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
						TOPSOIL: dark brown friable gravelly sandy CLAY with a medium cobble content. Cobbles are subangular diorite. Gravel is angular to subangular medium to coarse diorite. Frequent rootlets.	(0.30)	
							0.30	
0.50	1.0	ES				Stiff light orangish brown mottled light grey CLAY. (OADBY MEMBER)		
1.00	2.0	D					(1.40)	
1.00		V	c_u=42/38/48			. . . Between 1.10m and 1.50m boulders of diorite		
							1.70	
						Stiff dark reddish brown mottled light grey slightly sandy CLAY. With pockets of firm light grey clay. (OADBY MEMBER) Trial pit terminated at 1.70m depth.		

Plan (Not to Scale)



General Remarks

1. Sides remained stable during excavation
2. No groundwater encountered
3. Backfilled with arisings

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**Tracked excavator**	**CLawrence**	

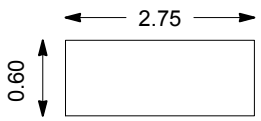
FINAL
TRIAL PIT LOG

Contract:	Client:	Trial Pit:
Jacqueline Road, Markfield	**Taylor Wimpey UK Ltd**	**TP114**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
301538	**23.01.15**	**---**	**E:449648.0 N:309501.0**	**1** of **1**
	End: **23.01.15**			

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
0.30	1	ES				TOPSOIL: dark brown friable gravelly sandy CLAY with a medium cobble content. Cobbles are subangular diorite. Gravel is angular to subangular medium to coarse diorite. Frequent rootlets.	(0.50) 0.50	
						Light orangish brown mottled light grey SAND (OADBY MEMBER)	(0.40) 0.90	
						Stiff reddish brown slightly sandy CLAY. Localised posckets of light grey sandy clay (OADBY MEMBER)	(0.90) 1.80	
						Trial pit terminated at 1.80m depth due to excavator slipping on top surface and unable to advance further.		

Plan (Not to Scale)



General Remarks

1. Sides remained stable during excavation
2. No groundwater encountered
3. Backfilled with arisings

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**Tracked excavator**	**CLawrence**	

APPENDIX G
LABORATORY CERTIFICATES FOR SOIL ANALYSIS

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 15/00415
Issue Number: 1 **Date:** 10 February, 2015

Client:
RSK Environment Ltd Derby
12 Royal Scot Road
Pride Park
Derby
Derbyshire
UK
DE24 8AJ

Project Manager: Claire Lawrence/Melanie Rowley
Project Name: Markfield
Project Ref: 301538
Order No: N/A
Date Samples Received: 28/01/15
Date Instructions Received: 28/01/15
Date Analysis Completed: 06/02/15

Prepared by:
Melanie Marshall
Laboratory Coordinator

Approved by:
Iain Haslock
Analytical Consultant

Envirolab Job Number: 15/00415

Client Project Name: Markfield

Client Project Ref: 301538

Lab Sample ID	15/00415/1	15/00415/2	15/00415/3	15/00415/4	15/00415/5	15/00415/6	15/00415/7	15/00415/8	Units	Method ref
Client Sample No										
Client Sample ID	TP101	TP102	TP104	TP105	TP107	TP108	TP109	TP110		
Depth to Top	0.15	0.20	0.15	0.15	0.15	0.20	0.15	0.20		
Depth To Bottom										
Date Sampled	22-Jan-15	22-Jan-15	22-Jan-15	23-Jan-15	23-Jan-15	23-Jan-15	23-Jan-15	23-Jan-15		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
MCERTS Sample Matrix Code	6E	6AE	6AE	4AE	6E	4AE	4AE	6AE		
% Stones >10mm$_A^{\#}$	<0.1	<0.1	6.7	28.3	<0.1	15.7	4.6	22.6	% w/w	A-T-044
pH$_D^{M\#}$	-	7.24	7.15	-	7.30	-	-	-	pH	A-T-031s
Sulphate (water sol 2:1)$_D^{M\#}$	-	<0.01	<0.01	-	<0.01	-	-	-	g/l	A-T-026s
Sulphate (acid soluble)$_D^{M\#}$	-	410	370	-	340	-	-	-	mg/kg	A-T-028s
Total Organic Carbon$_D^{M\#}$	-	1.92	-	-	1.83	-	-	-	% w/w	A-T-032s
Arsenic$_D^{M\#}$	4	4	5	4	4	4	4	3	mg/kg	A-T-024s
Cadmium$_D^{M\#}$	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	mg/kg	A-T-024s
Copper$_D^{M\#}$	20	18	17	14	12	15	20	23	mg/kg	A-T-024s
Chromium$_D^{M\#}$	18	19	19	15	18	16	15	14	mg/kg	A-T-024s
Lead$_D^{M\#}$	28	29	30	25	25	29	26	21	mg/kg	A-T-024s
Mercury$_D$	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	mg/kg	A-T-024s
Nickel$_D^{M\#}$	14	12	13	9	10	12	11	11	mg/kg	A-T-024s
Selenium$_D^{M\#}$	<1	<1	<1	<1	<1	2	<1	<1	mg/kg	A-T-024s
Zinc$_D^{M\#}$	80	58	59	34	45	67	82	57	mg/kg	A-T-024s

Envirolab Job Number: 15/00415

Client Project Name: Markfield

Client Project Ref: 301538

Lab Sample ID	15/00415/1	15/00415/2	15/00415/3	15/00415/4	15/00415/5	15/00415/6	15/00415/7	15/00415/8	Units	Method ref
Client Sample No										
Client Sample ID	TP101	TP102	TP104	TP105	TP107	TP108	TP109	TP110		
Depth to Top	0.15	0.20	0.15	0.15	0.15	0.20	0.15	0.20		
Depth To Bottom										
Date Sampled	22-Jan-15	22-Jan-15	22-Jan-15	23-Jan-15	23-Jan-15	23-Jan-15	23-Jan-15	23-Jan-15		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
MCERTS Sample Matrix Code	6E	6AE	6AE	4AE	6E	4AE	4AE	6AE		
TPH CWG										
Ali >C5-C6$_A^{\#}$	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
Ali >C6-C8$_A^{\#}$	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
Ali >C8-C10$_A^{\#}$	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
Ali >C10-C12$_A^{\#}$	-	<0.1	<0.1	-	<0.1	-	-	-	mg/kg	A-T-023s
Ali >C12-C16$_A^{\#}$	-	<0.1	<0.1	-	<0.1	-	-	-	mg/kg	A-T-023s
Ali >C16-C21$_A^{\#}$	-	<0.1	<0.1	-	<0.1	-	-	-	mg/kg	A-T-023s
Ali >C21-C35$_A^{\#}$	-	<0.1	<0.1	-	<0.1	-	-	-	mg/kg	A-T-023s
Total Aliphatics$_A$	-	<0.1	<0.1	-	<0.1	-	-	-	mg/kg	A-T-022+23s
Aro >C5-C7$_A^{\#}$	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
Aro >C7-C8$_A^{\#}$	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
Aro >C8-C9$_A^{\#}$	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
Aro >C9-C10$_A^{\#}$	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
Aro >C10-C12$_A^{\#}$	-	<0.1	<0.1	-	<0.1	-	-	-	mg/kg	A-T-023s
Aro >C12-C16$_A^{\#}$	-	<0.1	<0.1	-	<0.1	-	-	-	mg/kg	A-T-023s
Aro >C16-C21$_A^{\#}$	-	<0.1	<0.1	-	<0.1	-	-	-	mg/kg	A-T-023s
Aro >C21-C35$_A^{\#}$	-	<0.1	<0.1	-	<0.1	-	-	-	mg/kg	A-T-023s
Total Aromatics$_A$	-	<0.1	<0.1	-	<0.1	-	-	-	mg/kg	A-T-022+23s
TPH (Ali & Aro)$_A$	-	<0.1	<0.1	-	<0.1	-	-	-	mg/kg	A-T-022+23s
BTEX - Benzene$_A^{\#}$	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
BTEX - Toluene$_A^{\#}$	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
BTEX - o Xylene$_A^{\#}$	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
MTBE$_A^{\#}$	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_D^{\#}$	-	-	-	-	NAD	-	-	-		A-T-045
Asbestos ACM - Suitable for Water Absorption Test?$_D$	-	-	-	-	N/A	-	-	-		Gravimetry

Envirolab Job Number: 15/00415

Client Project Name: Markfield

Client Project Ref: 301538

Lab Sample ID	15/00415/1	15/00415/2	15/00415/3	15/00415/4	15/00415/5	15/00415/6	15/00415/7	15/00415/8	Units	Method ref
Client Sample No										
Client Sample ID	TP101	TP102	TP104	TP105	TP107	TP108	TP109	TP110		
Depth to Top	0.15	0.20	0.15	0.15	0.15	0.20	0.15	0.20		
Depth To Bottom										
Date Sampled	22-Jan-15	22-Jan-15	22-Jan-15	23-Jan-15	23-Jan-15	23-Jan-15	23-Jan-15	23-Jan-15		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
MCERTS Sample Matrix Code	6E	6AE	6AE	4AE	6E	4AE	4AE	6AE		
PAH 16										
Acenaphthene$_A^{M\#}$	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-019s
Anthracene$_A^{M\#}$	-	<0.02	<0.02	-	<0.02	-	-	-	mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	-	<0.04	0.06	-	<0.04	-	-	-	mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	-	<0.04	0.07	-	<0.04	-	-	-	mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	-	<0.05	0.08	-	<0.05	-	-	-	mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	-	<0.05	<0.05	-	<0.05	-	-	-	mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	-	<0.07	<0.07	-	<0.07	-	-	-	mg/kg	A-T-019s
Chrysene$_A^{M\#}$	-	<0.06	<0.06	-	<0.06	-	-	-	mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	-	<0.04	<0.04	-	<0.04	-	-	-	mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	-	<0.08	0.15	-	<0.08	-	-	-	mg/kg	A-T-019s
Fluorene$_A^{M\#}$	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	-	<0.03	0.05	-	<0.03	-	-	-	mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	-	<0.03	<0.03	-	<0.03	-	-	-	mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	-	<0.03	0.07	-	<0.03	-	-	-	mg/kg	A-T-019s
Pyrene$_A^{M\#}$	-	<0.07	0.13	-	<0.07	-	-	-	mg/kg	A-T-019s
PAH (total 16)$_A^{M\#}$	-	<0.08	0.59	-	<0.08	-	-	-	mg/kg	A-T-019s

Envirolab Job Number: 15/00415

Client Project Name: Markfield

Client Project Ref: 301538

Lab Sample ID	15/00415/9								Units	Method ref
Client Sample No										
Client Sample ID	TP114									
Depth to Top	0.30									
Depth To Bottom										
Date Sampled	23-Jan-15									
Sample Type	Soil - ES									
MCERTS Sample Matrix Code	6E									
% Stones >10mm$_A^{\#}$	<0.1								% w/w	A-T-044
pH$_D^{M\#}$	6.91								pH	A-T-031s
Sulphate (water sol 2:1)$_D^{M\#}$	0.02								g/l	A-T-026s
Sulphate (acid soluble)$_D^{M\#}$	430								mg/kg	A-T-028s
Total Organic Carbon$_D^{M\#}$	1.98								% w/w	A-T-032s
Arsenic$_D^{M\#}$	5								mg/kg	A-T-024s
Cadmium$_D^{M\#}$	<0.5								mg/kg	A-T-024s
Copper$_D^{M\#}$	21								mg/kg	A-T-024s
Chromium$_D^{M\#}$	19								mg/kg	A-T-024s
Lead$_D^{M\#}$	35								mg/kg	A-T-024s
Mercury$_D$	<0.17								mg/kg	A-T-024s
Nickel$_D^{M\#}$	12								mg/kg	A-T-024s
Selenium$_D^{M\#}$	<1								mg/kg	A-T-024s
Zinc$_D^{M\#}$	64								mg/kg	A-T-024s

Envirolab Job Number: 15/00415

Client Project Name: Markfield

Client Project Ref: 301538

Lab Sample ID	15/00415/9								Units	Method ref
Client Sample No										
Client Sample ID	TP114									
Depth to Top	0.30									
Depth To Bottom										
Date Sampled	23-Jan-15									
Sample Type	Soil - ES									
MCERTS Sample Matrix Code	6E									
TPH CWG										
Ali >C5-C6$_A^\#$	<0.01								mg/kg	A-T-022s
Ali >C6-C8$_A^\#$	<0.01								mg/kg	A-T-022s
Ali >C8-C10$_A^\#$	<0.01								mg/kg	A-T-022s
Ali >C10-C12$_A^\#$	<0.1								mg/kg	A-T-023s
Ali >C12-C16$_A^\#$	<0.1								mg/kg	A-T-023s
Ali >C16-C21$_A^\#$	<0.1								mg/kg	A-T-023s
Ali >C21-C35$_A^\#$	<0.1								mg/kg	A-T-023s
Total Aliphatics$_A$	<0.1								mg/kg	A-T-022+23s
Aro >C5-C7$_A^\#$	<0.01								mg/kg	A-T-022s
Aro >C7-C8$_A^\#$	<0.01								mg/kg	A-T-022s
Aro >C8-C9$_A^\#$	<0.01								mg/kg	A-T-022s
Aro >C9-C10$_A^\#$	<0.01								mg/kg	A-T-022s
Aro >C10-C12$_A^\#$	<0.1								mg/kg	A-T-023s
Aro >C12-C16$_A^\#$	<0.1								mg/kg	A-T-023s
Aro >C16-C21$_A^\#$	<0.1								mg/kg	A-T-023s
Aro >C21-C35$_A^\#$	<0.1								mg/kg	A-T-023s
Total Aromatics$_A$	<0.1								mg/kg	A-T-022+23s
TPH (Ali & Aro)$_A$	<0.1								mg/kg	A-T-022+23s
BTEX - Benzene$_A^\#$	<0.01								mg/kg	A-T-022s
BTEX - Toluene$_A^\#$	<0.01								mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^\#$	<0.01								mg/kg	A-T-022s
BTEX - m & p Xylene$_A^\#$	<0.01								mg/kg	A-T-022s
BTEX - o Xylene$_A^\#$	<0.01								mg/kg	A-T-022s
MTBE$_A^\#$	<0.01								mg/kg	A-T-022s

Envirolab Job Number: 15/00415

Client Project Name: Markfield

Client Project Ref: 301538

Lab Sample ID	15/00415/9								Units	Method ref
Client Sample No										
Client Sample ID	TP114									
Depth to Top	0.30									
Depth To Bottom										
Date Sampled	23-Jan-15									
Sample Type	Soil - ES									
MCERTS Sample Matrix Code	6E									
PAH 16										
Acenaphthene$_A^{M\#}$	<0.01								mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	<0.01								mg/kg	A-T-019s
Anthracene$_A^{M\#}$	<0.02								mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	<0.04								mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	<0.04								mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	<0.05								mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	<0.05								mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	<0.07								mg/kg	A-T-019s
Chrysene$_A^{M\#}$	<0.06								mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	<0.04								mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	<0.08								mg/kg	A-T-019s
Fluorene$_A^{M\#}$	<0.01								mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	<0.03								mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	<0.03								mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	<0.03								mg/kg	A-T-019s
Pyrene$_A^{M\#}$	<0.07								mg/kg	A-T-019s
PAH (total 16)$_A^{M\#}$	<0.08								mg/kg	A-T-019s

REPORT NOTES

Notes - Soil chemical analysis
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones >10mm are removed or excluded from the sample prior to analysis and reported results corrected to a whole sample basis. For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis.

Notes - General
This report shall not be reproduced, except in full, without written approval from Envirolab.
Subscript "A" indicates analysis performed on the sample as received. "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve, unless asbestos is found to be present in which case all analysis is performed on the sample as received.
All analysis is performed on the dried and crushed sample for samples with Matrix Code 7 and this supercedes any "A" subscripts.
All analysis is performed on the sample as received for soil samples from outside the European Union and this supercedes any "D" subscripts.
Superscript "M" indicates method accredited to MCERTS.
If results are in italic font they are associated with an AQC failure. These are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

TPH analysis of water by method A-T-007
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Asbestos in soil
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if present as discrete fibres/fragments. Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified a being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER.
Samples with Matrix Code 7 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations.

Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

IS indicates Insufficient sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Analytical results reflect the quality of the sample at the time of analysis only. Opinions and interpretations expressed are outside the scope of our accreditation.

Please contact us if you need any further information.

APPENDIX H
SOAKAWAY TEST RESULTS

FULL SCALE SOAKAWAY TEST

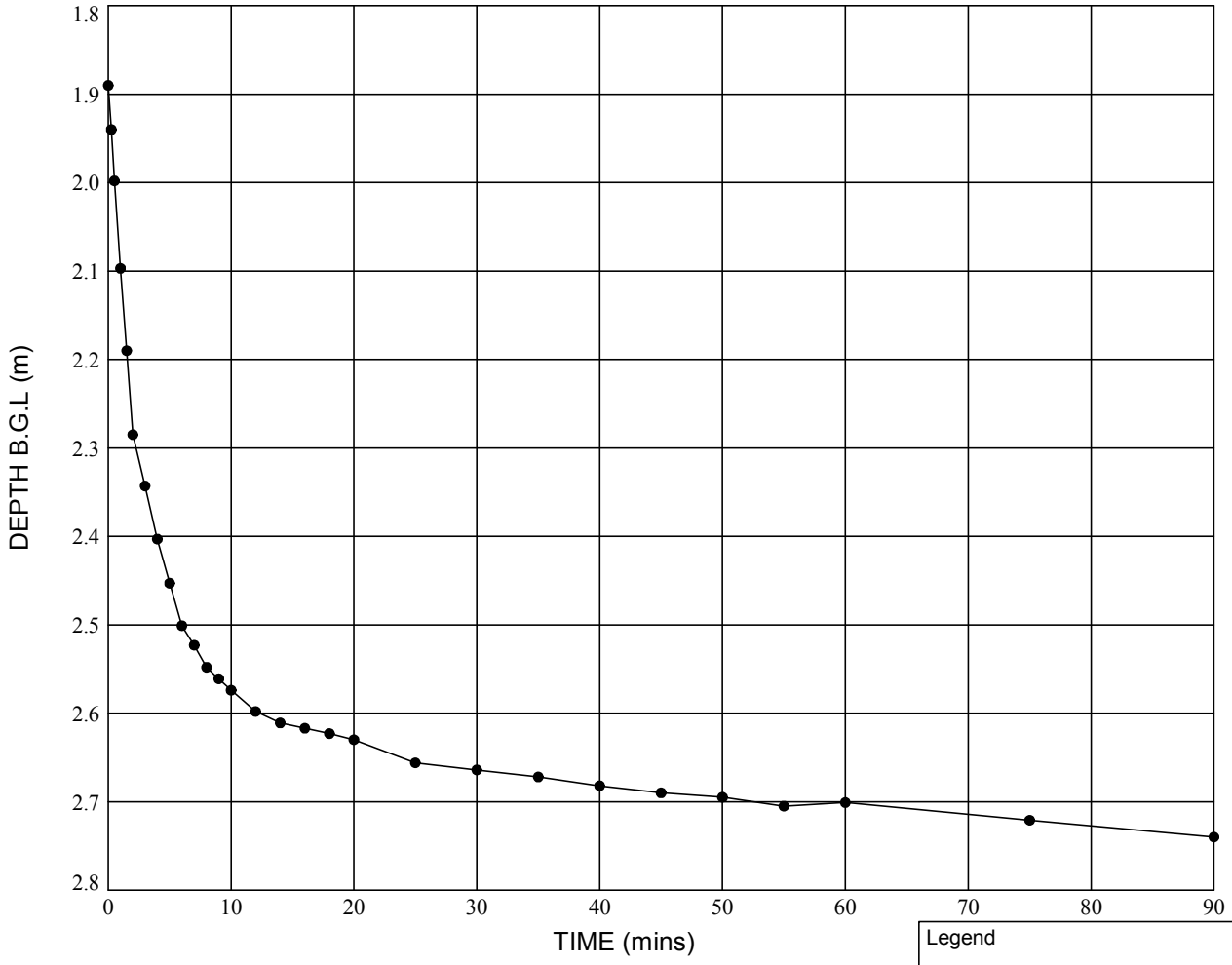
In accordance with BRE Digest 365

Soakaway Test - Position ID : **TP101**

Ground Level: **---**

National Grid Co-ordinates: **E:449728.0 N:309581.0**

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME

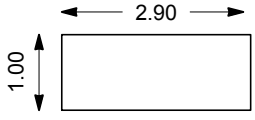


Legend

● Test 1 (22.01.15)

Pit start depth	=	2.95	m
Pit final depth	=	2.95	m
Effective depth, De	=	1.06	m
Effective storage volume, V_{p75-25}	=	1.5370	m^3
Surface area, a_{p50}	=	7.0340	m^2
Time, t_{p75-25}	=	2433	secs
Infiltration rate, f	=	8.98×10^{-5}	m/s

Plan (Not to scale)



No Bearing Taken

RSK Environment Ltd
12 Royal Scot Road
Pride Park
Derby
DE24 8AJ

Compiled By	Date	Checked By	Date
Lawrence	17/02/15		

Contract: **Jacqueline Road, Markfield**

Contract Ref: **301538**

FULL SCALE SOAKAWAY TEST

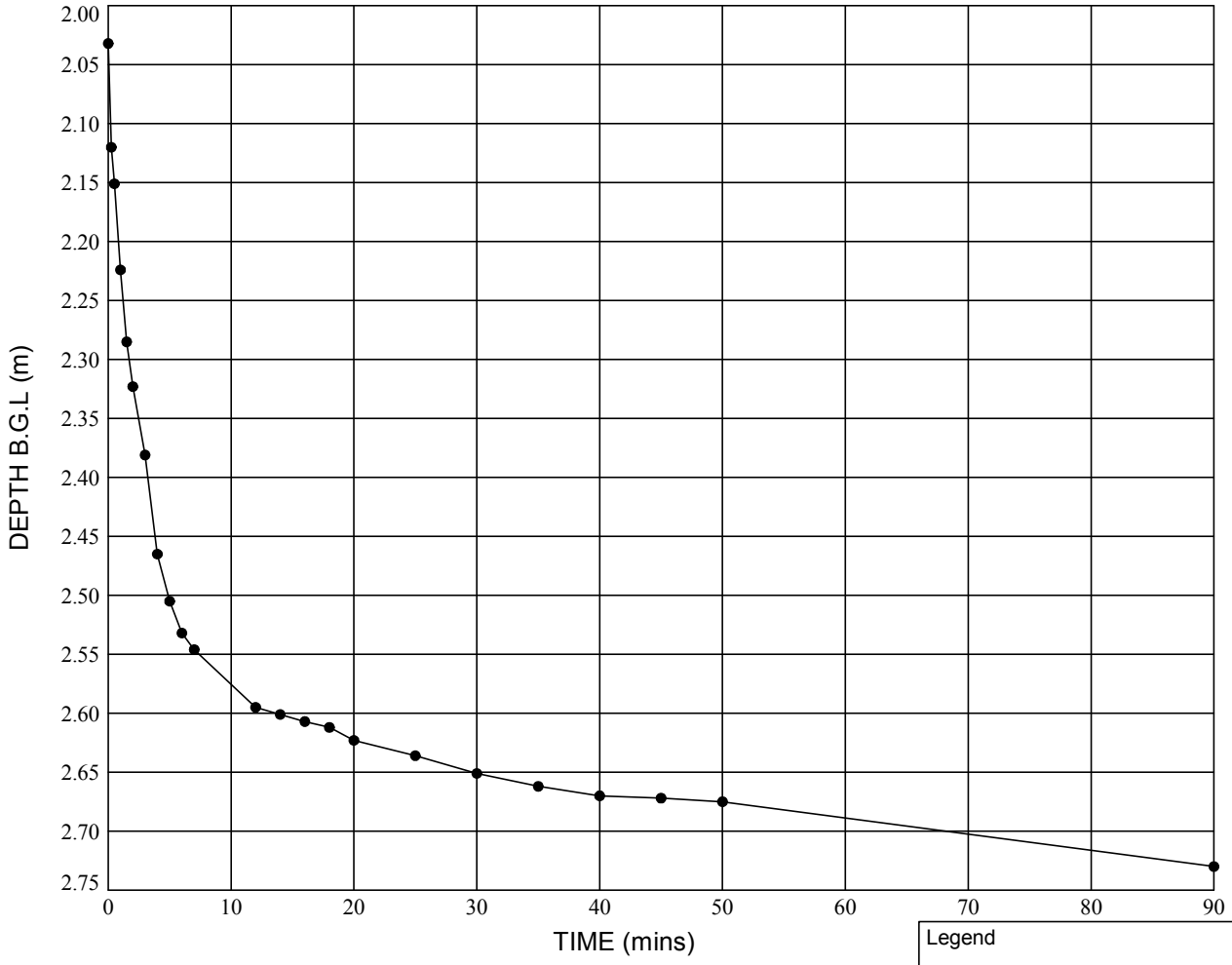
In accordance with BRE Digest 365

Soakaway Test - Position ID : **TP101**

Ground Level: **---**

National Grid Co-ordinates: **E:449728.0 N:309581.0**

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME

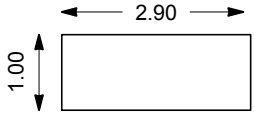


Legend

● Test 2 (22.01.15)

Pit start depth	=	2.95	m
Pit final depth	=	2.95	m
Effective depth, De	=	0.92	m
Effective storage volume, V_{p75-25}	=	1.3311	m^3
Surface area, a_{p50}	=	6.4802	m^2
Time, t_{p75-25}	=	4907	secs
Infiltration rate, f	=	4.19×10^{-5}	m/s

Plan (Not to scale)



No Bearing Taken

RSK Environment Ltd 12 Royal Scot Road Pride Park Derby DE24 8AJ	Compiled By	Date	Checked By	Date
	Lawrence	17/02/15		
	Contract: **Jacqueline Road, Markfield**		Contract Ref: **301538**	

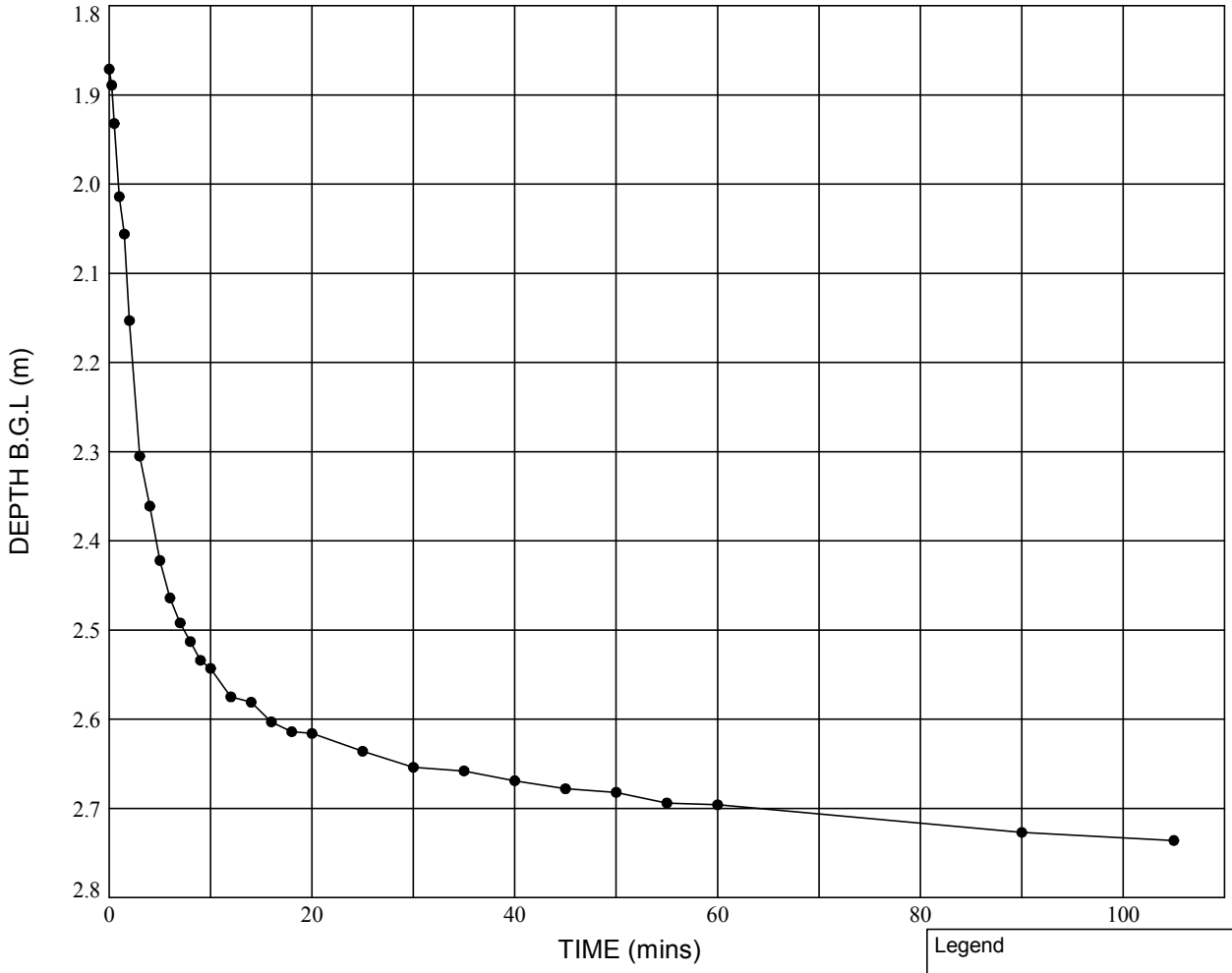
FULL SCALE SOAKAWAY TEST

In accordance with BRE Digest 365

Soakaway Test - Position ID : **TP101**

Ground Level: **---** National Grid Co-ordinates: **E:449728.0 N:309581.0**

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME

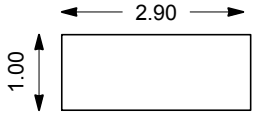


Legend

● Test 3 (23.01.15)

Pit start depth	=	2.95	m
Pit final depth	=	2.95	m
Effective depth, De	=	1.08	m
Effective storage volume, V_{p75-25}	=	1.5646	m^3
Surface area, a_{p50}	=	7.1081	m^2
Time, t_{p75-25}	=	2753	secs
Infiltration rate, f	=	8.00×10^{-5}	m/s

Plan (Not to scale)



No Bearing Taken

RSK Environment Ltd 12 Royal Scot Road Pride Park Derby DE24 8AJ	Compiled By	Date	Checked By	Date
	Lawrence	17/02/15		
	Contract: **Jacqueline Road, Markfield**		Contract Ref: **301538**	

FULL SCALE SOAKAWAY TEST

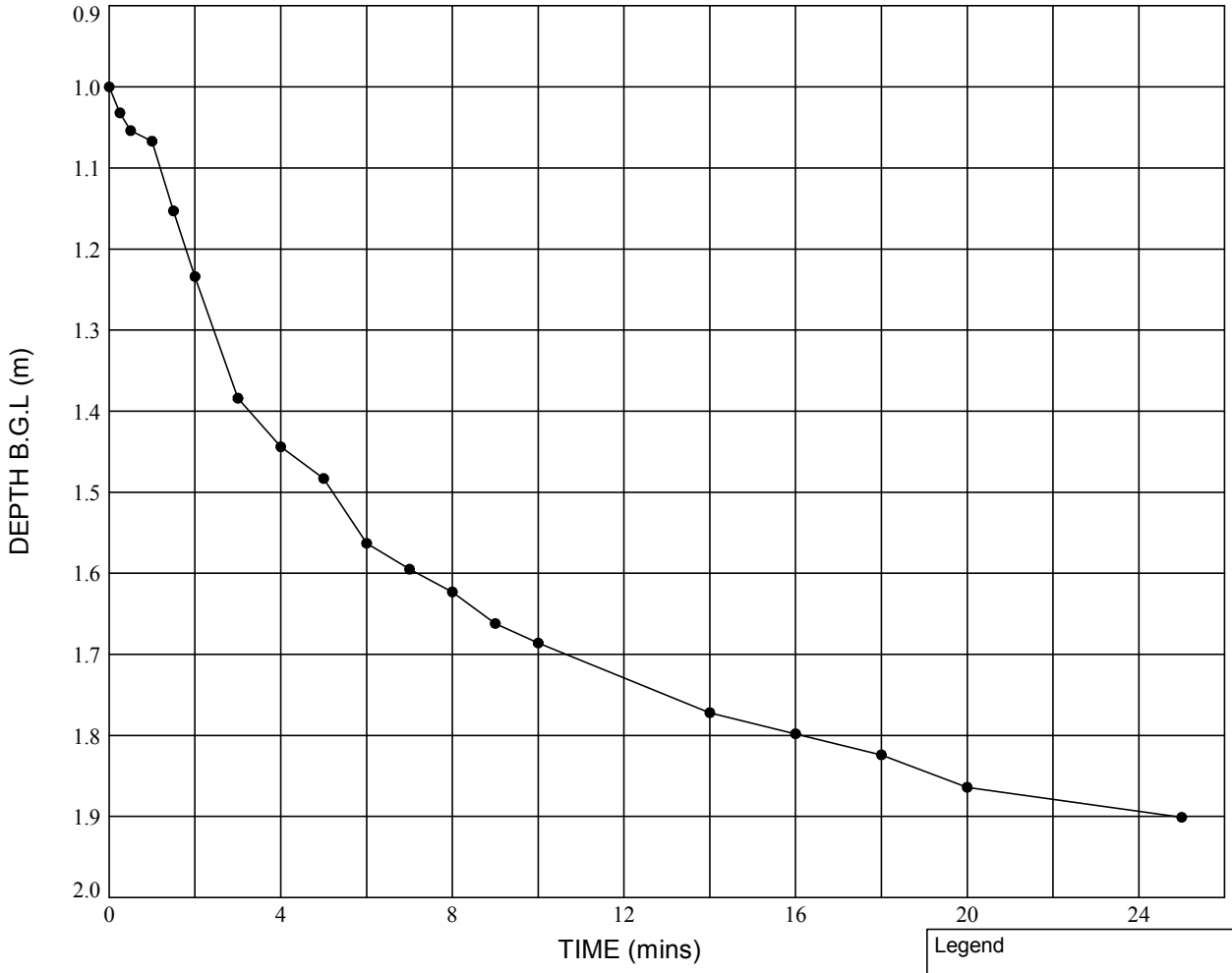
In accordance with BRE Digest 365

Soakaway Test - Position ID : **TP103**

Ground Level: **---**

National Grid Co-ordinates: **E:449727.0 N:309465.0**

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME

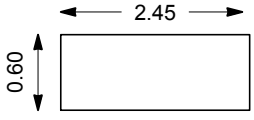


Legend

● Test 1 (22.01.15)

Pit start depth	=	2.01	m
Pit final depth	=	2.01	m
Effective depth, De	=	1.01	m
Effective storage volume, V_{p75-25}	=	0.7424	m^3
Surface area, a_{p50}	=	4.5505	m^2
Time, t_{p75-25}	=	673	secs
Infiltration rate, f	=	2.42×10^{-4}	m/s

Plan (Not to scale)



No Bearing Taken

RSK Environment Ltd 12 Royal Scot Road Pride Park Derby DE24 8AJ	Compiled By	Date	Checked By	Date
	Lawrence	17/02/15		
	Contract: **Jacqueline Road, Markfield**		Contract Ref: **301538**	

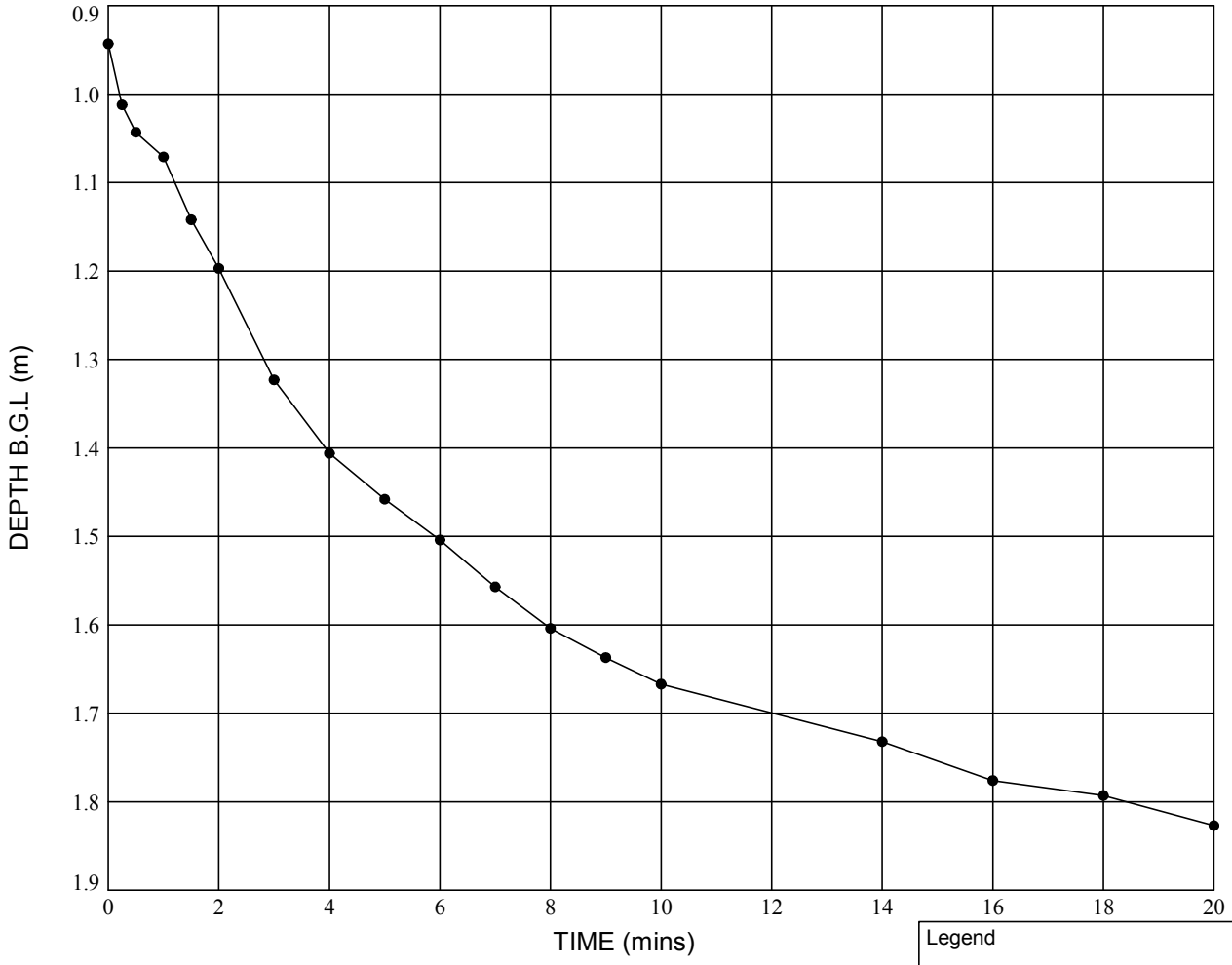
FULL SCALE SOAKAWAY TEST

In accordance with BRE Digest 365

Soakaway Test - Position ID : **TP103**

Ground Level: **---** National Grid Co-ordinates: **E:449727.0 N:309465.0**

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME



Legend

● Test 2 (22.01.15)

Plan (Not to scale)

No Bearing Taken

Pit start depth	= 2.01	m	
Pit final depth	= 2.01	m	
Effective depth, De	= 1.07	m	
Effective storage volume, V_{p75-25}	= 0.7842	m^3	
Surface area, a_{p50}	= 4.7244	m^2	
Time, t_{p75-25}	= 745	secs	
Infiltration rate, f	= 2.23×10^{-4}	m/s	

RSK Environment Ltd 12 Royal Scot Road Pride Park Derby DE24 8AJ	Compiled By	Date	Checked By	Date
	Lawrence	17/02/15		
	Contract: **Jacqueline Road, Markfield**		Contract Ref: **301538**	

FULL SCALE SOAKAWAY TEST

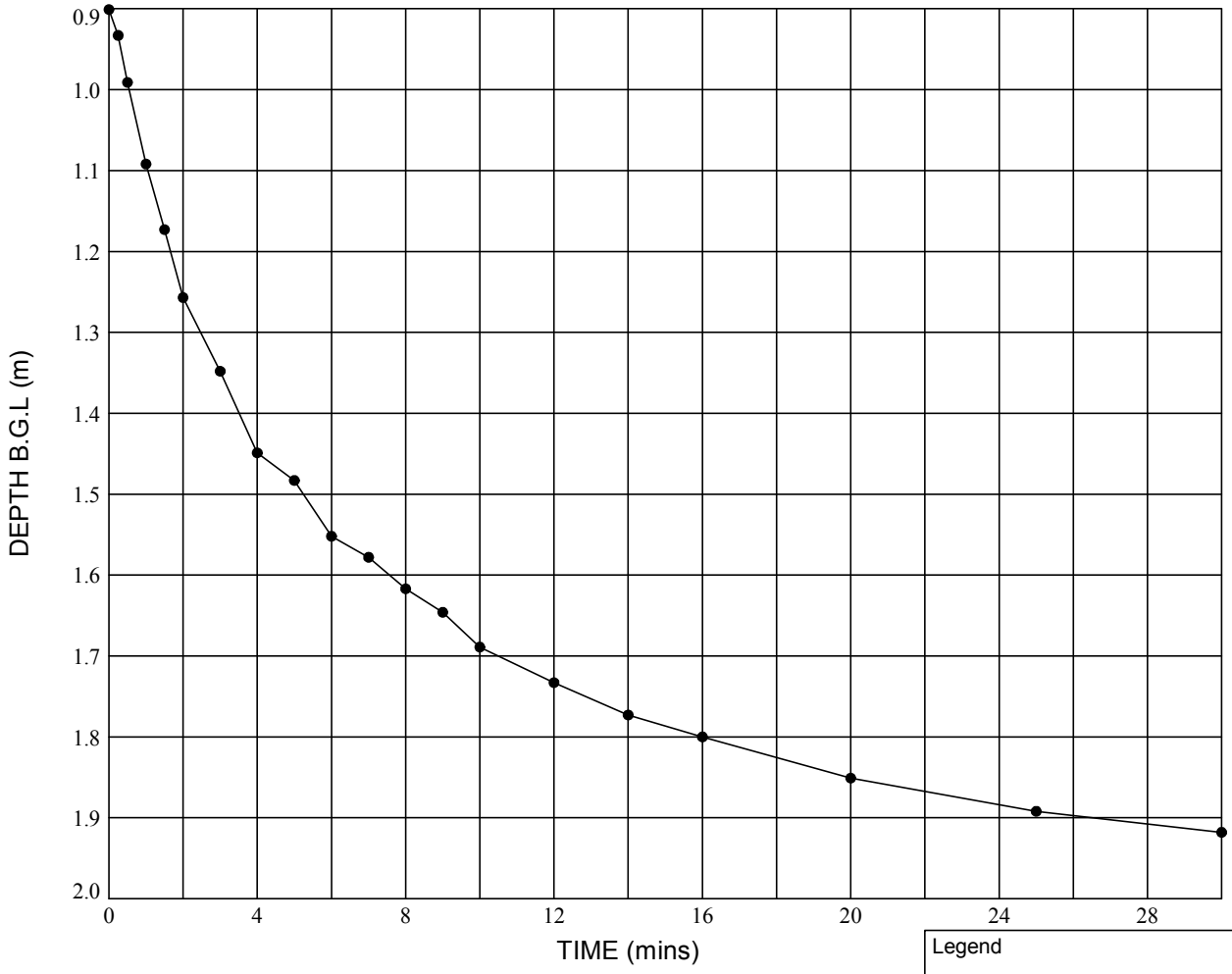
In accordance with BRE Digest 365

Soakaway Test - Position ID : **TP103**

Ground Level: **---**

National Grid Co-ordinates: **E:449727.0 N:309465.0**

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME

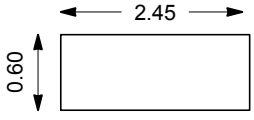


Legend

● Test 3 (23.01.15)

Pit start depth	=	2.01	m
Pit final depth	=	2.01	m
Effective depth, De	=	1.11	m
Effective storage volume, V_{p75-25}	=	0.8151	m^3
Surface area, a_{p50}	=	4.8525	m^2
Time, t_{p75-25}	=	627	secs
Infiltration rate, f	=	2.68×10^{-4}	m/s

Plan (Not to scale)



No Bearing Taken

RSK Environment Ltd 12 Royal Scot Road Pride Park Derby DE24 8AJ	Compiled By	Date	Checked By	Date
	Lawrence	17/02/15		
	Contract: **Jacqueline Road, Markfield**		Contract Ref: **301538**	

APPENDIX I
CERTIFICATES OF GEOTECHNICAL ANALYSIS

TESTING VERIFICATION CERTIFICATE

UKAS TESTING

1774

The test results included in this report are certified as:-

ISSUE STATUS: **FINAL**

In accordance with Structural Soils Ltd Laboratory Quality Assurance Manual, Issue 6, January 2010 all results sheets and summaries of results issued by the laboratory are checked by an approved signatory. This check will also involve checking of at least 10% of calculations for each test type to ensure that data has been correctly entered into the computer and calculated. The integrity of the test data and results are ensured by control of the computer system employed by the laboratory as part of the Software Verification Program as detailed in the Laboratory Quality Assurance Manual.

This testing verification certificate covers all testing compiled on or before the following datetime: **11/02/2015 14:05:29**.

Testing reported after this date is not covered by this Verification Certificate.

Approved Signatory
Mark Athorne (Laboratory Quality Manager)

STRUCTURAL SOILS The Potteries Pottery Street Castleford W. Yorkshire WF10 1NJ	Contract: **Markfield**	Job No: **781521**

AGS

STRUCTURAL SOILS LTD

TEST REPORT

Report No. 781521 R1

Date 10-February-2015 Contract Markfield

Client RSK Environment Ltd
Address Spring Lodge
172 Chester Road
Helsby
Cheshire WA6 0AR

For the Attention of Claire Lawrence

Samples submitted by client	26/01/2015	Client Reference	301538
Testing Started	28/01/2015	Client Order No.	
Testing Completed	09/02/2015	Instruction Type	Written

Ukas Accredited Tests Underatken

Moisture Content (oven drying method) BS1377:Part 2:1990,clause 3.2
Liquid Limit (one point method) BS1377:Part 2:1990,clause 4.4
Plastic Limit BS1377:Part 2:1990,clause 5.3
Plasticity Index Derivation BS1377:Part 2:1990,clause 5.4
Particle Size Distribution wet sieve method BS1377:Part 2:1990,clause 9.2

Please Note: Remaining samples will be retained for a period of one month from today and will then be disposed of

SUMMARY OF SOIL CLASSIFICATION TESTS

In accordance with clauses 3.2,4.3,4.4,5.3,5.4,7.2,8.2,8.3 of BS1377:Part 2:1990

Exploratory Position ID	Sample Ref	Sample Type	Depth (m)	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index %	% <425um	Description of Sample
TP102	4	D	0.70	29	60	19	41	98	Orange grey brown slightly gravelly CLAY
TP104	5	D	1.30	22	49	19	30	90	Red brown slightly sandy slightly gravelly CLAY
TP105	6	D	1.20	24	47	15	32	91	Red brown slightly gravelly CLAY
TP107	7	D	0.90	33	60	19	41	94	Orange brown slightly sandy slightly gravelly CLAY
TP108	8	D	1.20	21	60	21	39	73	Red grey brown slightly sandy slightly gravelly CLAY
TP111	9	D	0.90	27	67	21	46	93	Red brown slightly gravelly CLAY
TP113	10	D	1.00	27	63	20	43	92	Red grey slightly gravelly CLAY

STRUCTURAL SOILS LTD

Contract:

Markfield

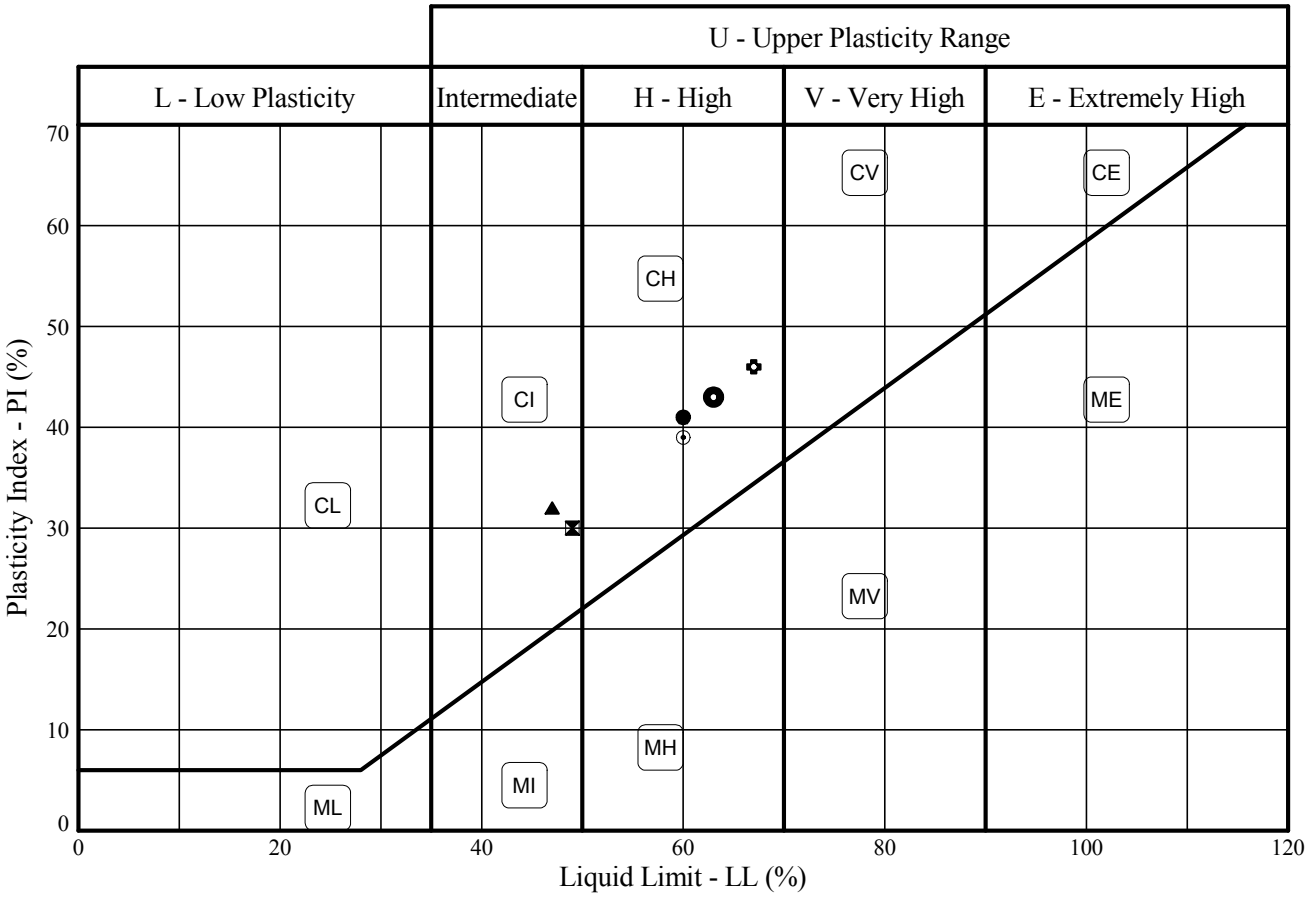
Contract Ref:

781521

AGS

PLASTICITY CHART - PI Vs LL

In accordance with clause 42.3 of BS5930:1999
Testing in accordance with BS1377-2:1990



Sample Identification				BS Test Method #	Preparation Method +	MC %	LL %	PL %	PI %	<425um %	
	Exploratory Position ID	Sample	Depth (m)								
●	TP102	4D	0.70	3.2/4.4/5.3/5.4	4.2.3	29	60	19	41	98	
⊠	TP104	5D	1.30	3.2/4.4/5.3/5.4	4.2.4	22	49	19	30	90	
▲	TP105	6D	1.20	3.2/4.4/5.3/5.4	4.2.4	24	47	15	32	91	
★	TP107	7D	0.90	3.2/4.4/5.3/5.4	4.2.4	33	60	19	41	94	
⊙	TP108	8D	1.20	3.2/4.4/5.3/5.4	4.2.4	21	60	21	39	73	
✿	TP111	9D	0.90	3.2/4.4/5.3/5.4	4.2.4	27	67	21	46	93	
◉	TP113	10D	1.00	3.2/4.4/5.3/5.4	4.2.4	27	63	20	43	92	

Tested in accordance with the following clauses of BS1377-2:1990.

3.2 - Moisture Content
4.3 - Cone Penetrometer Method
4.4 - One Point Cone Penetrometer Method
4.6 - One Point Casagrande Method
5.3 - Plastic Limit Method
5.4 - Plasticity Index

+ Tested in accordance with the following clauses of BS1377-2:1990.

4.2.3 - Natural State
4.2.4 - Wet Sieved

Key: * = Non standard test, NP = Non plastic.

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STRUCTURAL SOILS
The Potteries
Pottery Street
Castleford
W. Yorkshire WF10 1NJ

Compiled By		Date
M. Fisher.	MAUREEN FISHER	10/02/15

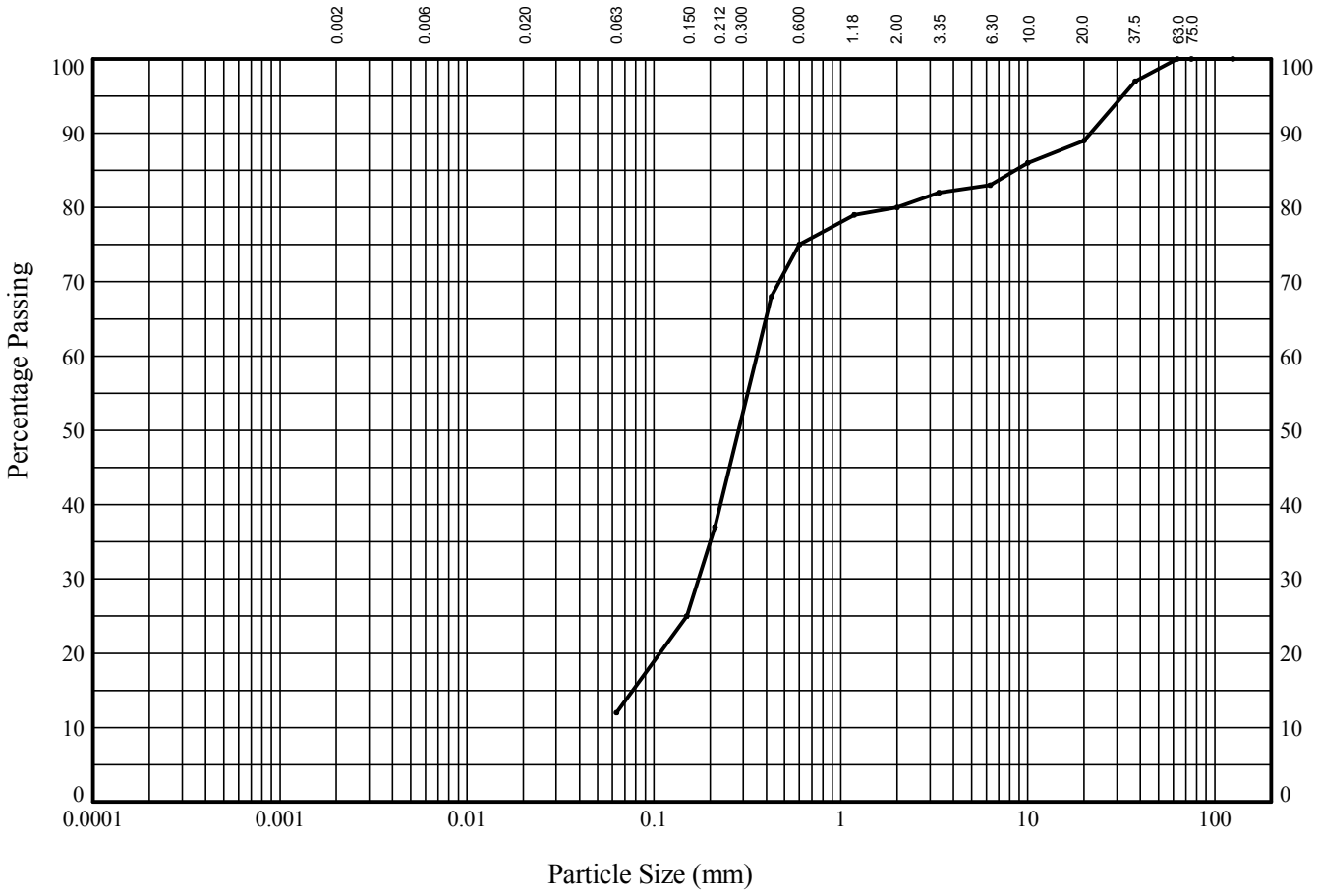
Contract	Contract Ref:
Markfield	**781521**

AGS

PARTICLE SIZE DISTRIBUTION TEST

In accordance with clauses 9.2,9.5 of BS1377:Part 2:1990

Trial Pit : **TP102** Sample Ref: **1** Sample Type: **B** Depth (m): **1.70**



CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	COBBLES
	SILT			SAND			GRAVEL			

BS Test Sieve (mm)	Percentage Passing
125.0	100
75.0	100
63.0	100
37.5	97
20.0	89
10.0	86
6.30	83
3.35	82
2.00	80
1.18	79
0.600	75
0.425	68
0.212	37
0.150	25
0.063	12

Particle Diameter	Percentage Passing

Soil Fraction	Sieve Percentage
GRAVEL	**20**
SAND	**68**
SILT/CLAY	**12**

Soil Description:
Brown clayey very gravelly SAND

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M. Fisher	**MAUREEN FISHER**	**10/02/15**

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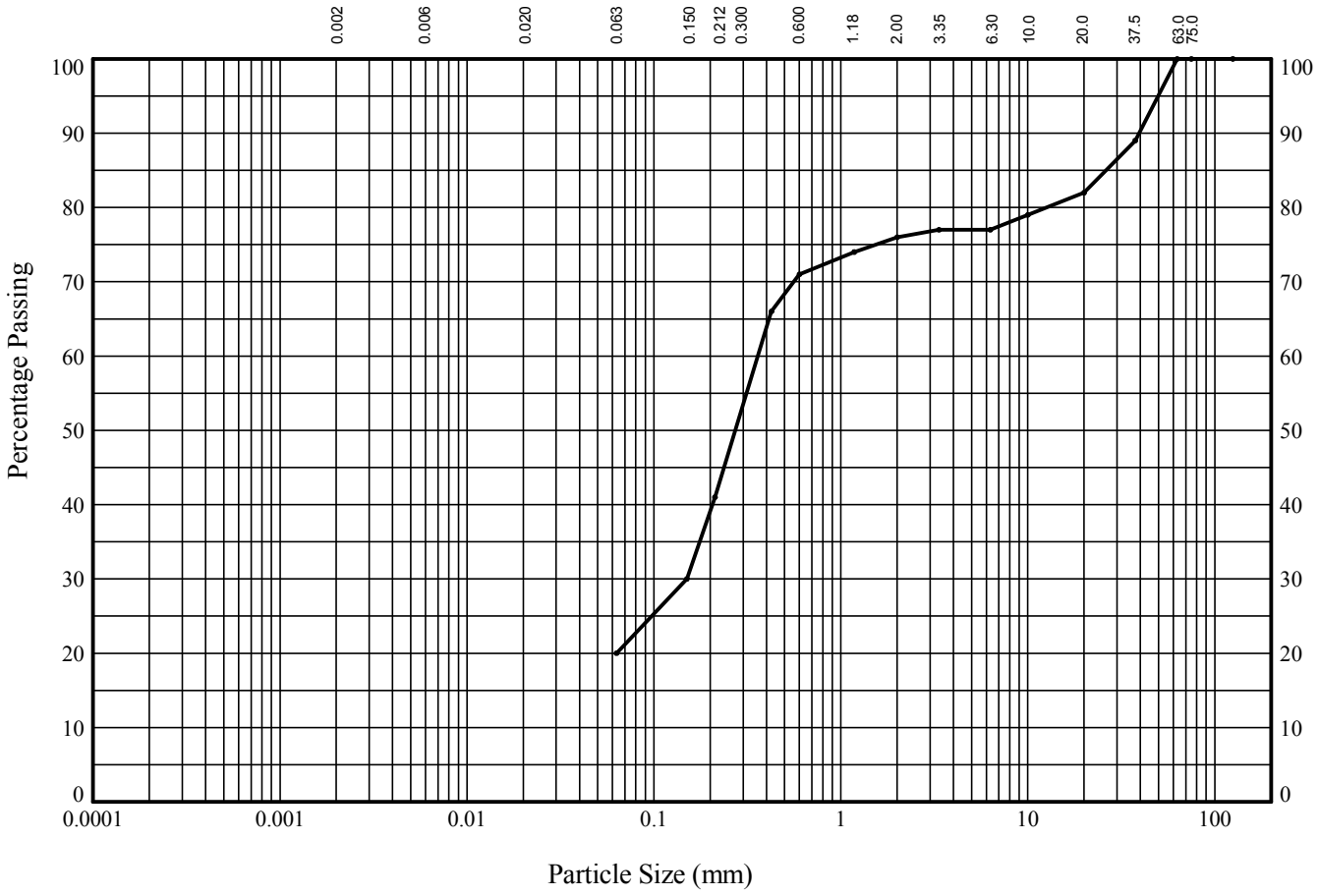
PARTICLE SIZE DISTRIBUTION TEST

In accordance with clauses 9.2,9.5 of BS1377:Part 2:1990

Trial Pit : **TP104** Sample Ref: **2** Sample Type: **B** Depth (m): **1.90**



CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	COBBLES
	SILT			SAND			GRAVEL			

BS Test Sieve (mm)	Percentage Passing
125.0	100
75.0	100
63.0	100
37.5	89
20.0	82
10.0	79
6.30	77
3.35	77
2.00	76
1.18	74
0.600	71
0.425	66
0.212	41
0.150	30
0.063	20

Particle Diameter	Percentage Passing

Soil Fraction	Sieve Percentage
GRAVEL	**24**
SAND	**56**
SILT/CLAY	**20**

Soil Description:
Brown very clayey very gravelly SAND

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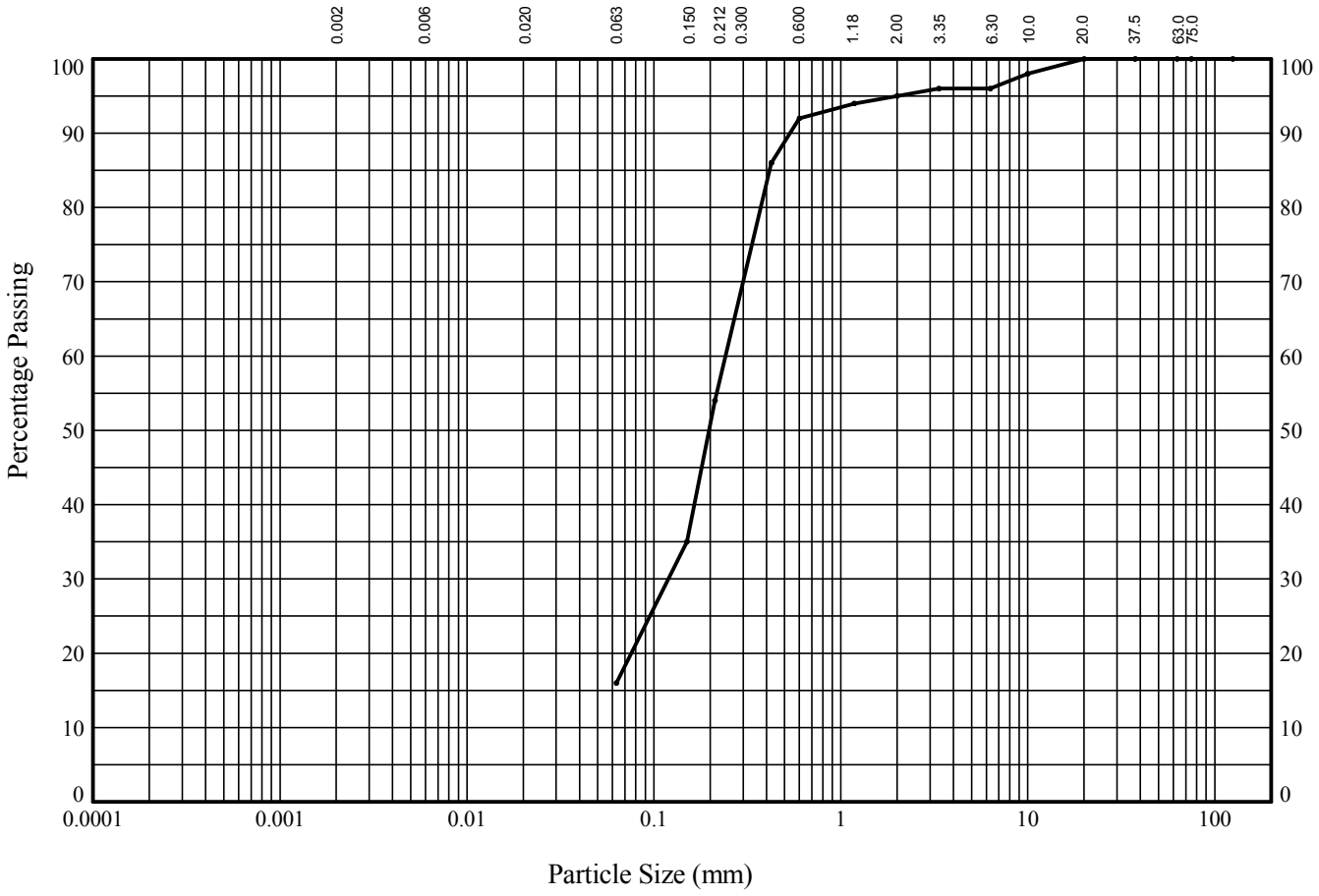
PARTICLE SIZE DISTRIBUTION TEST

In accordance with clauses 9.2,9.5 of BS1377:Part 2:1990

Trial Pit : **TP111** Sample Ref: **3** Sample Type: **B** Depth (m): **1.90**



CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	COBBLES
	SILT			SAND			GRAVEL			

BS Test Sieve (mm)	Percentage Passing
125.0	100
75.0	100
63.0	100
37.5	100
20.0	100
10.0	98
6.30	96
3.35	96
2.00	95
1.18	94
0.600	92
0.425	86
0.212	54
0.150	35
0.063	16

Particle Diameter	Percentage Passing

Soil Fraction	Sieve Percentage
GRAVEL	**5**
SAND	**79**
SILT/CLAY	**16**

Soil Description:
Brown clayey gravelly SAND

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APPENDIX J
HUMAN HEALTH GENERIC ASSESSMENT CRITERIA

Generic assessment criteria for human health: residential scenario – private gardens

The human health generic assessment criteria (GAC) have been developed during a period of regulatory review and updating of the Contaminated Land Exposure Assessment (CLEA) project. Therefore, the Environment Agency (EA) is in the process of publishing updated reports relating to the CLEA project and the GAC presented in this document may change to reflect these updates. This issue was prepared following the publication of soil guideline value (SGV) reports and associated publications[(1)] for mercury, selenium, benzene, toluene, ethylbenzene and xylene in March 2009, arsenic and nickel in May 2009, cadmium and phenol in June 2009, dioxins, furans and dioxin-like polychlorinated biphenyls (PCBs) in September 2009. It was also produced following publication of GAC by LQM[(6)]. Where available, the published soil guideline values (SGV)[(1)] were used as the GAC. The GAC for lead is discussed separately below owing to it not being derived using the same approach as other compounds.

Lead GAC derivation

The Environment Agency SGV and Tox reports for lead were withdrawn in 2009. In addition, the provisional tolerable weekly intake data published in the Netherlands were withdrawn in 2010 owing to concerns that they were not suitably protective of human health. The withdrawn SGVs were based on a target blood lead concentration of 10µg/dl. In the absence of current guidelines many consultants continue to use the withdrawn SGV. However, as this is not considered sufficiently protective of human health, after attendance at the SOBRA summer workshop June 2011, RSK has revised its GAC and is currently undertaking a review of recent toxicological developments that will be used to refine this GAC further in the coming months. In the meantime, RSK has undertaken sensitivity analysis using the Society of Environmental Geochemistry and Health (SEGH) equation and the CLEA model to produce an interim GAC value. The results are summarised below:

- Using CLEA with the former provisional tolerable weekly intake (PTWI) (25 µg/kg bw), assuming 100% lead is bioavailable, produces a GAC of 212 mg/kg
- Using CLEA with the former PTWI, assuming 50% lead is bioavailable, produces a GAC of 478 mg/kg
- Using the SEGH equation amended for a blood target concentration of 5.6 µg/dl (equal to the LOAEL for IQ defects) gives a negative GAC number unless other factors such as child background blood concentration or delta are amended. Without undertaking further research into these numbers, RSK can present sensitivity analysis to demonstrate the sensitivity of these input parameters but cannot justify one parameter over another. The results are:
    - GAC between 39mg/kg and 99mg/kg if the value of delta (the slope or response of blood Pb versus soil and dust Pb relationship) only is amended from 5 to 2µg/dl/1000µg/g. The value of 2 was chosen as it is within the reasonable range quoted in the former SGV report
    - GAC between 244mg/kg and 610mg/kg if the geometric mean of blood lead concentration in young children is reduced from 3.4µg/dl to 2µg/dl. This decrease has been simulated on the basis that blood concentrations are likely to decrease over time across the UK owing to a ban on lead in petrol, lead within paint used internally and water pipe replacement. This decrease is considered reasonable as the site is a new development

so lead-based paints will not be used internally and lead water supply pipelines will be absent.

Therefore, given the results above RSK proposes to use a GAC of **300mg/kg** for a residential end use. This value is broadly in the middle of the range of sensitivity modelling results quoted above when background mean blood lead concentrations in children are reduced to reflect a new development. The value is also broadly in the middle of the range of sensitivity modelling results for a range of bioavailability of lead between 50% and 100%. This number is considered reasonably protective of human health while being practical for use.

GAC derivation for other metals and organic compounds

Model selection

Soil assessment criteria (SAC) were calculated using CLEA v1.06 and the supporting UK guidance[1–6]. Groundwater assessment criteria (GrAC) protective of human health via the inhalation pathway were derived using the RBCA 1.3b model. RSK has updated the inputs within RBCA to reflect the UK guidance[1–5]. The SAC and GrAC collectively are termed GAC.

Conceptual model

In accordance with EA Science Report SC050221/SR3[3], the residential with private garden scenario considers risks to a female child between the ages of 0 and 6 years old. In accordance with Box 3.1, SR3[3], the pathways considered for production of the SAC in the residential with gardens 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, and
- inhalation of indoor and outdoor dust and vapours.

Figure 1 is a conceptual model illustrating these linkages.

The pathway considered in production of the GrAC is the volatilisation of compounds from groundwater and subsequent vapour inhalation by residents while indoors. Figure 2 illustrates this linkage. Although the outdoor air inhalation pathway is also valid, this contributes little to the overall risks owing to the dilution in outdoor air. Within RBCA, the solubility limit of the determinant restricts the extent of volatilisation, which in turn drives the indoor air inhalation pathway. While the same restriction is not built into the CLEA model, the CLEA model output cells are flagged red where the soil saturation limit has been exceeded.

An assumption used in the CLEA model is that of simple linear partitioning of a chemical in the soil between the sorbed, dissolved and vapour phase[4]. The upper boundaries of this partitioning are represented by the aqueous solubility and pure saturated vapour concentration of the chemical. The CLEA software uses a traffic light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous-based or the vapour based

saturation limits. Where model output cells are flagged red the soil or vapour saturation limit has been exceeded and further consideration of the SAC to be used within the assessment is required. One approach that could be adopted is to use the 'modelled' solubility saturation limit or vapour saturation limit of the compound as the SAC. However, as stated within the CLEA handbook[4] this is likely to not be practical in many cases because of the very low limits and, in any case, is highly conservative. Unless free-phase product is present, concentrations of the chemical are unlikely to be present at sufficient concentration to result in an exceedance of the health criteria value (HCV).

RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH[6] whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the SAC with the corresponding solubility or vapour saturation limit given in brackets. Therefore, when using the SAC to screen laboratory analysis the assessor should take note if a given SAC has a corresponding solubility or vapour saturation limit (in brackets), and subsequently incorporate this piece of information within the screening analytical discussion. If further assessment is required following this process then an additional approach can be utilised as detailed within Section 4.12 of the CLEA model handbook[4], which explains how to calculate an effective assessment criterion manually.

Input selection

Chemical data was obtained from EA Report SC050021/SR7[5] and the health criteria values (HCV) from the UK TOX[1] reports where available. For SAC for total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAH), toxicological and chemical specific parameters were obtained from the LQM/CIEH report[6]. Similarly, toxicological and specific chemical parameters for the volatile organic compound 1,2,4-trimethylbenzene were obtained from EIC/AGS/CL:AIRE[7].

For total petroleum hydrocarbons (TPH), aromatic hydrocarbons C_5-C_8 were not modelled since benzene and toluene are being modelled separately. The aromatic C_8-C_9 hydrocarbon fraction comprises ethylbenzene, xylene and styrene. Since ethylbenzene and xylene are being modelled separately, the physical, chemical and toxicological data for this band has been taken from styrene.

Owing to the lack of UK-specific data, default information in the RBCA model was used to evaluate methyl tertiary butyl ether (MTBE). No published UK data was available for 1,3,5-trimethylbenzene, so information was obtained from the US EPA as in the RBCA model. RBCA uses toxicity data for the inhalation pathway in different units to the CLEA model and cannot consider separately the mean daily intake (MDI), occupancy periods or breathing rates. Therefore, the HCV in RBCA was amended to take account of:

- amendments to the MDI using Table 3.4 of SR2[2]
- a child weighing 13.3kg (average of 0–6 year old female in accordance with Table 4.6 of SR3[3]) and breathing 11.85m^3 (average daily inhalation rate for a 0–6-year old female in accordance with Table 4.14 of SR3[3]

1. The 50% rule (for petroleum hydrocarbons, trimethylbenzenes and MTBE)[2] where MDI data is not available but background exposure is considered important in the overall exposure.

Physical parameters

For the residential with private gardens scenario, the CLEA default building is a small two-storey terrace house with concrete ground-bearing slab. The house is assumed to have a 100m^2 private garden consisting of lawn, flowerbeds and incorporating a 20m^2 plot for growing fruit and vegetables consumed by the residents. SR3[3] notes this residential building type to be the most conservative in terms of protection from vapour intrusion. The building parameters are outlined in Table 5.

The parameters for a sandy loam soil type were used in line with SR3[3]. This includes a value of 6% for the percentage of soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site-specific risk assessments for this parameter, RSK has produced an additional set of SAC for an SOM of 1% and 2.5%. For the GrAC, the depth to groundwater was taken as 2.5m based on RSK's experience of assessing the volatilisation pathway from groundwater.

GAC

The SAC were produced using the input parameters in Tables 1 to 5 and the GrAC using input parameters in Table 6. The final selected GAC are presented by pathway in Table 7 and the combined GAC in Table 8.

Figure 1: Conceptual model for CLEA residential scenario – private gardens

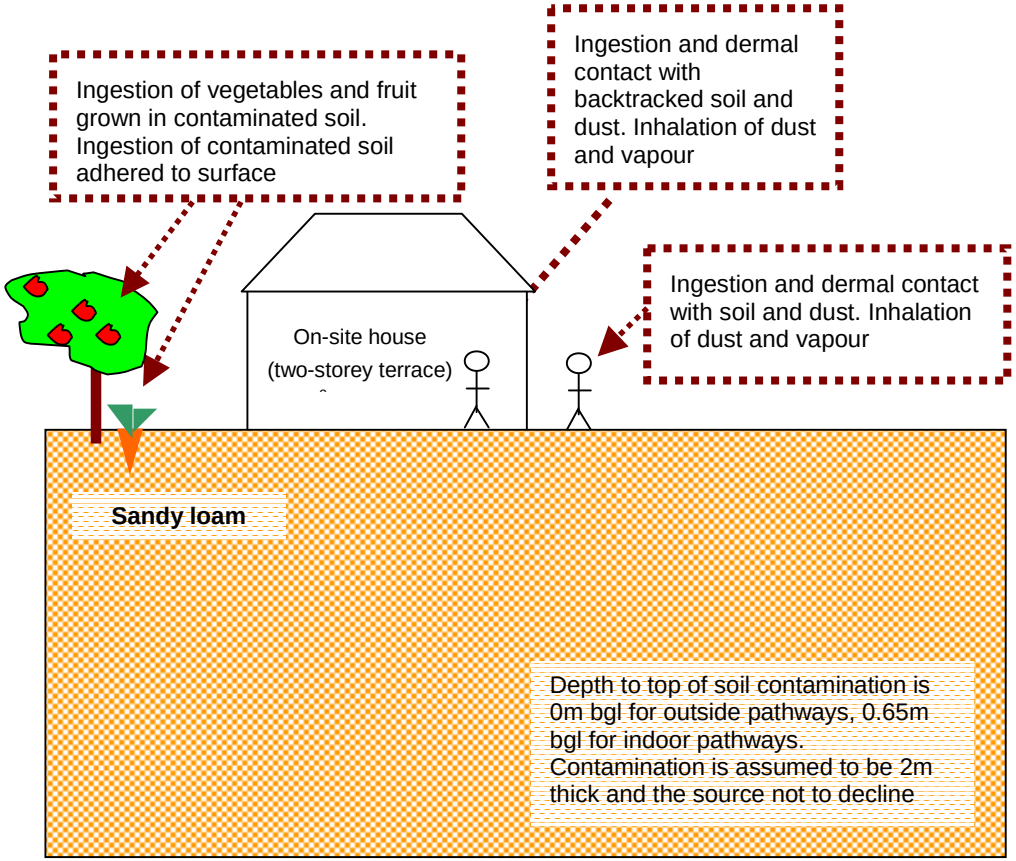

Table 1: Exposure assessment parameters for residential scenario - private gardens – inputs for CLEA model

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, report SC050021/SR3[3]
Building	Small terraced house	Key generic assumption given in Box 3.1, report SC050021/SR3. Two storey small terraced house chosen as it is the most conservative residential building type in terms of protection from vapor intrusion (Section 3.4.6, report SC050021/SR3)[3]
Soil type	Sandy Loam	Most common UK soil type (Section 4.3.1, From Table 3.1, report SC050021/SR3)[3]
Start AC (age class)	1	Range of age classes corresponding to key generic assumption that the critical receptor is a young female child aged zero to six. From Box 3.1, report SC050021/SR3[3]
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'[8]
	1	To provide SAC for sites where SOM <6% as often observed by RSK
	2.5	
pH	7	Model default

Table 2: Residential with private gardens –home-grown produce data for CLEA model

	Consumption rate (g FW kg^{-1} BW day^{-1}) by age class						Dry weight conversion factor	Home-grown fraction (average)	Home-grown fraction (high end)	Soil loading factor	Preparation correction factor
Name	1	2	3	4	5	6	g DW g^{-1} FW	-	-	g g^{-1} DW	-
Green vegetables	7.12	6.85	6.85	6.85	3.74	3.74	0.096	0.05	0.33	1.00E-03	2.00E-01
Root vegetables	10.69	3.30	3.30	3.30	1.77	1.77	0.103	0.06	0.4	1.00E-03	1.00E+00
Tuber vegetables	16.03	5.46	5.46	5.46	3.38	3.38	0.21	0.02	0.13	1.00E-03	1.00E+00
Herbaceous fruit	1.83	3.96	3.96	3.96	1.85	1.85	0.058	0.06	0.4	1.00E-03	6.00E-01
Shrub fruit	2.23	0.54	0.54	0.54	0.16	0.16	0.166	0.09	0.6	1.00E-03	6.00E-01
Tree fruit	3.82	11.96	11.96	11.96	4.26	4.26	0.157	0.04	0.27	1.00E-03	6.00E-01
Justification	Table 4.17, SR3(3)						Table 6.3, SR3(3)	Table 4.19, SR3(3)		Table 6.3, SR3(3)	

Table 3: Residential with private gardens – land use data for CLEA model

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}	180	365	365	365	365	365
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 3.1, SR3[3]					
Occupancy period (indoor)	hr day^{-1}	23	23	23	23	19	19
Occupancy period (outdoor)	hr day^{-1}	1	1	1	1	1	1
Justification		Table 3.2, SR3[3]					
Soil to skin adherence factor (indoor)	mg cm^{-2} day^{-1}	6.00E-02	6.00E-02	6.00E-02	6.00E-02	6.00E-02	6.00E-02
Soil to skin adherence factor (outdoor)	mg cm^{-2} day^{-1}	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Justification		Table 8.1, SR3[3]					
Soil and dust ingestion rate	g day^{-1}	1.00E-01	1.00E-01	1.00E-01	1.00E-01	1.00E-01	1.00E-01
Justification		Table 6.2, SR3[3]					

Of note, 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 only in childhood but averaged over a longer time period. See the Environment Agency Science report: SC05002 / TOX 3 [1] and Science Report SC050021/Cadmium SGV [1] for more information.

Table 4: Residential with private gardens – receptor data for CLEA model

Parameter	Unit	Age Class						Justification
		1	2	3	4	5	6	
Body weight	kg	5.6	9.8	12.7	15.1	16.9	19.7	Table 4.6, SR3[3]
Body height	m	0.7	0.8	0.9	0.9	1	1.1	
Inhalation rate	m^3 day^{-1}	8.5	13.3	12.7	12.2	12.2	12.2	Table 4.14, SR3[3]
Max exposed skin fraction (indoor)	m^2 m^{-2}	0.32	0.33	0.32	0.35	0.35	0.33	Table 4.8, SR3[3]
Max exposed skin fraction (outdoor)	m^2 m^{-2}	0.26	0.26	0.25	0.28	0.28	0.26	

See cadmium note as per Table 3 above.

Table 5: Residential with private gardens – soil and building inputs for CLEA model

Parameter	Unit	Value	Justification
Soil properties for sandy loam			
Porosity, total	cm^3 cm^{-3}	0.53	Default soil type is sandy loam, Section 4.3.1, SR3[3] Parameters for sandy loam from Table 4.4, SR3[3]
Porosity, air filled	cm^3 cm^{-3}	0.20	
Porosity, water filled	cm^3 cm^{-3}	0.33	
Residual soil water content	cm^3 cm^{-3}	0.12	
Saturated hydraulic conductivity	cm s^{-1}	3.56E-03	
van Genuchten shape parameter (*m*)	-	3.20E-01	
Bulk density	g cm^{-3}	1.21	
Threshold value of wind speed at 10m	m s^{-1}	7.20	Default value taken from Section 9.2.2, SR3[3]
Empirical function (F_x) for dust model	-	1.22	Value taken from Section 9.2.2, SR3[3]
Ambient soil temperature	K	283	Annual average soil temperature representative of UK surface soils. Section 4.3.1, SR3[3]
Air dispersion model			
Mean annual wind speed (10m)	m s^{-1}	5.00	Default value taken from Section 9.2.2, SR3[3]
Air dispersion factor at height of 0.8m	g m^{-2} s^{-1} per kg m^{-3}	2400	Values for a 0.01 ha site, appropriate to a residential land use in Newcastle (most representative city for UK). (from Table 9.1, SR3)[3] Assumed child of 6 is not tall enough to reach 1.6m
Air dispersion factor at height of 1.6m	g m^{-2} s^{-1} per kg m^{-3}	0	
Fraction of site with hard or vegetative cover	m^2 m^{-2}	0.75	Section 3.2.6, SR3 [3] based on residential land use

Parameter	Unit	Value	Justification
Building properties for small terrace house with ground-bearing floor slab			
Building footprint	m^2	28	From Table 3.3 and 4.21, SR3[3]
Living space air exchange rate	hr^{-1}	0.50	
Living space height (above ground)	m	4.8	
Living space height (below ground)	m	0.0	Assumed no basement
Pressure difference (soil to enclosed space)	Pa	3.1	From Table 3.3, SR3[3]
Foundation thickness	m	0.15	
Floor crack area	cm^2	423	
Dust loading factor	$\mu g\ m^{-3}$	50	Default value for a residential site taken from Section 9.3, SR3[3]
Vapour model			
Default soil gas ingress rate	$cm^3\ s^{-1}$	25	Generic flow rate, Section 10.3, SR3[3]
Depth to top of source (beneath building)	cm	50	Section 3.2.6, SR3 [3] states source is 50cm below building or 65cm below ground surface
Depth to top of source (no building)	cm	0	Section 10.2, SR3 [3] assumes impact from 0m to 1m for outdoor inhalation pathway
Thickness of contaminant layer	cm	200	Model default for indoor air, Section 4.9, SR4[4]
Time average period for surface emissions	years	6	Time period of a 0 to 6 year old, Box 3.5, SR3[3]
User-defined effective air permeability	cm^2	3.05E-08	Calculated for sandy loam using equations in Appendix 1, SR3[3]

Figure 2: GrAC conceptual model for RBCA residential with private gardens scenario

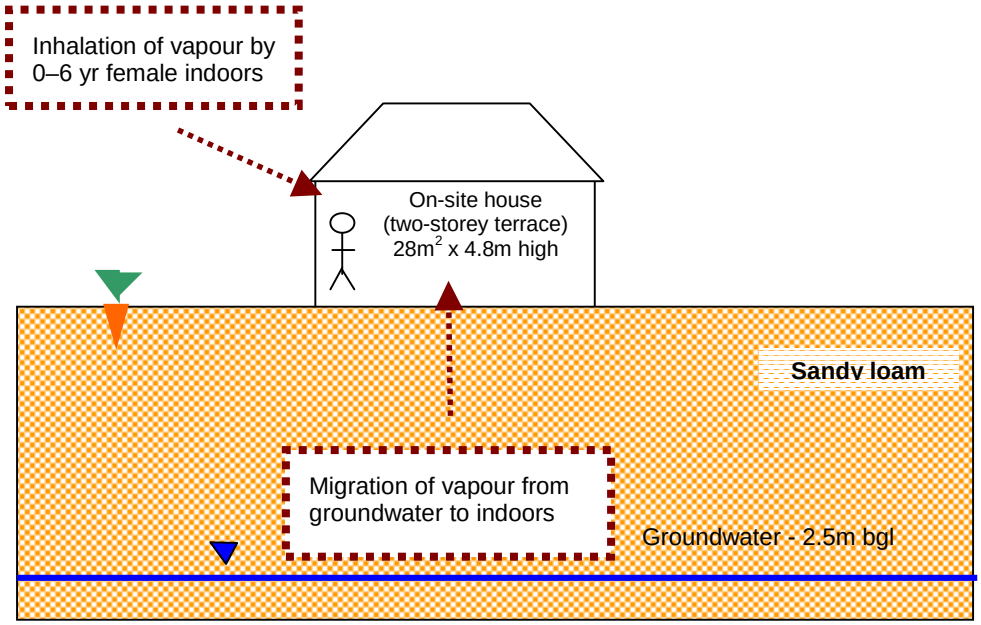

Table 6: Residential with private gardens – RBCA inputs

Parameter	Unit	Value	Justification
Receptor			
Averaging time	Years	6	From Box 3.1, SR3[3]
Receptor weight	kg	13.3	Average of CLEA 0–6 year old female data, Table 4.6, SR3[3]
Exposure duration	Years	6	From Box 3.1, report, SR3[3]
Exposure frequency	Days/yr	350	Weighted using occupancy period of 23 hours per day for 365 days of the year
Soil type – sandy loam			
Total porosity	-	0.53	CLEA value for sandy loam. Parameters for sandy loam from Table 4.4, SR3[3]
Volumetric water content	-	0.33	
Volumetric air content	-	0.20	
Dry bulk density	g cm^{-3}	1.21	
Vertical hydraulic conductivity	cm s^{-1}	3.56E-3	CLEA value for saturated conductivity of sandy loam, Table 4.4, SR3[3]
Vapour permeability	m^2	3.05E-12	Calculated for sandy loam using equations in Appendix 1, SR3[3]
Capillary zone thickness	m	0.1	Professional judgement

Parameter	Unit	Value	Justification
Fraction organic carbon	%	(i) 0.0348	Representative of sandy loam according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[8]
		(ii) 0.0058	To provide SAC for sites where SOM < 6% as often observed by RSK
Building			
Building volume/area ratio	m	4.8	Table 3.3, SR3[3]
Foundation area	m^2	28	
Foundation perimeter	m	22	Calculated assuming building measures 7m x 4m to give 28m^2 foundation area
Building air exchange rate	d^{-1}	12	Table 3.3, SR3[3]
Depth to bottom of foundation slab	m	0.15	
Foundation thickness	m	0.15	
Foundation crack fraction	-	0.0151	Calculated from floor crack area of 423 cm^2 and building footprint of 28m^2 in Table 4.21, SR3[3]
Volumetric water content of cracks	-	0.33	Assumed equal to underlying soil type in assumption that cracks become filled with soil over time. Parameters for sandy loam from Table 4.4, SR3[3]
Volumetric air content of cracks	-	0.2	
Indoor/outdoor differential pressure	Pa	3.1	From Table 3.3, SR3[3]

References

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

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

4. Environment Agency (2009), Contaminated Land Exposure Assessment (CLEA) software, version 1.06.

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6. Chartered Institute for Environmental Health and Land Quality Management (2009), 'The LQM/CIEH Generic Assessment Criteria for Human Health', second edition.

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8. Changes made to the CLEA framework documents after the three-month evaluation period in 2008, released January 2009 by the Environment Agency.

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH PRIVATE GARDENS

Table 7

Human Health Generic Assessment Criteria by Pathway for Residential Scenario - Private Gardens

Compound	Notes	GrAC (mg/l)	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	(b)(c)	-	3.24E+01	8.50E+01	-	NR	3.24E+01	8.50E+01	-	NR	3.24E+01	8.50E+01	-	NR
Cadmium	(b)	-	1.12E+01	1.85E+02	1.10E+01	NR	1.12E+01	1.85E+02	1.10E+01	NR	1.12E+01	1.85E+02	1.10E+01	NR
Chromium (III) - oxide		-	1.84E+04	3.55E+03	2.98E+03	NR	1.84E+04	3.55E+03	2.98E+03	NR	1.84E+04	3.55E+03	2.98E+03	NR
Chromium (VI) - hexavalent		-	1.02E+01	4.25E+00	3.21E+00	NR	1.02E+01	4.25E+00	3.21E+00	NR	1.02E+01	4.25E+00	3.21E+00	NR
Copper		-	2.66E+03	1.04E+04	2.33E+03	NR	2.66E+03	1.04E+04	2.33E+03	NR	2.66E+03	1.04E+04	2.33E+03	NR
Lead	(a)	-	3.00E+02	-	-	NR	3.00E+02	-	-	NR	3.00E+02	-	-	NR
Elemental Mercury (Hg^0)	(b)(d)	9.40E-03	-	1.70E-01	-	4.31E+00	-	4.24E-01	-	1.07E+01	-	1.02E+00	-	2.58E+01
Inorganic Mercury (Hg^{2+})	(b)	-	1.81E+02	2.55E+03	1.69E+02	NR	1.81E+02	2.55E+03	1.69E+02	NR	1.81E+02	2.55E+03	1.69E+02	NR
Methyl Mercury (Hg^{4+})	(b)	2.00E+01	1.39E+01	1.59E+01	7.40E+00	7.33E+01	1.39E+01	3.08E+01	9.55E+00	1.42E+02	1.39E+01	6.53E+01	1.14E+01	3.04E+02
Nickel	(b)(d)	-	5.31E+02	1.27E+02	-	NR	5.31E+02	1.27E+02	-	NR	5.31E+02	1.27E+02	-	NR
Selenium	(b)(c)	-	3.50E+02	-	-	NR	3.50E+02	NR	-	NR	3.50E+02	-	-	NR
Zinc	(c)	-	3.75E+03	2.55E+07	-	NR	3.75E+03	2.55E+07	-	NR	3.75E+03	2.55E+07	-	NR
Cyanide		-	2.66E+01	3.97E+00	3.68E+00	NR	2.66E+01	3.97E+00	3.68E+00	NR	2.66E+01	3.97E+00	3.68E+00	NR
Volatile Organic Compounds														
Benzene	(b)	7.20E+00	1.12E-01	2.69E-01	7.92E-02	1.22E+03	2.28E-01	4.99E-01	1.57E-01	2.26E+03	4.89E-01	1.04E+00	3.32E-01	4.71E+03
Toluene	(b)	1.90E+03	1.47E+02	6.26E+02	1.19E+02	8.69E+02	3.35E+02	1.38E+03	2.70E+02	1.92E+03	7.59E+02	3.14E+03	6.11E+02	4.36E+03
Ethylbenzene	(b)	2.60E+02	1.06E+02	1.70E+02	6.52E+01	5.18E+02	2.51E+02	3.98E+02	1.54E+02	1.22E+03	5.70E+02	9.32E+02	3.54E+02	2.84E+03
Xylene - m	(b)	8.40E+01	2.02E+02	5.56E+01	4.36E+01	6.25E+02	4.80E+02	1.31E+02	1.03E+02	1.47E+03	1.09E+03	3.07E+02	2.40E+02	3.46E+03
Xylene - o		1.00E+02	1.85E+02	5.98E+01	4.52E+01	4.78E+02	4.38E+02	1.40E+02	1.06E+02	1.12E+03	9.96E+02	3.27E+02	2.46E+02	2.62E+03
Xylene - p		8.70E+01	1.91E+02	5.34E+01	4.17E+01	5.76E+02	4.51E+02	1.26E+02	9.82E+01	1.35E+03	1.02E+03	2.94E+02	2.28E+02	3.17E+03
Total xylene		8.40E+01	2.02E+02	5.56E+01	4.36E+01	6.25E+02	4.80E+02	1.31E+02	1.03E+02	1.47E+03	1.09E+03	3.07E+02	2.40E+02	3.46E+03
Methyl t-Butyl ether		2.20E+03	1.75E+00	1.84E+02	1.75E+00	1.66E+04	3.68E+00	2.40E+02	3.67E+00	2.16E+04	7.41E+00	3.70E+02	7.37E+00	3.34E+04
Trichloroethene		1.80E+00	2.83E+00	1.10E-01	1.06E-01	1.54E+03	6.25E+00	2.30E-01	2.22E-01	3.22E+03	1.40E+01	5.11E-01	4.93E-01	7.14E+03
Tetrachloroethene		3.60E+00	1.06E+01	1.03E+00	9.36E-01	4.24E+02	2.44E+01	2.30E+00	2.10E+00	9.51E+02	5.55E+01	5.28E+00	4.82E+00	2.18E+03
1,1,1-Trichloroethane		2.60E+01	3.20E+02	6.33E+00	6.21E+00	1.43E+03	6.97E+02	1.29E+01	1.27E+01	2.92E+03	1.55E+03	2.84E+01	2.79E+01	6.39E+03
1,1,1,2 Tetrachloroethane		1.40E+01	5.19E+00	1.08E+00	8.93E-01	2.60E+03	1.22E+01	2.50E+00	2.08E+00	6.02E+03	2.78E+01	5.83E+00	4.82E+00	1.40E+04
1,1,2,2-Tetrachloroethane		1.40E+01	2.70E+00	2.76E+00	1.37E+00	2.67E+03	5.85E+00	5.65E+00	2.87E+00	5.46E+03	1.30E+01	1.24E+01	6.34E+00	1.20E+04
Carbon Tetrachloride		5.50E-02	1.05E+00	1.81E-02	1.79E-02	1.52E+03	2.41E+00	3.97E-02	3.93E-02	3.32E+03	5.44E+00	8.99E-02	8.92E-02	7.54E+03
1,2-Dichloroethane		3.00E-01	3.06E-02	6.46E-03	5.34E-03	3.41E+03	5.53E-02	9.32E-03	7.98E-03	4.91E+03	1.05E-01	1.60E-02	1.39E-02	8.43E+03
Vinyl Chloride		1.90E-02	3.69E-03	5.43E-04	4.73E-04	1.36E+03	6.64E-03	7.02E-04	6.35E-04	1.76E+03	1.21E-02	1.07E-03	9.86E-04	2.69E+03
1,2,4-Trimethylbenzene		7.50E-02	-	3.51E-01	-	5.57E+02	-	8.55E-01	-	1.36E+03	-	2.10E+00	-	3.25E+03
1,3,5-Trimethylbenzene		4.70E-02	1.45E+01	4.60E-01	4.56E-01	9.47E+01	3.47E+01	1.10E+00	1.09E+00	2.26E+02	7.94E+01	2.59E+00	2.56E+00	5.33E+02
Semi-Volatile Organic Compounds														
Acenaphthene		3.20E+00	2.18E+02	3.46E+03	2.05E+02	5.70E+01	5.08E+02	8.54E+03	4.79E+02	1.41E+02	1.06E+03	2.03E+04	1.01E+03	3.36E+02
Acenaphthylene		4.20E+00	1.78E+02	3.27E+03	1.68E+02	8.61E+01	4.17E+02	8.03E+03	3.97E+02	2.12E+02	8.90E+02	1.91E+04	8.51E+02	5.06E+02
Anthracene		2.10E-02	2.31E+03	1.08E+05	2.26E+03	1.17E+00	5.03E+03	2.65E+05	4.93E+03	2.91E+00	9.33E+03	6.15E+05	9.19E+03	6.96E+00
Benzo(a)anthracene		3.80E-03	7.00E+00	5.55E+00	3.10E+00	1.71E+00	8.98E+00	9.83E+00	4.69E+00	4.28E+00	1.01E+01	1.41E+01	5.88E+00	1.03E+01
Benzo(b)fluoranthene		2.00E-03	8.06E+00	1.79E+01	5.56E+00	1.22E+00	9.78E+00	1.97E+01	6.53E+00	3.04E+00	1.07E+01	2.05E+01	7.02E+00	7.29E+00
Benzo(g,h,i)perylene		2.60E-04	6.68E+01	1.27E+02	4.38E+01	1.54E-02	7.04E+01	1.32E+02	4.59E+01	3.85E-02	7.19E+01	1.34E+02	4.68E+01	9.23E-02
Benzo(k)fluoranthene		8.00E-04	1.25E+01	2.66E+01	8.51E+00	6.87E-01	1.44E+01	2.83E+01	9.56E+00	1.72E+00	1.53E+01	2.91E+01	1.00E+01	4.12E+00
Chrysene		2.00E-03	8.76E+00	1.95E+01	6.00E+00	4.40E-01	1.20E+01	2.45E+01	8.04E+00	1.10E+00	1.41E+01	2.72E+01	9.27E+00	2.64E+00
Dibenzo(a,h)anthracene		6.00E-04	1.19E+00	2.13E+00	7.62E-01	3.93E-03	1.33E+00	2.42E+00	8.58E-01	9.82E-03	1.39E+00	2.56E+00	9.03E-01	2.36E-02
Fluoranthene		2.30E-01	2.59E+02	2.69E+04	2.57E+02	1.89E+01	4.67E+02	6.23E+04	4.63E+02	4.73E+01	6.78E+02	1.28E+05	6.74E+02	1.13E+02
Fluorene		1.90E+00	1.70E+02	4.35E+03	1.63E+02	3.09E+01	3.91E+02	1.07E+04	3.77E+02	7.65E+01	8.00E+02	2.54E+04	7.76E+02	1.83E+02
Indeno(1,2,3-cd)pyrene		2.00E-04	4.58E+00	1.04E+01	3.18E+00	6.13E-02	5.74E+00	1.17E+01	3.85E+00	1.53E-01	6.37E+00	1.22E+01	4.19E+00	3.68E-01
Phenanthrene		5.30E-01	9.35E+01	5.04E+03	9.18E+01	3.60E+01	2.04E+02	1.23E+04	2.01E+02	8.96E+01	3.81E+02	2.86E+04	3.76E+02	2.14E+02
Pyrene		1.30E-01	5.69E+02	6.18E+04	5.63E+02	2.20E+00	1.05E+03	1.44E+05	1.04E+03	5.49E+00	1.56E+03	2.97E+05	1.56E+03	1.32E+01
Benzo(a)pyrene		3.80E-03	1.21E+00	2.62E+00	8.26E-01	9.11E-01	1.42E+00	2.81E+00	9.43E-01	2.28E+00	1.52E+00	2.90E+00	9.98E-01	5.46E+00
Naphthalene		1.90E+01	2.68E+01	1.64E+00	1.54E+00	7.64E+01	6.36E+01	3.93E+00	3.70E+00	1.83E+02	1.43E+02	9.27E+00	8.71E+00	4.32E+02
Phenol	(b)	-	4.51E+02	3.11E+02	1.84E+02	4.16E+04	9.38E+02	4.20E+02	2.90E+02	8.15E+04	2.04E+03	5.21E+02	4.15E+02	1.74E+05

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH PRIVATE GARDENS

Table 7

Human Health Generic Assessment Criteria by Pathway for Residential Scenario - Private Gardens

Compound	Notes	GrAC (mg/l)	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	
Total Petroleum Hydrocarbons														
Aliphatic hydrocarbons EC_5-EC_6		1.00E+01	4.79E+03	2.98E+01	2.97E+01	3.04E+02	1.08E+04	5.47E+01	5.46E+01	5.58E+02	2.35E+04	1.13E+02	1.13E+02	1.15E+03
Aliphatic hydrocarbons >EC_6-EC_8		5.40E+00	1.43E+04	7.27E+01	7.26E+01	1.44E+02	3.21E+04	1.62E+02	1.62E+02	3.22E+02	6.36E+04	3.72E+02	3.71E+02	7.36E+02
Aliphatic hydrocarbons >EC_8-EC_{10}		2.30E-01	1.46E+03	1.89E+01	1.88E+01	7.77E+01	2.44E+03	4.60E+01	4.58E+01	1.90E+02	3.30E+03	1.09E+02	1.08E+02	4.51E+02
Aliphatic hydrocarbons >EC_{10}-EC_{12}		3.40E-02	3.52E+03	9.34E+01	9.28E+01	4.75E+01	4.01E+03	2.32E+02	2.29E+02	1.18E+02	4.24E+03	5.57E+02	5.37E+02	2.83E+02
Aliphatic hydrocarbons >EC_{12}-EC_{16}		7.60E-04	4.37E+03	7.82E+02	7.44E+02	2.37E+01	4.40E+03	1.95E+03	1.69E+03	5.91E+01	4.41E+03	4.68E+03	3.03E+03	1.42E+00
Aliphatic hydrocarbons >EC_{16}-EC_{35}	(c)	-	4.51E+04	-	-	8.48E+00	6.38E+04	-	-	2.12E+01	7.61E+04	-	-	5.09E+01
Aliphatic hydrocarbons >EC_{35}-EC_{44}	(c)	-	4.51E+04	-	-	8.48E+00	6.38E+04	-	-	2.12E+01	7.61E+04	-	-	5.09E+01
Aromatic hydrocarbons >EC_8-EC_9 (styrene)		7.40E+00	1.66E+02	2.65E+02	1.33E+02	6.20E+02	3.92E+02	6.47E+02	3.16E+02	1.52E+03	8.50E+02	1.54E+03	7.02E+02	3.61E+03
Aromatic hydrocarbons >EC_9-EC_{10}		7.40E+00	5.55E+01	3.33E+01	2.69E+01	6.13E+02	1.31E+02	8.16E+01	6.54E+01	1.50E+03	2.84E+02	1.94E+02	1.51E+02	3.58E+02
Aromatic hydrocarbons >EC_{10}-EC_{12}		2.50E-01	7.97E+01	1.82E+02	6.91E+01	3.64E+02	1.86E+02	4.48E+02	1.62E+02	8.99E+02	3.87E+02	1.07E+03	3.46E+02	2.15E+03
Aromatic hydrocarbons >EC_{12}-EC_{16}		5.80E+00	1.40E+02	2.00E+03	1.38E+02	1.69E+02	3.13E+02	4.96E+03	3.08E+02	4.19E+02	6.01E+02	1.18E+04	5.93E+02	1.00E+03
Aromatic hydrocarbons >EC_{16}-EC_{21}	(c)	-	2.47E+02	-	-	5.37E+01	4.82E+02	-	-	1.34E+02	7.66E+02	-	-	3.21E+02
Aromatic hydrocarbons >EC_{21}-EC_{35}	(c)	-	8.88E+02	-	-	4.83E+00	1.11E+03	-	-	1.21E+01	1.22E+03	-	-	2.90E+01
Aromatic hydrocarbons >EC_{35}-EC_{44}	(c)	-	8.88E+02	-	-	4.83E+00	1.11E+03	-	-	1.21E+01	1.22E+03	-	-	2.90E+01

Notes:

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

NR - the compound is not volatile and therefore a soil saturation limit not calculated within CLEA

EC - equivalent carbon. GrAC - groundwater assessment criteria. 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 effect the interpretation of any exceedances since the contribution of the indoor and outdoor vapour pathway to total exposure is >10%. This shading has also been used for the RBCA output where the theoretical solubility limit has been exceeded. The SAC has been set as the model calculated SAC with the saturation limits shown in brackets.

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

Calculated SAC does not exceed the soil saturation limit.

For consistency where the theoretical solubility limit within RBCA has been exceeded in production of the GrAC, these cellls have also been hatched red.

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, polycyclic aromatic hydrocarbons, MTBE, 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) Sensitivity analysis undertaken on SEGH equation and CLEA model, considered reasonable in absence of UK specific data

(b) GAC taken from the Environment Agency SGV reports published 2009.

(c) SAC for selenium, aliphatic and aromatic hydrocarbons >EC16 does not include inhalation pathway owing to absence of toxicity data. SAC for arsenic is only based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report. The same approach has been adopted for zinc.

(d) SAC for elemental mercury, chromium VI and nickel is based on the inhalation pathway only owing to an absence of toxicity for elemental mercury, in accordance with the SGV report for nickel and LQM report for chromium VI.

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH PRIVATE GARDENS

Table 8
Human Health Generic Assessment Criteria for Residential Scenario - Private Gardens

Compound	GrAC for Groundwater (mg/l)	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 2.5% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals				
Arsenic	-	32	32	32
Cadmium	-	10	10	10
Chormium (III) - oxide	-	3,000	3,000	3,000
Chromium (VI) - hexavalent	-	4.3	4.3	4.3
Copper	-	2,300	2,300	2,300
Lead	-	300	300	300
Elemental Mercury (Hg^0)	0.009	0.17	0.42	1.0
Inorganic Mercury (Hg^{2+})	-	170	170	170
Methyl Mercury (Hg^{4+})	20	7.4	9.6	11
Nickel	-	130	130	130
Selenium	-	350	350	350
Zinc	-	3,800	3,800	3,800
Cyanide	-	3.7	3.7	3.7
Volatile Organic Compounds				
Benzene	7	0.079	0.157	0.33
Toluene	1,900	120	270	610
Ethylbenzene	260	65	154	350
Xylene - m	100	44	103	240
Xylene - o	87	45	106	250
Xylene - p	84	42	98	230
Total xylene	84	44	103	240
Methyl tertiary butyl ether (MTBE)	2,200	1.8	3.7	7.4
Trichloroethene	1.8	0.11	0.2	0.49
Tetrachloroethene	3.6	0.94	2.1	4.8
1,1,1-Trichloroethane	26	6.2	12.7	28
1,1,1,2Tetrachloroethane	14	0.89	2.1	4.8
1,1,2,2-Tetrachloroethane	14	1.4	2.87	6.3
Carbon Tetrachloride	0.055	0.018	0.039	0.089
1,2-Dichloroethane	0.30	0.0053	0.0080	0.014
Vinyl Chloride	0.019	0.00047	0.0006	0.001
1,2,4-Trimethylbenzene	0.075	0.35	0.85	2.1
1,3,5-Trimethylbenzene	0.047	0.46	1.1	2.6
Semi-Volatile Organic Compounds				
Acenaphthene	3.2	210	480	1,000
Acenaphthylene	4.2	170	400	850
Anthracene	0.021	2,300	4,900	9,200
Benzo(a)anthracene	0.0038	3.1	4.7	5.9
Benzo(b)fluoranthene	0.0020	5.6	6.5	7.0
Benzo(g,h,i)perylene	0.00026	44	46	47
Benzo(k)fluoranthene	0.00080	8.5	9.6	10
Chrysene	0.0020	6.0	8.0	9.3
Dibenzo(a,h)anthracene	0.00060	0.76	0.86	0.90
Fluoranthene	0.23	260	460	670
Fluorene	1.9	160	380	780
Indeno(1,2,3-cd)pyrene	0.0002	3.2	3.8	4.2
Phenanthrene	0.53	92	200	380
Pyrene	0.13	560	1,000	1,600
Benzo(a)pyrene	0.0038	0.83	0.94	1.0
Naphthalene	19	1.5	3.7	8.7
Phenol	-	180	290	420
Total Petroleum Hydrocarbons				
Aliphatic hydrocarbons EC_5-EC_6	10	30	55	110
Aliphatic hydrocarbons >EC_6-EC_8	5.4	73	160	370
Aliphatic hydrocarbons >EC_8-EC_{10}	0.23	19	46	110
Aliphatic hydrocarbons >EC_{10}-EC_{12}	0.034	93 (48)	230 (118)	540 (283)
Aliphatic hydrocarbons >EC_{12}-EC_{16}	0.00076	744 (24)	1,700 (59)	3,000 (142)
Aliphatic hydrocarbons >EC_{16}-EC_{35}	-	45,100 (8.48)	64,000 (21)	76,000
Aliphatic hydrocarbons >EC_{35}-EC_{44}	-	45,100 (8.48)	64,000 (21)	76,000
Aromatic hydrocarbons >EC_8-EC_9 (styrene)	7.4	130	316	700
Aromatic hydrocarbons >EC_9-EC_{10}	7.4	27	65	150
Aromatic hydrocarbons >EC_{10}-EC_{12}	25	69	160	346
Aromatic hydrocarbons >EC_{12}-EC_{16}	5.8	140	310	593
Aromatic hydrocarbons >EC_{16}-EC_{21}	-	250	480	770
Aromatic hydrocarbons >EC_{21}-EC_{35}	-	890	1,100	1,230
Aromatic hydrocarbons >EC_{35}-EC_{44}	-	890	1,100	1,230

Notes:

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

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

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, polycyclic aromatic hydrocarbons, MTBE, 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.

The SAC has been set as the model calculated SAC with the saturation limit shown in brackets. For consistency where the GrAC exceeds the solubility limit, GrAC has been set at the solubility limit. The GrAC conservative since concentrations of the chemical are very unlikely to be at sufficient concentration to result in an exceedance of the health criteria value at the point of exposure (i.e. indoor air) provided free-phase product is absent.

APPENDIX K
GENERIC ASSESSMENT CRITERIA FOR POTABLE WATER SUPPLY PIPES

A range of pipe materials is available and careful selection, design and installation is required to ensure that water supply pipes are satisfactorily installed and meet the requirements of the Water Supply (Water Fittings) Regulations 1999 in England and Wales, the Byelaws 2000 in Scotland and the Northern Ireland Water Regulations. The regulations include a requirement to use only suitable materials when laying water pipes and laying water pipes without protection is not permitted at contaminated sites. The water supply company has a statutory duty to enforce the regulations.

Contaminants in the ground can pose a risk to human health by permeating potable water supply pipes. To fulfil their statutory obligation, UK water supply companies require robust evidence from developers to demonstrate either that the ground in which new plastic supply pipes will be laid is free from specific contaminants, or that the proposed remedial strategy will mitigate any existing risk. If these requirements cannot be demonstrated to the satisfaction of the relevant water company, it becomes necessary to specify an alternative pipe material on the whole development or in specific zones.

In 2010, UK Water Industry Research (UKWIR) published *Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites* (Report Ref. No. 10/WM/03/21). This report reviewed previously published industry guidelines and threshold concentrations adopted by individual water supply companies.

The focus of the UKWIR research project was to develop clear and concise procedures, which provide consistency in the pipe selection decision process. It was intended to provide guidance that can be used to ensure compliance with current regulations and to prevent water supply pipe failing prematurely due to the presence of contamination.

The report concluded that in most circumstances only organic contaminants pose a potential risk to plastic pipe materials and Table 3.1 of the report provides threshold concentrations for polyethylene (PE) and polyvinyl chloride (PVC) pipes for the organic contaminants of concern. The report also makes recommendations for the procedures to be adopted in the design of site investigations and sampling strategies, and the assessment of data, to ensure that the ground through which water supply pipes will be laid is adequately characterised.

Risks to water supply pipes have therefore been assessed against the threshold concentrations for PE and PVC pipe specified in Table 3.1 of Report 10/WM/03/21, which have been adopted as the GAC for this linkage and are reproduced in Table A3 below.

Since water supply pipes are typically laid at a minimum depth of 0.75m below finished ground levels, sample results from depths between 0.5m and 1.5m below finished level are generally considered suitable for assessing risks to water supply. Samples outside these depths can be used, providing the stratum is the same as that in which water supply pipes are likely to be located. The report specifies that sampling should characterise the ground conditions to a minimum of 0.5m below the proposed depth of the pipe.

It should be noted that the assessment provided in this report is a guide and the method of assessment and recommendations should be checked with the relevant water supply company.

Table A3: Generic assessment criteria for water supply pipes

		Pipe material	
		GAC (mg/kg)	
	Parameter group	**PE**	**PVC**
1	Extended VOC suite by purge and trap or head space and GC-MS with TIC (Not including compounds within group 1a)	0.5	0.125
1a	• BTEX + MTBE	0.1	0.03
2	SVOCs TIC by purge and trap or head space and GC-MS with TIC (aliphatic and aromatic C_5–C_{10}) (Not including compounds within group 2e and 2f)	2	1.4
2e	• Phenols	2	0.4
2f	• Cresols and chlorinated phenols	2	0.04
3	Mineral oil C_{11}–C_{20}	10	Suitable
4	Mineral oil C_{21}–C_{40}	500	Suitable
5	Corrosive (conductivity, redox and pH)	Suitable	Suitable
Specific suite identified as relevant following site investigation			
2a	Ethers	0.5	1
2b	Nitrobenzene	0.5	0.4
2c	Ketones	0.5	0.02
2d	Aldehydes	0.5	0.02
6	Amines	Not suitable	Suitable
Notes: where indicated as 'suitable', the material is considered resistant to permeation or degradation and no threshold concentration has been specified by UKWIR.			