East Midlands Gateway
Phase 2 (EMG2)

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ENVIRONMENTAL STATEMENT

Technical Appendices

Appendix 14J

EMG1 Preliminary Ground Investigation Interpretative Report

October 2025

14

The East Midlands Gateway Phase 2
and Highway Order 202X and The East Midlands Gateway
Rail Freight and Highway (Amendment) Order 202X

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Roxhill Developments Limited

East Midlands Gateway Strategic Rail Freight Interchange

Zone 1 Main Development Plateau and Rail Freight Terminal

Preliminary Ground Investigation Interpretive Report

312494/1 - 03 (00)

DECEMBER 2013

RSK GENERAL NOTES

Project No.: 312494/1 – 03 (00)

Title: Preliminary ground investigation report: East Midlands Gateway: Strategic Rail Freight Interchange: Zone 1 Main Development Plateau and Rail Freight Terminal

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1 INTRODUCTION

1.1 Introduction

RSK Environment Limited (RSK) has been commissioned by Roxhill Developments Limited (the Client) to carry out a series of Preliminary Ground Investigation Interpretative Reports for the site of the proposed East Midlands Gateway: Strategic Rail Freight Interchange (the Main Development Site).

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

RSK has produced a Preliminary Sources Study Report (reference 312494/1 - 01 (00), November 2013) and a Factual Ground Investigation Report (reference 312494/1 – 02 (00), December 2013) pertaining to the site, both of which support and should be read in conjunction with this report.

1.2 Terms of reference

This report comprises a preliminary ground investigation report in general accordance with the requirements of;

- BS5930:1999+A2:2010 'Code of practice for site investigations'
- Environment Agency CLR 11 2004a 'Model Procedures for the Management of Land Contamination' (Contaminated Land Risk Assessment)
- Highways Agency HD22/08, 'Managing Geotechnical Risk' (Ground Investigation)
- BS EN 1997-2:2007. Eurocode 7 — Geotechnical design — Part 2: Ground investigation and testing

1.3 Proposed development

It is understood that the site is being considered for development to provide a Strategic Rail Freight Interchange for the East Midlands regions. This includes a large distribution warehousing complex, major trunk road improvements to the A453, A50 and M1 Junctions 24 and 24a, a new bypass to the south of Kegworth including bridge over the M1, and a new rail freight terminal and associated branch line from the Castle Donington line.

For the purpose of discussion, and to facilitate reporting; the site has been divided into four Zones, on the basis of the four main elements of the proposals as follows. The extent of each of the four Zones is defined by the proposed general arrangement presented as Figure 2.

- Zone 1: Main Development Plateau and Rail Freight Terminal
- Zone 2: Rail Branch Line (Network Rail)
- Zone 3: Major Trunk Road Improvements
- Zone 4: Kegworth Bypass including bridge over the M1

This report presents the investigation relating to Zone 1; Main Development Plateau and Rail Freight Terminal.

1.4 Objective

The subject of this report is Zone 1, the proposed Main Development Plateau for the construction of distribution warehouses and the Rail Freight Terminal. In accordance with the Client's specific objectives, requirements and brief; the objective for the works was developed with the aim of providing a preliminary ground investigation report which includes:

- provide sufficient data to confirm the ground model
- obtain data to provide a chemical and geotechnical characterisation of each strata
- assist with master planning design
- provide data to support planning applications

In line with Eurocode 7, BS5930, BS10175 and CLR 11 further phases of targeted investigation (post Planning Approval) may be required to provide specific data and information for detailed design of individual elements of the scheme as the design evolves.

1.5 Scope

The project has been carried out to an agreed brief as set out in RSK's proposal (ref. East Midlands Gateway; Geotechnical and Geo-environmental Services - Master Planning and EIA Support, dated 13th August 2013).

No investigation was possible within the south western corner of the site as land agreements were not in place with East Midlands Airport at the time that the preliminary investigations were undertaken.

1.6 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. In addition, groundwater levels and ground gas concentrations and flows may vary from those reported due to seasonal, or other, effects.

2 SITE DETAILS

2.1 Site location

The Development Site covers approximately 374 hectares and currently consists of farmland with some areas of woodland. The M1 motorway, A453 runs roughly north to the east of the main development area of the site. The village of Castle Donington is situated approximately 600m to the west of the site. Hemington and Lockington villages are present directly to the north and East Midlands Airport is adjacent to the southern boundary of the site. The site location is presented within Figure 1.

Zone 1 covers an area of approximately 231Ha, the centre of which is defined by the following National Grid co-ordinates: 447330, 326660. The Zone is bound to the east by the A453 road, to the south by the East Midlands Airport; to the west and north there are no physical boundaries other than the hedgerows which form the field boundaries.

2.2 Local topography, geography and geomorphology

The site sits within a formerly glaciated area signified by rolling hills created by the harder geological formations and erosion of the glacial deposits.

Zone 1 generally slopes from the high plateau where East Midlands Airport is located with a general ground level of approximately 88m AOD down to the north east which has a ground level of approximately 44m AOD. The land across Zone 1 is rolling farmland dissected by minor streams with a knoll located in the north west. Two very minor drainage ditch / streams are shown to dissect Zone 1 and appear to originate from springs or rises in the southern part of Zone 1, although they are also fed by the surrounding watershed from the rolling farm lands which they dissect. One stream originates broadly in the middle of the eastern portion of Zone 1 close to Field Farm and runs west and then north through Zone 1 and beyond through Lockington Village, whilst a second stream originates further west and follows a similar path through natural folds in the ground west then north along Zone 1 western boundary through Hemington Village.

The ground beyond the northern boundary of Zone 1 is relatively flat but for the disturbance of manmade features, forming a river terrace to the River Trent which runs broadly west to east approximately 3km north of the Zone 1. The land to the east and west of Zone 1 follows a similar rolling farm land form with a general fall to the north, although further east the land falls east toward the River Soar which flows south to north to join the River Trent.

The geological sequence of the area is understood to be one of interbedded clays, mudstones, siltstones and sandstones deposited within sea conditions and eroded by periods of glaciations and later deposition and erosion from the River Trent which has cut through the geological strata depositing Alluvium and River Gravels along its course and flood plain.

2.3 Site description

A site walkover was undertaken on the 9th September 2013. Zone 1 is predominately used for arable farming with hedgerow field boundaries including a variety of small, medium and mature sized trees with occasional small areas of woodland. There is one field located in the far north west corner of Zone 1 which was used as a paddock for horses. The majority of fields were under crop or stubble from recent harvesting.

There are two main public footpaths which cross Zone 1 one east west and one north south broadly intersecting each other in the centre of Zone 1 and connecting to the nearby villages of Lockington and Castle Donington.

King Street Plantation located in the centre of Zone 1 is understood to be protected woodland comprising of mature deciduous trees.

Field Farm located in the south eastern quadrant of Zone 1 is the principal set of buildings on Zone 1. The farm is operational and buildings comprise a brick built two storey farm house with outbuildings, office and store including a small garden to the south east and courtyard to the west. The Farm House buildings are surrounded to the west and north by farm sheds, silage bays, a pond/lagoon feature and small overgrown stockpile of soil materials understood to originate from the excavation of the more recent crop drying shed footprint. The crop drying shed is a large aluminium clad grain drying store located in the south western corner of the complex and is heated by a Calor Gas system with two gas tanks being located on its north eastern corner. The larger farm buildings are predominantly steel framed and many appear to be clad and roofed in a corrugated cement bonded boards which may contain asbestos. These barns are used to house tractors, plant and machinery, seed, fertiliser and other ancillary arable farming equipment. There are an extensive number of smaller disused wooden framed former cattle sheds and large bays for the storage of silage and cattle waste together with a heavily overgrown area anticipated to house a lagoon/pond although this was not visible at the time of the walkover. The farmyard area is a combination of mainly concrete hardstanding with some more open gravel at the periphery extents. A large trailer water tank is located centrally and is understood to be topped up with mains water and utilised for spraying. Two large modern diesel tanks are present in the farm yard and are understood to be used for fuel to plant and machinery. A single large tank is located on the northern periphery of the farm yard and is used for fertiliser storage. There are a number of small containers used for storing equipment in too. No spills or obvious areas of contamination were observed and the farmyard was in good order.

A small stand of what appeared to be Japanese Knotweed is located on the perimeter of the farm garden.

Power is received via low level overhead feed from the east with an above ground small substation mounted on the pole to the east of the farm.

The farm is connected by concrete access roads to Lockington Lane in the north east and the A453 in the south east. Further farm tracks and set aside field margins are present around many of the fields affording access for farm machinery to each of the arable fields. Anecdotal evidence suggests that cattle carcases may be buried in the north eastern corner of the farm yard beneath the arising from when the drying warehouse was constructed.

The area of the airport land and the land enclosed within the Airport land in the south western corner of Zone 1 was not accessible at the time of the site walkover.

It is understood from conversations with the Farm Foreman that the farm had until 2000 been used predominantly for milk production with cattle using the fields. From 2000 the farm was turned over to arable crops. It is also understood that the area owned by the airport (formerly part of the RAF Castle Donington) had had some form of earth bunding and partially buried bunkers but that it was believed that these had been decommissioned and removed after the war with only concrete hard standing access roads still being retained.

The springs and streams locations were examined, however in the main the streams were dry or not flowing and only soft boggy ground with occasional stagnant water pools were present at the time of the visit.

3 SUMMARY OF AVAILABLE INFORMATION

3.1 Published geology and expected ground conditions

The British geological Survey (BGS) plans and maps obtained have been reviewed to determine the anticipated geology beneath Zone 1.

It is envisaged that the local geology beneath Zone 1 will be in line with the summary below detailed within table 1.

Table 1: Expected geology

Geology	Comment
Surfacing and Buried Structures: (source: Envirocheck History Maps, Site Observation)	The main surfacing area is associated with farm located in the south eastern quadrant of the Zone. There is also the main access road which runs from the north of the Zone to the south to the farm yard and then to the southern boundary. Additional hardstanding tracks and bunkers may still be present in the south western corner of Zone 1.
Made Ground: (source: BGS Maps, Available Borehole Logs, Envirocheck Geology and History Maps, memoirs)	There are several minor areas of made ground deposits located across the zone. An area of disturbed ground is located in the north western corner of Zone 1 likely to be associated with a former quarry. There are four small areas of made ground deposits and infilled materials located in the south western corner of Zone 1 within the East Midlands Airport land probably associated with the former RAF base operations. There are areas of worked and disturbed ground located in the centre of Zone 1 near to the King Street Plantation. Further made ground deposits are shown within the farm yard area.
Drift Deposits: (source: BGS Maps, Available Borehole Logs, Envirocheck Geology and History Maps, memoirs)	A cap of **Thrussington Member** (Glacial Till) expected to take the form of sandy gravelly Clay is noted in the north western area of Zone 1 forming the knoll feature. There is a finger of **Head** deposits indicated to be located within the centre of Zone 1 orientated north to south, with further Head deposits indicated to be located in northern area wrapping round along the eastern boundary with a small area in the north western corner. Head deposits are expected to vary between silts, clays, sands and gravels. A thin finger of **Eagle Moore Sand and Gravel** is anticipated to be located in the northern part of Zone 1 with further sand and gravel deposits located in the north of Zone 1 orientated north west to south east, these been defined as the **Egginton Common Sand and Gravel** and the **Wanlip Member**.
Bedrock (source: BGS Maps, Available Borehole Logs, Envirocheck Geology and History Maps, memoirs)	Zone 1 is underlain by the **Mercia Mudstone Group** which is sub divided into the following differing lithologies; The majority of Zone 1 is underlain by the **Taporley Siltstone Formation** which comprises interbedded mudstones, siltstone and sandstones. The southern boundary of Zone 1 is underlain by the **Gunthorpe Member** which comprises of interbedded mudstone and dolomitic siltstone. The far

Geology	Comment
	north of the Zone 1 is underlain by the **Edwalton Member** which comprises primarily of mudstone with siltstone and sandstone skerry bands. The underlying **Bromsgrove Sandstone Formation** is indicated to be present in two small areas to the east and the west. It is anticipated that where no drift deposits overlay the solid deposits the Mudstones will have weathered to clays, siltstones to silt and sandstones to sand.
Soil Chemistry (source: Envirocheck / BGS)	Available soil chemistry data suggests that the natural soils anticipated to be present across the site do not have any elevated concentrations of contaminants that would be considered to represent a risk to Human Health for the elements tested for.
Mining (source: Coal Authority web viewer, BGS Maps, Available Borehole Logs, Envirocheck records, Geology and History Maps)	None expected.
Faults (source: BGS Maps, Available Borehole Logs, Envirocheck Geology Maps, memoirs)	A major fault (**Normanton Hills Fault**) is shown crossing the northern area of Zone 1 with an orientation of east to west down thrown to the north which is the division between the Taporley Siltstone and Edwalton Formation. Two further faults are shown in the western half of the Zone which is orientated north to south and both are down thrown to the east.
Opencast Quarrying (source: Coal Authority web viewer, BGS Maps, Envirocheck History Maps)	Two areas of disturbed ground are shown; one in the north western corner and one to the west of the King Street Plantation in the centre of Zone 1.
Mineral Protection (source: Local Authority Plan)	Zone 1 does not fall within the Mineral Protection area.
Groundwater Levels: (source: Available GI)	Due to the variable deposits anticipated to be present across Zone 1 and in particular the interbedded nature of the majority of the solid deposits it is expected that more permeable strata (sandstone and siltstone) beds confined between less permeable mudstones may yield local water tables. Initial monitoring of the preliminary Ground Investigation undertaken by others confirms that when drilled most boreholes were dry; however minor water strikes were encountered in discrete permeable beds. **Monitoring of wells installed to different depths and with differing response zones suggest a variety of water tables are present confined within the various confined permeable strata.** Several installations remained dry, while others collected only small amounts of groundwater. Given the rural location of Zone 1, it is considered unlikely that the development will be affected by rising groundwater levels associated with diminished abstraction by industry.

4 GROUND INVESTIGATION

The investigation undertaken at Zone 1 comprised the following:

- Setting out and service clearance (RSK SafeGround).
- Excavation of twenty seven trial pits using an operated wheeled excavator to provisional depths of between 1.50m and 4.60m bgl.
- Completion of six soakaway tests in selected trial pits in general accordance with BRE 365.
- Sinking of nineteen boreholes to depths of between 2.32m and 10.94m bgl using a standard cable percussive drilling rig.
- Sinking of six rotary cored boreholes (air/mist) open holed to rock head and cored (P size) to depth of between 20.00m and 30.00m bgl.
- Installation of twenty eight combined groundwater/gas monitoring wells and piezometers to varying depths including provision of flush lockable covers and 1.5m high wooden marker stakes (in fields).
- Four initial return visits to monitor groundwater levels/ground gas concentrations.
- One groundwater sampling visit.
- Surveying in of as built exploratory hole positions using GPS surveying equipment.
- Associated sampling and in-situ testing.
- Soil and rock sample geotechnical laboratory testing.
- Soil sample chemical and contamination laboratory testing.
- Groundwater sample chemical and contamination laboratory testing.

Full records and details covering the methodology of the investigation, the location rationale for exploratory holes, exploratory hole logs, completed laboratory testing results and exploratory hole location drawings are presented separately within the Factual Ground Investigation Report (312494/1 – 02 (00)).

The ground investigation was developed to supplement the findings of the desk study research which is presented separately within the Preliminary Sources Study Report (312494/1 – 01 (00)). The investigation was designed to confirm the anticipated ground conditions and to obtain strata geotechnical and chemical properties to allow design assessments to be refined. Specific issues targeted by the ground investigation are identified in Table 2 below:

Table 2: Issues identified within ground investigation

	Area	Issue	Exploratory Holes	Testing	Comments
Geo-environmental	Whole Site	General chemical characteristics of the Topsoil and near surface sub soils as site is Greenfield	All	Chemical analysis	To confirm contamination risk potential. To confirm in ground aggressivity for concrete mix designs
Geotechnical	Whole Site	General geotechnical characteristics	All	Soils testing	To confirm distribution, classification, uniformity in plan and depth
	Cuttings and earthworks properties	Strata depths and properties and groundwater levels	CP(R)203-208 CP210/211 TP311/312/313/314/319/321/322/324/325/326/327	SPT, PI, QUTxl, Consols, Point Loads, UCS, Compaction, MCV/MCC, Recompact CBR	To confirm strata strength characteristics and uniformity. To confirm distribution, classification and reusability in earthworks filling operations
	Embankment Foundations	Strata depths and properties and groundwater levels	CP215/216/217/218/221 TP301(s)/307/308/309	Classification and Compaction testing	To confirm strata strength characteristics and uniformity
	Buildings Plateau Foundations	Strata depths and properties and groundwater levels	CP(R)203/204/205/208 CP203-205/208/210 - 218 TP307/308/309/315-326	PI, QUTxl, Consols	To confirm bearing and settlement characteristics and uniformity of strata
	Flood Attenuation Ponds	Soil Infiltration	TP(S)301-305/351-352	Soakaways, permeability tests and classification tests	To define permeability's and effectiveness of soakaways or need for lining of ponds

5 GROUND CONDITIONS IDENTIFIED

The results of the Preliminary Ground 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 and details of monitoring well installations are included on the exploratory hole records presented separately in the Factual Ground Investigation Report (312494/1 – 02 (00)).

5.1 Ground conditions

The exploratory holes revealed that the site is underlain by a variable thickness of topsoil, subsoil or made ground over various types of drift deposits including, Head Deposits, Thrussington Member, the Wanlip Member and the Egginton Common Sand and Gravel.

Underlying these drift deposits the strata of the Mercia Mudstone Group was primarily clay with weathered mudstones of the Gunthorpe member in the south, the Tarporley Siltstone Formation across the majority of the site and the Edwalton Member in the north. These were underlain by Bromsgrove Sandstone Formation at depth which was encountered in the east. This appears to confirm the stratigraphical succession described within the initial conceptual model. For the purpose of discussion, the ground conditions are summarised in Table 3 and the strata discussed in subsequent subsections.

Table 3: General succession of strata encountered

Strata	Exploratory holes encountered	Depth to top of stratum m bgl	Thickness (m)
Topsoil or Subsoil	TPS301, TPS302, TPS303, TPS304, TPS305, TPS351, TPS352, TP307, TP308, TP309, TP310, TP311, TP312, TP313, TP314, TP315, TP317, TP319, TP320, TP321, TP322, TP323, TP324, TP325, TP326, TP327, CP203, CP204, CP205, CP206, CP208, CP210, CP211, CP212, CP213, CP214, CP217, CP219, CP220, CP221	Ground level	0.05 to 0.60
Made ground	TP316, CP207, CP222	Ground level	0.30 to 0.50
Head Deposits	TPS304, TP308, TP309, TP311, TP313, TP314, TP315, TP321, TP322, TP324,	0.25 to 0.60	0.20 to 1.35

Strata	Exploratory holes encountered	Depth to top of stratum m bgl	Thickness (m)
	TP325, TP326, TP327, CP205, CP214, CP220		
Thrussington Member	TPS302, TPS303, TP307, TP316, TP317, TP320, CP212, CP215, CP217, CP218, CP219	Ground level to 0.30	0.30 to 3.00
Wanlip Member	TPS305, TPS351, TPS352, CP222	0.30	2.25 to 3.10
Egginton Common Sand and Gravel	TP310, CP221	0.30 to 0.35	2.15 to 4.30
Gunthorpe Member	CP204, CP211, CP(R)204	Ground Level to 0.45	2.45 to 19.55
Edwalton Member	TPS303, TPS304, TP311, CP219, CP220, CP221, CP222	0.90 to 3.40	1.35 to 8.44
Tarporley Siltstone Member	TPS301, TPS302, TP307, TP308, TP309, TP312, TP313, TP314, TP315, TP316, TP317, TP319, TP320, TP321, TP322, TP323, TP324, TP325, TP326, TP327, CP203, CP205, CP206, CP207, CP208, CP210, CP212, CP213, CP214, CP216, CP217, CP218, CP219, CP(R)203, CP(R)205, CP(R)207, CP(R)208	Ground level to 3.00	1.00 to 13.00
Bromsgrove Sandstone Formation	CP206, CP215, CP(R)203, CP(R)205, CP(R)206, , CP(R)207, CP(R)208	2.00 to 16.07	0.35 -21.10
Arden Sandstone Formation	CP221	10.50	0.44
Note: **Thickness' are proven thickness in exploratory holes and not full thickness of strata. Strata are likely to be thicker.**			

5.1.1 Topsoil and subsoil

The topsoil and subsoil (ploughed surface materials) across the site generally comprised slightly sandy slightly gravelly clay. The gravel comprised angular to rounded fine to coarse sandstone, quartzite, flint and rare brick. The subsoil ranged in thickness between 0.05 to 0.60m thick but was generally 0.3m thick across most of the site.

The recorded in-situ test results and laboratory test results are detailed within the Factual Ground Investigation Report presented separately.

Four soil samples of these deposits were sent for contamination screening testing.

5.1.2 Made ground

The made ground varied within the exploratory holes in which it was encountered and ranged in thickness from 0.30m to 0.50m. The made ground within TP316 comprised very stiff slightly gravelly slightly sandy silty clay with the gravel comprising of subangular to rounded fine to coarse quartzite and brick. Within CP207 the made ground comprised slightly gravelly slightly clayey fine sand with the gravel comprising of angular brick, clinker, quartzite and concrete. Within CP222 the made ground comprised clayey sand over gravel of angular limestone.

One soil sample of these deposits was sent for contamination screening testing.

5.1.3 Head deposits

This stratum was encountered locally within select exploratory holes in Zone 1 beneath the topsoil/subsoil and generally comprised very stiff slightly gravelly sandy clay between 0.20m and 1.35m in thickness.

These deposits were recorded to be stable during excavation.

A summary of the in-situ and laboratory test results in this stratum is presented in Table 4 below.

The recorded in-situ test results and laboratory test results are detailed within the Factual Ground Investigation Report presented separately.

Table 4: Summary of in-situ and laboratory test results for the Head Deposits

Soil parameters	Range	No Tests
Undrained shear strength (kN/m^2) from shear vane and undrained triaxial testing	68-96	1
Stiffness term	Firm to Stiff	
Coefficient of compressibility C_v (m^2/Yr) *at overburden*	13	1
Coefficient of compressibility M_v (m^2/MN) *at overburden*	0.11	
Settlement term	Low to Medium Compressibility	

One soil sample of these deposits was sent for contamination screening testing.

5.1.4 Thrussington Member

This stratum was encountered locally within select exploratory holes in Zone 1 from ground level to beneath the topsoil/subsoil to 0.30m depth and varies between 0.30m and 3.00m in thickness. Based on the site descriptions and laboratory and in-situ tests carried out this layer can generally be described as a stiff slightly sandy slightly gravelly clay. The gravel comprised quartzite, sandstone, occasional coal and rare flint.

These deposits were recorded to be stable during excavation.

A summary of the in-situ and laboratory test results in this stratum is presented in Table 5 below.

The recorded in-situ test results and laboratory test results are detailed within the Factual Ground Investigation Report presented separately.

Table 5: Summary of in-situ and laboratory test results for the Thrussington Member

Soil parameters	Range	No Tests
Undrained shear strength (kN/m^2) from shear vane and undrained triaxial testing	74 - >120	4
Stiffness term	Stiff	
Coefficient of compressibility C_v (m^2/Yr) *at overburden*	22	1
Coefficient of compressibility M_v (m^2/MN) *at overburden*	0.11	
Settlement term	Low to Medium Compressibility	

One sample of this stratum was scheduled for chemical analysis to determine concrete mix design. The results identified concentrations of water-soluble sulphate of 142 mg/l and a pH of 8.71.

5.1.5 Wanlip Member

This stratum was encountered beneath the topsoil/subsoil in a select number of exploratory holes and generally comprised very stiff slightly gravelly slightly sandy clay, very clayey very gravelly sand or slightly clayey sand and gravel between 2.25m and 3.10m in thickness. The gravel comprised quartzite, occasional flint and sandstone.

These deposits were recorded to be stable during excavation.

A summary of the in-situ and laboratory test results in this stratum is presented in Table 6 below.

The recorded in-situ test results and laboratory test results are detailed within the Factual Ground Investigation Report presented separately.

Table 6: Summary of in-situ and laboratory test results for the Wanlip Member

Soil parameters	Range	No Tests
Moisture content (%)	9.4	1
SPT 'N' values	12 - 18	2
Density term	Medium dense	

One soil sample of these deposits was sent for contamination screening testing.

5.1.6 Egginton Common Sand and Gravel

This stratum was encountered beneath the topsoil/subsoil in a select number of exploratory holes and generally comprised slightly clayey silty gravelly fine to medium sand between 2.15m and 4.30m in thickness. The gravel comprised flint, quartzite and sandstone.

These deposits were recorded to be stable during excavation.

A summary of the in-situ and laboratory test results in this stratum is presented in Table 7 below.

The recorded in-situ test results and laboratory test results are detailed within the Factual Ground Investigation Report presented separately.

Table 7: Summary of in-situ and laboratory test results for the Egginton Common Sand and Gravel

Soil parameters	Range	No tests
SPT 'N' values	15 to 16	2
Density term	Medium dense	

One soil sample of these deposits was sent for contamination screening testing.

Two samples of these strata were scheduled for chemical analysis to determine concrete mix design. The results identified concentrations of water-soluble sulphate of <10 to 12mg/l and a pH of 7.35 – 8.22.

5.1.7 Mercia Mudstone Group

The Mercia Mudstone Group strata include:

- Gunthorpe Member;
- Taporley Siltstone Formation; and

- Edwalton Member.

These deposits have been identified to be present beneath the localised drift deposits and comprise Interbedded Mudstones, siltstones and subordinate sandstones. Close to sub crop these variously weathered to stiff clays, silts and sands.

These deposits have been proven from immediately beneath the sub soils and drift deposits to depths of upto 19.55m.

These deposits were recorded to be stable during excavation.

A summary of the in-situ and laboratory test results in this stratum is presented in Table 8 below.

The recorded in-situ test results and laboratory test results are detailed within the Factual Ground Investigation Report presented separately.

Table 8: Summary of in-situ and laboratory test results for Mercia Mudstone Group

Soil parameters	Range	No tests
Liquid limit (%)	24 – 39*	14
Plasticity limit (%)	15 – 26*	
Plasticity index (%)	7 – 22*	
Plasticity term	Low - Intermediate	
Clay (%)	1 - 21	6
Silt (%)	3 - 67	
Sand (%)	1 - 37	
Gravel (%)	2 – 35	
Cobbles (of rock)	0 - 63	
Moisture content (%)	10 – 35	24
Maximum Dry Density – 4.5kg Rammer (Mg/m^3)	1.96 – 2.01	4
Optimum Moisture Content - 4.5kg Rammer (%)	10 - 12	
Re-compacted CBR – 4.5kg Rammer (%)	1.9 – 6.8 (15 - 18% mc)	6
Moisture Condition Value (MCV)	9.8 (15% Nat mc) 9.9 (17% Nat mc)	2
Moisture Condition Calibration (MCC) MCV 8 = MCV 12 =	 14.50 – 19.50%mc 11.00 – 16.50%mc	4
SPT ‘N’ values	7 - >50	68

Soil parameters	Range	No tests
Undrained shear strength inferred from SPT 'N' values (kN/m^2)	30 - >300	
Stiffness term	Soft to Very Stiff	
Undrained shear strength measured by triaxial testing (kN/m^2)	13 - 179	12
Stiffness term	Very Soft to Very Stiff	
Bulk Density (Mg/m^3)	1.91 – 2.20	
Dry density (Mg/m^3)	1.51 – 1.95	
Undrained shear strength measured by shear vane testing (kN/m^2)	54 - 120	3
Stiffness term	Firm to stiff	
Coefficient of Consolidation C_v (m^2/Yr) *at overburden*	1 – 61	3
Coefficient of compressibility M_v (m^2/MN) *at overburden*	0.093 - 0.27	
Settlement Term	Low to Medium Compressibility	
Unconfined Compressive Strength (MPa)	3.2 – 6.8	2
Strength Term	Moderately Weak	
Rock Bulk Density(Mg/m^3)	2.38 – 2.41	
Rock Dry Density(Mg/m^3)	2.17 – 2.26	
Rock Moisture Content (%)	5.7 - 12	16
Unconfined compressive strength from point load testing (MN/m^2)	0.03 to 1.18	32
Strength Term	Very stiff to Moderately Weak	
*One test indicated high plasticity materials with a LL = 61, PL = 26 and PI = 35.		

The following table 9 summarises the testing undertaken previously in 2012 by Geotechnics Ltd.

Table 9: Summary of soil parameters for the Mercia Mudstone Group (Geotechnics Ltd)

Soil parameters	Range	No tests
Liquid limit (%)	28 – 40*	11
Plasticity limit (%)	16 – 20*	
Plasticity index (%)	11 – 20*	
Plasticity term	Low - Intermediate	
Moisture content (%)	11 - 21	16
SPT 'N' values	6 - >50	35
Undrained shear strength inferred from SPT 'N' values (kN/m^2)	25 - >300	
Mudstone		5
Unconfined Compressive Strength (MPa)	0.192 – 2.81	
Rock Bulk Density(Mg/m^3)	1.62 – 2.30	
Rock Dry Density(Mg/m^3)	1.50 – 2.13	
Rock Moisture Content	7.6 - 13	
Unconfined compressive strength from point load testing (MN/m^2)	0.011 – 0.945	17
Siltstone		5
Unconfined Compressive Strength (MPa)	0.178 – 2.777	
Rock Bulk Density(Mg/m^3)	2.14 – 2.42	
Rock Dry Density(Mg/m^3)	1.85 – 2.30	
Rock Moisture Content	5.2 - 15	
Unconfined compressive strength from point load testing (MN/m^2)	0.033 – 0.427	17
Insitu Packer Permeability Tests (m/s)	$4.44x10^{-8}$ - $4.79x10^{-6}$	5
*A single test indicated high plasticity soil with LL = 59, PL = 24 and PI = 35.		

The SPT data is plotted against depth and level and presented graphically in Appendix J. As expected in most instances this indicates a progressive increase in SPT and corresponding strength of the strata with depth as the strata graduates from residual weathered soils to weak rock. Initially the weathered strata are noted to be firm to stiff locally soft where close to surface and highly weathered.

The compaction tests undertaken indicate an optimum moisture content range of 10 - 12% however natural moisture contents are shown to range from 10 – 35% which suggests that the samples tested are wetter than the optimum.

The two MCV tests carried on a sample with a natural moisture content of 15 and 17% confirms MCV's of 9.8 and 9.9% respectively and thus in theory suggest that the

samples tested should be compactable. MCV tests are used to control the suitability of materials for compaction and directly relate to moisture content. In most instances an MCV range of between 8 and 13 are set as the acceptability criteria to control the earthworks and ensure that only suitable moisture content materials are incorporated within the works which can therefore be compacted. MCC tests carried out suggest moisture contents 14.5 -19.5% for MCV of 8 and 11 -14.5% for MCV of 13. This suggests that soils with moisture contents of between 11 and 19% would be compactable in the field. When looking at the results some of the soil strata will be too wet within this range and many of the rock strata (which were not tested for compaction or MCV) would be too dry.

It should however be recognised that the testing carried out to date is indicative only, it is considered that there is currently a small statistical number of tests and that further investigation and testing will be required to confirm this for earthworks specification and designs. Due to the variation in material properties, the size of the site and the volume of cut materials it is recommended that at the detailed design and specification stage that an intensive sampling and testing investigation is undertaken to confirm the properties of the materials from the proposed cut areas.

The effect of moisture content is also further demonstrated in the results of the re-compacted CBR tests. CBR tests carried out on re-compacted samples with moisture contents closer to optimum achieved far higher CBR values than samples tested with a higher natural moisture content. This demonstrates the affect and susceptibility of these strata to moisture content when reused.

Three soil samples of these deposits were sent for contamination screening testing.

Twelve samples of these strata were scheduled for chemical analysis to determine concrete mix design. The results identified concentrations of water-soluble sulphate of <10 to 39mg/l and a pH of 6.94 – 8.74.

5.1.8 Bromsgrove Sandstone Formation

The Bromsgrove Sandstone Formation was encountered from between 2.00m and 16.07m depth to the full depth of the investigation in select deep boreholes in the east of the site. The strata comprised loose to dense slightly gravelly clayey to slightly clayey sand tending to sandstone at depth. The gravel comprised sandstone and quartzite. The sandstone was described as weak to strong.

A summary of the in-situ and laboratory test results in this stratum is presented in Table 10 below.

The recorded in-situ test results and laboratory test results are detailed within the Factual Ground Investigation Report presented separately. Results vary with depth, and material tested.

Table 10: Summary of soil parameters for the Bromsgrove Sandstone Formation

Soil parameters	Range	No tests
Sandstone		3
Unconfined Compressive Strength (MPa)	11.3 – 21	
Rock Bulk Density(Mg/m^3)	2.25 – 2.45	
Rock Dry Density(Mg/m^3)	2.04 – 2.31	
Rock Moisture Content	4.4 – 10.1	
Unconfined compressive strength from point load testing (MN/m^2)	0.11 – 0.18	2

The following table 11 summarises the testing undertaken previously in 2012 by Geotechnics Ltd. Results vary with depth, and material tested.

Table 11: Summary of soil parameters for the Bromsgrove Sandstone Formation (Geotechnics Ltd)

Soil parameters	Range	No tests
Sandstone		5
Unconfined Compressive Strength (MPa)	1.848 – 5.349	
Rock Bulk Density(Mg/m^3)	2.09 – 2.37	
Rock Dry Density(Mg/m^3)	1.94 – 2.21	
Rock Moisture Content	6.2 – 8.8	
Unconfined compressive strength from point load testing (MN/m^2)	0.025 -1.503	25

Four samples of these strata were scheduled for chemical analysis to determine concrete mix design. The results identified concentrations of water-soluble sulphate of <10 to 17mg/l and a pH of 8.95 – 9.25.

5.1.9 Results of soakaway testing

The results of soakaway testing are summarised in Table 12.

Table 12: Soakaway test results

Trial pit	Geological unit	Test result (m/s)
TPS301	Tarporley Siltstone Formation	Insufficient drop in water level. Unable to calculate infiltration rate.
TPS302	Tarporley Siltstone Formation	Insufficient drop in water level. Unable to calculate infiltration rate.
TPS303	Edwalton Member	Insufficient drop in water level. Unable to calculate infiltration rate.

Trial pit	Geological unit	Test result (m/s)
TPS304	Edwalton Member	Insufficient drop in water level. Unable to calculate infiltration rate.
TPS305	Wanlip Member	Insufficient drop in water level. Unable to calculate infiltration rate.
TPS351	Wanlip Member	Insufficient drop in water level. Unable to calculate infiltration rate.
TPS352	Wanlip Member	Insufficient drop in water level. Unable to calculate infiltration rate.
Notes:		

5.2 Groundwater

Groundwater was encountered during the investigation as detailed in Table 13.

Table 13: Groundwater results during investigation

BH/TP	Stratum	Strike (m bgl)	Level (mAOD)	Rise (m)	Level (mAOD)
TPS351	Wanlip Member	2.35	36.19	-	
TP320	Tarporley Siltstone Formation	1.80	69.68	-	
TP320	Tarporley Siltstone Formation	2.70	65.88	-	
TP322	Tarporley Siltstone Formation	2.15	72.05	-	
TP326	Tarporley Siltstone Formation	1.80	57.49	-	
CP211	Gunthorpe Member	7.00	73.98	-	
CP213	Tarporley Siltstone Formation	4.00	61.13	3.80	61.33
CP215	Bromsgrove Sandstone Formation	4.50	54.57	4.25	54.82
CP221	Edwalton Member	9.65	32.01	9.65	32.01
CP222	Edwalton Member	6.40	30.65	5.66	31.39

Where not listed, exploratory holes did not encounter groundwater strikes during formation. It should be noted that the speed of drilling and casing of holes can often mask minor seepages and water strikes. Indeed the addition of air/mist flush within

rotary cored boreholes may obscure minor water strikes, however major water strikes would be evident.

It should be noted that groundwater levels might fluctuate for a number of reasons including in the short term the prevailing weather conditions immediately before and during investigation and monitoring works and longer term seasonal variations should be expected.

The results of the subsequent groundwater monitoring rounds and well surveying exercise are summarised in Table 14. The data is produced within a groundwater elevation statistics report included within Appendix J.

Table 14: Groundwater monitoring data (16/10/2013 to 12/11/2013)

Monitoring well	Response Zone (m bgl)	Strata	Ground Level elevation (m AOD)	Monitored Groundwater Depth Range (mb GL)	Monitored Groundwater Elevation (m AOD)
CP203	1.00 – 4.11	MMG – clay and mudstone	67.92	Dry	Dry
CP204	1.00 – 4.00	MMG – clay and mudstone	82.82	Dry	Dry
CP205	1.00 – 4.30	MMG – clay and mudstone	56.42	4.12 -4.20	52.22 – 52.30
CP206	0.50 – 3.30	MMG/BSF – clay, mudstone and sandstone	51.90	Dry	Dry
CP207	1.00 – 2.70	MMG – clay and mudstone	63.04	Dry	Dry
CP208	1.00 – 2.00	MMG - clay	66.58	Dry	Dry
CP210	8.50 – 9.50 (gravel 1 – 9.5)	MMG- clay, mudstone and siltstone	78.01	5.47 -3.27	72.54 – 74.74
CP211	1.00 – 7.00	MMG – clay, silt and mudstone	80.98	Dry to 5.96	74.84
CP212	1.00 – 3.30	TM and MMG - clay, silt and mudstone	69.14	1.04 – 2.22	66.92 – 68.10
CP213	1.00 – 4.20	MMG - mudstone	65.13	1.78 – 2.39	62.74 – 63.35
CP214	1.00 – 4.20	MMG- clay, mudstone and sandstone	60.97	2.13 – 3.49	57.48 – 58.84
CP215	1.00 – 4.80	BSF - sand	59.07	0.55 – 1.72	57.35 – 58.52

Monitoring well	Response Zone (m bgl)	Strata	Ground Level elevation (m AOD)	Monitored Groundwater Depth Range (mb GL)	Monitored Groundwater Elevation (m AOD)
CP216	0.50 – 2.40	MMG – clay, mudstone and sands tone	64.46	Dry	Dry
CP217	1.00 – 4.60	MMG – clay and mudstone	71.51	1.43 – 2.25	69.26 – 70.08
CP218	1.00 – 4.60	TM and MMG – sand and mudstone	65.61	Dry – 4.63	Dry to 60.98(damp)
CP219	1.00 – 7.50	TM and MMG – clay and siltstone	54.45	Dry – 7.32	47.125
CP220	1.00 – 5.70	Head and MMG – sand, clay and mudstone	43.62	2.08 – 4.40	39.22 – 41.54
CP221	1.00 – 10.70	EGS and MMG –clay and sand	41.66	5.36 – 5..50	36.16 – 36.30
CP222	5.70 – 6.00 (cell 2.2 – 6.00)	Wan and MMG - clay	37.05	2.42 – 2.93	34.12 – 34.63
CP(R)203	7.00 – 25.00	MMG and BSF – mudstone and sandstone	67.92	Dry to 24.47	43.45
	29.00(p) 28.00 – 30.00	BSF – sandstone		Dry	Dry
CP(R)204	14.00 – 20.00	MMG - mudstone	82.81	14.93 – 15.9	66.91 – 67.88
CP(R)205	4.00 – 19.00	MMG and BSF – mudstone and sandstone	56.42	18.26 – 18.28	38.14 – 38.16
CP(R)206	9.00 – 21.00	BSF – sandstone and mudstone	51.84	14.63 – 14.72	37.12 – 37.21
	24.00 (p) 23.00-25.00	BSF – sandstone		14.57 – 14.69	37.06 – 37.27
CP(R)207	12.00 (p) 11.00 – 13.00	MMG – mudstone and sandstone	63.04	10.81 - 10.90	52.14 – 52.23
	17.00 – 25.00	BSF - sandstone		24.24 – 24.54	38.50 – 38.80
CP(R)208	5.00 – 15.00	MMG and BSF – mudstone and sandstone	66.58	Dry	Dry

Monitoring well	Response Zone (m bgl)	Strata	Ground Level elevation (m AOD)	Monitored Groundwater Depth Range (mb GL)	Monitored Groundwater Elevation (m AOD)
Geotechnics Wells 2012 (re-monitored 2013)					
CP/RC101	14.00 – 27.60	MMG- mudstone and sandstone	65.39	26.07 – 26.20	39.19 – 39.32
CP/RC102	4.00 – 17.20	MMG – mudstone and sandstone	54.82	Dry – 4.34?	Dry (37.62) – 50.48?
CP/RC103	15.00 (p) 12.00 – 16.00	MMG – mudstone and sandstone	80.56	Dry – 14.56	Dry – 66.00
	1.00 – 5.00	MMG – clay and mudstone		Dry – 3.83	Dry – 76.73
CP/RC104	18.00 (p) 16.00 – 18.00	MMG – mudstone and siltstone	88.96	Dry	Dry
	7.00 – 14.00	MMG – mudstone		Dry	Dry
CP/RC105	1.00 – 14.70	MMG – clay, mudstone and sandstone	75.05	Dry – 14.44	Dry – 60.61
CP/RC106	8.00 – 16.50	MMG – clay, siltstone, mudstone and sandstone	84.91	11.32 – 11.84	73.07 -73.59
MMG – Mercia Mudstone Group (Inclusive of Gunthorpe &Taporley) BSF – Bromsgrove Sandstone Formation, EGS - Eggington Sand & Gravel, Wan – Wanlip Member, TM – Thrussington Member.					

The detailed records and plots of groundwater with time are provided within Appendix J and are also included within the factual Ground Investigation Report 312494/1 – 02(00) presented separately.

The findings appear to confirm the site is underlain by a series of confined aquifer strata, some of which bear water and others that do not or do from time to time during periods of wet weather. This is in line with our understanding of the Mercia Mudstone Group geology with subordinate water bearing skerry bands of siltstone and sandstone.

The exploratory holes record multiple subordinate interbedded siltstone and sandstone strata between low permeability Mudstones. The inconsistency of depths of these strata suggests that bedding is dipping and intermittent consistent with the method of geological deposition. This is further complicated by faulting across the site area. It is possible that these more permeable strata crop out near to surface further upslope perhaps beyond the site boundary (airport) and drain surface water down between the very low permeable clays and mudstones along the dip and strike of the strata during periods of precipitation. This would explain the sporadic and relatively random and highly variable water strikes. The variation also appears consistent with the variation in

prevailing weather conditions and it is important to note that many holes were dry when drilled and throughout much of the monitoring period which was relatively dry but that as prevailing weather conditions deteriorated and became wetter water tables were recorded.

It's should also be appreciated that some of the instrumentation installed cover large response zones including some more permeable strata trapped between less permeable strata. If the more permeable strata yield water these standpipes would fill up to the draining layer trapped in the less permeable mudstone surrounding them below and therefore maintain what appears to be a long term water table which may not reflect reality. Multiple strikes are also possible where several water bearing strata are intersected. Indeed this is demonstrated by the shallow and deep wells installed within the same holes or holes immediately adjacent to one another.

The principal aquifer beneath the site is the Bromsgrove Sandstone which lies beneath deposits of the Mercia Mudstone Group and this is up faulted closer to ground levels in the east of the site. It would appear that a more stable and clear permanent groundwater table is present within this. Consistent readings in wells in this area from past and more recent investigations suggest a water table falling from around 41m AOD in the south east (CP/RC101) to 38.78 (CP/RC102) further north with similar readings in CP(R) 205 to 207. This may also be in continuity with water tables further north in CP222 and beyond however faulting and changes in geology may mean that this is not in continuity.

Due to the complex stratification of the site it is difficult to confirm this assessment with any certainty at this stage. Therefore it is recommended that a full hydrogeological assessment should be carried out and supported by further ongoing groundwater monitoring and investigations where necessary.

Eight water samples were obtained from monitoring instrumentation installed using bailer sampling techniques and were sent for contamination screening testing.

5.3 Ground gas regime

The results of the ground gas monitoring and testing carried out are given in Appendix H of the Factual Ground Investigation Report. The minimum and maximum results are recorded in Table 15.

Table 15: Summary of ground gas monitoring results

Borehole	Response zone/strata	Probable source(s) of ground gas	Number of monitoring visits	Methane (%)	Carbon dioxide (%)	Oxygen (%)	Flow rate (l/hr)	Water level (m b TOC)	Atmospheric pressure (mbar)
CP203	TSF	None expected	4	0.1	2.1	17.7	0.3	Dry	987
CP204	GM	None expected	4	<0.1	1.7	15.8	0.0	Dry	983
CP205	TSF	None expected	4	<0.1	1.4	18.6	1.0	4.12	987
CP206	TSF/ BSF	None expected	4	<0.1	3.5	12.3	0.4	Dry	988
CP207	TSF	None expected	4	<0.1	1.9	17.5	0.1	Dry	987
CP208	TSF	None expected	4	<0.1	1.3	15.5	0.9	Dry	1003
CP210	TSF	None expected	4	<0.1	2.0	15.9	1.6	3.27	984
CP211	GM	None expected	4	<0.1	2.6	10.9	0.1	5.96	1005
CP212	TM/T SF	None expected	4	<0.1	3.2	16.8	0.4	1.04	984
CP213	TSF	None expected	4	<0.1	2.4	17.0	2.5	1.78	983
CP214	TSF	None expected	4	<0.1	4.1	12.5	0.3	2.13	1005
CP215	BSF	None expected	4	<0.1	3.2	14.4	10.1	0.555	1005
CP216	TSF	None expected	4	<0.1	1.0	18.3	2.4	Dry	1011
CP217	TSF	None expected	4	<0.1	0.4	18.8	1.6	1.43	984
CP218	TM/T SF	None expected	4	<0.1	2.7	14.0	0.9	4.63	1005
CP219	TSF/ EM	None expected	4	<0.1	1.6	14.6	1.5	7.32	1003
CP220	HD/E M	None expected	4	<0.1	0.9	19.4	1.6	2.08	988

Borehole	Response zone/strata	Probable source(s) of ground gas	Number of monitoring visits	Methane (%)	Carbon dioxide (%)	Oxygen (%)	Flow rate (l/hr)	Water level (m b TOC)	Atmospheric pressure (mbar)
CP221	ECS/ EM	None expected	4	<0.1	1.7	17.6	0.1	5.36	1003
CP222	EM	None expected	4	<0.1	0.1	20.5	0.4	2.42	988
CP(R)203	TSF/ BSF	None expected	4	<0.1	2.6	15.0	-0.2	24.47	987
CP(R)204	GM	None expected	4	<0.1	1.8	14.0	0.0	14.93	985
CP(R)205	TSF/ BSF	None expected	4	<0.1	2.0	16.6	-0.1	18.26	987
CP(R)206	BSF	None expected	4	<0.1	2.6	16.1	1.6	14.63	988
CP(R)207	BSF	None expected	4	<0.1	2.5	14.9	-3.4	24.24	989
CP(R)208	TSF/ BSF	None expected	4	0.1	1.4	17.2	1.3	Dry	1002

Note: *BSF – Bromsgrove Sandstone Formation, TSF – Tarporley Siltstone Formation, GM – Gunthorpe member, BMF – Branscombe Mudstone Formation, TM – Thrussington member, EM – Edwalton Member, HD – Head Deposits, ECS – Egginton Common Sand and Gravel*

No obvious sources of gas were identified during the investigation and the results detailed above are believed to represent the natural soil gas conditions.

5.4 Visual/olfactory evidence of soil and groundwater contamination

No visual or olfactory evidence of soil or groundwater contamination was encountered.

5.5 Ground model

The ground model for the site is localised nominal thickness of Thrussington Member in the north west, Head and River Terrace Deposits (Wanlip and Egginton) in the north overlying the Mercia Mudstone Group deposits which are primarily clays and weathered mudstones. The Bromsgrove Sandstone was encountered beneath in the east. The ground model is shown on plan drawings and a general section drawing included within Figures 4 - 11.

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, groundwater, soil gas and ground gas results with generic assessment criteria (GAC) that are appropriate to the linkage being assessed. This comparison can be undertaken directly against the laboratory results or following statistical analysis depending upon the sampling procedure that was adopted.

6.1 Linkages for assessment

Section 5.5 outlines the refined conceptual model which identified the linkages that required assessment after the findings of the site investigation had been considered. These linkages together with the method of assessment are presented in Table 16.

Table 16: Linkages for generic quantitative risk assessment

Potentially relevant pollutant linkage	Assessment method
1. Direct contact with impacted soil by future end users	Direct comparison of laboratory results of soil samples compared to human health GAC in Appendix B for a proposed **commercial and Industrial end use.**
2. Inhalation exposure of future end users to contaminants in the vapour phase	Human health GAC outlined in Appendix B for soil and groundwater based on indoor inhalation exposure to vapour-phase volatile organic compounds (VOC).
3. Inhalation exposure of future end users to asbestos fibres	Qualitative assessment based on the asbestos minerals present, their form, concentration, location and the nature of the proposed development.
3. Uptake of contaminants by vegetation potentially impacting plant growth	Comparison of soil data to GAC in Appendix C
4. Contaminants permeating potable water supply pipes	Comparison of soil data to GAC in Appendix E for plastic water supply pipes using UKWIR (2010) guidance.
5. Leaching of soil contaminants and dissolved phase migration to Principal aquifer and unnamed watercourses	Since no leachate data is available the potential for leaching has been considered qualitatively using soil and groundwater results.
6. Migration of contaminants to wider secondary aquifer body	Comparison of groundwater data to GAC in Table 1 of Appendix F
7. Concentrations of methane	Gas screening values (GSV) have been calculated using

Potentially relevant pollutant linkage	Assessment method
and carbon dioxide in ground gas entering and accumulating in: depressions and excavations that could affect workers enclosed spaces or small rooms in new buildings, which could affect future residents. In the case of methane this could create a potentially explosive atmosphere, while death by asphyxiation could result from carbon dioxide.	maximum methane and carbon dioxide concentrations with maximum flow rates recorded at the site. The GSV have been compared with the revised Wilson and Card classification presented within CIRIA report C665 (Wilson et al., 2007) owing to the development comprising buildings with a ground floor slab.
Notes:	

6.2 Methodology and results

The methodology and results of the GQRA are presented for each relevant pollutant linkage in turn.

6.2.1 Direct contact with impacted soil by future end users

End users of the site are defined as those who are exposed to sources of contamination on a regular and predictable basis. In the case of developments for a commercial end use, the critical receptor is defined within SR3 as a 16 to 65 year old female.

The chemical test results have been compared directly to the appropriate GAC for each contaminant, based upon a conservative Soil Organic Matter (SOM) of 1%. The direct comparison table, which presents the chemical laboratory data set compared against the appropriate GAC, is included within Appendix C.

All samples are below the GAC and the results of the assessment indicate the strata encountered are suitable for use.

Based on the above assessment, no potentially significant risks associated with the soil contamination have been identified and it is considered that the site may be regarded as suitable for the proposed end use.

6.2.2 Inhalation exposure of future residents to asbestos fibres

The visual inspection at the laboratory identified no materials suspected of potentially containing asbestos and the scheduled laboratory screening for asbestos found no detectable asbestos fibres within the samples of made ground.

6.2.3 Uptake of contaminants by vegetation potentially inhibiting plant growth

The results have been compared with the GAC presented in Appendix D for this linkage. The results indicate that a relevant pollutant is unlikely to exist associated with phytotoxic effects.

6.2.4 Impact of organic contaminants on potable water supply pipes

For initial assessment purposes, the results of the investigation have been compared with the GAC presented in Appendix E 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 pollutant polyethylene (PE) and/or 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 route(s) of the supply pipe(s) 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.

6.2.5 Leaching of contaminants to groundwater in principal aquifer and subsequent migration to surface watercourse

Soil samples were not analysed for leachable contaminants. However, concentrations at the site are typical of those recorded in natural strata and topsoil. Furthermore, as demonstrated in Section 6.2.6, groundwater analysis reports concentrations below the GAC. Therefore, risks associated with the leaching pathway are considered acceptable.

6.2.6 Migration of dissolved phase contaminants to wider secondary aquifer body

The analytical results are generally below the GAC indicating pollutant linkages associated with contaminants in the dissolved phase are incomplete. Except for one sample collected from CP210 which had a result for phenols of 0.05mg/l, which was above the freshwater EQS of 0.03mg/l. There is no known source of phenols on site, phenols are a highly mobile contaminant and therefore we would consider the slightly elevated result is from an off-site source. There has not been any indication of phenols present within any other exploratory holes within either soil or groundwater. Therefore we would not consider this slightly elevated result to be as a result of a source present onsite and as such will not be considered further. The results of the comparison of the groundwater results to the groundwater GACs are provided within Appendix G.

6.2.7 Ground gas

The results have been assessed in accordance with the guidance provided in *CIRIA Report C665: Assessing risks posed by hazardous ground gases to buildings* (Wilson et al., 2007). In the assessment of risks and selection of appropriate mitigation measures, the report identifies two types of development, termed Situation A (modified Wilson and Card method), appropriate to all development excluding traditional low-rise construction, and Situation B (National House-Building Council, NHBC) only appropriate to traditional low-rise construction with ventilated sub-floor voids.

Both methods are based on calculations of the limiting borehole gas volume flow for methane and carbon dioxide, renamed as the gas screening value (GSV). The GSV (litres of gas per hour) is calculated by multiplying borehole flow rate (litres per hour) and gas concentration (percent by volume).

In both situations, it is important to note that the GSV thresholds are guideline values and not absolute. The GSV thresholds may be exceeded in certain circumstances, if the site conceptual model indicates it is safe to do so. Similarly, consideration of additional factors such as very high concentrations of methane, should lead to consideration of the need to adopt a higher risk classification than the GSV threshold indicates.

Situation A relates to all development types except low-rise housing and, by combining the qualitative assessment of risk with the gas monitoring results, provides a semi-quantitative estimate of risk for a site. The method uses both gas concentrations and borehole flow rates to define a characteristic situation for a site based on the limiting borehole gas volume flows for methane and carbon dioxide. Having calculated the worst case GSVs for methane and carbon dioxide, the Characteristic Situation is then determined from Table 8.5 of CIRIA C665.

The site is to be redeveloped with high bay distribution warehousing and therefore falls under Situation A.

The GSV calculations for each borehole are included in Appendix H.

The gas monitoring data has identified a maximum methane concentration of 0.1% and a maximum concentration of carbon dioxide of 4.1%. A maximum gas flow rate of 2.5l/hr has been recorded. The calculated GSV for methane is 0.00l/hr and the GSV for carbon dioxide is 0.10l/hr. Based on the GSVs the site has been characterised as ***CS2 Low Risk.***

For a characteristic Situation 2 the typical scope of protection measures is for a gas resistant membrane of 2000 gauge with all joints and penetrations sealed possibly along with under floor venting or pressurisation.

It should be noted that for low risk sites (Characteristic Situation 2), CIRIA C665 recommends a minimum thickness of gas resistant membrane of 2000 gauge is

provided, as the report considers that the standard unreinforced 1200 gauge membrane/DPM is unlikely to survive the construction process intact.

It is considered that the gas monitoring programme carried out to-date is likely to have established the 'worst-case' scenario and has characterised the ground gas regime sufficient to enable the confident assessment of risk and subsequent design of an appropriate gas protection scheme(s) for the proposed development.

6.3 Summary of quantitative risk assessment

The site is currently in use as arable farm land and grazing land.

Intrusive ground investigations carried out across the site have confirmed that the majority of the site is directly underlain by natural soils the exception being some very shallow areas of reworked natural soils in areas close to access tracks. No contaminated strata were identified during the field works.

The comparison of laboratory testing results of the soils collected from the ground investigation indicate that pollutant linkages are unlikely to exist for risk to human health, phytotoxic effects, water supply pipes or risks to the underlying secondary aquifer and nearby water courses.

Ground gas monitoring has indicated that the design of gas protection should be adopted in line with characteristic situation 2 for which the typical scope of protection measures is for a gas resistant membrane of 2000 gauge with all joints and penetrations sealed possibly along with under floor venting or pressurisation.

7 ASSESSMENT OF POTENTIAL LAND CONTAMINATION

7.1 Potential sources of contamination

Likely ground contamination resulting from the current and former land uses has been determined from the desk study research and reference to; the Environment Agency Publication CLR 8 'Potential Contaminants for the Assessment of Land' and the relevant Department of the Environment Industry Profiles.

The initial Assessment of Potential Land Contamination based upon site walkover and available data collated is included within the Preliminary Sources Study Report for Zone 1 ref: 312494/1 – 01 (00) presented separately.

This report updates the initial assessment by taking account of;

- the ground model proven by recent ground investigations and outlined within Figures 4 - 11 and discussed in section 5 of this report and;
- the Quantitative Risk Assessment of the chemical analysis of soil and groundwater samples taken from the recent ground investigations and assessment of gas monitoring results also undertaken as part of the recent ground investigations.

In summary there do not appear to be any primary significant contaminative sources, materials or processes that have historically or are presently taking place on or across Zone 1 or within the immediate surrounding area of any significance.

Furthermore, visual evidence gathered during the site walkover and examination of soil samples during the ground investigations suggests that no significant contamination is present, indeed little or no Made Ground is present.

Table 17 below updates the primary issues of concern previously identified:

Table 17: Identified risks of potential contamination sources

	Contaminants of concern	Notes
On-site historical		
Quarry (North west) Minor area.	Possibility of infill; fill material could include putresible wastes – risk of contamination and soil gas generation.	Trial Pit 301 CP218 did not find any evidence of contamination, Made Ground or putresible wastes.
Areas denoted as Made Ground	Fill material could include putresible wastes – risk of contamination and	TP 308 did not identify any significant Made Ground or disturbed ground.

	Contaminants of concern	Notes
(Central) Very minor area.	soil gas generation.	
WWII Airport Land and possible bomb storage bunkers (South west) Minor area.	Heavy metals, explosives.	This area was not accessible during the recent ground investigations; however exploratory holes in the surrounding areas did not encounter any significant Made Ground or contamination. It is assumed that ordnance was removed prior to decommissioning and demolition if these were indeed bomb storage bunkers.
On-site present day		
Farm yard – overgrown stockpile (East) Very minor area.	Soil Stockpile; fill material could include putresible wastes – risk of contamination and soil gas generation.	Thought to be natural soils from building excavations. This area has not been investigated.
Farmyard – oil tanks Very minor area	Hydrocarbons	Visually in good conditions and no signs of spills This area has not been investigated.
Farmyard - Storage of chemicals Very minor area	Lube oil, Grease (for plant and machinery)	No signs of spills. This area has not been investigated.
Farmland – use of pesticides and herbicides. Site Wide	Potential for persistent harmful pesticides and herbicides.	Farm changed from milk to arable 2000, therefore chemicals likely to be environmentally friendly and non persistent. Testing undertaken across the farm did not indicate any harmful pesticides or herbicides. Significant concentrations of pesticides were not detected.
Other Issues; • Japanese Knotweed • Asbestos cement board cladding	To be investigated by others	
Off-site		
Air Crash site – Fuel Spill (South East)	Aviation fuel, hydrocarbons, hydraulic fluids.	Crash was in 1989 and happened in the M1 cutting so any spills likely to have been caught in Motorway drainage. Testing of soils and groundwater obtained from deep holes on Zone 1 and 3 in the area did not encounter

	Contaminants of concern	Notes
		any contamination.
East Midlands Airport – Fuel Spills (South)	Aviation fuel, hydrocarbons, hydraulic fluids.	EMA will have an Environmental assessment and monitoring policy and operations controlled by current pollution prevention and control policies. Main maintenance and fuelling is undertaken >600m south of Zone 1. It is anticipated that suitable drainage will intercept any leaks. No contamination encountered within soils or groundwater samples taken and tested from the exploratory holes close to the boundary with EMA.
East Midlands Airport – Runway and aircraft defrosting and De-icing (South)	Glycols	

In summary available ground investigation has not identified any significant areas of Made Ground or potential contamination confirming as expected that the vast majority of the site is undisturbed Greenfield land underlain by clean natural geological strata.

Chemical analyses of both soil samples and groundwater samples from across Zone 1 indicate that no contaminants exceed the relevant SGV / SSV's for the proposed end use (In this case commercial) and therefore these materials are not considered to be contaminated with respect to Human Health for the proposed end use. Section 6 of this report discusses the significance of the chemical testing analyses for soil and groundwater in more detail and the results are presented in Appendices C and G, in tabular form.

Gas monitoring of instrumentation installed within exploratory holes indicated a relatively low risk in line with a Characteristic Situation 2 for which minimal gas protection measures as discussed within Section 6.2.7 are required.

Figures 4 – 11 indicate the expected ground model, with the ground model sections included in Figures 9 – 11 clearly showing the expected ground conditions.

The information detailed above has been used to update the Contaminated Land Risk Assessment (Conceptual Site Model) Matrix included in Appendix I.

The main identified risks are discussed below in more detail however reference should be made to the risk matrix to understand all of the risks assessed

7.2 Preliminary contaminated land risk assessment

7.2.1 Risk to human health during construction

Considering that no significant Made Ground or contamination has been observed or proven by testing, is shown to have been present upon historical plans, within

environmental data or is shown to be present within available investigations and that the scheme will be built using clean site won materials or / and suitable imported material the risk to human health during construction is considered to be Negligible

7.2.2 Risk to human health post construction

Given the nature of the proposed scheme is for a large scale commercial development human exposure to soils and groundwater will be extremely low. Also when considering that no significant Made Ground or contamination has been observed, is shown to have been present upon historical plans, within environmental data or is shown to be present within recent ground investigations and that the scheme will be built using clean site won materials or / and suitable imported material the risk to human health upon completion to workers and site users is considered to be Negligible.

7.2.3 Risk to local ecology and landscape planting

Given that the crops and flora are thriving upon Zone 1 and that no significant Made Ground or contamination has been observed or proven by testing, is shown to have been present upon historical plans, within environmental data or is shown to be present within available investigations and that the scheme will be built using clean site won materials or / and suitable imported material the risk to the local ecology from contamination is considered to be Negligible.

7.2.4 Risk to surface water

Considering that no significant Made Ground or contamination has been observed or proven by testing, is shown to have been present upon historical plans, within environmental data or is shown to be present within available investigations and that the scheme will be built using clean site won materials or / and suitable imported material the risk to surface water from contamination is considered to be Negligible.

The greatest risks to surface waters are from potential uncontrolled release of silt, created during construction activities and subsequent effects on aquatic flora and fauna. This will be controlled by a suitable site specific construction environmental management plan and code of practice.

7.2.5 Risk to groundwater

Considering that no significant Made Ground or contamination has been observed or proven by testing, is shown to have been present upon historical plans, within environmental data or is shown to be present within available investigations and that the scheme will be built using clean site won materials or / and suitable imported material the risk to groundwater from contamination is considered to be Negligible.

7.2.6 Risk due to ground gas

The Envirocheck data suggests that there are no landfills present within the vicinity of Zone 1. The anticipated geology is not indicative of the widespread presence of strata likely to naturally degrade and produce harmful soil gases. Therefore it is concluded that no significant source of ground gas is likely to be present on Zone 1.

Monitoring of ground gas on the site has yielded no concentrations of methane gas, very low concentrations of carbon dioxide and no to low flow conditions.

As the proposed scheme design for Zone 1 is an Industrial Development the exposure to ground gases posing a risk to human health post-construction is considered to be negligible if basic gas protection measures in line with a Characteristic Situation 2 as recommended within CIRIA C665 are adopted within the design and construction of the buildings.

In regards to ground gases posing a risk to workers during the construction there is considered to be a low risk to personnel from asphyxiation where they have to enter below ground excavations or in ground inspection chambers. Provided suitable atmosphere testing is carried out and confined spaces protocols are observed and these risks to construction and maintenance workers are considered to be low. These risks are managed through health and safety procedures including CDM regulations therefore the resultant risks are expected to be Negligible.

7.2.7 Risk to buried structures and services

The evidence available at the time of this report suggests that no Made Ground or contamination is likely to be present. However information to date suggests that naturally occurring elevated sulphates in the form of sulphate crystals (gypsum) are likely to be present within cohesive soils present beneath Zone 4. Testing has been undertaken and provided in ground concrete mixes are designed in accordance with the findings of the testing and BRE SD1:2005 the risk of damage to concrete exposed to naturally aggressive substances is considered to be Negligible.

This has been confirmed by recent investigations with testing suggesting that **DS-1 AC-1** class concrete will be required to be adopted. However it is recommended that further testing is undertaking at detailed design stage to confirm this over a broader selection of samples depths.

7.3 Requirement for further assessment

When access is available onto Airport controlled ground in the south west corner of Zone 1 further investigation is recommended to confirm the ground conditions within this area and also to examine the possible bunker type features that appear to have been present in the past. In particular a UXO/UXB risk assessment would be required prior to any intrusive investigations being planned. Depending upon the findings of the

UXO/UXB risk assessments it may be necessary to undertake initial non intrusive geophysical investigations to examine any risk areas identified. Following completion of satisfactory UXO /UXB risk assessments an intrusive investigation should be undertaken to examine the soils across this area to confirm the anticipated ground model. As part of this investigation some specialist investigation may be required to look at specific former RAF features and soils from around these features may require testing for a suite of metals and explosives chemicals to confirm that no residual contamination is present.

At enabling works stage it is also recommended that a watching brief is undertaken by a geo-environmental engineer to examine and test the ground in the area of Field Farm with particular attention paid to the areas where fuel tanks, maintenance and fertiliser, pesticides and herbicides have been stored. This is also likely to extend to works within the area of the airport land where former RAF features appear to have been identified.

8 GEOTECHNICAL SITE ASSESSMENT

8.1 Preliminary geohazard and geotechnical assessment

Using all of the available information and taking into account the be expected ground model for Zone 1 outlined upon Figures 4 to 11 the Preliminary Geotechnical Risk Register presented in Appendix K has been prepared and highlights several potential risks associated with Zone 1. The main identified risks are discussed below in more detail however reference should be made to the risk matrix to understand all of the risks assessed.

8.1.1 Mining and natural cavities

Zone 1 is not within an area affected by coal mining or brine extraction. The geology is not conducive to the formation of large natural cavities. This has been confirmed by the ground investigation which has confirmed the anticipated geology.

8.1.2 Man made voids or obstructions

There is the possibility that some small bunkers were present in the south west corner of Zone 1. Examination of this area should be undertaken when access is available to confirm if these still exist.

No voids have been identified during the ground investigation.

8.1.3 Earthworks

Significant cut to fill earthworks are required to be undertaken to achieve the proposed redevelopment of Zone 1 and to form the main development plateau and rail freight interchange.

In order to reduce the risk of excessive cost for offsite disposal and on site importation it is assumed that;

- site won materials will be utilised
- a cut to fill volume balance will be achieved.

The ground investigation has determined that clean natural soils are present within the areas of cut and that these materials should be suitable for reuse provided they are carefully selected and managed in accordance with a suitable earthworks specification. In particular careful control of moisture content is anticipated to be required as the majority of the sites won soils are likely to be cohesive clays or weathered mudstones. The prevailing weather conditions will have a substantial effect on suitability, however subject to testing it is possible that lime modification or stabilisation techniques could be

used to allow marginal materials to be used within structural fill, however all materials are likely to be acceptable for use within landscape features.

Further ground investigation aimed specifically at the reuse of cut material is recommended to confirm strata classification and suitability at detailed design stage.

8.1.4 Existing cut slopes

There are no existing cut slopes located within Zone 1.

8.1.5 Existing embankment slopes

There are no existing embankment slopes on Zone 1. The A453 is on a low embankment close to the eastern boundary of Zone 1; however this is maintained by the Highways Agency and do not appear to be showing any signs of instability.

8.1.6 Proposed cut slope design

Significant cut slopes are required in the south east and along the southern boundary of Zone 1 in order to form the main development plateau and the rail freight interchange head.

It is anticipated that significant cost will be incurred in the formation of the cut slopes required to achieve the scheme plateau on Zone 1 and the Rail Freight Interchange. Deep cuttings will be necessary and are anticipated to encounter bedrock materials at relatively shallow depths. Therefore heavy plant and expensive breaking and ripping techniques may need to be utilised to excavate these slopes.

Cut slope stability will need to be carefully assessed and a suitably robust engineering design provided which includes drainage of the strata anticipated to be encountered.

Initial cut slope stability analysis has been undertaken by others and this has confirmed that 1:3 cut slopes will be stable in the weathered residual soils closest to surface whilst within the solid bedrock soils 1:1.75 slopes are likely to be stable provided suitable drainage is provided. Options for value engineering these designs by inclusion of stepped slopes, face drainage, cut off drains including band drains behind the slope, soil nailing or retaining wall solutions to part or all of the height of the required cut slopes.

It is recommended that at detail design stage further investigation and detailed slope stability analysis should be undertaken to value engineer and refine the cut slope design angles as it may be possible to steepen these slopes and reduce cut volumes. In particular the assessment of groundwater levels and drainage is considered to be key to the successful and safe design of these cut slopes.

As a result of the complex interbedded geology and groundwater levels discussed earlier in this report it is recommended that a hydrogeological assessment supported by further ongoing groundwater monitoring and further investigation if necessary is

undertaken at detailed design stage to understand the groundwater regime. In particular if interbedded strata bearing water are intersected there is a risk that without sufficient drainage these strata could soften underlining strata on the cut face and cause instability.

8.1.7 Proposed embankment design

Large embankments are proposed for Zone 1, although these are believed to be non structural landscape embankments around the periphery of Zone 1 in the north and west.

It is anticipated that significant cost will be incurred in the formation of the embankments due to the volumes of materials required to be placed. It is assumed that clean site won materials will be suitable for reuse within the embankment construction as part of a cut fill balance design to avoid excessive costs for importation of materials to form the embankment. The design of the embankment will need to take account of the classification of the materials being utilised for its construction. Options for increasing side slopes and reducing footprint and volume may be explored and these may include reinforced embankments (geogrids) or soil stabilisation (lime and cement) or even retaining walls if required.

Investigations have confirmed that no unstable geology considered susceptible to significant settlement or instability is likely to be present along the footprint of the Embankment. Therefore there is considered that there is a negligible risk that failure and settlement of any proposed embankment and embankment side slopes will occur as a result of the foundation soils beneath.

The risk of failure of embankments is increased where fine grained soils are used to construct them particularly if insufficient compaction and drainage is designed and the works proceed too quickly. Therefore it is recommended that staged construction is undertaken and that granular basal and interim granular layers are installed and linked to the wider drainage network to avoid the build-up of pore water pressures in fine soils as works progress. This will aid and speed up consolidation and increase stability. Alternatively or additionally the use of soil stabilisation or reinforced earth might be considered partially in transition zones and around abutments or for the entire embankment.

Embankment slopes must be designed appropriate to the stability of the soils being used to construct the embankment and take account of the strength of the underlying foundation soils and any predicted loads along the crest.

Drainage will need to be carefully designed to cope with surface water and to avoid runneling and softening of the slope faces and softening in the foundation soils, in particular at the toe of the slopes.

Embankment settlement and slope stability analysis will be required at detailed design stage. Further investigation may also be required to be undertaken in areas of the

embankment formation and into cut material to assess the classification and suitability of cut materials for reuse to allow the embankment designs to be refined. A detailed Earthworks Specification and Works Design drawings will also need to be prepared.

8.1.8 Cut to fill transition zones

It is anticipated that there will be a cut to fill transition line running broadly east to west across the centre of the Main development plateau in Zone 1.

This change from cut to filled areas can cause differential settlement to building foundations and floor slabs. It is understood that the scheme layout takes account of this by providing the main development spine road along the cut to fill transition and avoiding placing buildings (which are more sensitive) across this line.

8.1.9 Earthworks – Materials Reuse

In this case it is expected that the embankments will be constructed from site-won arisings from the major cutting works.

It is expected that the granular River Terrace Deposits present within the northern areas of the wider site would be suitable for reuse within embankment fill as a Class 1 general fill. Whilst cohesive soils (Head, Thrussington Member and upper weathered Mercia Mudstone Group Materials) and mudstones are likely to breakdown under excavation and compaction to form more cohesive soils in line with Class 2 materials. The harder siltstones and sandstones may require breaking and crushing to make a class 1 granular material, although some will be mixed in with mudstones and more cohesive strata during excavation.

There is considered to be a low to moderate risk that the underlying mudstone strata will include high sulphates. As such careful consideration should be given to the design and specification of earthworks given to the potential for sulphate induced heave especially where the materials noted above are used within a cut and fill program where soils would be significantly disturbed allowing a greater oxidation potential. Soil stabilisation techniques will also require careful consideration for the same reasons. Such materials would however be suitable for reuse within landscape features where the potential for heave does not present a risk. To date only low concentrations of sulphates have been confirmed in the limited number of samples tested from Zone 1.

According to the CL:AIRE guidance “The Definition of Waste: Development Industry Code of Practice” (version 2, March 2011), any material that may be otherwise considered by the Environment Agency as waste (such as made ground), if dealt with in accordance with the Code of Practice under a Materials Management Plan (MMP) will not be considered as waste if used for the purposes of land development. Any Clean and Naturally occurring material may be reused on the site of origin without the need to be included within an MMP.

It is recommended that at detail design stage further investigation should be undertaken to more comprehensively classify and test the compacted properties of the cut strata such that a suitable earthworks specification maybe formulated.

8.1.10 Earthworks Classification

An initial classification, based on the Highways Agency Specification for Highway's Works (SHW 2004), of the materials likely to be encountered on the site is presented in Table 18 below:

Table 18: Earthworks classification

Material	SHW Classification	Recommended use below	Notes on use
Topsoil	5	Country Park and cover to embankment and cutting side slopes	Careful control on storage and avoidance of using saturated materials, particularly on slopes.
Head Deposits and Thrussington Till (clays)	2	General Fill	Should be possible to reuse in structural fill. Moisture content will need to be carefully controlled.
River Terrace Deposits (Wanlip and Egginton) (sand and gravel)	1	General Fill	Only present in the north to shallow depth.
Mercia Mudstone Group (clay, mudstone, siltstone)	2	General Fill	Should be possible to reuse in structural fill. Moisture content will need to be carefully controlled.
Bromsgrove Sandstone Formation - sandstone	1	General Fill	May require crushing, only likely from deep excavations for rail head.

In summary it is expected that the majority of the site won deposits will be suitable for reuse with the majority of the near surface weathered cohesive materials being slightly wet of the optimum range. Therefore they may require drying or modification/ stabilisation to make them acceptable for reuse within structural fill. However less weathered materials from greater depth are likely to be drier and therefore the mixing of the materials which is likely to occur upon excavation could make materials suitable for use in the natural state. Much will depend upon the prevailing weather conditions at the time the earthworks are undertaken and the care with which the selection of materials and works are undertaken.

If significant volumes of material are deemed unsuitable for reuse by means of moisture contents alone it is recommended that soil modification or stabilisation is considered to render these materials suitable for use within engineering fill. Stabilisation works will need to be mindful of the risks of sulphates being present within the soils which could react with lime to cause heave. Investigation and test results undertaken at this preliminary stage on Zone 1 do not indicate significant sulphates concentrations are present. If stabilisation techniques are considered further it is suggested that it will be necessary to undertake further more comprehensive investigation and testing to confirm the suitability of these techniques, a suitable economic design mix and achievable properties of the modified or stabilised materials.

It is recommended that at detailed design stage a suitably robust Earthworks Specification is developed and that all materials are placed and compacted in accordance with this specification.

8.1.11 Foundations and Floor Slabs

Cut areas

It is anticipated that the main distribution warehouses on the southern side of the cut/fill transition line will be founded directly upon competent solid strata and as such standard strip and pad foundations and ground bearing floor slabs are anticipated to be suitable. However some considerations into the potential risk of heave in the unloaded strata across the large building footprints maybe necessary if the structures have tight tolerances.

Filled areas

Foundations within filled areas will be designed according to the prevailing conditions and the standards of engineering fill provided. Where fill is relatively shallow foundations could be formed as over deepened pad or trench fill foundations extended through the full depths of fill into the competent underlying natural strata. Where deeper fill is placed piled foundations may need to be considered.

However, depending upon the standard of earthworks engineering fill achieved ground bearing floor slabs might be considered. Alternatively if high tolerances of floor slab are required additional engineering options include soil stabilisation of placed fill to improve bearing and settlement characteristics or the use of vibro-replacement columns might need to be considered. Given the nature of the main enabling and earthworks for the scheme it is most likely that a suitably engineered fill option will be utilised.

8.1.12 Highway and Rail construction

As Zone 1 requires significant cut to fill earthworks to achieve the required development levels, it is anticipated that engineering earthworks design specification will be provided to cover these elements.

This is considered likely to include a performance specification for the formation levels beneath highway and rail track beds in both cut and filled embankment areas.

Embankment earthworks designs will need to be checked for foundation bearing, settlement and slope stability to ensure that the embankments will not suffer detrimental settlement or failure once constructed.

Based upon available testing only low CBR of <2% would be recommended for re-compacted cohesive soils as they are likely to be wet of optimum. This could of course be increased if modification or stabilisation techniques were used or more granular materials were placed and compacted at final formation levels.

8.1.13 Groundwater levels

The prevailing groundwater table is highly variable and discussed in detail above within section 5.2.

It is anticipated that the primary aquifer the Bromsgrove Sandstone is at depth, however the deep cutting excavations are likely to intercept this in the east of Zone 1. The overlying strata of the Mercia Mudstone Group (Gunthorpe Member, Taporley Siltstone Formation and the Edwalton Member) also appear to have permeable siltstone and sandstone strata which yield local water strikes. The River Terrace deposits in the northern part of Zone 1 are anticipated to have a shallow groundwater table present which is considered likely to be in continuity with the River Trent some distance to the north.

Due to the complex stratification of the site it is recommended that a full hydrogeological assessment should be carried out and supported by further ongoing groundwater monitoring and investigations where necessary.

8.1.14 Drainage

Minor springs, seepages and rises are noted on historic plans of Zone 1. Investigations to date also seem to suggest that excavation into the natural underlying strata could intersect multiple confined aquifer strata (sandstone and siltstone bands) which will also yield water. Designs should accommodate suitable drainage systems to cut off and intersect such strata and springs and to filter them away from the development. Temporary works drainage will also need to be carefully considered.

It is also anticipated that the majority of the shallow strata present across Zone 1 will not be conducive to infiltration drainage techniques. However areas of sand and gravel to the north may be more suitable for such techniques, however testing to date proved unsuccessful in Zone 1.

8.1.15 Excavations Stability

Conventional plant should be suitable for general excavations at the Site. However, where designs require excavation to penetrate down below weathered materials into weak mudstones, siltstones and at depth sandstones then ripping and breaking may need to be considered, particularly if significant depth and volume of penetration is required where the rock is massive and has a substantial thickness.

Excavations with vertical sides in granular strata are likely to be unstable and will therefore require battering back or appropriate trench support to be provided. Excavations with vertical sides into cohesive deposits are likely to retain some limited stability in the short term but if man entry is required then slopes should be battered to a suitable safe and stable angle or appropriate trench supports will need to be provided.

Groundwater may be expected to be present at shallow depth within the River Terrace deposits in the north and is likely to induce instability, boiling and running sand conditions when standing water levels are penetrated. Groundwater seepages are also expected to be present within excavations undertaken into the Mercia Mudstone Group. Dewatering will need careful consideration, design and implementation to avoid causing loss of fines and later inundation collapse settlement in local ground.

Man entry into any excavations should not be undertaken without provision of suitable shoring and support and dewatering or suitable regrading and battering of side slopes to safe angles. Confined spaces protocols for the Health and Safety of personnel should always be used where man entry into excavations is to be undertaken as low oxygen conditions may be present.

8.1.16 Foundation works risk assessment

It is anticipated that a foundation works risk assessment report will not be required for the development because concentrations of chemicals of potential concern (COPC) within natural soils and groundwater were typically below corresponding GAC.

8.1.17 Chemical attack on buried concrete

The soils beneath Zone 1 are known to include naturally occurring sulphates (gypsum) and as such in ground concrete will need to be designed to accommodate the risks represented by contact with such sulphates.

As such careful consideration should be given to the design chemical and sulphate class of concrete used within the development particularly when in contact with the strata noted above. In addition consideration will need to be given to the potential for sulphate induced heave especially where the materials noted above are used within a cut and fill program where soils would be significantly disturbed allowing a greater oxidation potential.

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 Greenfield that has not been subject to previous industrial development and the geology is not referenced within BRE;SD1 as containing pyrite. A suite of chemical analyses appropriate to this site classification was carried out on soil samples.

The maximum water-soluble sulphate content in groundwater of 142mg/l has been taken as the characteristic value. As this value is below the limiting value of 3.0g/l consideration magnesium analysis is not required. Design Sulphate Class of DS-1, may be adopted for the site.

Based on the findings of the groundwater monitoring it has been assumed that groundwater conditions are mobile. From consideration of the characteristic pH value of 6.94, an aggressive chemical environment for concrete classification of AC-1 may be assumed for design purposes.

9 REUSE OF MATERIALS

9.1 Reuse of suitable materials

It is understood that no soil wastes are anticipated to be generated from the site with a complete cut to fill balance having been achieved in modelling.

As the site has not been previously developed all excavation works are expected to generate only clean and naturally occurring soils.

Under the Waste Framework Directive naturally occurring soils are not considered waste if re-used on the site of origin. Therefore it should not be necessary to either obtain a licence or prepare a Materials Management Plan in accordance with the CL;AIRE Code of Practice.

9.2 Wastes for landfill disposal

Whilst it is not anticipated that any soils will be removed to landfill an initial assessment of waste classification has been undertaken using the soil contamination data. This is presented within Appendix L. The results suggest that the soils tested would be classified as Non Hazardous for disposal. Given that arisings are anticipated to be natural strata it is possible that they could be classified as inert waste, however full Waste Acceptance Criteria analysis would be required to confirm this.

9.3 Landfill tax

Waste producers disposing of material to landfill are required to pay landfill tax by HM Revenue and Customs.

Currently (since April 2013), landfill tax is £72 per tonne and the tax rate will increase annually by £8 until the cost reaches £80 in 2014. Further, the Treasury has confirmed that for five years thereafter the tax will not fall below £80.

Material disposed of at a soil treatment centre will not be subject to landfill tax.

10 CONCLUSIONS

10.1 Conclusions

Zone 1 is primarily considered to be Greenfield in nature and there is little evidence to suggest there are any significant potential sources of contamination likely to be present that would detrimentally impact upon the proposed scheme design within areas of the site that were investigated. Potentially unknown risks may remain within the area of the Farmyard and within the area formerly occupied by the RAF.

Ground gas monitoring has indicated that the design of gas protection should be adopted in line with characteristic situation 2 for which the typical scope of protection measures is for a gas resistant membrane of 2000 gauge with all joints and penetrations sealed possibly along with under floor venting.

The geology of Zone 1 is reasonably complex and this could impact upon the geotechnical elements of the detailed design, however these conditions are not anticipated to represent significant risks and would be anticipated to be resolved by normal engineering design and construction methods.

There are also no identified particular natural geohazards that would significantly impact the scheme.

It is however considered important to establish the groundwater regime present beneath Zone 1, particularly within the area of proposed cuttings so that designs can be refined to include appropriate drainage solutions where necessary.

Further investigation is necessary of the South western corner of the site once land agreements are in place taking particular note of the former use by the RAF, however based upon the available information it is not anticipated that any significant contamination will be present, indeed any residual contamination will be very localised and contained by the cohesive soils. Higher risks relate to UXO and therefore specialist risk assessments and non intrusive searches will be necessary prior to any investigation or enabling works in these areas.

At enabling works stage it is also recommended that a watching brief is put in place during the demolition and removal of hard standings relating to the Farm Buildings, although again the risk of contamination is considered low.

11 RECOMMENDATIONS

11.1 General recommendations

Some of the key recommendations are summarised below. Many of the technical or advice recommendations have not been included below. The whole of the report should be read to identify all recommendations and advice.

- Further groundwater monitoring should be considered particularly within the instrumented boreholes in the areas of cutting to confirm the groundwater conditions variation over a longer period to take account of variation with prevailing weather conditions and seasonal variations such that detailed designs maybe be refined to account for suitable drainage measures.

- It is recommended that a full and detailed hydrogeological assessment of the groundwater regime at the site should be undertaken.

- It is recommended that the findings of the Contaminated Land Risk Assessment are discussed with the local regulatory authorities.

- It is recommended that a site wide Earthworks Specification is prepared which should include testing frequency requirements and performance criteria for the various elements of the scheme design.

- At detailed design stage it is recommended that cutting slope designs should be refined and value engineered to account of drainage and geometric constraints.

- At detailed design stage it is recommended that embankment design geometries should be checked for slope stability and settlement. However it should be understood that the stability of an embankment will be a function of its geometry, the materials with which it is built, the degree of compaction applied, speed of construction and the foundation strata and underlying groundwater table on to which it is formed. This information will be required to feed into the earthworks specification.

- Drainage will need to be designed with care due to the poor drainage infiltration of the underlying shallow soils.

- In ground concrete should be designed to resist elevated sulphates with DS-1 AC-1 requirements although a precautionary approach is recommended and either further testing or an uplifted concrete design mix DS-2 AC-2 could be adopted to allow for the potential for unidentified and untested naturally occurring sulphates within the Mercia Mudstone deposits.

- Further investigation is necessary of the South western corner of the site once land agreements are in place taking particular note of the former use by the RAF, however based upon the available information it is not anticipated that any significant contamination will be present, indeed any residual contamination will be very localised and contained by the cohesive soils. Higher risks relate to UXO and therefore

specialist risk assessments and non intrusive searches will be necessary prior to any investigation or enabling works in these areas.

- At enabling works stage it is also recommended that a watching brief is put in place during the demolition and removal of hard standings relating to the Farm Buildings, although again the risk of contamination is considered low.

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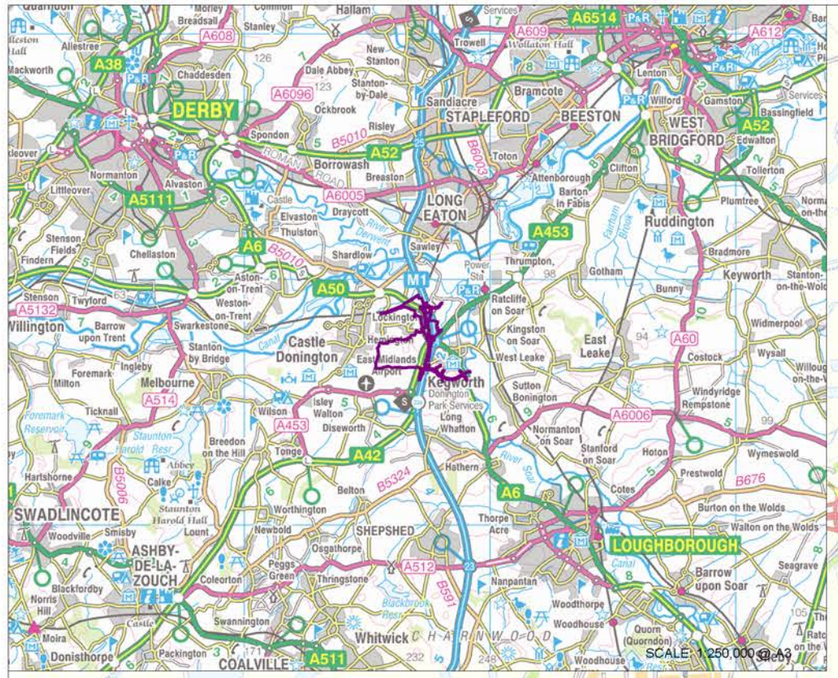
FIGURES



Boundary

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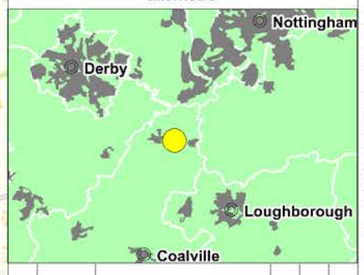
kilometre



Rev	Date	Description	Drn	Chk	App
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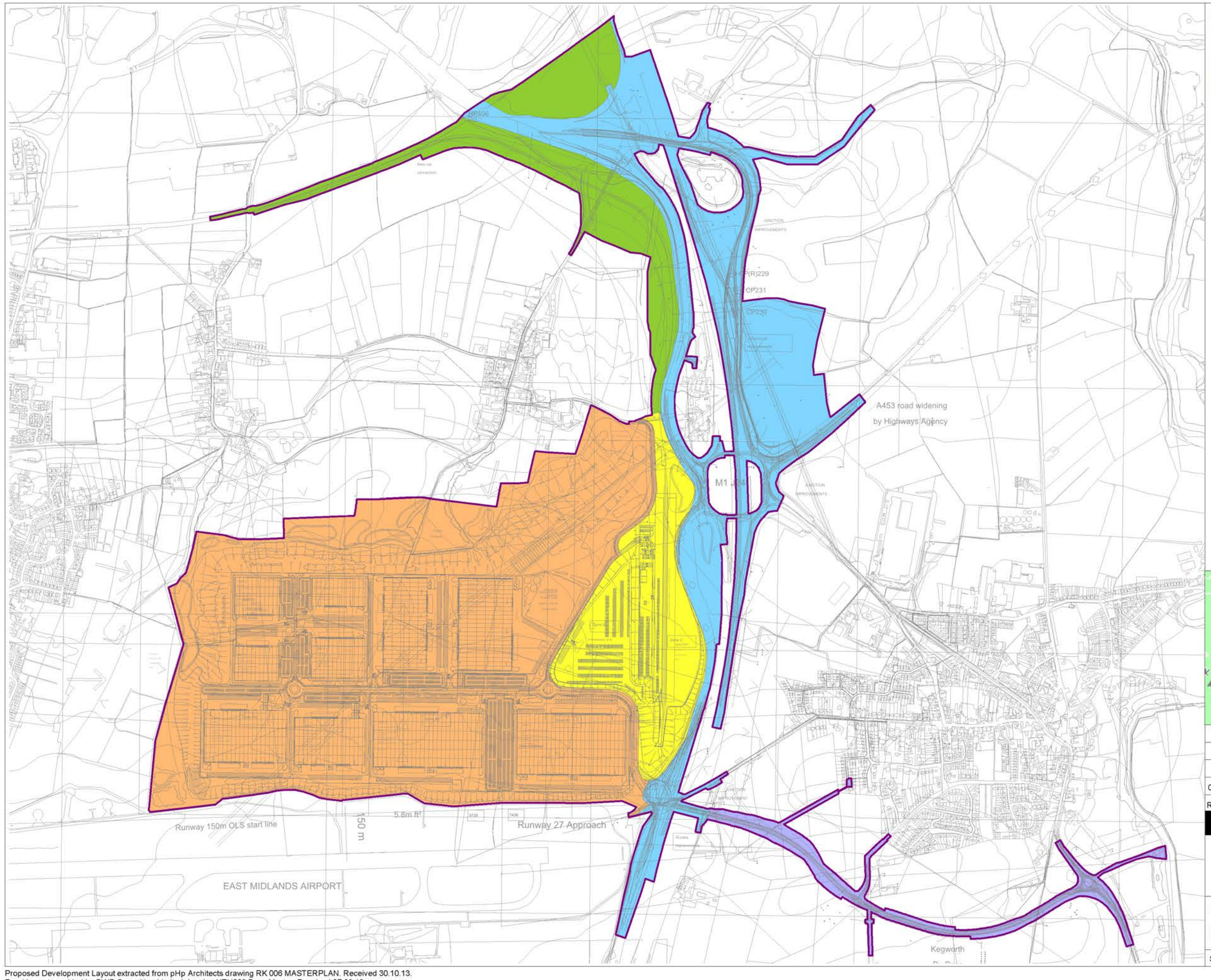
Figure 1

Site Location Plan

SCALE: 1:28,000 @ A3 | REV 00

FILE NAME: X:\Cov Ground and Environment\Enquiries\Focal Point Enquiries\312400 - 312499\East Midlands Gateway\GIS

Site boundary extracted from pHp Architects drawing RK 006 MASTERPLAN. Received 30.10.13.



Boundary

Zone 1A - Main Development Plateau - Distribution

Zone 1B - Main Development Plateau - Rail Freight Terminal

Zone 2 - New Rail Branch Line

Zone 3 - Major Trunk Road Improvements (Highways Agency)

Zone 4 - Kegworth Bypass (Local Authority Highways)

N
W E
S

0 500

metres

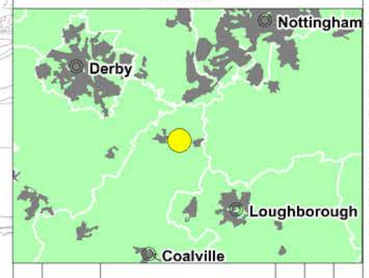


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Figure 2

Proposed Development Plan and Zones For Reporting

SCALE: 1:14,000 @ A3 | REV 00

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Proposed Development Layout extracted from pHp Architects drawing RK 006 MASTERPLAN. Received 30.10.13.
Road Layout provided by BWB Consulting Limited drawing NTH209 Base Master. Received 27.08.13.

Zone 1 Boundary

N
W E
S

0 250

metres

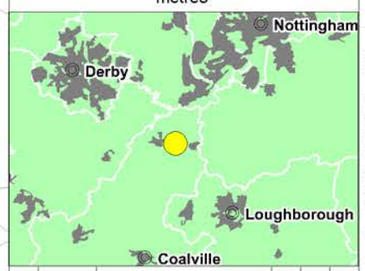

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Figure 3

Zone 1 Plan

SCALE: 1:7,500 @ A3 | REV 00

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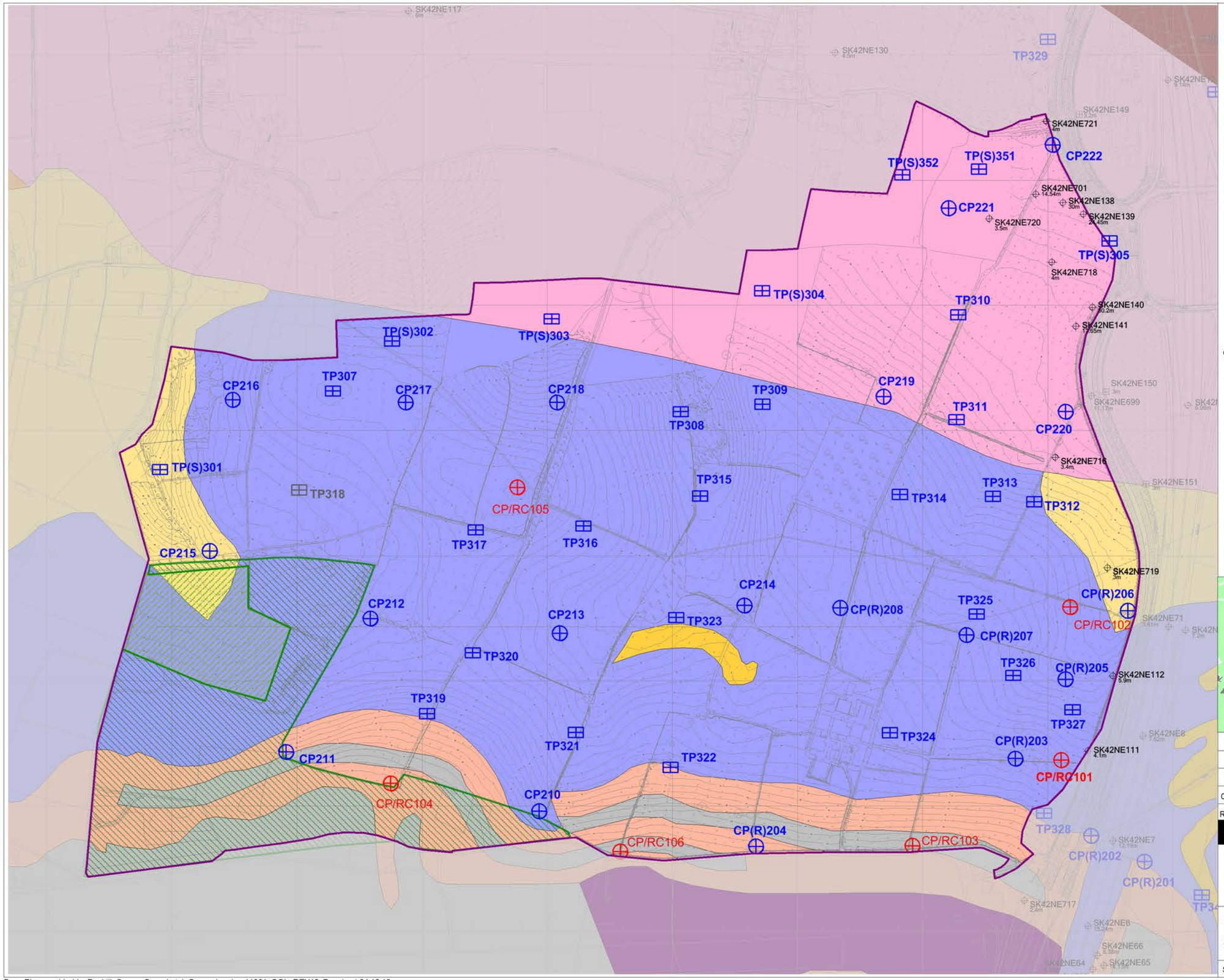

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Figure 4

Zone 1 Solid Geology showing Available Ground Investigation and Exploratory Hole Locations

SCALE: 1:7,500 @ A3 | REV 00

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Base Plan provided by Roxhill. Source Greenhatch Group drawing 11361_OGL_REV10. Received 24.10.13.
Historical Exploratory Holes based on British Geological Survey materials © NERC 2013. Geotechnics Exploratory Holes taken from PC124998 Kegworth Factual Report.
Geology based on British Geological Survey materials © NERC 2013.

Zone 1 Boundary
Airport land - Unavailable for investigation
Land access unavailable at time of survey
Eagle Moor Sand and Gravel Member
Egginton Common Sand and Gravel Member
Head - Clay, Silt, Sand and Gravel
Thrussington Member
Wanlip Member

Symbols Key

CP Cable Percussion Borehole
CP/RC Cable Percussion and Rotary Cored Borehole
CP(R) Cable Percussion with Rotary follow on Borehole
TP Trial Pit
TP(S) Trial Pit (S) Soakaway

Colour Key

Historical Exploratory Holes (BGS/HA)
Preliminary Investigation (Geotechnics Ltd 2012)
Phase 2 Investigation (Autumn 2013)
Exploratory hole not undertaken due to crops

N W E S

0 250
metres

Nottingham
Derby
Loughborough
Coalville

Rev	Date	Description	Drn	Chk	App
00	28.11.13	Geo	RG	SP	DB

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Figure 5

Zone 1 Drift Geology showing Available Ground Investigation and Exploratory Hole Locations

SCALE: 1:7,500 @ A3 | REV 00

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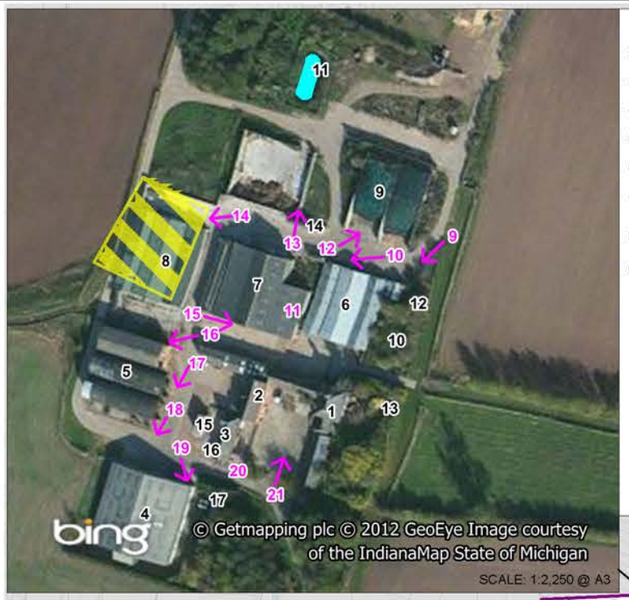
Base Plan provided by Roxhill. Source Greenhatch Group drawing 11361_OGL_REV10. Received 24.10.13.
Historical Exploratory Holes based on British Geological Survey materials © NERC 2013. Geotechnics Exploratory Holes taken from PC124998 Kegworth Factual Report.
Geology based on British Geological Survey materials © NERC 2013.



1	Farm house (brick) (Photo 21)
2	Farm offices / welfare (brick) (Photo 21)
3	Brick barn / store (Photo 21)
4	Modern crop drying shed (Photo 18)
5	Large barn - plant storage (Photo 17)
6	Old brick - vehicles store
7	Old cow shed - fertilizer, plants, equipment
8	Old cow shed - fertilizer, plants, equipment (Photo 11 / 14)
9	Compost / silage (Photo 12)
10	Containers x 2 (Photo 9)
11	Pond (not seen onsite)
12	Raised ground (heavily vegetated)
13	Japanese Knotweed (possible)
14	Large fertilizer tank (Photo 13)
15	Water tank (Photo 17 / 18)
16	2 x large diesel tank (Photo 20)
17	2 x Calor gas tanks (Photo 19)

Zone 1 Boundary
Airport land - Unavailable for investigation
Land access unavailable at time of survey
King Street Plantation (Protected)
Area of old quarries
Approximate area of 1989 Kegworth Air Disaster
Standing / running water
Disturbed ground
Infilled ground
Made ground
Worked ground
Possible bunkers circa WWII (possible explosives storage)
Photograph location and direction (Appendix C)

Symbols Key

- CP — Cable Percussion Borehole
- CP/RC — Cable Percussion and Rotary Cored Borehole
- CP(R) — Cable Percussion with Rotary follow on Borehole
- TP — Trial Pit
- TP(S) — Trial Pit (S) Soakaway

Colour Key

- Historical Exploratory Holes (BGS/HA)
- Preliminary Investigation (Geotechnics Ltd 2012)
- Phase 2 Investigation (Autumn 2013)
- Exploratory hole not undertaken due to crops

N W E S

0 250

metres

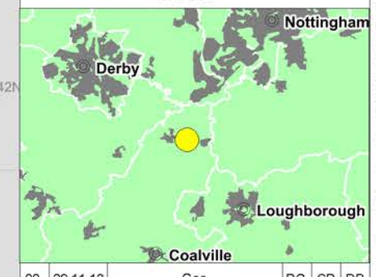


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Figure 6

Zone 1 Hazard Plan showing Available Ground Investigation and Exploratory Hole Locations

SCALE: 1:7,500 @ A3 | REV 00

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Base Plan provided by Roxhill. Source Greenhatch Group drawing 11361_OGL_REV10. Received 24.10.13.
Historical Exploratory Holes based on British Geological Survey materials © NERC 2013. Geotechnics Exploratory Holes taken from PC124998 Kegworth Factual Report.
Information shown extracted from Landmark Envirocheck Historical Map, Site Sensitivity Map and Artificial Ground and Landslip Map

Zone 1 Boundary

Airport land - Unavailable for investigation

Land access unavailable at time of survey

Symbols Key

CP Cable Percussion Borehole

CP/RC Cable Percussion and Rotary Cored Borehole

CP(R) Cable Percussion with Rotary follow on Borehole

TP Trial Pit

TP(S) Trial Pit (S) Soakaway

Colour Key

Historical Exploratory Holes (BGS/HA)

Preliminary Investigation (Geotechnics Ltd 2012)

Phase 2 Investigation (August 2013)

Exploratory hole not undertaken due to crops

N W E S

0 250

metres

Nottingham
Derby
Loughborough
Coalville

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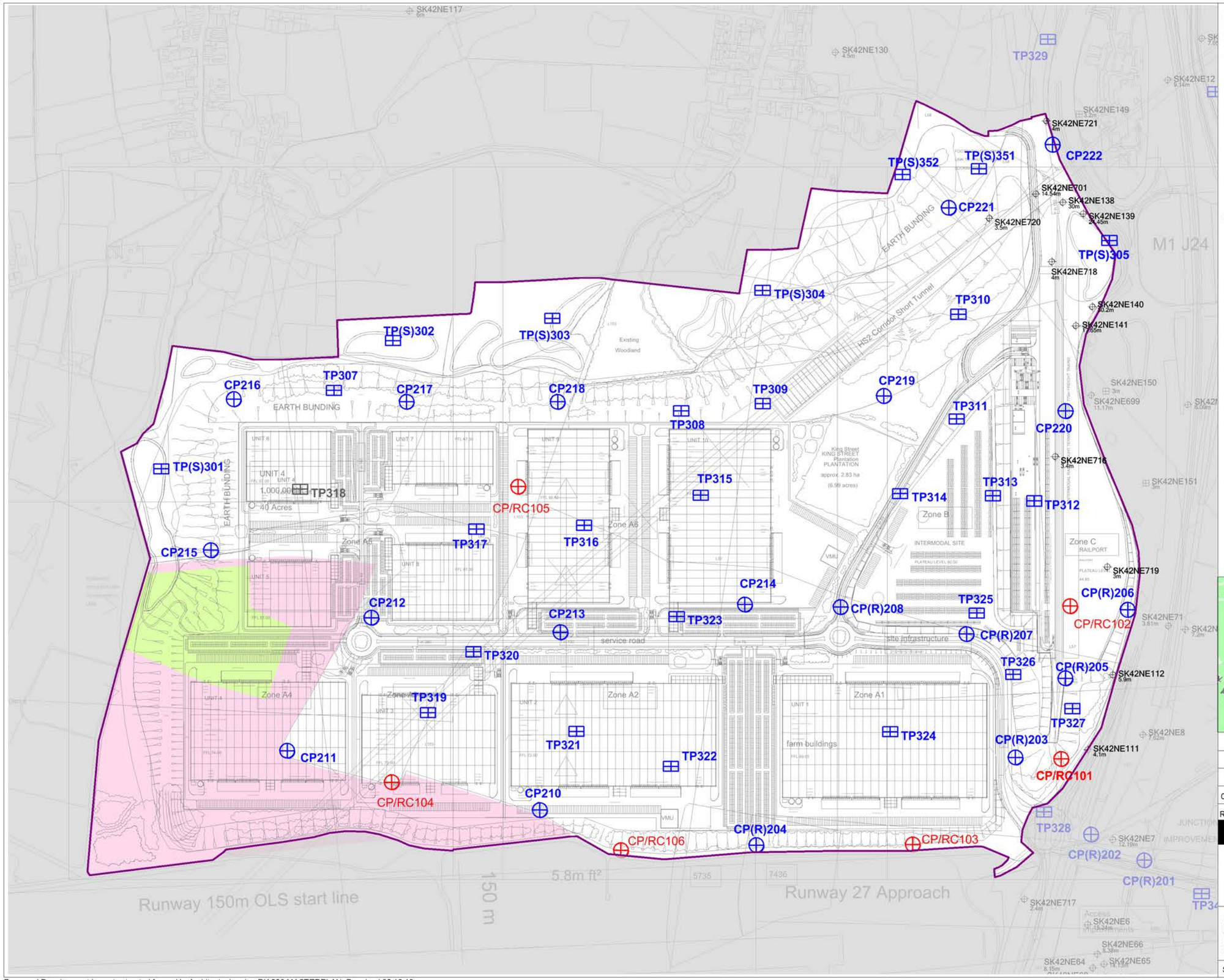
Figure 7
Zone 1 Available Ground Investigation and Exploratory Hole Locations over Topographical Drawing

SCALE: 1:7,500 @ A3

REV 00

FILE NAME: X:\Cov Ground and Environment\Enquiries\Focal Point Enquiries\312400 - 312499\East Midlands Gateway\GIS

Base Plan provided by Roxhill. Source Greenhatch Group drawing 11361_OGL_REV10. Received 24.10.13.



Rev	Date	Description	Drn	Chk	App
00	28.11.13	Geo	RG	SP	DB

East Midlands Gateway

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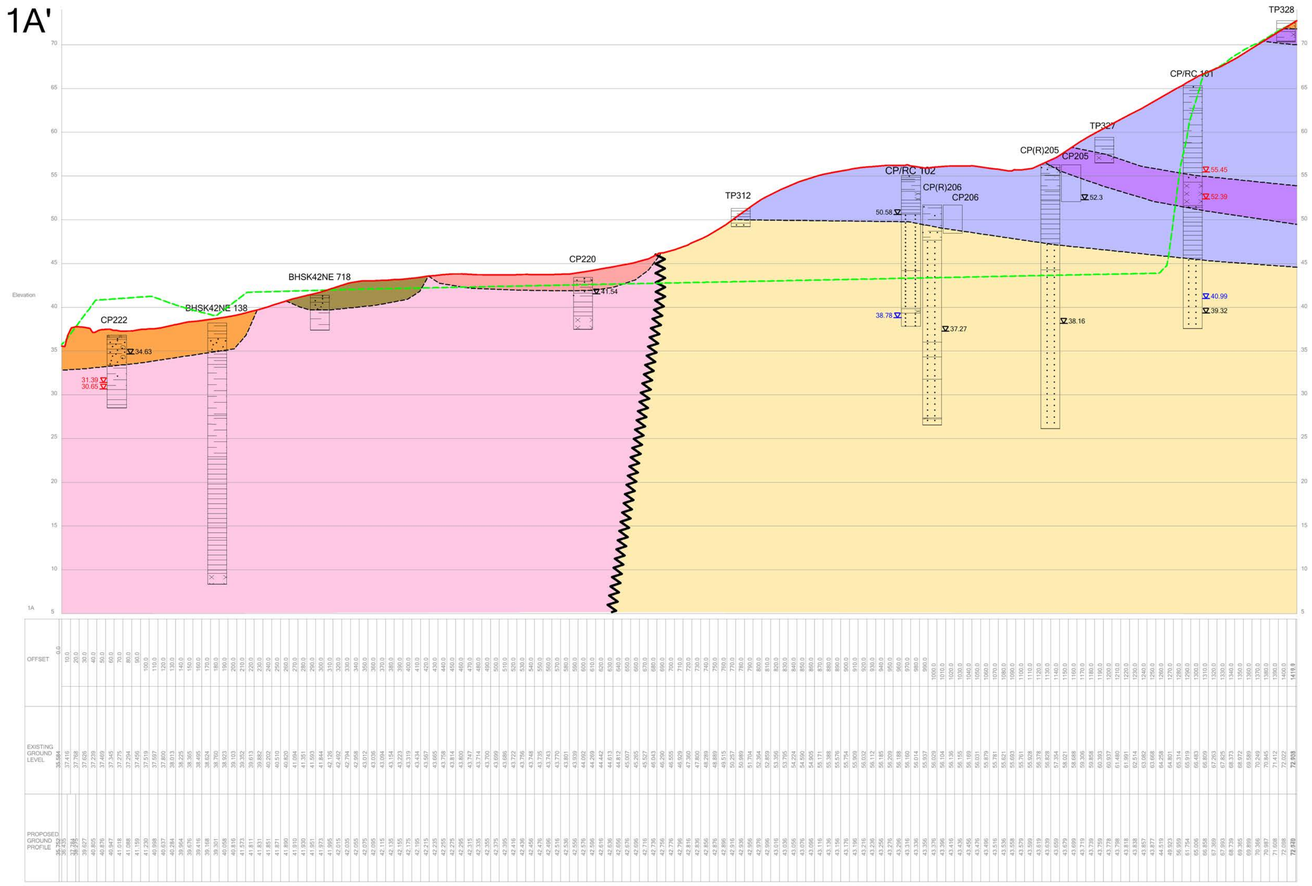
Figure 8
Zone 1 Available Ground Investigation and Exploratory Hole Locations over Proposed Scheme

SCALE: 1:7,500 @ A3 | REV 00

FILE NAME: X:\Cov Ground and Environment\Enquiries\Focal Point Enquiries\312400 - 312499\East Midlands Gateway\GIS

Proposed Development Layout extracted from pHp Architects drawing RK 006 MASTERPLAN. Received 30.10.13.
Historical Exploratory Holes based on British Geological Survey materials © NERC 2013. Geotechnics Exploratory Holes taken from PC124998 Kegworth Factual Report.



Existing Ground Level

Proposed Ground Profile

Fault line

Egginton Common Sand and Gravel Member

Head - Clay, Silt, Sand and Gravel

Wanlip Member

Tarporley Siltstone Formation - Siltstone and Sandstone - Mainly Siltstone

Tarporley Siltstone Formation - Siltstone and Sandstone

Edwalton Member - Mudstone

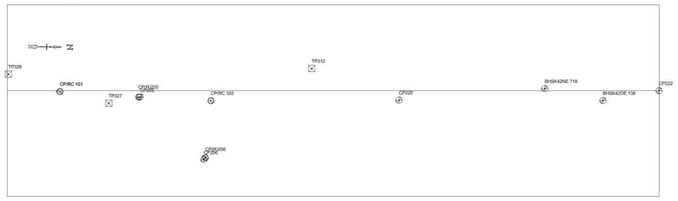
Bromsgrove Sandstone Formation - Sandstone

Groundwater strike during investigation (absence indicates hole dry)

Highest monitored groundwater level Oct-Nov 2013

Highest monitored groundwater level Sept-Oct 2012

Sitemap and Section Baseline



Materials Legend

CLAY

Clayey gravelly SAND

Gravelly clayey SAND

Clayey SAND

GRAVEL

Gravelly SILT

MADE GROUND

Mudstone

SAND

Sandstone

Sandy CLAY

Silty sandy CLAY

Sandy gravelly silty CLAY

Siltstone

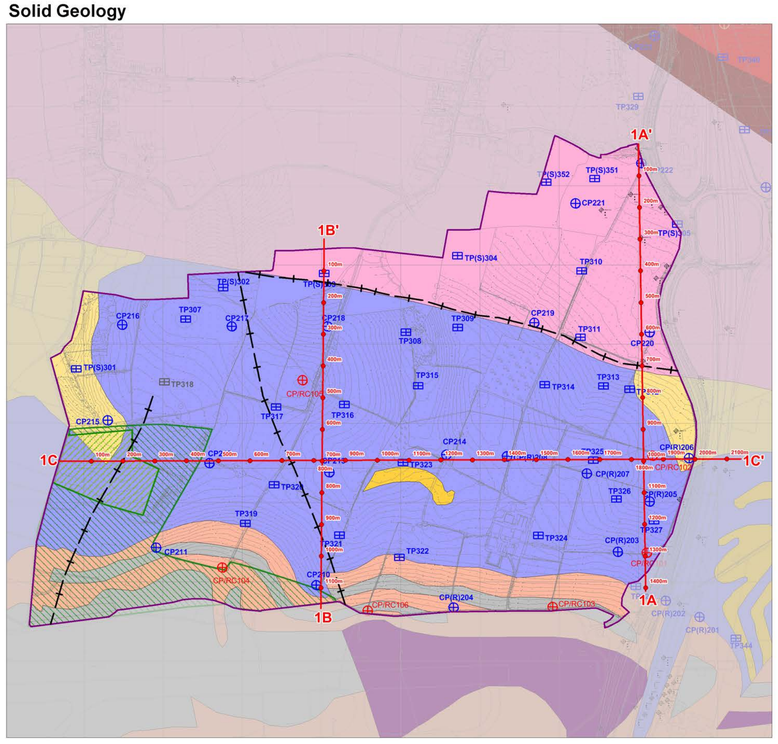
Sandy SILT

Topsoil

Silty CLAY

Gravelly silty SAND

Solid Geology



Zone 1 Boundary

Airport land - Unavailable for investigation

Land access unavailable at time of survey

Gunthorpe Member - Dolomitic Siltstone

Tarporley Siltstone Formation - Siltstone And Sandstone

Edwalton Member - Mudstone

Bromsgrove Sandstone Formation - Sandstone

Tarporley Siltstone Formation - Sandstone

Gunthorpe Member - Mudstone

Fault line

Section line and 100m marker

Symbols Key

CP Cable Percussion Borehole

CP/RC Cable Percussion and Rotary Cored Borehole

CP(R) Cable Percussion with Rotary follow on Borehole

TP Trial Pit

TP(S) Trial Pit (S) Soakaway

Colour Key

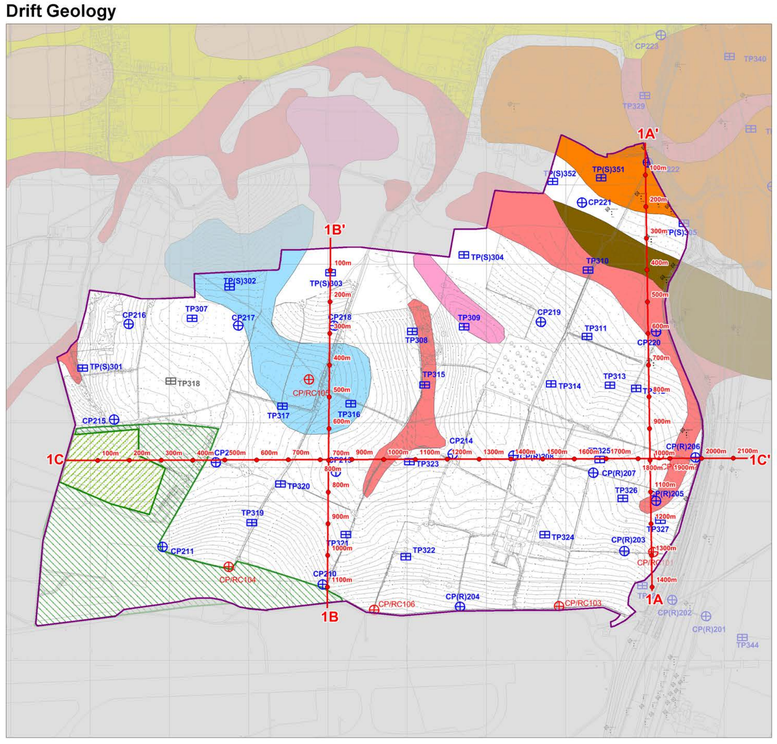
Historical Exploratory Holes (BGS/HA)

Preliminary Investigation (Geotechnics Ltd 2012)

Phase 2 Investigation (Autumn 2013)

Exploratory hole not undertaken due to crops

Drift Geology



Zone 1 Boundary

Airport land - Unavailable for investigation

Land access unavailable at time of survey

Eagle Moor Sand and Gravel Member

Egginton Common Sand and Gravel Member

Head - Clay, Silt, Sand and Gravel

Thrussington Member

Wanlip Member

Section line and 100m marker

Symbols Key

CP Cable Percussion Borehole

CP/RC Cable Percussion and Rotary Cored Borehole

CP(R) Cable Percussion with Rotary follow on Borehole

TP Trial Pit

TP(S) Trial Pit (S) Soakaway

Colour Key

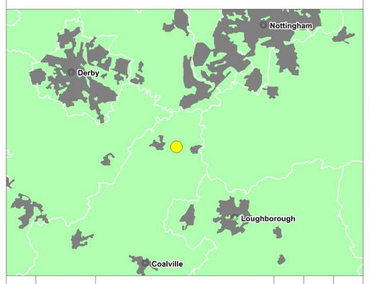
Historical Exploratory Holes (BGS/HA)

Preliminary Investigation (Geotechnics Ltd 2012)

Phase 2 Investigation (Autumn 2013)

Exploratory hole not undertaken due to crops

The geology shown is indicative only and has been tentatively defined from available exploratory hole data and available BGS mapping.
The strata shown only include major geological units and do not show minor subordinate strata and bands. For full details of strata please refer to the borehole logs and data included in the Factual Ground Investigation Report.



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East Midlands Gateway

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Figure 9

Section 1A

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Sections provided by BWB Consulting Limited drawing 131108 SECTIONS. Received 08.11.13.
Base Plan provided by Roxhill. Source Greenhatch Group drawing 11361_OGL_REV10. Received 24.10.13.
Historical Exploratory Holes based on British Geological Survey materials © NERC 2013. Geotechnics Exploratory Holes taken from PC124998 Kegworth Factual Report.
Geology based on British Geological Survey materials © NERC 2013.

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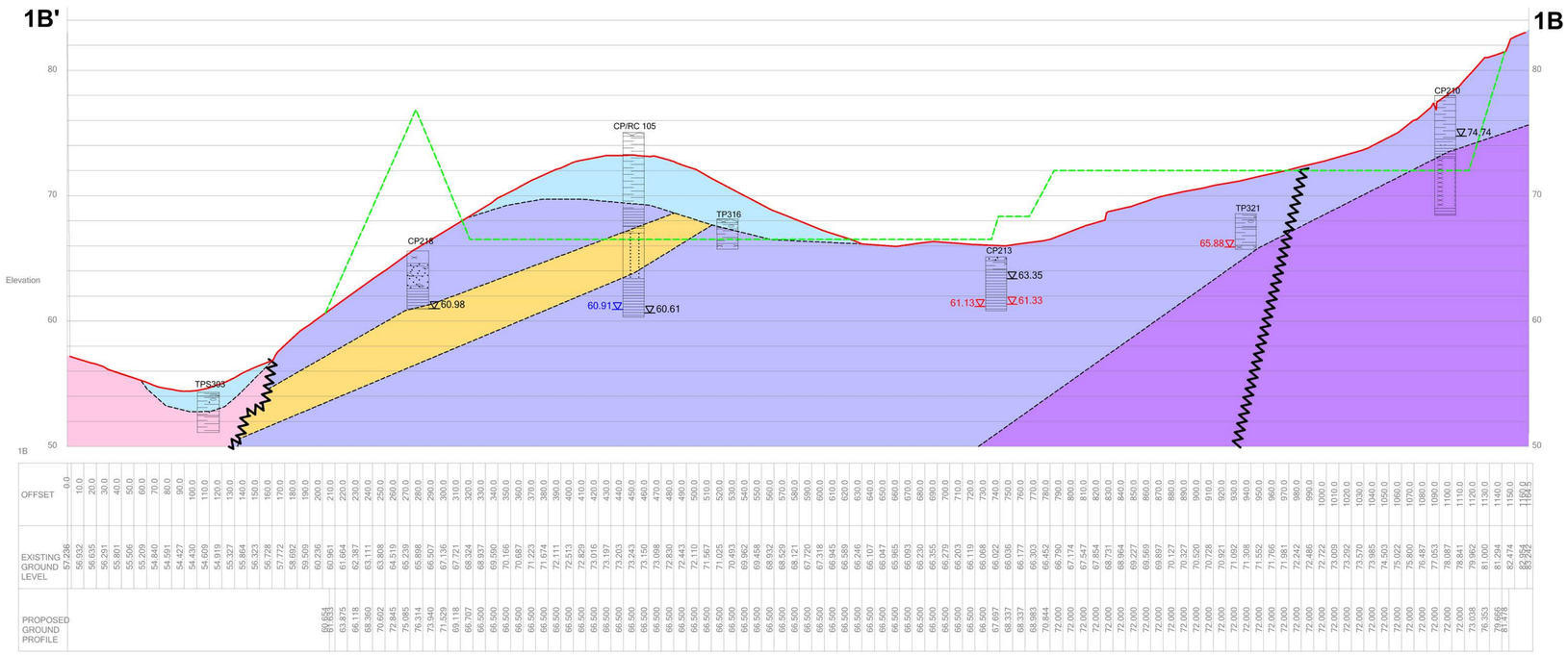


Sitemap and Section Baseline

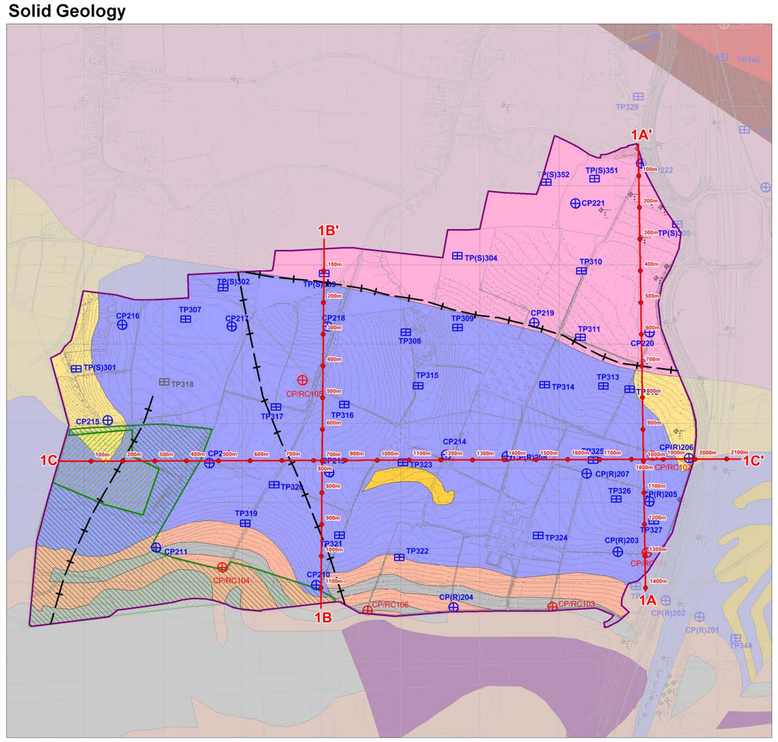
Materials Legend

- CLAY
- Gravelly clayey SAND
- Gravelly CLAY
- MADE GROUND
- Mudstone
- Sandstone
- Sandy silty CLAY
- Sandy gravelly CLAY
- Sandy gravelly silty CLAY
- Siltstone
- Topsoil
- SILT
- Clayey SILT
- Silty CLAY

- Existing Ground Level
- Proposed Ground Profile
- Fault line
- Thrussington Member
- Tarporley Siltstone Formation - Siltstone and Sandstone - Mainly Siltstone
- Tarporley Siltstone Formation - Siltstone and Sandstone - Mainly Mudstone
- Edwalton Member - Mudstone
- Tarporley Siltstone Formation - Sandstone
- Groundwater strike during investigation (absence indicates hole dry)
- Highest monitored groundwater level Oct-Nov 2013
- Highest monitored groundwater level Sept-Oct 2012

The geology shown is indicative only and has been tentatively defined from available exploratory hole data and available BGS mapping.
The strata shown only include major geological units and do not show minor subordinate strata and bands. For full details of strata please refer to the borehole logs and data included in the Factual Ground Investigation Report.

Solid Geology

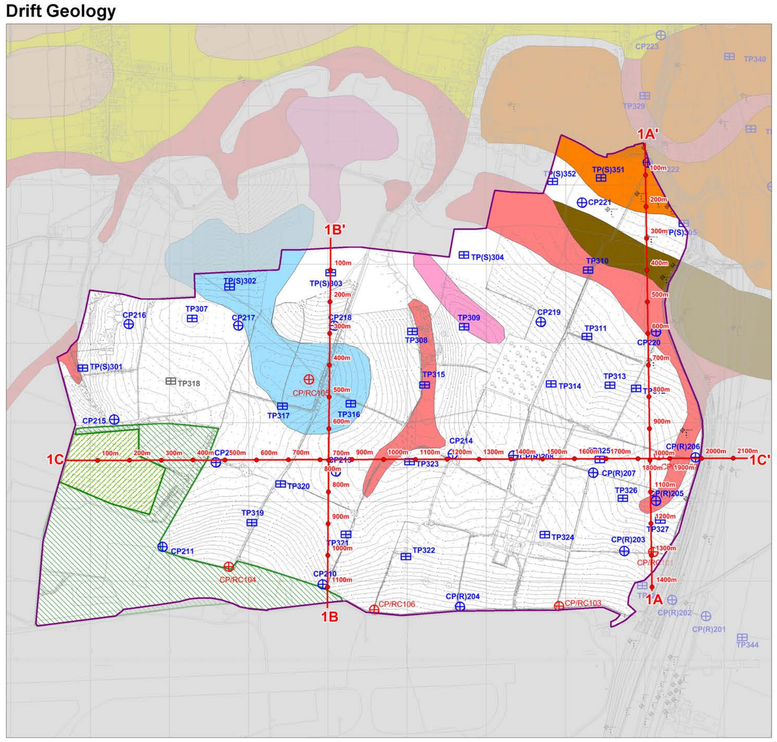


- Zone 1 Boundary
- Airport land - Unavailable for investigation
- Land access unavailable at time of survey
- Gunthorpe Member - Dolomitic Siltstone
- Tarporley Siltstone Formation - Siltstone And Sandstone
- Edwalton Member - Mudstone
- Bromsgrove Sandstone Formation - Sandstone
- Tarporley Siltstone Formation - Sandstone
- Gunthorpe Member - Mudstone
- Fault line
- Section line and 100m marker

Symbols Key
- CP Cable Percussion Borehole
- CP/RC Cable Percussion and Rotary Cored Borehole
- CP(R) Cable Percussion with Rotary follow on Borehole
- TP Trial Pit
- TP(S) Trial Pit (S) Soakaway

Colour Key
- Historical Exploratory Holes (BGS/HA)
- Preliminary Investigation (Geotechnics Ltd 2012)
- Phase 2 Investigation (Autumn 2013)
- Exploratory hole not undertaken due to crops

Drift Geology



- Zone 1 Boundary
- Airport land - Unavailable for investigation
- Land access unavailable at time of survey
- Eagle Moor Sand and Gravel Member
- Egginton Common Sand and Gravel Member
- Head - Clay, Silt, Sand and Gravel
- Thrussington Member
- Wanlip Member
- Section line and 100m marker

Symbols Key
- CP Cable Percussion Borehole
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- Historical Exploratory Holes (BGS/HA)
- Preliminary Investigation (Geotechnics Ltd 2012)
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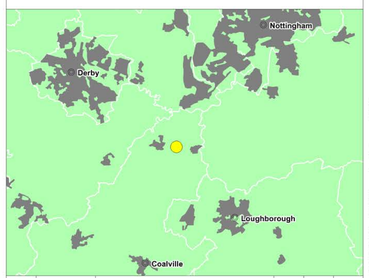

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East Midlands Gateway

RSK

Figure 10

Section 1B

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Sections provided by BWB Consulting Limited drawing 131108 SECTIONS. Received 08.11.13.
Base Plan provided by Roxhill. Source Greenhatch Group drawing 11361_OGL_REV10. Received 24.10.13.
Historical Exploratory Holes based on British Geological Survey materials © NERC 2013. Geotechnics Exploratory Holes taken from PC124998 Kegworth Factual Report.
Geology based on British Geological Survey materials © NERC 2013.

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Existing Ground Level

Proposed Ground Profile

Fault line

Thrussington Member

Tarporley Siltstone Formation - Siltstone And Sandstone

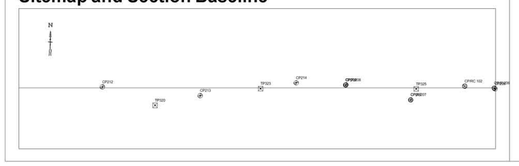
Bromsgrove Sandstone Formation - Sandstone

Groundwater strike during investigation (absence indicates hole dry)

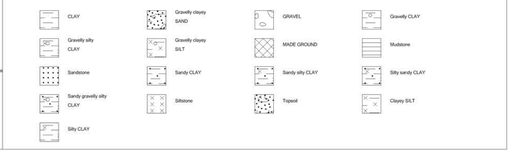
Highest monitored groundwater level Oct-Nov 2013

Highest monitored groundwater level Sept-Oct 2012

Sitemap and Section Baseline



Materials Legend



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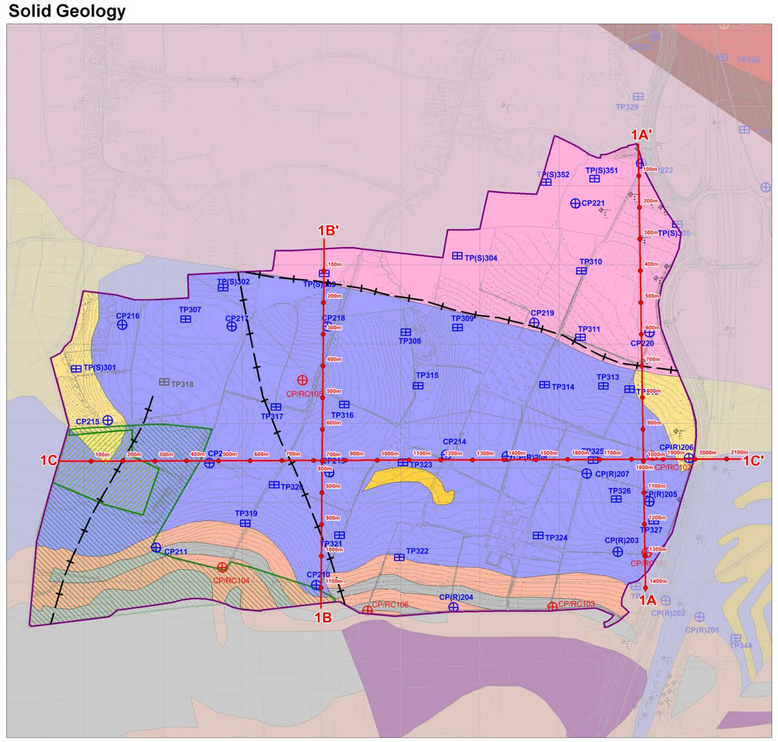
Solid Geology



Zone 1 Boundary

Airport land - Unavailable for investigation

Land access unavailable at time of survey

Gunthorpe Member - Dolomitic Siltstone

Tarporley Siltstone Formation - Siltstone And Sandstone

Edwalton Member - Mudstone

Bromsgrove Sandstone Formation - Sandstone

Tarporley Siltstone Formation - Sandstone

Gunthorpe Member - Mudstone

Fault line

Section line and 100m marker

Symbols Key

CP Cable Percussion Borehole

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Colour Key

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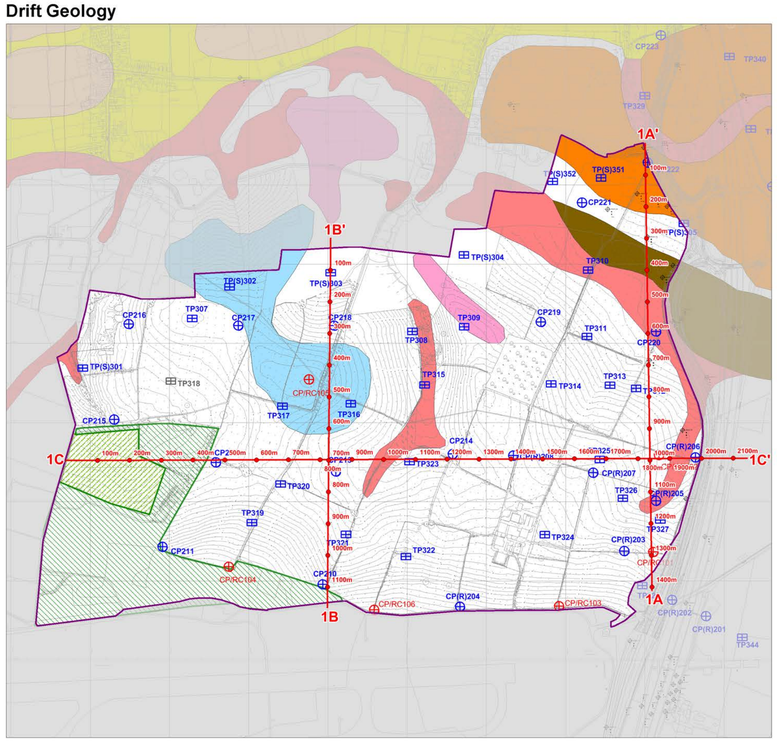
Drift Geology



Zone 1 Boundary

Airport land - Unavailable for investigation

Land access unavailable at time of survey

Eagle Moor Sand and Gravel Member

Egginton Common Sand and Gravel Member

Head - Clay, Silt, Sand and Gravel

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Wanlip Member

Section line and 100m marker

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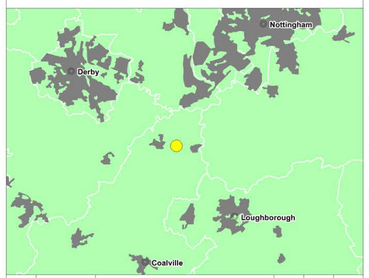
Phase 2 Investigation (Autumn 2013)

Exploratory hole not undertaken due to crops



Rev	Date	Description	Drn	Chk	App
00	16.12.13	Geo	RG	SP	DB

East Midlands Gateway

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Figure 11

Section 1C

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REV 00

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Sections provided by BWB Consulting Limited drawing 131108 SECTIONS. Received 08.11.13.
Base Plan provided by Roxhill. Source Greenhatch Group drawing 11361_OGL_REV10. Received 24.10.13.
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Geology based on British Geological Survey materials © NERC 2013.

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 Roxhill Developments Limited in accordance with the terms of a contract between RSK and the "client", dated 3rd September 2013. 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 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 hereof, 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 phase II or 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.

APPENDIX B
HUMAN HEALTH GENERIC ASSESSMENT CRITERIA

Generic assessment criteria for human health: commercial scenario

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 was also withdrawn in 2010 owing to concerns that it was not suitably protective of human health. The withdrawn SGV was based on a target blood lead concentration 10 μg/dl. In the absence of current guidelines, many consultants have continued to use the withdrawn SGV. However, as this is not considered sufficiently protective of human health RSK has revised its GAC for lead and is currently undertaking a review of recent toxicological developments that will be used to refine this GAC further in the coming months.

Variable	Description of variable	Units	Value in SGV10	Revised value for RSK GAC
T	Health criteria value – reduced owing to concern that 10ug/dl may not be suitably protective of human health	ug/dl	10	5
G	Geometric standard deviation for B typically in range of 1.8 to 2.1	-	2.0	1.8
B	Geometric mean of blood lead concentration in adult women. The value used in SGV10 was based on UK data from 1995 from women in an urban area aged 16–44. Data in the US has shown decreases from between 1.7 and 2.2 to 1ug/dl between the late 1980s/early 1990s and late 1990s/early 2000s for adult females between 17 and 45 years old. Lead concentrations in blood are likely to be decreasing in the UK owing to a ban on lead in internal paint, a ban on lead in fuel and replacement of lead pipes for water supply	ug/dl	2.3	1.0
n	Selected on the basis of the degree of protection needed for a population at risk at the target concentration (T); the default value is 95%	-	1.645	1.645
$AT_{S, D}$	Averaging time assuming exposure over working lifetime. The value has been revised to reflect 49 years in accordance with CLEA commercial scenario outlined in SR3	days	15695	17885
BKSF	Biokinetic slope factor	ug/dl per ug/day	0.4	0.4
IR_S	Soil ingestion rate (including soil-derived indoor dust). This value has been revised to reflect the CLEA commercial scenario outlined in SR3	g/day	0.040	0.050
$AF_{S, D}$	Absorption fraction (same for soil and dust)	-	0.12	0.12
$EF_{S, D}$	Exposure frequency – based on CLEA commercial conceptual model	days/yr	230	230
ED	Exposure duration. This value has been revised to reflect CLEA commercial conceptual model outlined in SR3	years	43	49

The methodology utilised for the adult receptor is the Adult Lead Methodology used in the USA, which is a similar equation to that used in production of the UK SGV outlined in R&D publication SGV10. Parameters within the equation are presented below and have been updated to reflect:

- a revised and more health protective target blood level
- more recent US data pertaining to the geometric blood lead concentration, which indicates decreasing concentrations from 1988 to 2004
- more recent US data regarding the geometric standard deviation (the measure of inter-individual variability in blood lead concentrations within the adult population).

Although the update is based on US data, RSK considers that background blood levels in the UK will also be decreasing owing to lead pipes being replaced, lead no longer being used in fuel and lead paints being banned from internal use. Furthermore, RSK has run the equation with varying inputs to ascertain its sensitivity to certain parameters. Using the parameters outlined above RSK obtains a GAC of **600mg/kg** for an adult in a commercial setting. A similar value is obtained if all input parameters remain equal to those used in production of the former SGV but the soil ingestion rate is increased to reflect 50mg/day reported for the commercial scenario in SR3.

GAC derivation for other metals and organic compounds

Model selection

Soil assessment criteria (SAC) were calculated for compounds where SGV have not been published 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[2–5]. The SAC and GrAC collectively are termed GAC.

Pathway selection

In accordance with EA Science Report SC050221/SR3[3] the commercial scenario considers risks to a female worker who works from the age of 16 to 65 years. It should be noted that this end use is not suitable for a workplace nursery but also may be appropriate for a sport centre or shopping centre where children are present. In accordance with Box 3.5, SR3[3] the pathways considered for production of the SAC in the commercial scenario are:

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

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 workers 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 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 be impractical in many cases because of the very low solubility/vapour saturation 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 limits 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 saturation or vapour saturation limit (in brackets), and subsequently incorporate this 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 specific chemical 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 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. As ethylbenzene and xylene are being modelled separately, the physical, chemical and toxicological data for this band have 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:

- an adult weighing 70kg and breathing 14.8m^3 air per day in accordance with the UK TOX reports[2] and SR3[3]
- the 50% rule (for petroleum hydrocarbons, trimethylbenzenes and MTBE)[2] where MDI data is not currently available but background exposure is considered important in the overall exposure.

Physical parameters

For the commercial end use, the CLEA default pre-1970s three-storey office building was used. SR3 notes this commercial building type to be the most conservative in terms of protection from vapour intrusion. The building parameters are outlined in Table 3.

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, 2 and 3 and the GrAC using the input parameters in Table 4. The final selected GAC are presented by pathway in Table 5 with the combined GAC in Table 6.

Figure 1: Conceptual model for CLEA commercial scenario

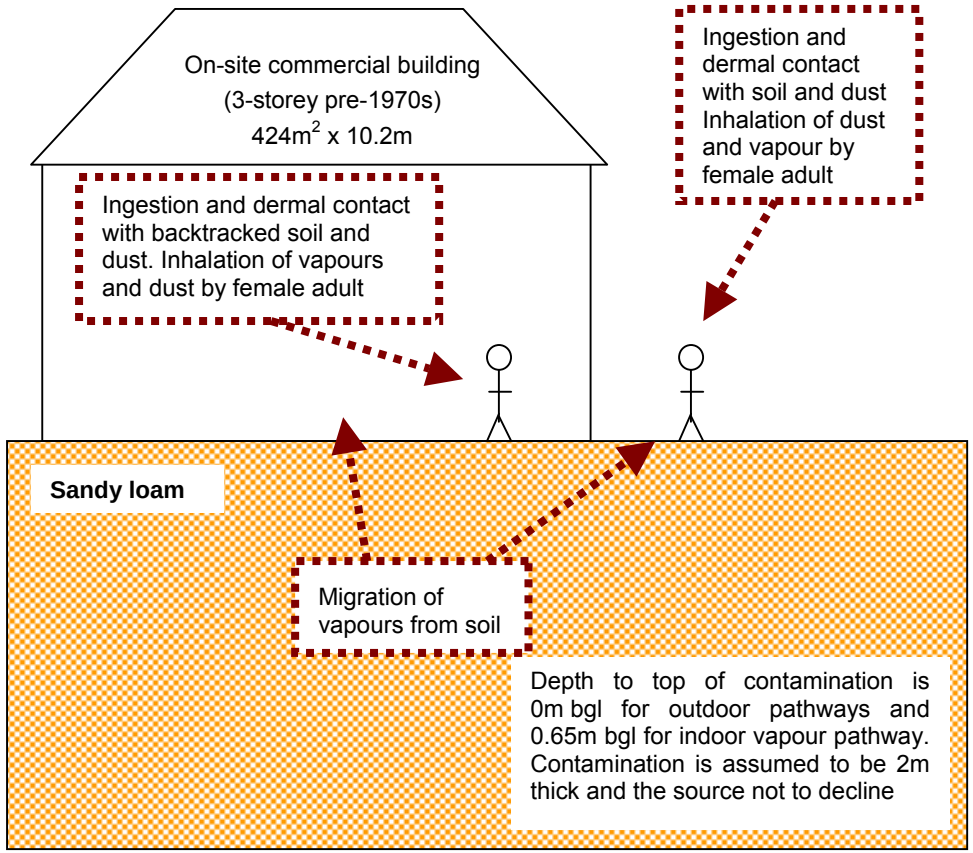


Table 1: Exposure assessment parameters for commercial scenario – inputs for CLEA model

Parameter	Value	Justification
Land use	Commercial	Chosen land use
Receptor	Female worker	Taken as female adult exposed over 49 years from age 16 to 65 years, Box 3.5, SR3[3]
Building	Office (pre-1970)	Key generic assumption given in Box 3.5, SR3[3]. Pre-1970s three-storey office building chosen as it is the most conservative in terms of protection from vapour intrusion (Section 3.4.6, SR3[3])
Soil type	Sandy loam	Most common UK soil type (Section 4.3.1, Table 4.4, SR3[3]). Table 4 presents soil-specific inputs
Start age class (AC)	17	AC corresponding to key generic assumption that the critical receptor is a working female adult exposed over a 49-year period from age 16 to 65 years. Assumption given in Box 3.5, SR3[3]. Data specific to AC exposure is presented in Table 2 and receptor specific in Table 3
End AC	17	
SOM (%)	6	Representative of sandy loam according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[8]
	1	To provide SAC for sites where SOM < 6% as often observed by RSK
	2.5	
pH	7	Model default

Table 2: Commercial – receptor inputs for CLEA model

Parameter	Unit	Value	Justification
Exposure frequency (EF) (soil and dust ingestion)	day yr^{-1}	230	From Table 3.9, SR3[3]. The working week is assumed 45 hours including a 1-hour lunch break each day. Indoor and outdoor exposure are weighted by the frequency of time spent indoors and outdoors (8.3 hours a day and 0.7 hours a day respectively)
EF (dermal contact with dust. indoor)	day yr^{-1}	230	
EF (dermal contact with soil, outdoor)	day yr^{-1}	170	
EF (inhalation of dust and vapour, indoor)	day yr^{-1}	230	
EF (inhalation of dust and vapour, outdoor)	day yr^{-1}	170	
Occupancy period (indoor)	hr day^{-1}	8.3	Box 3.6, SR3[3]. Weighted average based on a nine-hour day including one-hour lunch being spent outside 75% of the year
Occupancy period (outdoor)	hr day^{-1}	0.7	
Soil to skin adherence factor (indoor and outdoor)	mg cm^{-2} day^{-1}	0.14	Table 8.1, SR3[3] for age class 17
Soil and dust ingestion rate	g day^{-1}	0.05	Table 6.2, SR3[3] for age class 17
Body weight	kg	70	Table 4.6, SR3[3] for female AC 17
Body height	m	1.6	Table 4.6, SR3[3] for female AC 17
Inhalation rate	m^3 day^{-1}	14.8	Table 4.14, SR3[3] for female AC 17
Max. exposed skin fraction (indoor and outdoors)	m^2 m^{-2}	0.08	Based on adult female assuming face and hands are exposed. Table 4.7, SR3[3]

Table 3: Commercial – soil, air 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	$cm\ s^{-1}$	0.00356	
van Genuchten shape parameter (*m*)	-	0.3201	
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 of UK surface soils. Section 4.3.1, SR3[3]
Air dispersion model			
Mean annual wind speed (10m)	$m\ s^{-1}$	5.0	Default value taken from Section 9.2.2, SR3[3]
Air dispersion factor at height of 1.6m	$g\ m^{-2}\ s^{-1}$ per $kg\ m^{-3}$	120	From Table 9.1, SR3. Values for a 2ha site, appropriate to a commercial land use in Newcastle (most representative city for UK, section 9.2.1,SR3[3])
Fraction of site with hard or vegetative cover	$m^2\ m^{-2}$	0.8	Section 3.4.6 and 9.2.2, SR3[3] for average office such as that used in the commercial scenario
Building properties for office (pre-1970) with ground-bearing floor slab			
Building footprint	m^2	424	From Table 3.10, SR3[3]
Living space air exchange rate	hr^{-1}	1.0	
Living space height (above ground)	m	9.6	
Living space height (below ground)	m	0.0	Assumed no basement.
Pressure difference (soil to enclosed space)	Pa	4.4	From Table 3.10, SR3[3]
Foundation thickness	m	0.15	

Parameter	Unit	Value	Justification
Floor crack area	m^2	0.165	
Dust loading factor	$\mu g\ m^{-3}$	100	Default value for a commercial site taken from Section 9.3, SR3[3]
Vapour model			
Default soil gas ingress rate	$cm^3\ s^{-1}$	150	Section 10.3, report SC050021/SR3[3]
Depth to top of source (beneath building for indoor exposure)	cm	50	Section 3.4.6, SR3[3] states source is 50cm below building or 65cm below ground surface
Depth to top of source (outdoors)	cm	0	Section 10.2, SR3[3] assumes impact from 0-1m 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	49	Working lifetime from 16–65 years. Key generic assumption given in 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 commercial scenario

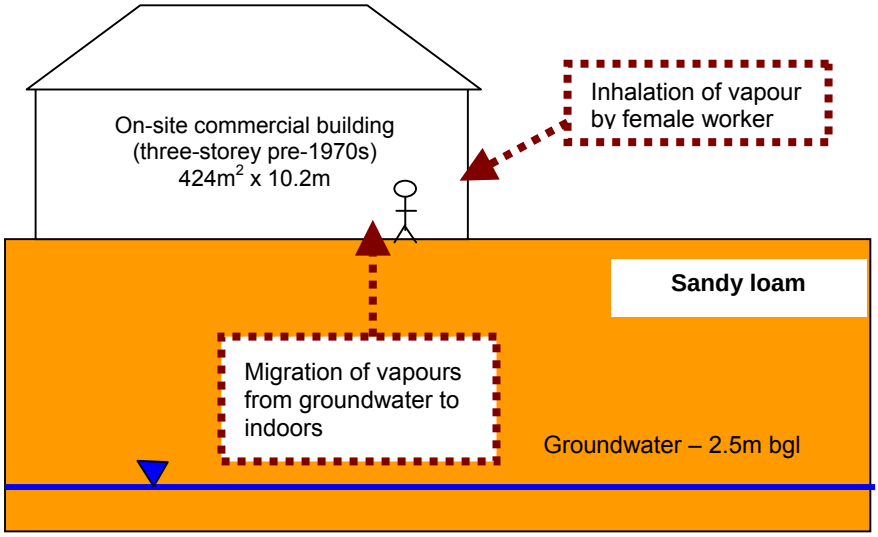


Table 4: Commercial – RBCA inputs

Parameter	Unit	Value	Justification
Receptor			
Averaging time	Years	49	From Box 3.5, SR3[3]
Receptor weight	kg	70	Female adult, Table 4.6, SR3[3]
Exposure duration	Years	49	From Box 3.5, SR3[3]
Exposure frequency	Days/yr	86.25	Weighted using occupancy period of 9 hours per day for 230 days of the year ((9hours x 230 days)/24 hours)
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	m	0.1	Professional judgement

Parameter	Unit	Value	Justification
thickness			
Building			
Building volume/area ratio	m	9.6	Table 3.10, SR3[3]
Foundation area	m^2	424	Table 3.10, SR3[3]
Foundation perimeter	m	82.40	Based on square root of building area being 20.59m
Building air exchange rate	d^{-1}	24	Table 3.10, SR3[3]
Depth to bottom of foundation slab	m	0.15	
Foundation thickness	m	0.15	Table 3.10, SR3[3]
Foundation crack fraction	-	3.89E-04	Calculated from floor crack area of 0.165m^2 and building footprint of 424m^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	4.4	From Table 3.10, SR3[3]

References

1. Environment Agency (2009), 'Science Report SC050021/benzene SGV, toluene SGV, ethylbenzene SGV, xylene SGV, mercury SGV, selenium SGV, nickel SGV, arsenic SGV, cadmium SGV, phenol SGV, dioxins, furans and dioxin like PCBs SGVs', 'Supplementary information for the derivation of SGV for: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin- like PCBs', and 'Contaminants in soil: updated collation of toxicological data and intake values for humans: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin- like PCBs', March 2009, May 2009 and September 2009.

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.

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

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

7. CL:AIRE (2009), *Soil Generic Assessment Criteria for Human Health Risk Assessment* (London: CL:AIRE).

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

Table 5

Human health generic assessment criteria by pathway for commercial scenario

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)	-	6.35E+02	6.95E+02	-	NR	6.35E+02	6.95E+02	-	NR	6.35E+02	6.95E+02	-	NR
Cadmium	(b)	-	3.99E+02	3.87E+02	2.30E+02	NR	3.99E+02	3.87E+02	2.30E+02	NR	3.99E+02	3.87E+02	2.30E+02	NR
Chromium (III) - oxide		-	3.31E+05	3.34E+04	3.04E+04	NR	3.31E+05	3.34E+04	3.04E+04	NR	3.31E+05	3.34E+04	3.04E+04	NR
Chromium (VI) - hexavalent		-	2.01E+03	3.48E+01	3.42E+01	NR	2.01E+03	3.48E+01	3.42E+01	NR	2.01E+03	3.48E+01	3.42E+01	NR
Copper		-	1.78E+05	9.60E+04	7.17E+04	NR	1.78E+05	9.60E+04	7.17E+04	NR	1.78E+05	9.60E+04	7.17E+04	NR
Lead	(a)	-	6.00E+02	-	-	NR	6.00E+02	-	-		6.00E+02	-	-	NR
Elemental mercury (Hg^0)	(b)(d)	5.60E-02	-	1.84E+01	-	4.31E+00	-	4.57E+01	-	1.07E+01	-	1.09E+02	-	2.58E+01
Inorganic mercury (Hg^{2+})	(b)	-	4.41E+03	2.09E+04	3.64E+03	NR	4.41E+03	2.09E+04	3.64E+03		4.41E+03	2.09E+04	3.64E+03	NR
Methyl mercury (Hg^{4+})	(b)	1.00E+02	4.25E+02	2.73E+03	3.68E+02	7.33E+01	4.25E+02	4.97E+03	3.91E+02	1.42E+02	4.25E+02	9.41E+03	4.07E+02	3.04E+02
Nickel	(b)	-	2.22E+04	1.79E+03	-	NR	2.22E+04	1.79E+03	-	NR	2.22E+04	1.79E+03	-	NR
Selenium	(b)(c)	-	1.30E+04	-	-	NR	1.30E+04	-	-	NR	1.30E+04	-	-	NR
Zinc	(c)	-	6.67E+05	2.09E+08	-	NR	6.67E+05	2.09E+08	-	NR	6.67E+05	2.09E+08	-	NR
Cyanide		-	1.69E+04	1.95E+03	1.81E+03	NR	1.69E+04	1.95E+03	1.81E+03	NR	1.69E+04	1.95E+03	1.81E+03	NR
Volatile organic compounds														
Benzene	(b)	1.40E+02	5.53E+02	2.96E+01	2.81E+01	1.22E+03	5.53E+02	5.51E+01	5.01E+01	2.26E+03	5.53E+02	1.14E+02	9.47E+01	4.71E+03
Toluene	(b)	5.90E+02	4.25E+05	6.85E+04	5.90E+04	8.69E+02	4.25E+05	1.51E+05	1.11E+05	1.92E+03	4.25E+05	3.42E+05	1.89E+05	4.36E+03
Ethylbenzene	(b)	1.80E+02	1.91E+05	1.84E+04	1.68E+04	5.18E+02	1.91E+05	4.31E+04	3.51E+04	1.22E+03	1.91E+05	1.00E+05	6.57E+04	2.84E+03
Xylene - m	(b)	2.00E+02	3.43E+05	6.59E+03	6.46E+03	6.25E+02	3.43E+05	1.55E+04	1.48E+04	1.47E+03	3.43E+05	3.61E+04	3.27E+04	3.46E+03
Xylene - o	(b)	1.70E+02	3.43E+05	7.08E+03	6.94E+03	4.78E+02	3.43E+05	1.65E+04	1.58E+04	1.12E+03	3.43E+05	3.84E+04	3.46E+04	2.62E+03
Xylene - p	(b)	2.00E+02	3.43E+05	6.34E+03	6.22E+03	5.76E+02	3.43E+05	1.48E+04	1.42E+04	1.35E+03	3.43E+05	3.45E+04	3.14E+04	3.17E+03
Total xylene	(b)	2.00E+02	3.43E+05	6.59E+03	6.46E+03	6.25E+02	3.43E+05	1.55E+04	1.48E+04	1.47E+03	3.43E+05	3.61E+04	3.27E+04	3.46E+03
Methyl tertiary butyl ether (MTBE)		4.80E+04	9.53E+03	2.09E+04	8.21E+03	1.66E+04	9.53E+03	2.72E+04	8.55E+03	2.16E+04	9.53E+03	4.18E+04	8.93E+03	3.34E+04
Trichloroethene		3.60E+01	9.92E+03	1.19E+01	1.19E+01	1.54E+03	9.92E+03	2.49E+01	2.49E+01	3.22E+03	9.92E+03	5.54E+01	5.50E+01	7.14E+03
Tetrachloroethene		2.30E+02	2.65E+04	1.31E+02	1.31E+02	4.24E+02	2.65E+04	2.94E+02	2.91E+02	9.51E+02	2.65E+04	6.75E+02	6.58E+02	2.18E+03
1,1,1-Trichloroethane		1.30E+03	1.14E+06	7.01E+02	7.00E+02	1.43E+03	1.14E+06	1.43E+03	1.43E+03	2.92E+03	1.14E+06	3.14E+03	3.13E+03	6.39E+03
1,1,1,2 Tetrachloroethane		1.10E+03	1.10E+04	1.16E+02	1.15E+02	2.60E+03	1.10E+04	2.68E+02	2.62E+02	6.02E+03	1.10E+04	6.24E+02	5.91E+02	1.40E+04
1,1,2,2 Tetrachloroethane		1.10E+03	1.10E+04	2.98E+02	2.90E+02	2.67E+03	1.10E+04	6.10E+02	5.78E+02	5.46E+03	1.10E+04	1.34E+03	1.19E+03	1.20E+04
Carbon Tetrachloride (tetrachloromethane)		5.70E+00	2.70E+03	3.04E+00	3.04E+00	1.52E+03	2.70E+03	6.67E+00	6.65E+00	3.32E+03	2.70E+03	1.51E+01	1.50E+01	7.54E+03
1,2-Dichloroethane		6.10E+00	2.29E+02	7.14E-01	7.12E-01	3.41E+03	2.29E+02	1.03E+00	1.03E+00	4.91E+03	2.29E+02	1.77E+00	1.75E+00	8.43E+03
Vinyl Chloride (chloroethene)		4.10E-01	2.67E+01	6.31E-02	6.30E-02	1.36E+03	2.67E+01	8.16E-02	8.14E-02	1.76E+03	2.67E+01	1.25E-01	1.24E-01	2.69E+03
1,2,4-Trimethylbenzene		5.70E+01	-	4.17E+01	-	5.57E+02	-	9.89E+01	-	1.36E+03	-	2.19E+02	-	3.25E+03
1,3,5-Trimethylbenzene		3.80E+01	2.19E+04	4.71E+01	4.71E+01	9.47E+01	2.19E+04	1.12E+02	1.12E+02	2.26E+02	2.19E+04	2.63E+02	2.63E+02	5.33E+02
Semi-volatile organic compounds														
Acenaphthene		3.20E+00	1.10E+05	3.75E+05	8.49E+04	5.70E+01	1.10E+05	8.95E+05	9.77E+04	1.41E+02	1.10E+05	2.00E+06	1.04E+05	3.36E+02
Acenaphthylene		1.61E+01	1.10E+05	3.64E+05	8.43E+04	8.61E+01	1.10E+05	8.68E+05	9.74E+04	2.12E+02	1.10E+05	1.94E+06	1.04E+05	5.06E+02
Anthracene		2.10E-02	5.49E+05	1.19E+07	5.25E+05	1.17E+00	5.49E+05	2.49E+07	5.37E+05	2.91E+00	5.49E+05	4.38E+07	5.42E+05	6.96E+00
Benzo(a)anthracene		3.80E-03	2.52E+02	1.39E+02	8.95E+01	1.71E+00	2.52E+02	1.52E+02	9.48E+01	4.28E+00	2.52E+02	1.59E+02	9.74E+01	1.03E+01
Benzo(b)fluoranthene		2.00E-03	2.60E+02	1.63E+02	1.00E+02	1.22E+00	2.60E+02	1.67E+02	1.02E+02	3.04E+00	2.60E+02	1.69E+02	1.03E+02	7.29E+00
Benzo(g,h,i)perylene		2.60E-04	1.66E+03	1.08E+03	6.54E+02	1.54E-02	1.66E+03	1.09E+03	6.59E+02	3.85E-02	1.66E+03	1.10E+03	6.61E+02	9.23E-02
Benzo(k)fluoranthene		8.00E-04	3.66E+02	2.31E+02	1.41E+02	6.87E-01	3.66E+02	2.35E+02	1.43E+02	1.72E+00	3.66E+02	2.38E+02	1.44E+02	4.12E+00
Chrysene		2.00E-03	3.66E+02	2.20E+02	1.37E+02	4.40E-01	3.66E+02	2.29E+02	1.41E+02	1.10E+00	3.66E+02	2.34E+02	1.43E+02	2.64E+00
Dibenzo(a,h)anthracene		6.00E-04	3.29E+01	2.80E+01	1.27E+01	3.93E-03	3.29E+01	2.12E+01	1.29E+01	9.82E-03	3.29E+01	2.15E+01	1.30E+01	2.36E-02
Fluoranthene		2.30E-01	2.29E+04	2.01E+06	2.26E+04	1.89E+01	2.29E+04	2.89E+06	2.27E+04	4.73E+01	2.29E+04	3.52E+06	2.27E+04	1.13E+02
Fluorene		1.90E+00	7.31E+04	4.82E+05	6.35E+04	3.09E+01	7.31E+04	1.12E+06	6.87E+04	7.65E+01	7.31E+04	2.38E+06	7.10E+04	1.83E+02
Indeno(1,2,3-cd)pyrene		2.00E-04	1.57E+02	9.71E+01	6.00E+01	6.13E-02	1.57E+02	9.98E+01	6.11E+01	1.53E-01	1.57E+02	1.01E+02	6.17E+01	3.68E-01
Phenanthrene		5.30E-01	2.28E+04	5.67E+05	2.19E+04	3.60E+01	2.28E+04	1.16E+06	2.24E+04	8.96E+01	2.28E+04	1.98E+06	2.26E+04	2.14E+02
Pyrene		1.30E-01	5.49E+04	4.74E+06	5.42E+04	2.20E+00	5.49E+04	6.86E+06	5.44E+04	5.49E+00	5.49E+04	8.39E+06	5.45E+04	1.32E+01
Benzo(a)pyrene		3.80E-03	3.66E+01	2.30E+01	1.41E+01	9.11E-01	3.66E+01	2.35E+01	1.43E+01	2.28E+00	3.66E+01	2.38E+01	1.44E+01	5.46E+00
Naphthalene		1.90E+01	3.64E+04	2.05E+02	2.04E+02	7.64E+01	3.64E+04	4.90E+02	4.83E+02	1.83E+02	3.64E+04	1.15E+03	1.12E+03	4.32E+02
Phenol	(b)(e)	-	1.54E+06	3.16E+04	3.10E+04	4.16E+04	1.00E+06	3.57E+04	3.49E+04	8.15E+04	1.54E+06	3.85E+04	3.76E+04	1.74E+05
Total petroleum hydrocarbons														
Aliphatic hydrocarbons EC_5–EC_6		3.60E+01	4.77E+06	3.38E+03	3.39E+03	3.04E+02	4.77E+06	6.21E+03	6.21E+03	5.58E+02	4.77E+06	1.28E+04	1.28E+04	1.15E+03
Aliphatic hydrocarbons >EC_6–EC_8		5.40E+00	4.77E+06	8.26E+03	8.25E+03	1.44E+02	4.77E+06	1.84E+04	1.84E+04	3.22E+02	4.77E+06	4.21E+04	4.20E+04	7.36E+02
Aliphatic hydrocarbons >EC_8–EC_{10}		4.30E-01	9.53E+04	2.14E+03	2.13E+03	7.77E+01	9.53E+04	5.21E+03	5.14E+03	1.90E+02	9.53E+04	1.24E+04	1.19E+04	4.51E+02
Aliphatic hydrocarbons >EC_{10}–EC_{12}		3.40E-02	9.53E+04	1.06E+04	1.03E+04	4.75E+01	9.53E+04	2.62E+04	2.42E+04	1.18E+02	9.53E+04	6.25E+04	4.93E+04	2.83E+02

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - COMMERCIAL

Table 5

Human health generic assessment criteria by pathway for commercial scenario

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	
Aliphatic hydrocarbons >EC_{12}–EC_{16}		7.60E-04	9.53E+04	8.75E+04	6.08E+04	2.37E+01	9.53E+04	2.16E+05	8.26E+04	5.91E+01	9.53E+04	5.10E+05	9.50E+04	1.42E+02
Aliphatic hydrocarbons >EC_{16}–EC_{35}	(c)	-	1.59E+06	-	-	8.48E+00	1.76E+06	-	-	2.12E+01	1.83E+06	-	-	5.09E+01
Aliphatic hydrocarbons >EC_{35}–EC_{44}	(c)	-	1.59E+06	-	-	8.48E+00	1.76E+06	-	-	2.12E+01	1.83E+06	-	-	5.09E+01
Aromatic hydrocarbons >EC_{8}–EC_{9} (styrene)		6.50E+01	1.14E+05	3.00E+04	2.77E+04	6.20E+02	1.14E+05	7.30E+04	5.81E+04	1.52E+03	1.14E+05	1.73E+05	9.00E+04	3.61E+03
Aromatic hydrocarbons >EC_{9}–EC_{10}		6.50E+01	3.81E+04	3.76E+03	3.67E+03	6.13E+02	3.81E+04	9.16E+03	8.56E+03	1.50E+03	3.81E+04	2.17E+04	1.78E+04	3.58E+03
Aromatic hydrocarbons >EC_{10}–EC_{12}		2.50E+01	3.81E+04	2.03E+04	1.69E+04	3.64E+02	3.81E+04	4.97E+04	2.85E+04	8.99E+02	3.81E+04	1.17E+05	3.45E+04	2.15E+03
Aromatic hydrocarbons >EC_{12}–EC_{16}	(c)	5.80E+00	3.81E+04	2.15E+05	3.63E+04	1.69E+02	3.81E+04	5.05E+05	3.74E+04	4.19E+02	3.81E+04	1.09E+06	3.78E+04	1.00E+03
Aromatic hydrocarbons >EC_{16}–EC_{21}	(c)	-	2.82E+04	-	-	5.37E+01	2.83E+04	-	-	1.34E+02	2.84E+04	-	-	3.21E+02
Aromatic hydrocarbons >EC_{21}–EC_{35}	(c)	-	2.84E+04	-	-	4.83E+00	2.84E+04	-	-	1.21E+01	2.84E+04	-	-	2.90E+01
Aromatic hydrocarbons >EC_{35}–EC_{44}	(c)	-	2.84E+04	-	-	4.83E+00	2.84E+04	-	-	1.21E+01	2.84E+04	-	-	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 screening value. SAC - soil screening value.

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

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

Calculated SAC does not exceed the soil saturation limit.

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

The SAC for organic compounds are dependent 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) RSK Lead GAC obtained following sensitivity analysis of blood lead concentrations.

(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.

(e) The GAC for phenol is based on a threshold which is protective of acute direct skin contact with phenol (the figure in brackets is based on health effects following long-term exposure and is provided for illustration only).

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - COMMERCIAL

Table 6
Selected human health generic assessment criteria for commercial scenario

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	-	640	640	640
Cadmium	-	230	230	230
Chromium (III) - oxide	-	30,000	30,000	30,000
Chromium (VI) - hexavalent	-	35	35	35
Copper	-	72,000	72,000	72,000
Lead	-	600	600	600
Elemental mercury (Hg^0)	0.056	18 (4.3)	46 (11)	110 (26)
Inorganic mercury (Hg^{2+})	-	3,600	3,600	3,600
Methyl mercury (Hg^{4+})	100	370 (73)	391	410
Nickel	-	1,800	1,800	1,800
Selenium	-	13,000	13,000	13,000
Zinc	-	670,000	670,000	670,000
Cyanide	-	1,800	1,800	1,800
Volatile organic compounds				
Benzene	140	28	50	95
Toluene	590	59,000 (870)	110,000 (1,900)	189,000 (4,400)
Ethylbenzene	180	17,000 (520)	35,000 (1,200)	65,700 (2,800)
Xylene - m	200	6,500 (620)	15,000 (1,500)	32,700 (3,500)
Xylene - o	170	6,900 (480)	16,000 (1,100)	34,600 (2,600)
Xylene - p	200	6,200 (580)	14,000 (1,400)	31,400 (3,200)
Total xylene	200	6,500 (630)	15,000 (1,500)	32,700 (3,500)
Methyl tertiary butyl ether (MTBE)	48,000	8,200	8,600	8,900
Trichloroethene	36	12	25	55
Tetrachloroethene	230	130	1,400	660
1,1,1-Trichloroethane	1,300	700	1,400	3,100
1,1,1,2 Tetrachloroethane	1,100	120	260	590
1,1,2,2 Tetrachloroethane	1,100	290	580	1,200
Carbon tetrachloride (tetrachloromethane)	5.7	3.0	6.7	15
1,2-Dichloroethane	6.1	0.71	1.0	1.8
Vinyl chloride (chloroethene)	0.41	0.063	0.08	0.12
1,2,4-Trimethylbenzene	57	42	99	220
1,3,5-Trimethylbenzene	38	47	110	260
Semi-volatile organic compounds				
Acenaphthene	3.2	85,000 (57)	98,000 (141)	100,000
Acenaphthylene	16	84,000 (86)	97,000 (212)	100,000
Anthracene	0.021	530,000	540,000	540,000
Benzo(a)anthracene	0.0038	90	95	97
Benzo(b)fluoranthene	0.0020	100	100	100
Benzo(g,h,i)perylene	0.00026	650	660	660
Benzo(k)fluoranthene	0.00080	140	140	140
Chrysene	0.0020	140	140	140
Dibenzo(a,h)anthracene	0.00060	13	13	13
Fluoranthene	0.23	23,000	23,000	23,000
Fluorene	1.9	64,000 (31)	69,000	71,000
Indeno(1,2,3-cd)pyrene	0.00020	60	61	62
Phenanthrene	0.53	22,000	22,000	23,000
Pyrene	0.13	54,000	54,000	55,000
Benzo(a)pyrene	0.0038	14	14	14
Naphthalene	19	200 (76)	480 (183)	1100 (432)
Phenol	-	3,200 * (31,000)	3,200* (35,000)	3,200 * (38,000)
Total petroleum hydrocarbons				
Aliphatic hydrocarbons EC_5–EC_6	36	3,400 (304)	6,200 (558)	13,000 (1,150)
Aliphatic hydrocarbons >EC_6–EC_8	5.4	8,300 (144)	18,000 (322)	42,000 (736)
Aliphatic hydrocarbons >EC_8–EC_{10}	0.43	2,100 (78)	5,100 (190)	12,000 (451)
Aliphatic hydrocarbons >EC_{10}–EC_{12}	0.034	10,000 (48)	24,000 (118)	49,000 (283)
Aliphatic hydrocarbons >EC_{12}–EC_{16}	0.00076	61,000 (24)	83,000 (59)	91,000 (142)
Aliphatic hydrocarbons >EC_{16}–EC_{35}	-	1,000,000**	1,000,000**	1,000,000**
Aliphatic hydrocarbons >EC_{35}–EC_{44}	-	1,000,000**	1,000,000**	1,000,000**
Aromatic hydrocarbons >EC_8–EC_9 (styrene)	65	28,000 (620)	58,000 (1,500)	90,000 (3,600)
Aromatic hydrocarbons >EC_9–EC_{10}	65	3,700 (610)	8,600 (1,500)	18,000 (3,600)
Aromatic hydrocarbons >EC_{10}–EC_{12}	25	17,000 (364)	29,000 (899)	35,000 (2,150)
Aromatic hydrocarbons >EC_{12}–EC_{16}	5.8	36,000 (169)	37,000	38,000
Aromatic hydrocarbons >EC_{16}–EC_{21}	-	28,000	28,000	28,000
Aromatic hydrocarbons >EC_{21}–EC_{35}	-	28,000	28,000	28,000
Aromatic hydrocarbons >EC_{35}–EC_{44}	-	28,000	28,000	28,000

Notes:

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

** Denotes SAC calculated exceeds 100% contaminant. Hence 100% taken as SAC.

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

* The GAC for phenol is based on a threshold which is protective of direct skin contact with phenol (the figure in brackets is based on health effects following long-term exposure and is provided for illustration only).

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 are highly conservative as 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 C
COMPARISON OF SOIL LABORATORY DATA TO HUMAN HEALTH GAC

312494 - East Midlands Gateway - Zone 1 - Human Health Risk Assessment Soil Results Summary Table and Direct Comparison

Sample Identity		Industrial/Commercial Screening Value (1% SOM)		TP310	TP314	TP323	TP324	TP316	TP319	TP326
Depth		SGV	GACs	0.80-0.90	0.60-0.70	0.50	0.10-0.20	0.10-0.20	0.10-0.20	0.60-0.70
Strata				ECS&G	HD	TSF	SS	MG	SS	HD
Determinants	**Units**									
Visual Fibre Screen					NAD				NAD	
pH	pH			6.36	7.46	7.98	4.96	5.66	8.3	7
Sulphate BRE (water sol 2:1)	g/l									
Cyanide (free)	mg/kg		1800							
Phenols - Total by HPLC	mg/kg		3200							
Loss on ignition (550°C)	% w/w									
Total Organic Carbon	% w/w			0.41	0.29	0.19		1.64		0.36
Metals										
Arsenic	mg/kg	640		3	1	2	4	4	3	2
Boron (water soluble)	mg/kg									
Cadmium	mg/kg	230		<0.5	0.7	1	0.5	0.7	0.7	0.5
Copper	mg/kg		72000	10	14	28	19	17	12	16
Chromium	mg/kg		30000	20	45	57	25	30	40	30
Chromium (hexavalent)	mg/kg		35	<1	<1	<1	<1	<1	<1	<1
Lead	mg/kg	750		11	10	8	25	27	54	9
Mercury	mg/kg	3600		<0.17	0.22	0.3	0.24	0.21	0.27	<0.17
Nickel	mg/kg	1800		12	28	44	15	21	26	19
Selenium	mg/kg	13000		<1	<1	1	<1	<1	<1	<1
Zinc	mg/kg		670000	52	102	77	64	71	76	52
Total Petroleum Hydrocarbons Criteria Working Group (TPHCWG)										
Ali >C5-C6	mg/kg		3400	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ali >C6-C8	mg/kg		8300	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ali >C8-C10	mg/kg		2100	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ali >C10-C12	mg/kg		10000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ali >C12-C16	mg/kg		61000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ali >C16-C21	mg/kg		500000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ali >C21-C35	mg/kg		500000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Aliphatics	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aro >C5-C7	mg/kg		28 (benzene)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aro >C7-C8	mg/kg		59000 (toluene)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aro >C8-C9	mg/kg		28000	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aro >C9-C10	mg/kg		3700	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aro >C10-C12	mg/kg		17000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aro >C12-C16	mg/kg		36000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aro >C16-C21	mg/kg		28000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aro >C21-C35	mg/kg		28000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Aromatics	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TPH (Ali & Aro)	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
BTEX - Benzene	mg/kg		28	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BTEX - Toluene	mg/kg		59000	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BTEX - Ethyl Benzene	mg/kg		17000	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BTEX - m & p Xylene	mg/kg		6200	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BTEX - o Xylene	mg/kg		6900	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
MTBE	mg/kg			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PAHs (Polycyclic Aromatic Hydrocarbons)										
Acenapthene	mg/kg		85000	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenapthylene	mg/kg		84000	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Anthracene	mg/kg		530000	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(a)anthracene	mg/kg		90	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Benzo(a)pyrene	mg/kg		14	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Benzo(b)fluoranthene	mg/kg		100	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(ghi)perylene	mg/kg		650	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	mg/kg		140	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Chrysene	mg/kg		140	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Dibenzo(ah)anthracene	mg/kg		13	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Fluoranthene	mg/kg		23000	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Fluorene	mg/kg		64000	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Indeno(123-cd)pyrene	mg/kg		60	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Napthalene	mg/kg		200	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Phenanthrene	mg/kg		22000	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Pyrene	mg/kg		54000	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Total PAH	mg/kg			<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Organo Chlorine Pesticides (OCP) and Organo Phosphorous Pesticides (OPP)										
Mevinphos	ug/kg						<50		<50	
Dichlorvos	ug/kg		842000**				<50		<50	
Alpha-Hexachlorocyclohexane (HCH)	ug/kg		14000**				<50		<50	
Diazinon	ug/kg						<50		<50	
Gamma-Hexachlorocyclohexane (HCH/Lindane)	ug/kg		532000**				<50		<50	
Heptachlor	ug/kg						<50		<50	
Aldrin	ug/kg		54000**				<50		<50	
Beta-Hexachlorocyclohexane (HCH)	ug/kg		1120000**				<50		<50	
Methyl Parathion	ug/kg						<50		<50	
Malathion	ug/kg						<50		<50	
Fenitrothion	ug/kg						<50		<50	
Heptachlor Epoxide	ug/kg						<50		<50	
Parathion	ug/kg						<50		<50	
p,p'-DDE	ug/kg						<50		<50	
p,p'-DDT	ug/kg						<50		<50	
p,p'-Methoxychlor	ug/kg						<50		<50	
p,p'-TDE(DDD)	ug/kg						<50		<50	
o,p'-DDE	ug/kg						<50		<50	
o,p'-DDT	ug/kg						<50		<50	
o,p'-Methoxychlor	ug/kg						<50		<50	
o,p'-TDE(DDD)	ug/kg						<50		<50	
Endosulphan I	ug/kg		2310000**				<50		<50	
Endosulphan II	ug/kg		2580000**				<50		<50	
Endosulphan sulphate	ug/kg						<50		<50	
Endrin	ug/kg						<50		<50	
Ethion	ug/kg						<50		<50	
Dieldrin	ug/kg		90000**				<50		<50	
Azinphos methyl	ug/kg						<50		<50	
Triazines										
Ametryne	mg/kg						<0.2		<0.2	
Atraton	mg/kg						<0.2		<0.2	
Atrazine	mg/kg						<0.02		<0.02	
Cyanazine	mg/kg						<0.02		<0.02	
Prometon	mg/kg						<0.2		<0.2	
Prometryn	mg/kg						<0.02		<0.02	
Propazine	mg/kg						<0.02		<0.02	
Simazine	mg/kg						<0.02		<0.02	
Simetryn	mg/kg						<0.2		<0.2	
Terbuthylazine	mg/kg						<0.02		<0.02	
Terbutryn	mg/kg						<0.02		<0.02	

= Exceedence of GAC for an industrial/commercial end-use

= Exceedence due to limit of detection

All GACs calculated by RSK other than * = EIC/AGS/CLAIRE Generic Assessment Criteria; and ** = LQM/CIEH Generic Assessment Criteria

' = Based on Hazardous Waste Acceptance Criteria

312494 - East Midlands Gateway - Zone 1 - Human Health Risk Assessment Soil Results Summary Table and Direct Comparison

Sample Identity		Industrial/Commercial Screening Value (1% SOM)		TP328	TP301	TP303	TP352
Depth		SGV	GACs	0.15-0.25	0.50	0.10-0.20	0.50-0.70
Strata				SS	TSF	SS	WM
Determinants	**Units**						
Visual Fibre Screen						NAD	
pH	pH			7.08	8.32	6.26	6.06
Sulphate BRE (water sol 2:1)	g/l						
Cyanide (free)	mg/kg		1800				
Phenols - Total by HPLC	mg/kg		3200				
Loss on ignition (550°C)	% w/w						
Total Organic Carbon	% w/w				0.61	0.99	0.46
Metals							
Arsenic	mg/kg	640		5	8	3	4
Boron (water soluble)	mg/kg						
Cadmium	mg/kg	230		0.6	<0.5	<0.5	<0.5
Copper	mg/kg		72000	21	28	14	12
Chromium	mg/kg		30000	26	30	23	18
Chromium (hexavalent)	mg/kg		35	<1	<1	<1	<1
Lead	mg/kg	750		56	11	27	21
Mercury	mg/kg	3600		0.37	<0.17	0.17	<0.17
Nickel	mg/kg	1800		22	23	14	10
Selenium	mg/kg	13000		<1	<1	<1	<1
Zinc	mg/kg		670000	77	45	57	51
Total Petroleum Hydrocarbons Criteria Working Group (TPHCWG)							
Ali >C5-C6	mg/kg		3400	<0.01	<0.01	<0.01	<0.01
Ali >C6-C8	mg/kg		8300	<0.01	<0.01	<0.01	<0.01
Ali >C8-C10	mg/kg		2100	<0.01	<0.01	<0.01	<0.01
Ali >C10-C12	mg/kg		10000	<0.1	<0.1	<0.1	<0.1
Ali >C12-C16	mg/kg		61000	<0.1	<0.1	<0.1	<0.1
Ali >C16-C21	mg/kg		500000	<0.1	<0.1	<0.1	<0.1
Ali >C21-C35	mg/kg		500000	<0.1	<0.1	<0.1	<0.1
Total Aliphatics	mg/kg			<0.1	<0.1	<0.1	<0.1
Aro >C5-C7	mg/kg		28 (benzene)	<0.01	<0.01	<0.01	<0.01
Aro >C7-C8	mg/kg		59000 (toluene)	<0.01	<0.01	<0.01	<0.01
Aro >C8-C9	mg/kg		28000	<0.01	<0.01	<0.01	<0.01
Aro >C9-C10	mg/kg		3700	<0.01	<0.01	<0.01	<0.01
Aro >C10-C12	mg/kg		17000	<0.1	<0.1	<0.1	<0.1
Aro >C12-C16	mg/kg		36000	<0.1	<0.1	<0.1	<0.1
Aro >C16-C21	mg/kg		28000	<0.1	<0.1	<0.1	<0.1
Aro >C21-C35	mg/kg		28000	<0.1	<0.1	<0.1	<0.1
Total Aromatics	mg/kg			<0.1	<0.1	<0.1	<0.1
TPH (Ali & Aro)	mg/kg			<0.1	<0.1	<0.1	<0.1
BTEX - Benzene	mg/kg		28	<0.01	<0.01	<0.01	<0.01
BTEX - Toluene	mg/kg		59000	<0.01	<0.01	<0.01	<0.01
BTEX - Ethyl Benzene	mg/kg		17000	<0.01	<0.01	<0.01	<0.01
BTEX - m & p Xylene	mg/kg		6200	<0.01	<0.01	<0.01	<0.01
BTEX - o Xylene	mg/kg		6900	<0.01	<0.01	<0.01	<0.01
MTBE	mg/kg			<0.01	<0.01	<0.01	<0.01
PAHs (Polycyclic Aromatic Hydrocarbons)							
Acenapthene	mg/kg		85000	<0.01	<0.01	<0.01	<0.01
Acenapthylene	mg/kg		84000	<0.01	<0.01	<0.01	<0.01
Anthracene	mg/kg		530000	<0.02	<0.02	<0.02	<0.02
Benzo(a)anthracene	mg/kg		90	<0.04	<0.04	<0.04	<0.04
Benzo(a)pyrene	mg/kg		14	0.04	<0.04	<0.04	<0.04
Benzo(b)fluoranthene	mg/kg		100	<0.05	<0.05	<0.05	<0.05
Benzo(ghi)perylene	mg/kg		650	<0.05	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	mg/kg		140	<0.07	<0.07	<0.07	<0.07
Chrysene	mg/kg		140	<0.06	<0.06	<0.06	<0.06
Dibenzo(ah)anthracene	mg/kg		13	<0.04	<0.04	<0.04	<0.04
Fluoranthene	mg/kg		23000	<0.08	<0.08	<0.08	<0.08
Fluorene	mg/kg		64000	<0.01	<0.01	<0.01	<0.01
Indeno(123-cd)pyrene	mg/kg		60	<0.03	<0.03	<0.03	<0.03
Napthalene	mg/kg		200	<0.03	<0.03	<0.03	<0.03
Phenanthrene	mg/kg		22000	0.04	<0.03	<0.03	<0.03
Pyrene	mg/kg		54000	<0.07	<0.07	<0.07	<0.07
Total PAH	mg/kg			0.09	<0.08	<0.08	<0.08
Organo Chlorine Pesticides (OCP) and Organo Phosphorous Pesticides (OPP)							
Mevinphos	ug/kg			<50		<50	
Dichlorvos	ug/kg		842000**	<50		<50	
Alpha-Hexachlorocyclohexane (HCH)	ug/kg		14000**	<50		<50	
Diazinon	ug/kg			<50		<50	
Gamma-Hexachlorocyclohexane (HCH/Lindane)	ug/kg		532000**	<50		<50	
Heptachlor	ug/kg			<50		<50	
Aldrin	ug/kg		54000**	<50		<50	
Beta-Hexachlorocyclohexane (HCH)	ug/kg		1120000**	<50		<50	
Methyl Parathion	ug/kg			<50		<50	
Malathion	ug/kg			<50		<50	
Fenitrothion	ug/kg			<50		<50	
Heptachlor Epoxide	ug/kg			<50		<50	
Parathion	ug/kg			<50		<50	
p,p'-DDE	ug/kg			<50		<50	
p,p'-DDT	ug/kg			<50		<50	
p,p'-Methoxychlor	ug/kg			<50		<50	
p,p'-TDE(DDD)	ug/kg			<50		<50	
o,p'-DDE	ug/kg			<50		<50	
o,p'-DDT	ug/kg			<50		<50	
o,p'-Methoxychlor	ug/kg			<50		<50	
o,p'-TDE(DDD)	ug/kg			<50		<50	
Endosulphan I	ug/kg		2310000**	<50		<50	
Endosulphan II	ug/kg		2580000**	<50		<50	
Endosulphan sulphate	ug/kg			<50		<50	
Endrin	ug/kg			<50		<50	
Ethion	ug/kg			<50		<50	
Dieldrin	ug/kg		90000**	<50		<50	
Azinphos methyl	ug/kg			<50		<50	
Triazines							
Ametryne	mg/kg			<0.2		<0.2	
Atraton	mg/kg			<0.2		<0.2	
Atrazine	mg/kg			<0.02		<0.02	
Cyanazine	mg/kg			<0.02		<0.02	
Prometon	mg/kg			<0.2		<0.2	
Prometryn	mg/kg			<0.02		<0.02	
Propazine	mg/kg			<0.02		<0.02	
Simazine	mg/kg			<0.02		<0.02	
Simetryn	mg/kg			<0.2		<0.2	
Terbuthylazine	mg/kg			<0.02		<0.02	
Terbutryn	mg/kg			<0.02		<0.02	

= Exceedence of GAC for an industrial/commercial end-use

= Exceedence due to limit of detection

All GACs calculated by RSK other than * = EIC/AGS/CLAIRE Generic Assessment Criteria; and ** = LQM/CIE

' = Based on Hazardous Waste Acceptance Criteria

APPENDIX D
GENERIC ASSESSMENT CRITERIA FOR PHYTOTOXIC EFFECTS

Several compounds can inhibit plant growth; hence it is important to have generic assessment criteria (GAC) to promote healthy plant growth. In the absence of other published GAC, the GAC have been obtained from legislation (UK and European) and guidance related to the use of sewage sludge on agricultural fields.

The Council of European Communities Sewage Sludge Directive (86/278/EEC) dated 1986, has been transposed into UK law by Statutory Instrument No. 1263, The Sludge (use in Agriculture) Regulations 1989 (Public Health England, Wales and Scotland), as amended in 1990 and The Sludge (use in Agriculture) Regulations (Northern Ireland) SR No, 245, 1990. In addition the Department of Environment (DoE) produced a Code of Practice (CoP) (Updated 2nd Edition) in 2006 which provided guidance on the application of sewage sludge on agricultural land (however the status of this document is unclear as it is on the archive section of the Defra website).

The directive seeks to encourage the use of sewage sludge in agriculture and to regulate its use in such a way as to "***prevent harmful effects on soil, vegetation, animals and man".*** To this end, it prohibits the use of untreated sludge on agricultural land unless it is injected or incorporated into the soil. Treated sludge is defined as having undergone "biological, chemical or heat treatment, long-term storage or any other appropriate process so as significantly to reduce its fermentability and the health hazards resulting from its use". To provide protection against potential health risks from residual pathogens, sludge must not be applied to soil in which fruit and vegetable crops are growing, or less than ten months before fruit and vegetable crops are to be harvested. Grazing animals must not be allowed access to grassland or forage land less than three weeks after the application of sludge.

The specified limits of concentrations of selected elements in soil are presented in Table 4 of the updated 2nd Edition of the DoE Code of Practice and are designed to protect plant growth. It is noted that these values are more stringent than the values set in current UK regulations. However since they were amended following recommendations from the Independent Scientific Committee in 1993. (MAFF/DOE 1993). The GAC are presented in Table 1.

Table 1: Generic assessment criteria

Determinant	Generic assessment criteria (mg/kg)			
	pH 5.0 < 5.5	pH 5.5 < 6.0	pH 6.0 < 7.0	pH >7.0
Zinc	200	200	200	300
Copper	80	100	135	200
Nickel	50	60	75	110
Lead	300	300	300	300
Cadmium	3	3	3	3
Mercury	1	1	1	1
Note: Only compounds with assessment criteria documented within the Directive 86/278/EEC have been included, although criteria for 5 additional compounds have been presented within the 2006 CoP.				

APPENDIX E
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.			

APPENDIX F
GENERIC ASSESSMENT CRITERIA FOR CONTROLLED WATERS

Generic assessment criteria for controlled waters

The water environment in England and Wales is protected under a number of regulatory regimes, many regulated by the Environment Agency. The Environment Agency is consulted where there may be a risk that pollution of 'controlled waters' may occur or may have occurred in the past. Controlled waters are coastal waters, inland freshwaters and groundwaters. The EU Water Framework Directive (WFD) (2000/60/EC) is implemented via various regulations and guidance, covering aspects of groundwater, surface water and drinking water supply policy. The regulations mainly apply to England and Wales, therefore if you are working on a site in Scotland or Northern Ireland, please review the equivalent legislation and guidance provided by the Scottish Environmental Protection Agency (SEPA) or the Northern Ireland Environment Agency (NIEA).

The main objectives of the protection and remediation of groundwater under threat from land contamination are set out in the Environment Agency's Groundwater Protection: Principles and Practice (GP3) series of documents(1). When assessing risks to groundwater the following need to be taken into consideration:

- Where pollutants have not yet entered groundwater, all necessary and reasonable measures must be taken to:
    - *Prevent the input of hazardous substances into groundwater (see description of hazardous substances below)*
    - *Limit the entry of other (non-hazardous) pollutants into groundwater so as to avoid pollution, and to avoid deterioration of the status of groundwater bodies or sustained, upward trends in pollutant concentration*
- Where hazardous substances or non-hazardous pollutants have already entered groundwater, the priority is to:
    - *Minimise further entry of hazardous substances and non-hazardous pollutants into groundwater*
    - *Take necessary and reasonable measures to limit the pollution of groundwater or impact on the status of the groundwater body from the future expansion of a contaminant 'plume', if necessary by actively reducing its extent.*

Definitions

Hazardous Substances are defined in the Water Framework Directive 2000/60/EC as 'substances or groups of substances that are toxic, persistent and liable to bio-accumulate, and other substances or groups of substances which give rise to an equivalent level of concern. All List 1 substances under the old Groundwater Directive (80/68/EEC) are hazardous substances, all radioactive substances are hazardous substances.

Non-hazardous Substances are defined as 'substances capable of causing pollution that have not been classified as hazardous substances'. The non-hazardous list of pollutants does not simply replace the old WFD List II but includes a wider range.

For the current list of classified substances please visit the UKTAG website www.wfduk.org./jagdag/

When assessing the risks to surface waters, various standards apply, including Environmental Quality Standards which are protective of the water ecology[14].

The Water Supply (Water Quality) Regulations[2,3] are the primary source for assessing water bodies which may be used for public water supplies. There are also Private Water Supply Regulations which may be applicable in some cases.

This appendix presents the generic assessment criteria (GAC) that RSK considers are suitable for assessing risks to controlled waters.

The RSK GAC for controlled waters are presented in Table 1. In line with the Environment Agency's (2006b) Remedial Targets Methodology, the GAC for controlled waters are termed 'target concentrations'.

The target concentration can be derived by several means with consideration to:

- whether the substance is classified as hazardous or non-hazardous by the EU under the Water Framework Directive (2000/60/EC) and Groundwater Daughter Directive (2006/118/EC) implemented though the Environmental Permitting Regulations 2010
- background concentrations in the aquifer
- published guidance such as Environmental Quality Standards that are protective of ecology or The Water Supply (Water Quality) Regulations 2010 that are protective of drinking water
- Minimum Reporting Values (or method detection limits if MRV are not provided).

Table 1: Target concentrations for Controlled Waters

Analytes in bold are hazardous, *analytes in italics are non hazardous*, analytes in plain text are unclassified; according to JAGDAG Determination List June 2010

Target Concentrations shaded in GREEN are Statutory Values ORANGE are Non-Statutory Values

Determinant	Target concentrations (mg/l)			
	Minimum Reporting Value	UK Drinking Water Standard or Best Equivalent	Environmental Quality Standard or Best Equivalent	
			Freshwater	Transitional (estuaries) and Coastal Waters
Metals				
Arsenic	-	0.01[2]	0.05[13a]	0.025[13a]
Cadmium	0.0001[4]	0.005[2]	≤0.00008, 0.00008, 0.00009, 0.00015, 0.00025 [13b]	0.0002[13c]
Chromium (total)	-	0.05[2]	Use values for chromium III and VI	
Chromium (III)	-	Use value for total chromium	0.0047 [13a]	0.032[13c]
Chromium (VI)			0.0034 [13a]	0.0006[13a]
Copper	-	2.0[2]	0.001, 0.006, 0.01, 0.028[13e]	0.005[13a]
Lead	-	0.025 (before 25/12/2013), 0.01 (after 25/12/2013)[2]	0.0072[13c]	0.0072[13c]
Mercury	0.00001[4]	0.001[2]	0.00005[13c]	0.00005[13c]

Determinant	Target concentrations (mg/l)			
	Minimum Reporting Value	UK Drinking Water Standard or Best Equivalent	Environmental Quality Standard or Best Equivalent	
			Freshwater	Transitional (estuaries) and Coastal Waters
Nickel	-	0.02[2]	0.02[13c]	0.02[13c]
Selenium	-	0.01[2]	-	-
Zinc	-	5[3]	0.008, 0.05, 0.075, 0.125 [13e]	0.04[13a]
Chlorinated solvents				
Trichloroethene	0.0001[4]	0.01[2]	0.01[13c]	0.01[13c]
Tetrachloroethene	0.0001[4]	0.01[2]	0.01[13c]	0.01[13c]
1,1,1-Trichloroethane	0.0001[4]	-	0.1[13c]	0.1[13c]
1,1,2-Trichloroethane	0.0001[4]	-	0.4[13c]	0.3[13c]
Carbon tetrachloride (Tetrachloromethane)	0.0001[4]	0.003[2]	0.012[13c]	0.012[13c]
1,2-Dichloroethane	0.001[4]	0.003[2]	0.01[13c]	0.01[13c]
Vinyl chloride (Chloroethene)	-	0.0005[2]	-	-
Trihalomethanes	-	0.1[2, 5]	-	-
Chloroform (Trichloromethane) (one of the trihalomethanes included above)	0.0001[4]	0.1[2, 5]	0.0025[13c]	0.0025[13c]
Polycyclic aromatic hydrocarbons				
Acenaphthene	-	-	0.0058[10]	
Acenaphthylene	-	-	0.0058[10]	
Anthracene	-	-	0.0001[13c]	0.0001[13c]

Determinant	Target concentrations (mg/l)			
	Minimum Reporting Value	UK Drinking Water Standard or Best Equivalent	Environmental Quality Standard or Best Equivalent	
			Freshwater	Transitional (estuaries) and Coastal Waters
Benzo(a)anthracene	-	-	0.000018[10]	
Benzo(b)fluoranthene	-	0.0001[2]	0.00003[13f]	0.00003[13f]
Benzo(k)fluoranthene	-			
Benzo(g,h,i)perylene	-		0.000002[13g]	0.000002[13g]
Indeno(1,2,3-cd)pyrene	-			
Chrysene	-	-	0.00001[10]	
Dibenzo(a,h)anthracene	-	-	0.00001[10]	
Fluoranthene	-	-	0.0001[13c]	0.0001[13c]
Fluorene	-	-	0.0021[10]	
Phenanthrene	-	-	0.003[10]	
Pyrene	-	-	0.00004[10]	
Benzo(a)pyrene	-	0.00001[2]	0.00005[13c]	0.00005[13c]
Naphthalene	-	-	0.0024[13c]	0.0012[13c]
Petroleum hydrocarbons				
Total petroleum hydrocarbons	-	0.01[3]	0.01[3, 11]	
Benzene	0.001[4]	0.001[2]	0.01[13c]	0.008[13c
Toluene	0.004[4]	0.7[9]	0.05[13a]	0.04[13a]
Ethylbenzene	-	0.3[9]	0.02[12]	0.02[12]
Xylene	0.003[4]	0.5[9]	0.03[13c]	0.03[13c]

Determinant	Target concentrations (mg/l)			
	Minimum Reporting Value	UK Drinking Water Standard or Best Equivalent	Environmental Quality Standard or Best Equivalent	
			Freshwater	Transitional (estuaries) and Coastal Waters
Methyl tertiary butyl ether	-	0.015[7]		
Pesticides and herbicides				
Aldrin	0.000003[4]	0.00003[2]	0.00001[13d]	0.000005[13d]
Dieldrin	0.003[4]	0.00003[2]		
Endrin	0.000003[4]	0.0006[9]		
Isodrin	0.000003[4]	-		
Heptachlor	-	0.00003[2]		
Heptachlor epoxide	-	0.00003[2]		
Other pesticides	-	0.0001[2]		
Total pesticides	-	0.0005[2]		
Total DDT	0.000004[4]	0.001[9]	0.000025[13c]	0.000025[13c]
Azinphos – methyl	0.000001[4]	-	0.00001[1]	
Cyfluthrin	0.0001[4]	-	0.000001[14]	
Demeton	0.00005[4]	-	0.0005[14	
Dichlorvos	-	-	0.000001[13c]	0.00004[13c]
Dimethoate	0.00001[4]	-	0.00048[13a]	0.00048[13a]
Endosulphan	0.000005[4]	-	0.000005[13c]	0.0000005[13c]
Fenitrothion	0.000001[4]	-	0.00001[13c]	0.00001[13c]
Flucofuron	0.0001[4]	-	0.001[14]	

Determinant	Target concentrations (mg/l)			
	Minimum Reporting Value	UK Drinking Water Standard or Best Equivalent	Environmental Quality Standard or Best Equivalent	
			Freshwater	Transitional (estuaries) and Coastal Waters
Malathion	0.000001[4]	-	0.00001[13c]	0.00002[13c]
Mevinphos	0.000005[4]	-	0.00002[14]	-
Omethoate	0.0001[4]	-	0.00001[14]	
PCSDs (cyfluthrin, sulcofuron, flucofuron and **permethrin**)	-	-	0.00005[15]	
Permethrin	0.000001[4]	-	0.00001[13a]	0.00001[13]
Sulcofuron	0.0001[4]	-	0.025[8,14]	
Triazaphos	0.0001[4]	-	0.000005[8]	
Atrazine	0.00003[4]	-	0.0006[13c]	0.0006[13c]
Simazine	0.00003[4]	-	0.001[13c]	0.001[13c]
Bentazone	0.1[4]	-	0.5[13c]	0.5[13a]
Linuron	0.0001[4]	-	0.0005[13a]	0.0005[13a]
Mecoprop	0.00004[4]	-	0.018[13a]	0.018[13a]
Trifluralin	0.00001[4]	-	0.00003[13c]	0.00003[13c]
Miscellaneous				
Cyanide (Hydrogen cyanide)	-	0.05[2]	0.001[13a]	0.001[13a]
Phenol	0.0005[4]	-	0.0077[13a]	0.0077[13a]
Sodium	-	200[2]	-	
Chloride	-	250[2]	250[6,14]	-

Determinant	Target concentrations (mg/l)			
	Minimum Reporting Value	UK Drinking Water Standard or Best Equivalent	Environmental Quality Standard or Best Equivalent	
			Freshwater	Transitional (estuaries) and Coastal Waters
Ammonium (as NH_4^+)	-	0.5[2]	0.3[13a]	
Ammonia (NH_3)	-	-	0.025[15]	0.021[13a]
Sulphate	-	250[2]	400[6,14]	-
Iron	-	0.20[2]	1[13a]	1[13a]
Manganese	-	0.05[2]	0.03[6,14]	No EQS required [12]
Aluminium	-	0.2[2]	-	
Nitrate (as NO_3)	-	50[2]	-	
Nitrite (as NO_2)	-	0.1[2]	0.01[15]	-

Analytes in bold are hazardous, *analytes in italics are non hazardous*, analytes in plain text are unclassified;
according to JAGDAG Determination List June 2010

Notes:

1. Environment Agency. Groundwater Protection: Principles and Policy (GP3). Part 1 – 4. Part 4 and 5 under consultation.
2. Statutory Instrument 2000 No. 3184. The Water Supply (Water Quality) Regulations 2000, as amended by SI 2001/2885, SI 2002/2469, SI 2005/2035, SI 2007/2734 and SI 2010/991 (applying from April 20 2010)
3. Statutory Instrument 1989 No. 1147. The Water Supply (Water Quality) Regulations 1989, as amended.
4. Minimum reporting values listed in Annex (j) of Horizontal Guidance Note H1 (H1 Environmental Risk Assessment Framework, Environment Agency, April 2010 v2.0). Note target concentration for xylenes is 0.003mg/l each for o-xylene and m/p xylene.
5. Statutory Instrument 2000 No. 3184. The Water Supply (Water Quality) Regulations 2000 – sum of chloroform, bromoform, dibromochloromethane and bromodichloromethane.
6. Proposed list of EQS for implementation of the Dangerous Substances Directive (76/464.EEC).
7. Environment Agency MTBE guidance, 2006.
8. Freshwater Environmental Quality Standards: The Water Framework Directive 200/60/EC.
9. WHO (2004) guidelines for drinking-water quality.
10. WRc plc (2002), R&D Technical Report P45. Where predicted no-effect concentration is below the laboratory method detection limit (LMDL) for chrysene, dibenzo(a,h)anthracene and fluoranthene, the target concentration has been set at the LMDL of 0.00001mg/l.
11. Please note this is a very conservative value. If necessary please refer to EA, 2009. *Petroleum hydrocarbons in Groundwater Supplementary Guidance for Hydrogeological Risk Assessment, which* provides advice on risk rankings of TPH CWG fractions. It may be possible to eliminate low risk fractions and/or those not detected above LMDL from concern.
12. Environment Agency Chemical Standards Database (May 2011). http://evidence.environment-agency.gov.uk/ChemicalStandards/home.aspx
13. The River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Directions 2010.
    - 13a. Annual mean concentration (mg/l) for 'Good' standard.
    - 13b. Applies to hardness ranges of <40mg/l $CaCO_3$, 40–<50mg/l $CaCO_3$, 50–<100mg/l $CaCO_3$, 100–<200mg/l $CaCO_3$ and >/=200mg/l $CaCO_3$. The target concentrations included in Table 1 are listed in order of increasing calcium carbonate concentrations.
    - 13c Annual Average EQS (surface waters).
    - 13d. Sum of aldrin, dieldrin, endrin and isodrin.
    - 13e. Applies to hardness ranges of 0–50mg/l $CaCO_3$, 50–100mg/l $CaCO_3$, 100–250mg/l $CaCO_3$ and >250mg/l $CaCO_3$. The target concentrations included in Table 1 are listed in order of increasing calcium carbonate concentrations; applies to annual mean concentration (mg/l) of $CaCO_3$. Applies to annual mean concentration of metal (mg/l) for 'Good' standard.

13f. Sum of benzo(b)fluoranthene and benzo(k)fluoranthene.

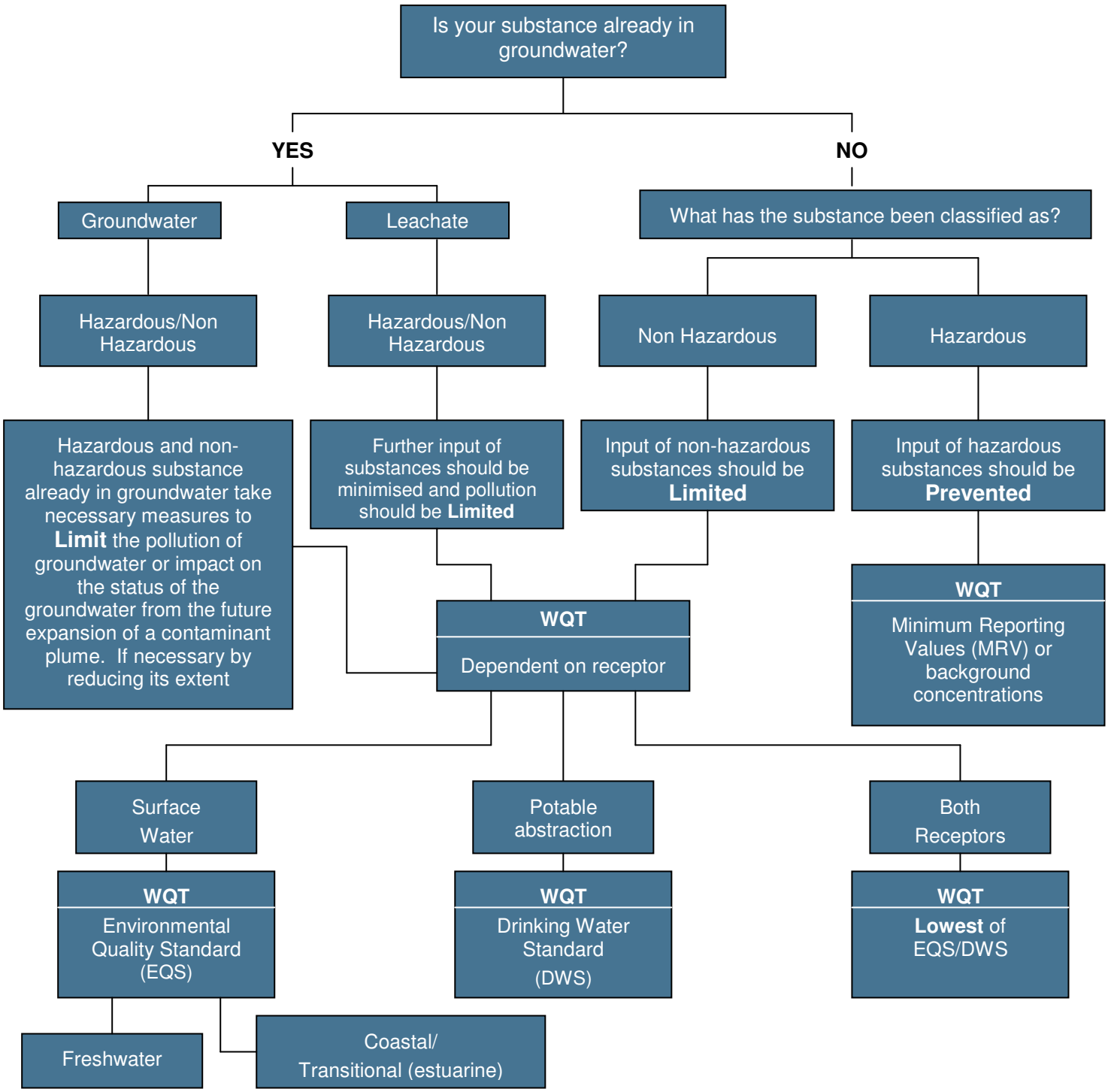
13g. Sum of benzo(g,h,i)perylene and indeno(1,2,3-cd)pyrene.

14. Council Directive on Pollution Caused by Certain Dangerous Substances Discharged into the Aquatic Environment of the Community (Dangerous Substances Directive) - List II Substances. Council Directive 76/464/EEC and Surface Waters (Dangerous Substances) (Classification) Regulations 1998

15. Council Directive on the Quality of Fresh Waters Needing Protection or Improvement in Order to Support Fish Life (Freshwater Fish Directive). Surface Waters (Fishlife) (Classification) Regulations 1997.

Note: '-' A target concentration is not available.

FLOW CHART TO ASSIST WITH SELECTION OF TARGET CONCENTRATIONS



WQT = Water Quality Target

When leachate is being assessed the 'compliance point' is the groundwater body. Therefore dilution within the groundwater body may be applied with caution before comparing with the WQT.

When directly assessing a receptor, e.g., a river, the appropriate WQT should be selected.

APPENDIX G
COMPARISON OF GROUNDWATER LABORATORY DATA TO CONTROLLED WATERS GAC

312494 - East Midlands Gateway - Zone 1 - Controlled Waters Risk Assessment Groundwater Results Summary Table and Direct Comparison

Sample Identity		Tier 2 Target Concentration (LTC2)								CPR206	CPR204	CP220	CP210	CP213	CP217	CP212	CP204
Depth										14.68							
Strata		Freshwater EQS	Saltwater EQS	EC EQSD Fresh	EC EQSD Saline	UK/EC DWS	WHO DWS	Dutch Intervention Value	US Regional Screening Levels (RSLs) - Tapwater								
Determinants	**Units**																
pH	pH	6 to 9	7 to 9			6.5-9.5				7.11	7.2	8.14	8.03	7.91	7.92	8.05	8
Redox potential	mV									239	232	246	263	274	284	287	259
Electrical conductivity @ 20oC	us/cm									1040	675	1220	1030	868	2690	847	645
Dissolved oxygen	mg/l									3.7	6.2	8.6	5.8	7.6	3.7	6.1	8.1
Hardness	mg/l Ca CO3									552	447	458	493	522	838	499	383
Ammonical Nitrogen NH3 + NH4)	mg/l	0.25 (REQ)								0.09	0.03	0.21	0.09	0.6	0.31	0.18	0.06
Phenols (total)	mg/l	0.03				0.005				<0.01	<0.01	0.02	0.05	<0.01	<0.01	<0.01	0.01
Metals																	
Arsenic (dissolved)	µg/l	50	25			10				<1	<1	1	1	<1	1	<1	<1
Boron (dissolved)	µg/l	2000	700			1000				50	25	48	62	52	82	53	22
Cadmium (dissolved)	µg/l	5	2.5			5				<1	<1	<1	<1	<1	<1	<1	<1
Copper (dissolved)	µg/l	28	5			2000				2	2	2	2	2	4	2	<1
Chromium (dissolved) (III + VI)	µg/l	50	15			50				<1	<1	<1	<1	<1	<1	<1	<1
Chromium (dissolved) (VI)	µg/l	3.4	0.6							<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lead (dissolved)	µg/l	20	25			25				<1	<1	<1	<1	<1	<1	<1	<1
Mercury (dissolved)	µg/l	1	0.03			1				0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel (dissolved)	µg/l	200	20			20				1	<1	3	3	1	3	1	<1
Selenium (dissolved)	µg/l					10				<1	<1	39	1	<1	4	<1	<1
Zinc (dissolved)	µg/l	125	40			5000				6	6	7	9	2	4	6	<1
Total Petroleum Hydrocarbons Criteria Working Group (TPHCWG)																	
BTEX - Benzene	µg/l	30	30			1				<1	<1	<1	<1	<1	<1	<1	<1
BTEX - Ethyl Benzene	µg/l	20	20				300			<1	<1	<1	<1	<1	<1	<1	<1
BTEX - Toluene	µg/l	50	40				700			<1	<1	<1	<1	<1	<1	<1	<1
BTEX - m & p Xylene	µg/l									<1	<1	<1	<1	<1	<1	<1	<1
BTEX - o Xylene	µg/l									<1	<1	<1	<1	<1	<1	<1	<1
Sum of xylenes	µg/l	30	30				500			<1	<1	<1	<1	<1	<1	<1	<1
MTBE	µg/l							9200		<1	<1	<1	<1	<1	<1	<1	<1
Ali >C5-C6	µg/l					10				<1	<1	<1	<1	<1	<1	<1	<1
Ali >C6-C8	µg/l					10				<1	<1	<1	<1	<1	<1	<1	<1
Ali >C8-C10	µg/l					10				<1	<1	<1	<1	<1	<1	<1	<1
Ali >C10-C12	µg/l					10				<5	<5	<5	<5	<5	<5	<5	<5
Ali >C12-C16	µg/l					10				<5	<5	<5	<5	<5	<5	<5	<5
Ali >C16-C21	µg/l					10				<5	<5	<5	<5	<5	<5	<5	<5
Ali >C21-C35	µg/l					10				<5	<5	<5	<5	<5	<5	<5	<5
Total Aliphatics	µg/l									<5	<5	<5	<5	<5	<5	<5	<5
Aro >C5-C7	µg/l					10				<1	<1	<1	<1	<1	<1	<1	<1
Aro >C7-C8	µg/l					10				<1	<1	<1	<1	<1	<1	<1	<1
Aro >C8-C9	µg/l					10				<1	<1	<1	<1	<1	<1	<1	<1
Aro >C9-C10	µg/l					10				<1	<1	<1	<1	<1	<1	<1	<1
Aro >C10-C12	µg/l					10				<5	<5	<5	<5	<5	<5	<5	<5
Aro >C12-C16	µg/l					10				<5	<5	<5	<5	<5	<5	<5	<5
Aro >C16-C21	µg/l					10				<5	<5	<5	<5	<5	<5	<5	<5
Aro >C21-C35	µg/l					10				<5	<5	<5	<5	<5	<5	<5	<5
Total Aromatics	µg/l									<5	<5	<5	<5	<5	<5	<5	<5
TPH (Ali & Aro)	µg/l									<5	<5	<5	<5	<5	<5	<5	<5
PAHs (Polycyclic Aromatic Hydrocarbons)																	
Acenapthene	µg/l								2200	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Acenapthylene	µg/l									<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Anthracene	µg/l			0.1	0.1					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Benzo(a)anthracene	µg/l							0.5		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Benzo(a)pyrene	µg/l	0.03	0.05			0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Benzo(b)fluoranthene	µg/l			0.03	0.03	0.025*				<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	-
Benzo(ghi)perylene	µg/l			0.002	0.002	0.025*				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Benzo(k)fluoranthene	µg/l			0.03	0.03	0.025*				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Chrysene	µg/l							0.2		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Dibenzo(ah)anthracene	µg/l								0.0029	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Fluoranthene	µg/l			0.1	0.1				1500	0.01	<0.01	0.02	<0.01	<0.01	0.02	<0.01	-
Fluorene	µg/l								240	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Indeno(123-cd)pyrene	µg/l			0.002	0.002	0.025*				<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	-
Naphthalene	µg/l	10	5							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Phenanthrene	µg/l							5		<0.01	<0.01	0.02	<0.01	<0.01	0.01	<0.01	-
Pyrene	µg/l								1100	<0.01	<0.01	0.03	<0.01	0.01	0.02	0.01	-
Total PAH	µg/l					0.1*				0.01	<0.01	0.08	<0.01	0.01	0.06	0.02	-
Volatile Organic Compounds (VOCs)																	
Dichlorodifluoromethane	µg/l									<1	<1	<1	<1	<1	<1	<1	<1
Chloromethane	µg/l								190	<1	<1	<1	<1	<1	<1	<1	<1
Vinyl Chloride	µg/l					0.5				<1	<1	<1	<1	<1	<1	<1	<1
Bromomethane	µg/l									<1	<1	<1	<1	<1	<1	<1	<1
Chloroethane	µg/l									<1	<1	<1	<1	<1	<1	<1	<1
Trichlorofluoromethane	µg/l									<1	<1	<1	<1	<1	<1	<1	<1
trans-1,2-Dichloroethylene :- {trans-1,2-Dichloroethene}	µg/l								110	<1	<1	<1	<1	<1	<1	<1	<1
Dichloromethane :- {Methylene Dichloride}	µg/l	2000	2000				20			<100	<100	<100	<100	<100	<100	<100	<100
Carbon Disulphide	µg/l									<1	<1	<1	<1	<1	<1	<1	<1
1,1-Dichloroethane	µg/l							900		<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dichloroethane	µg/l	10	10			13				<1	<1	<1	<1	<1	<1	<1	<1
cis-1,2-Dichloroethylene :- {cis-1,2-Dichloroethene}	µg/l					3				<1	<1	<1	<1	<1	<1	<1	<1
Bromochloromethane	µg/l									<5	<5	<5	<5	<5	<5	<5	<5
Chloroform :- {Trichloromethane}	µg/l	12	12				300			<25	<25	<25	<25	<25	<25	<25	<25
2,2-Dichloropropane	µg/l							80		<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dichloroethane	µg/l									<2	<2	<2	<2	<2	<2	<2	<2
1,1,1-Trichloroethane	µg/l	100	100							<1	<1	<1	<1	<1	<1	<1	<1
1,1-Dichloropropylene :- {1,1-Dichloropropene}	µg/l									<1	<1	<1	<1	<1	<1	<1	<1
Benzene	µg/l	30	30			1				<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride :- {Tetrachloromethane}	µg/l	12	12			3				<1	<1	<1	<1	<1	<1	<1	<1
Dibromomethane	µg/l								8.2	<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dichloropropane	µg/l						40			<1	<1	<1	<1	<1	<1	<1	<1
Bromodichloromethane	µg/l						60			<10	<10	<10	<10	<10	<10	<10	<10
Trichloroethylene :- {Trichloroethene}	µg/l	10	10			10				<1	<1	<1	<1	<1	<1	<1	<1
cis-1,3-Dichloropropylene :- {cis-1,3-Dichloropropene}	µg/l								40	<1	<1	<1	<1	<1	<1	<1	<1
trans-1,3-Dichloropropylene :- {trans-1,3-Dichloropropene}	µg/l								40	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2-Trichloroethane	µg/l	400	300							<1	<1	<1	<1	<1	<1	<1	<1
Toluene :- {Methylbenzene}	µg/l	50	40				700			<1	<1	<1	<1	<1	<1	<1	<1
1,3-Dichloropropane	µg/l							80		<1	<1	<1	<1	<1	<1	<1	<1
Dibromochloromethane	µg/l									<3	<3	<3	<3	<3	<3	<3	<3
1,2-Dibromoethane	µg/l						0.4			<1	<1	<1	<1	<1	<1	<1	<1
Tetrachloroethylene :- {Perchloroethylene}	µg/l	10	10			10				<1	<1	<1	<1	<1	<1	<1	<1
1,1,1,2-Tetrachloroethane	µg/l								1100	<1	<1	<1	<1	<1	<1	<1	<1
Chlorobenzene	µg/l						10			<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	µg/l	20	20				300			<1	<1	<1	<1	<1	<1	<1	<1
m & p Xylene	µg/l									<1	<1	<1	<1	<1	<1	<1	<1
Bromoform :- {Tribromomethane}	µg/l						100			<1	<1	<1	<1	<1	<1	<1	<1
Styrene :- {Vinylbenzene}	µg/l	50	50				20			<1	<1	<1	<1	<1	<1	<1	<1
1,1,2,2-Tetrachloroethane	µg/l								150	<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dimethylbenzene :- {o-Xylene}	µg/l	30	30							<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-Trichloropropane	µg/l								0.62	<1	<1	<1	<1	<1	<1	<1	<1
Isopropylbenzene	µg/l									<1	<1	<1	<1	<1	<1	<1	<1
Bromobenzene	µg/l								88	<1	<1	<1	<1	<1	<1	<1	<1
2-Chlorotoluene :- {1-Chloro-2-methylbenzene}	µg/l								730	<1	<1	<1	<1	<1	<1	<1	<1
n-Propylbenzene :- {1-phenylpropane}	µg/l								1300	<1	<1	<1	<1	<1	<1	<1	<1
4-Chlorotoluene :- {1-Chloro-4-methylbenzene}	µg/l									<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-Trimethylbenzene	µg/l								15	<1	<1	<1	<1	<1	<1	<1	<1
4-Isopropyltoluene :- {4-methyl-Isopropylbenzene}	µg/l									<1	<1	<1	<1	<1	<1	<1	<1
1,3,5-Trimethylbenzene :- {Mesitylene}	µg/l								370	<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dichlorobenzene	µg/l						1000			<1	<1	<1	<1	<1	<1	<1	<1
1,4-Dichlorobenzene	µg/l						300			<1	<1	<1	<1	<1	<1	<1	<1
sec-Butylbenzene :- {1-Methylpropylbenzene}	µg/l									<1	<1	<1	<1	<1	<1	<1	<1
tert-Butylbenzene :- {(1,1-Dimethylethyl)benzene}	µg/l									<2	<2	<2	<2	<2	<2	<2	<2
1,3-Dichlorobenzene	µg/l									<1	<1	<1	<1	<1	<1	<1	<1
n-Butylbenzene :- {1-Phenylbutane}	µg/l									<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dibromo-3-chloropropane	µg/l						1			<2	<2	<2	<2	<2	<2	<2	<2
1,2,4-Trichlorobenzene	µg/l									<3	<3	<3	<3	<3	<3	<3	<3
1,2,3-Trichlorobenzene	µg/l									<3	<3	<3	<3	<3	<3	<3	<3
Hexachlorobutadiene	µg/l									<1	<1	<1	<1	<1	<1	<1	<1
Semi-Volatile Organic Compounds (SVOCs)																	
1,2,4-Trichlorobenzene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
1,2-Dichlorobenzene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
1,3-Dichlorobenzene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
1,4-Dichlorobenzene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
2,4,5-Trichlorophenol	ug/l									<1	<1	<1	<1	<1	<1	<1	-
2,4,6-Trichlorophenol	ug/l									<1	<1	<1	<1	<1	<1	<1	-
2,4-Dichlorophenol	ug/l									<1	<1	<1	<1	<1	<1	<1	-
2,4-Dimethylphenol	ug/l									<1	<1	<1	<1	<1	<1	<1	-
2,4-Dinitrotoluene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
2,6-Dinitrotoluene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
2-Chloronaphthalene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
2-Chlorophenol	ug/l									<1	<1	<1	<1	<1	<1	<1	-
2-Methylnaphthalene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
2-Methylphenol	ug/l									<1	<1	<1	<1	<1	<1	<1	-
2-Nitrophenol	ug/l									<1	<1	<1	<1	<1	<1	<1	-
4-Bromophenyl phenyl ether	ug/l									<1	<1	<1	<1	<1	<1	<1	-
4-Chloro-3-methylphenol	ug/l									<1	<1	<1	<1	<1	<1	<1	-
4-Methylphenol	ug/l									<1	<1	<1	<1	<1	<1	<1	-
4-Nitrophenol	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Acenaphthene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Acenaphthylene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Anthracene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Bis(2-chloroethyl)ether	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Bis(2-chloroethoxy)methane	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Bis(2-ethylhexyl)phthalate	ug/l									<2	<2	<2	<2	<2	<2	<2	-
Benzo(a)anthracene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Benzyl butyl phthalate	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Benzo(b)fluoranthene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Benzo(k)fluoranthene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Benzo(a)pyrene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Benzo(ghi)perylene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Carbazole	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Chrysene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Dibenzofuran	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Di-n-butylphthalate	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Di-n-octylphthalate	ug/l									<5	<5	<5	<5	<5	<5	<5	-
nNitrosodi-n-propylamine	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Diethylphthalate	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Dimethylphthalate	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Dibenzo(ah)anthracene	ug/l									<1	<1	<1	<1	<1	<1	<1	-

Sample Identity		Tier 2 Target Concentration (LTC2)								CPR206	CPR204	CP220	CP210	CP213	CP217	CP212	CP204
Depth										14.68							
Strata		Freshwater EQS	Saltwater EQS	EC EQSD Fresh	EC EQSD Saline	UK/EC DWS	WHO DWS	Dutch Intervention Value	US Regional Screening Levels (RSLs) - Tapwater								
Determinants	Units																
Fluorene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Fluoranthene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Hexachlorobutadiene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Hexachlorobenzene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Pentachlorophenol	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Phenol	ug/l									4	<1	<1	<1	<1	<1	<1	-
Hexachloroethane	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Nitrobenzene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Naphthalene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Isophorone	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Hexachlorocyclopentadiene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Phenanthrene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Pyrene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Indeno(1,2,3cd)pyrene	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Bis(2-chloroisopropyl) ether	ug/l									<1	<1	<1	<1	<1	<1	<1	-
2,4-Dinitrophenol	ug/l									<1	<1	<1	<1	<1	<1	<1	-
4,6-Dinitro-2-methylphenol	ug/l									<1	<1	<1	<1	<1	<1	<1	-
Perylene	ug/l									<1	<1	<1	<1	<1	<1	<1	-

= exceedance of Tier 2 target concentrations

* = Total PAH EQS (0.1) assessed via comparsion of guideline value to 4 compounds (benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene and indeno(1,2,3-cd)perylene)

** = assessed using the guidance value for benzene

APPENDIX H
GROUND GAS RISK ASSESSMENT

Revised Wilson and Card Classification Ground Gas Risk Assessment

Job No.:	312494
Client:	Roxhill Developments Limited
Site:	East Midlands Gateway - Zone 1

For low-rise residential developments without a clear ventilated sub-floor void, flats and commercial / industrial sites

Characteristic Situation	Risk	GSV
1	Very Low	0.07
2	Low	0.7
3	Moderate	3.5
4	Moderate to High	15
5	High	70
6	Very High	>70

From CIRIA Report 659 (2006) "Assessing Risks Posed By Hazardous Ground Gases To Buildings", Wilson et al.

KEY:

GSV Gas Screening Value

GSV cannot be calculated on a site-specific basis

GSV indicates very low risk

GSV indicates low to moderate risk

GSV indicates moderate or greater risk; Concentrations of CH4 ≥20%V/V; CO2 ≥30%V/V

Oxygen concentration ≤10%v/v

Total ground gas concentrations >100%v/v

		CH4 I	CH4 SS	CO2 I	CO2 SS	O2 I	O2 SS	Flow	Baro	BH Press	I SUM	SS SUM	GSV		
BH NO.	DATE	%v/v	%v/v	%v/v	%v/v	%v/v	%v/v	l/hr	mbar	mbar	%v/v	%v/v	CH4	CO2	CS No.
CP203	16/10/2013	<0.1	<0.1	0.1	1.6	20.7	19.0		1003	1003	20.8	20.6	0.00	0.00	CS1
	23/10/2013	<0.1	<0.1	<0.1	2.0	20.8	18.7	0	987	987	20.8	20.7	0.00	0.00	CS1
	30/10/2013	<0.1	0.1	0.1	1.5	20.8	18.4	0	1010	1010	20.9	20.0	0.00	0.00	CS1
	12/11/2013	<0.1	<0.1	0.1	1.3	20.8	17.9	0.3	1020	1020	20.9	19.2	0.00	0.00	CS1
CP204	17/10/2013	<0.1	<0.1	<0.1	1.4	20.8	15.8		1010	1010	20.8	17.2	0.00	0.00	CS1
	22/10/2013	<0.1	<0.1	0.1	1.7	20.8	16.7	0	983	983	20.9	18.4	0.00	0.00	CS1
	30/10/2013	<0.1	<0.1	0.1	0.9	20.8	17.5	0	1009	1009	20.9	18.4	0.00	0.00	CS1
	12/11/2013	<0.1	<0.1	0.1	0.1	20.8	20.5	0	1020	1020	20.9	20.6	0.00	0.00	CS1
CP205	16/10/2013	<0.1	<0.1	0.1	1.2	20.7	19.7		1003	1003	20.8	20.9	0.00	0.00	CS1
	23/10/2013	<0.1	<0.1	0.1	1.4	20.8	18.6	0	987	987	20.9	20.0	0.00	0.00	CS1
	30/10/2013	<0.1	<0.1	0.1	1.1	20.8	18.8	-2.5	1010	1012	20.9	19.9	0.00	-0.03	CS1
	12/11/2013	<0.1	<0.1	0.1	1.2	20.8	19.0	1	1020	1020	20.9	20.2	0.00	0.01	CS1
CP206	16/10/2013	<0.1	<0.1	0.1	2.8	20.8	15.7		1003	1003	20.9	18.5	0.00	0.00	CS1
	22/10/2013	<0.1	<0.1	0.1	3.5	20.8	12.7	0.4	988	988	20.9	16.2	0.00	0.01	CS1
	30/10/2013	<0.1	<0.1	0.1	2.7	20.8	14.9	-0.7	1012	1012	20.9	17.6	0.00	-0.02	CS1
	11/11/2013	<0.1	<0.1	0.1	3.4	20.8	12.3	0	1017	1017	20.9	15.7	0.00	0.00	CS1
CP207	16/10/2013	<0.1	<0.1	0.1	1.5	20.7	17.8		1003	1003	20.8	19.3	0.00	0.00	CS1
	23/10/2013	<0.1	<0.1	<0.1	1.9	20.8	18.5	0	987	987	20.8	20.4	0.00	0.00	CS1
	30/10/2013	<0.1	<0.1	0.1	1.9	20.8	18.0	0	1010	1010	20.9	19.9	0.00	0.00	CS1
	12/11/2013	<0.1	<0.1	0.1	1.9	20.8	17.5	0.1	1017	1017	20.9	19.4	0.00	0.00	CS1
CP208	16/10/2013	<0.1	<0.1	<0.1	1.2	20.7	17.3		1003	1003	20.7	18.5	0.00	0.00	CS1
	24/10/2013	<0.1	<0.1	0.1	1.3	20.8	15.6	-0.1	1005	1005	20.9	16.9	0.00	0.00	CS1
	30/10/2013	<0.1	<0.1	0.1	1.1	20.8	16.0	-0.1	1009	1009	20.9	17.1	0.00	0.00	CS1
	11/11/2013	<0.1	<0.1	0.1	1.0	20.8	15.5	0.9	1016	1017	20.9	16.5	0.00	0.01	CS1
CP210	17/10/2013	<0.1	<0.1	<0.1	0.5	20.8	18.3		1012	1010	20.8	18.8	0.00	0.00	CS1
	23/10/2013	<0.1	<0.1	<0.1	0.4	20.8	19.7	0.1	984	984	20.8	20.1	0.00	0.00	CS1
	30/10/2013	<0.1	<0.1	0.1	0.8	20.8	19.3	0	1009	1009	20.9	20.1	0.00	0.00	CS1
	12/11/2013	<0.1	<0.1	0.1	2.0	20.8	15.9	1.6	1019	1020	20.9	17.9	0.00	0.03	CS1
CP211	17/10/2013	<0.1	<0.1	<0.1	2.0	20.8	11.8		1010	1010	20.8	13.8	0.00	0.00	CS1
	24/10/2013	<0.1	<0.1	<0.1	2.6	20.8	10.9	-0.1	1005	1005	20.8	13.5	0.00	0.00	CS1
	30/10/2013	<0.1	<0.1	0.1	1.8	20.8	14.5	-0.1	1008	1009	20.9	16.3	0.00	0.00	CS1
	12/11/2013	<0.1	<0.1	0.1	0.8	20.8	17.3	0.1	1018	1020	20.9	18.1	0.00	0.00	CS1
CP212	17/10/2013	<0.1	<0.1	<0.1	2.3	20.8	18.4		1010	1010	20.8	20.7	0.00	0.00	CS1
	23/10/2013	<0.1	<0.1	<0.1	3.2	20.8	16.8	0.1	984	984	20.8	20.0	0.00	0.00	CS1
	30/10/2013	<0.1	<0.1	0.1	1.8	20.8	19.1	0.4	1007	1009	20.9	20.9	0.00	0.01	CS1
	12/11/2013	<0.1	<0.1	0.1	2.8	20.8	17.5	-1.6	1020	1020	20.9	20.3	0.00	-0.04	CS1
CP213	17/10/2013	<0.1	<0.1	<0.1	1.6	20.8	18.1		1010	1010	20.8	19.7	0.00	0.00	CS1
	23/10/2013	<0.1	<0.1	<0.1	2.1	20.8	17.6	0.2	983	983	20.8	19.7	0.00	0.00	CS1
	30/10/2013	<0.1	<0.1	0.1	2.4	20.8	17.0	2.5	1012	1012	20.9	19.4	0.00	0.06	CS1
	12/11/2013	<0.1	<0.1	0.1	2.0	20.8	17.5	0.3	1020	1020	20.9	19.5	0.00	0.01	CS1
CP214	17/10/2013	<0.1	<0.1	<0.1	3.5	20.8	16.0		1011	1010	20.8	19.5	0.00	0.00	CS1
	24/10/2013	<0.1	<0.1	0.1	3.7	20.7	14.3	0.1	1005	1005	20.8	18.0	0.00	0.00	CS1
	30/10/2013	<0.1	<0.1	0.1	3.8	20.8	13.0	-1.5	1012	1012	20.9	16.8	0.00	-0.06	CS1
	12/11/2013	<0.1	<0.1	0.1	4.1	20.8	12.5	0.3	1020	1020	20.9	16.6	0.00	0.01	CS1
CP215	17/10/2013	<0.1	<0.1	<0.1	0.5	20.8	19.7		1010	1010	20.8	20.2	0.00	0.00	CS1
	24/10/2013	<0.1	<0.1	0.1	0.8	20.8	18.7	0.1	1005	1005	20.9	19.5	0.00	0.00	CS1
	30/10/2013	<0.1	<0.1	0.1	1.0	20.8	19.0	-2.3	1012	1012	20.9	20.0	0.00	-0.02	CS1
	12/11/2013	<0.1	<0.1	0.1	3.2	20.8	14.4	0	1019	1020	20.9	17.6	0.00	0.00	CS1
CP216	30/10/2013	<0.1	<0.1	0.1	1.0	20.8	18.3	2.4	1011	1011	20.9	19.3	0.00	0.02	CS1
	12/11/2013	<0.1	<0.1	0.1	0.9	20.8	18.3	2.2	1020	1020	20.9	19.2	0.00	0.02	CS1
CP217	17/10/2013	<0.1	<0.1	<0.1	0.3	20.8	18.8		1010	1010	20.8	19.1	0.00	0.00	CS1
	23/10/2013	<0.1	<0.1	0.1	0.2	20.7	20.6		984	984	20.8	20.8	0.00	0.00	CS1
	30/10/2013	<0.1	<0.1	0.1	0.2	20.8	20.2	1.6	1011	1012	20.9	20.4	0.00	0.00	CS1
	12/11/2013	<0.1	<0.1	0.1	0.4	20.8	20.0	0.4	1020	1020	20.9	20.4	0.00	0.00	CS1
CP218	17/10/2013	<0.1	<0.1	<0.1	2.1	20.8	16.7		1011	1010	20.8	18.8	0.00	0.00	CS1
	24/10/2013	<0.1	<0.1	<0.1	1.4	20.7	18.3	0.1	1005	1005	20.7	19.7	0.00	0.00	CS1
	30/10/2013	<0.1	<0.1	0.1	1.1	20.1	19.9	0.9	1013	1012	20.2	21.0	0.00	0.01	CS1
	12/11/2013	<0.1	<0.1	0.1	2.7	20.8	14.0	0.1	1020	1020	20.9	16.7	0.00	0.00	CS1
CP219	16/10/2013	<0.1	<0.1	0.1	1.6	20.8	14.6		1003	1003	20.9	16.2	0.00	0.00	CS1
	24/10/2013	<0.1	<0.1	0.1	0.1	20.8	20.2	0.1	1006	1006	20.9	20.3	0.00	0.00	CS1
	30/10/2013	<0.1	<0.1	0.1	0.5	20.8	17.8	0.2	1009	1009	20.9	18.3	0.00	0.00	CS1
	11/11/2013	<0.1	<0.1	0.1	0.3	20.8	20.0	1.5	1017	1017	20.9	20.3	0.00	0.00	CS1
CP220	16/10/2013	<0.1	<0.1	<0.1	0.9	20.7	19.6		1003	1003	20.7	20.5	0.00	0.00	CS1
	22/10/2013	<0.1	<0.1	0.1	0.4	20.8	19.4	0.8	988	988	20.9	19.8	0.00	0.00	CS1
	30/10/2013	<0.1	<0.1	0.1	0.4	20.8	20.2	-1.3	1013	1012	20.9	20.6	0.00	-0.01	CS1
	11/11/2013	<0.1	<0.1	0.1	0.1	20.8	20.6	1.6	1017	1017	20.9	20.7	0.00	0.00	CS1
CP221	16/10/2013	<0.1	<0.1	0.1	1.2	20.7	18.9		1003	1003	20.8	20.1	0.00	0.00	CS1
	24/10/2013	<0.1	<0.1	<0.1	1.2	20.8	18.7	0	1006	1006	20.8	19.9	0.00	0.00	CS1
	30/10/2013	<0.1	<0.1	0.1	1.3	20.8	18.1	0.1	1008	1009	20.9	19.4	0.00	0.00	CS1
	11/11/2013	<0.1	<0.1	0.1	1.7	20.8	17.6		1017	1017	20.9	19.3	0.00	0.00	CS1
CP222	16/10/2013	<0.1	<0.1	0.1	0.1	20.7	20.7		1003	1004	20.8	20.8	0.00	0.00	CS1
	22/10/2013	<0.1	<0.1	0.1	0.1	20.8	20.5	0.4	988	988	20.9	20.6	0.00	0.00	CS1
CP(R)203	16/10/2013	<0.1	<0.1	0.1	2.4	20.8	15.8		1003	1003	20.9	18.2	0.00	0.00	CS1
	23/10/2013	<0.1	<0.1	0.1	2.6	20.8	15.0	-0.2	987	987	20.9	17.6	0.00	-0.01	CS1
	30/10/2013	<0.1	0.1	0.1	1.5	20.8	18.8	-0.3	1010	1010	20.9	20.4	0.00	0.00	CS1
	12/11/2013	<0.1	<0.1	0.1	1.9	20.8	17.2	-1.6	1027	1027	20.9	19.1	0.00	-0.03	CS1
CP(R)204	17/10/2013	<0.1	<0.1	<0.1	0.9	20.8	18.5		1010	1010	20.8	19.4	0.00	0.00	CS1
	22/10/2013	<0.1	<0.1	<0.1	0.6	20.8	19.6	0	985	986	20.8	20.2	0.00	0.00	CS1
	30/10/2013	<0.1	<0.1	0.1	0.1	20.8	20.7	0	1008	1009	20.9	20.8	0.00	0.00	CS1
	12/11/2013	<0.1	<0.1	0.1	1.8	20.8	14.0	-14.1	1020	1020	20.9	15.8	0.00	-0.25	CS1

Characteristic Situation	Risk	GSV
1	Very Low	0.07
2	Low	0.7
3	Moderate	3.5
4	Moderate to High	15
5	High	70
6	Very High	>70

From CIRIA Report 659 (2006) "Assessing Risks Posed By Hazardous Ground Gases To Buildings", Wilson et al.

KEY:

GSV Gas Screening Value

GSV cannot be calculated on a site-specific basis

GSV indicates very low risk

GSV indicates low to moderate risk

GSV indicates moderate or greater risk; Concentrations of CH4 ≥20%V/V; CO2 ≥30%V/V

Oxygen concentration ≤10%v/v

Total ground gas concentrations >100%v/v

BH NO.	DATE	CH4 I %v/v	CH4 SS %v/v	CO2 I %v/v	CO2 SS %v/v	O2 I %v/v	O2 SS %v/v	Flow l/hr	Baro mbar	BH Press mbar	I SUM %v/v	SS SUM %v/v	GSV CH4	GSV CO2	CS No.
CP(R)205	16/10/2013	<0.1	<0.1	0.1	2.0	20.7	16.6		1002	1003	20.8	18.6	0.00	0.00	CS1
	23/10/2013	<0.1	<0.1	0.1	0.1	20.7	20.5	-3.1	987	987	20.8	20.6	0.00	0.00	CS1
	30/10/2013	<0.1	<0.1	0.1	0.1	20.8	20.4	-0.1	1011	1010	20.9	20.5	0.00	0.00	CS1
	12/11/2013	<0.1	<0.1	0.1	0.1	20.8	20.8	-12.6	1021	1020	20.9	20.9	0.00	-0.01	CS1
CP(R)206	16/10/2013	<0.1	<0.1	0.1	2.6	20.8	16.5		1003	1003	20.9	19.1	0.00	0.00	CS1
	22/10/2013	<0.1	<0.1	0.1	2.4	20.8	16.1	1.6	988	988	20.9	18.5	0.00	0.04	CS1
	30/10/2013	<0.1	<0.1	0.1	2.1	20.8	17.7	-4.6	1011	1012	20.9	19.8	0.00	-0.10	CS1
	11/11/2013	<0.1	<0.1	0.1	0.1	20.8	20.5	0.1	1017	1017	20.9	20.6	0.00	0.00	CS1
CP(R)207	16/10/2013	<0.1	<0.1	0.1	2.5	20.7	14.9		1001	1003	20.8	17.4	0.00	0.00	CS1
	23/10/2013	<0.1	<0.1	0.1	0.1	20.8	20.7	-3.4	989	987	20.9	20.8	0.00	0.00	CS1
	30/10/2013	<0.1	<0.1	0.1	0.7	20.8	19.3	-3.5	1012	1012	20.9	20.0	0.00	-0.02	CS1
	11/11/2013	<0.1	<0.1	0.1	0.6	20.8	19.9	-12.2	1017	1017	20.9	20.5	0.00	-0.07	CS1
CP(R)208	16/10/2013	0.1	<0.1	<0.1	1.4	20.7	17.2		1002	1003	20.8	18.6	0.00	0.00	CS1
	24/10/2013	<0.1	<0.1	0.1	0.1	20.7	20.5	-1.8	1006	1005	20.8	20.6	0.00	0.00	CS1
	30/10/2013	<0.1	<0.1	0.1	0.1	20.8	20.5	-0.1	1011	1010	20.9	20.6	0.00	0.00	CS1
	11/11/2013	<0.1	<0.1	0.1	0.1	20.8	20.6	1.3	1017	1017	20.9	20.7	0.00	0.00	CS1

WORST-CASE VALUES PER BOREHOLE

		Maximum CH4		Maximum CO2		Minimum O2		Max Flow	Not Applicable		Maximum Total		Maximum GSVs		CS No
CP203		<0.1	0.1	0.1	2.0	20.7	17.9	0.3			20.8	20.0	0.00	0.01	CS1
CP204		<0.1	<0.1	0.1	1.7	20.8	15.8	<0.1			20.9	17.5	0.00	0.00	CS1
CP205		<0.1	<0.1	0.1	1.4	20.7	18.6	1.0			20.8	20.0	0.00	0.01	CS1
CP206		<0.1	<0.1	0.1	3.5	20.8	12.3	0.4			20.9	15.8	0.00	0.01	CS1
CP207		<0.1	<0.1	0.1	1.9	20.7	17.5	0.1			20.8	19.4	0.00	0.00	CS1
CP208		<0.1	<0.1	0.1	1.3	20.7	15.5	0.9			20.8	16.8	0.00	0.01	CS1
CP210		<0.1	<0.1	0.1	2.0	20.8	15.9	1.6			20.9	17.9	0.00	0.03	CS1
CP211		<0.1	<0.1	0.1	2.6	20.8	10.9	0.1			20.9	13.5	0.00	0.00	CS1
CP212		<0.1	<0.1	0.1	3.2	20.8	16.8	0.4			20.9	20.0	0.00	0.01	CS1
CP213		<0.1	<0.1	0.1	2.4	20.8	17.0	2.5			20.9	19.4	0.00	0.06	CS1
CP214		<0.1	<0.1	0.1	4.1	20.7	12.5	0.3			20.8	16.6	0.00	0.01	CS1
CP215		<0.1	<0.1	0.1	3.2	20.8	14.4	0.1			20.9	17.6	0.00	0.00	CS1
CP216		<0.1	<0.1	0.1	1.0	20.8	18.3	2.4			20.9	19.3	0.00	0.02	CS1
CP217		<0.1	<0.1	0.1	0.4	20.7	18.8	1.6			20.8	19.2	0.00	0.01	CS1
CP218		<0.1	<0.1	0.1	2.7	20.1	14.0	0.9			20.2	16.7	0.00	0.02	CS1
CP219		<0.1	<0.1	0.1	1.6	20.8	14.6	1.5			20.9	16.2	0.00	0.02	CS1
CP220		<0.1	<0.1	0.1	0.9	20.7	19.4	1.6			20.8	20.3	0.00	0.01	CS1
CP221		<0.1	<0.1	0.1	1.7	20.7	17.6	0.1			20.8	19.3	0.00	0.00	CS1
CP222		<0.1	<0.1	0.1	0.1	20.7	20.5	0.4			20.8	20.6	0.00	0.00	CS1
CP(R)203		<0.1	0.1	0.1	2.6	20.8	15.0	-0.2			20.9	17.7	0.00	-0.01	CS1
CP(R)204		<0.1	<0.1	0.1	1.8	20.8	14.0	<0.1			20.9	15.8	0.00	0.00	CS1
CP(R)205		<0.1	<0.1	0.1	2.0	20.7	16.6	-0.1			20.8	18.6	0.00	0.00	CS1
CP(R)206		<0.1	<0.1	0.1	2.6	20.8	16.1	1.6			20.9	18.7	0.00	0.04	CS1
CP(R)207		<0.1	<0.1	0.1	2.5	20.7	14.9	-3.4			20.8	17.4	0.00	-0.09	CS1
CP(R)208		0.1	<0.1	0.1	1.4	20.7	17.2	1.3			20.9	18.6	0.00	0.02	CS1
Total across all boreholes		0.1	0.1	0.1	4.1	20.1	10.9	2.5			20.3	15.1	0.00	0.10	CS2

APPENDIX I
CONTAMINATED LAND RISK ASSESSMENT MATRIX

Contaminated Land Risk Assessment

In accordance with Environment Agency publication CLR 11 '*Model Procedures for the Management of Land Contamination*', a preliminary contaminated land risk assessment has been developed for the Site.

The risk assessment has been carried out using the risk model defined and outlined in the following table.

Potential sources have been identified from the desk study information and the guidance provided in EA publication CLR 8 '*Potential Contaminants for the Assessment of Land*'.

Hazard linkages will be determined by the proposed investigation and the risk re-assessed on the basis of the viability of the linkage.

If the hazard linkage is confirmed then remediation or management solutions will be proposed to ensure that no unacceptable risk remains following development.

	Category	Definition
Potential Severity	***Severe***	Acute risks to human health, catastrophic damage to buildings/property, major pollution of controlled waters
	Medium	Chronic risk to human health, pollution of sensitive controlled waters, significant effects on sensitive ecosystems or species, significant damage to buildings or structures
	Mild	Pollution of non sensitive waters, minor damage to buildings or structures
	Minor	Requirement for protective equipment during site works to mitigate health effects, damage to non sensitive ecosystems or species
Probability of Risk	***High Likelihood***	Pollutant linkage may be present, and risk is almost certain to occur in long term, or there is evidence of harm to the receptor
	Likely	Pollutant linkage may be present, and it is probable that the risk will occur over the long term
	Low Likelihood	Pollutant linkage may be present, and there is a possibility of the risk occurring, although there is no certainty that it will do so
	Unlikely	Pollutant linkage may be present, but the circumstances under which harm would occur are improbable

		Potential severity			
		Severe	***Medium***	***Mild***	***Minor***
Probability of Risk	***High Likelihood***	Very High	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/Low	Low
	Low Likelihood	Moderate	Moderate/Low	Low	Negligible
	Unlikely	Moderate/Low	Low	Negligible	Negligible

Contaminated Land Risk Assessment (Conceptual Site Model)

Source (type and location)	Pathway	Receptor	Initial Assessment from Desk Study Information			Proposed Investigation /Comments	Hazard Linkage	Revised Risk	Proposed Remediation / Management	Residual Risk
			Severity	Prob.	Risk					
Petroleum hydrocarbon compounds (petrol, diesel & oil) and associated volatile organic compounds within shallow soil / groundwater	Inhalation of vapour	Site workers	Severe	Unlikely	**Moderate /Low**	Site appears to be Greenfield no sources identified. General **Ground Investigation has been undertaken** to confirm the expected ground model. The site has been proven to be Greenfield. General screening testing of shallow near surface site soil samples has been undertaken. **No significant contamination detected.** Groundwater sampling has been undertaken on one occasion from monitoring wells installed, where feasible volumes of groundwater were present. The samples taken were tested for a general suit of contaminants. **No significant contamination detected.**	Absent	Negligible	Vigilance to be maintained throughout the earthworks and enabling works. Should any suspicious, unexpected strata, materials or Made Ground Materials be identified visually or by means of strange odours the advice of a specialist Geo-environmental engineer should be sought. The Geo-environmental advisor shall provide advice on immediate actions and undertake investigation, testing and liaison with regulators and contractors on how to proceed safely.	Negligible
		End users	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
	Ingestion and absorption via direct contact	Site workers	Severe	Unlikely	**Moderate /Low**		Absent	Negligible		Negligible
		End users	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
	Migration by surface run-off	Surface water drainage	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
	Migration by liquid flow	Surface water drainage	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
		Aquifer	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
	Plant uptake	Local flora	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
Toxic & phytotoxic heavy metals within shallow soil / groundwater	Inhalation of fugitive dust	Site workers	Medium	Unlikely	**Low**	Site appears to be Greenfield no sources identified. General **Ground Investigation has been undertaken** to confirm the expected ground model. The site has been proven to be Greenfield. General screening testing of shallow near surface site soil samples has been undertaken. **No significant contamination detected.** Groundwater sampling has been undertaken on one occasion from monitoring wells installed, where feasible volumes of groundwater were present. The samples taken were tested for a general suit of contaminants. **No significant contamination detected.**	Absent	Negligible	Vigilance to be maintained throughout the earthworks and enabling works. Should any suspicious, unexpected strata, materials or Made Ground Materials be identified visually or by means of strange odours the advice of a specialist Geo-environmental engineer should be sought. The Geo-environmental advisor shall provide advice on immediate actions and undertake investigation, testing and liaison with regulators and contractors on how to proceed safely.	Negligible
		End users	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
	Ingestion and absorption via direct contact	Site workers	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
		End users	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
	Migration by surface run-off	Surface water drainage	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
	Migration in solution via groundwater	Surface water drainage	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
		Aquifer	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
	Plant uptake	Local flora	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
Fly Tipped Material	Ingestion and absorption via direct contact	Site workers	Medium	Low Likelihood	**Low**	Site walkover suggests there is no evidence of fly tipped material within Zone 1. None seen during Ground Investigations.	Absent	Negligible		Negligible
		End users	Medium	Unlikely	**Low**					

Source (type and location)	Pathway	Receptor	Initial Assessment from Desk Study Information			Proposed Investigation	Hazard Linkage	Revised Risk	Proposed Remediation / Management	Residual Risk
			Severity	Prob.	Risk					
Toxic & phytotoxic semi-metals and non-metals within shallow soil / groundwater	Inhalation of fugitive dust	Site workers	Medium	Unlikely	**Low**	Site appears to be Greenfield no sources identified. General **Ground Investigation has been undertaken** to confirm the expected ground model. The site has been proven to be Greenfield. General screening testing of shallow near surface site soil samples has been undertaken. **No significant contamination detected.** Groundwater sampling has been undertaken on one occasion from monitoring wells installed, where feasible volumes of groundwater were present. The samples taken were tested for a general suit of contaminants. **No significant contamination detected.**	Absent	Negligible	Vigilance to be maintained throughout the earthworks and enabling works. Should any suspicious, unexpected strata, materials or Made Ground Materials be identified visually or by means of strange odours the advice of a specialist Geo-environmental engineer should be sought. The Geo-environmental advisor shall provide advice on immediate actions and undertake investigation, testing and liaison with regulators and contractors on how to proceed safely.	Negligible
		End users	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
	Ingestion and absorption via direct contact	Site workers	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
		End users	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
	Migration in solution via groundwater flow	Surface water drainage	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
		Aquifer	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
	Plant uptake	Local flora	Medium	Unlikely	**Low**		Absent	Negligible		Negligible
Asbestos within Made Ground	Inhalation of fugitive dust	Site workers	Severe	Unlikely	**Moderate to Low**	Site appears to be Greenfield no sources identified. Asbestos in roofing at farm would need care when demolition is undertaken. **General Ground Investigation has been undertaken** to confirm the expected ground model. No asbestos or suspected asbestos identified or suspected to be present within strata encountered. Mainly all natural strata present. Limited testing undertaken. No asbestos identified to be present in tested samples.	Absent	Negligible	Vigilance to be maintained throughout the earthworks and enabling works. Should any suspicious, unexpected strata, materials or Made Ground Materials be identified visually or by means of strange odours the advice of a specialist Geo-environmental engineer should be sought. The Geo-environmental advisor shall provide advice on immediate actions and undertake investigation, testing and liaison with regulators and contractors on how to proceed safely. Demolition and enabling works of farm buildings to be controlled separately ensuring that suitable asbestos surveys are undertaken in advance. Any identified asbestos containing materials shall be removed and disposed of to suitably licensed waste disposal facilities under suitable H&S notifications and controlled procedures.	Negligible
		End users	Minor	Unlikely	**Low**		Absent	Negligible		Negligible
Ground Gas from Made Ground and natural strata	Migration in to excavations	Site workers	Severe	Unlikely	**Low**	Site appears to be greenfield with no naturally occurring organic soils likely to be a potential source of soil gas. **General Ground Investigation has been undertaken and 4 monitoring visits to monitor soil gas and groundwater have been undertaken.** This monitoring confirms that no significant or elevated concentrations of harmful gases are present within the strata beneath the site.	Unlikely	Low	Construction workers should still ensure that any works that need to be undertaken below ground level or within excavation are treated as confined space works and all normal confined space H&S protocols are adopted including but not limited to atmosphere testing and suitable excavation support.	Negligible
	Migration in to development	End Users	Medium	Unlikely	**Low**		Unlikely	Negligible		Negligible
Aggressive substances (sulphates, acids, phenols, petroleum) in Shallow soils / groundwater	Direct contact with construction materials	Buried Structures	Medium	Low Likelihood	**Moderate to Low**	Available data suggests the presence of naturally occurring high sulphates levels. General **Ground Investigation has been undertaken** to confirm the expected ground model. The site has been proven to be Greenfield. Testing of various strata has been undertaken to define the sulphate potential of the various strata in plan and with depth across the site.	Likely	High	Design of in ground concrete will take account of the anticipated ground conditions and available test results to ensure a suitably robust concrete mix design is utilised in accordance with BRE SD1:2005.	Negligible
		Buried Services	Medium	Low Likelihood	**Moderate to Low**		Likely	High		Negligible

Source (type and location)	Pathway	Receptor	Initial Assessment from Desk Study Information			Proposed Investigation /Comments	Hazard Linkage	Revised Risk	Proposed Remediation / Management	Residual Risk
			Severity	Prob.	Risk					
Herbicides and Pesticides within shallow soil	Inhalation of vapour	Site workers	Medium	Unlikely	**Low**	Site is a modern arable farm. Modern arable farming should only utilise non persistent biodegradable safe pesticides and herbicides for crop production which are licensed and controlled. Prior to 2000 the farm was primarily used for cattle (milk Production) and as such the risk of widespread soil contamination by older uncontrolled and unlicensed persistent and dangerous herbicides and pesticides is considered to be low. General **Ground Investigation has been undertaken** to confirm the expected ground model. General screening testing of shallow near surface site soils has been undertaken. **No significant contamination detected.**	None	Negligible	Vigilance to be maintained throughout the earthworks and enabling works. Should any suspicious, unexpected strata, materials or Made Ground Materials be identified visually or by means of strange odours the advice of a specialist Geo-environmental engineer should be sought. The Geo-environmental advisor shall provide advice on immediate actions and undertake investigation, testing and liaison with regulators and contractors on how to proceed safely.	Negligible
		End users	Medium	Unlikely	**Low**		None	Negligible		Negligible
	Ingestion and absorption via direct contact	Site workers	Medium	Unlikely	**Low**		None	Negligible		Negligible
		End users	Medium	Unlikely	**Low**		None	Negligible		Negligible
	Migration by surface run-off	Surface water drainage	Medium	Unlikely	**Low**		None	Negligible		Negligible
	Migration by liquid flow	Surface water drainage	Medium	Unlikely	**Low**		None	Negligible		Negligible
		Aquifer	Medium	Unlikely	**Low**		None	Negligible		Negligible
	Plant uptake	Local flora	Medium	Unlikely	**Low**		None	Negligible		Negligible
Explosives related to the area of land owned by East Midlands Airport (sw corner of the site)	Inhalation of fugitive dust	Site workers	Severe	Unlikely	**Moderate /Low**	Site appears to now be Greenfield with only concrete roads remaining, the lands being farmed or covered in trees on this area and surrounding areas. The risk is considered to be low and very localised as a) The bunkers/stores and earth blast mounds (assumed from historic plans) appear to no longer be present (when viewed from satellite imagery). b) Available anecdotal data taken from reports on the internet suggests that the RAF base was predominantly a training base and not used extensively for operations. c) It is assumed that when the base was turned over to a commercial airport any munitions were disposed off and bunkers removed or closed. d) It has not been confirmed if these areas were used for munitions storage only anecdotal evidence available on the internet suggests this. e) The farm manger suggests that these features were partial above ground and partial below ground features and that were believed to have been removed in the past. f) Plants present across the site area seem in good health.	Unlikely	**Moderate /Low**	**A walkover study, UXB/UXO risk assessment, GPR survey and Ground Investigation should be undertaken** to confirm the ground model and determine if munitions storage bunkers are still present. Identified Made Ground, or materials thought to be contaminated by visual or olfactory identification should be tested. If contamination is identified its extent should be defined by further investigation and then it should be removed and remediated. Any contamination is anticipated to be very localised as it is likely to be contained within bunker areas as the near surface geology is primarily cohesive and will not allow leaching of contamination.	Negligible
		End users	Medium	Unlikely	**Low**		Unlikely	**Low**		Negligible
	Ingestion and absorption via direct contact	Site workers	Severe	Unlikely	**Moderate /Low**		Unlikely	**Moderate /Low**		Negligible
		End users	Medium	Unlikely	**Low**		Unlikely	**Low**		Negligible
	Migration by surface run-off	Surface water drainage	Medium	Unlikely	**Low**		Unlikely	**Low**		Negligible
	Migration in solution via groundwater	Surface water drainage	Medium	Unlikely	**Low**		Unlikely	**Low**		Negligible
		Aquifer	Medium	Unlikely	**Low**		Unlikely	**Low**		Negligible
	Plant uptake	Local flora	Medium	Unlikely	**Low**		Unlikely	**Low**		Negligible

APPENDIX J
GEOTECHNICAL DATA PLOTS

GROUNDWATER ELEVATION STATISTICS REPORT

Exploratory Position ID	Installation Date	Pipe Ref	Installation Depth (m)	Response Zone	Installation Type	Instrument Diameter (mm)	Number of Monitoring Rounds	Monitoring Round Date Range	Number of Dry Rounds	Minimum Water Depth (m bgl)	Average Water Depth (m bgl)	Maximum Water Depth (m bgl)	Minimum Water Elevation	Average Water Elevation	Maximum Water Elevation
CP203	25/09/2013	1	4.00	1.00 - 4.00		50	4	16/10/2013 - 12/11/2013	4.00						
CP204	24/09/2013	1	4.00	1.00 - 4.00		50	4	17/10/2013 - 12/11/2013	4.00						
CP205	26/09/2013	1	4.30	1.00 - 4.30		50	4	16/10/2013 - 12/11/2013	0.00	4.12	4.16	4.20	52.221	52.261	52.301
CP206	02/10/2013	1	3.30	0.50 - 3.30		50	4	16/10/2013 - 11/11/2013	4.00						
CP207	25/09/2013	1	2.70	1.00 - 2.70		50	4	16/10/2013 - 11/11/2013	4.00						
CP208	24/09/2013	1	2.00	1.00 - 2.00		50	4	16/10/2013 - 11/11/2013	4.00						
CP210	26/09/2013	1	9.50	8.50 - 9.50		50	4	17/10/2013 - 12/11/2013	0.00	3.27	4.35	5.47	72.536	73.656	74.736
CP211	27/09/2013	1	7.00	1.00 - 7.00		50	4	17/10/2013 - 12/11/2013	1.00	5.96	6.08	6.14	74.837	74.897	75.017
CP212	27/09/2013	1	3.30	1.00 - 3.30		50	4	17/10/2013 - 12/11/2013	0.00	1.04	1.64	2.22	66.923	67.503	68.103

Key: NDA denotes 'no data available'. Instrument Type Key: SP = Standpipe, SPIE = Standpipe piezometer
Remarks: None

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Contract: **East Midlands Gateway**

GROUNDWATER ELEVATION STATISTICS REPORT

Exploratory Position ID	Installation Date	Pipe Ref	Installation Depth (m)	Response Zone	Installation Type	Instrument Diameter (mm)	Number of Monitoring Rounds	Monitoring Round Date Range	Number of Dry Rounds	Minimum Water Depth (m bgl)	Average Water Depth (m bgl)	Maximum Water Depth (m bgl)	Minimum Water Elevation	Average Water Elevation	Maximum Water Elevation
CP213	25/09/2013	1	4.20	1.00 - 4.20		50	4	17/10/2013 - 12/11/2013	0.00	1.78	2.20	2.39	62.742	62.932	63.352
CP214	25/09/2013	1	4.20	1.00 - 4.20		50	4	17/10/2013 - 12/11/2013	0.00	2.13	3.00	3.49	57.476	57.966	58.836
CP215	30/09/2013	1	4.80	1.00 - 4.80		50	4	17/10/2013 - 12/11/2013	0.00	0.55	1.06	1.72	57.351	58.011	58.521
CP216	02/10/2013	1	2.40	0.50 - 2.40		50	2	30/10/2013 - 12/11/2013	2.00						
CP217	01/10/2013	1	4.60	1.00 - 4.60		50	4	17/10/2013 - 12/11/2013	0.00	1.43	1.74	2.25	69.26	69.77	70.08
CP218	01/10/2013	1	4.60	1.00 - 4.60		50	4	17/10/2013 - 12/11/2013	3.00	4.63	4.63	4.63	60.983	60.983	60.983
CP219	27/09/2013	1	7.50	1.00 - 7.50		50	4	16/10/2013 - 11/11/2013	2.00	7.32	7.33	7.34	47.115	47.125	47.135
CP220	26/09/2013	1	5.70	0.00 - 5.70		50	4	16/10/2013 - 11/11/2013	0.00	2.08	3.11	4.40	39.223	40.513	41.543
CP221	30/09/2013	1	10.70	1.00 - 10.70		50	4	16/10/2013 - 11/11/2013	0.00	5.36	5.44	5.50	36.162	36.222	36.302

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Remarks: None

GROUNDWATER ELEVATION STATISTICS REPORT

Exploratory Position ID	Installation Date	Pipe Ref	Installation Depth (m)	Response Zone	Installation Type	Instrument Diameter (mm)	Number of Monitoring Rounds	Monitoring Round Date Range	Number of Dry Rounds	Minimum Water Depth (m bgl)	Average Water Depth (m bgl)	Maximum Water Depth (m bgl)	Minimum Water Elevation	Average Water Elevation	Maximum Water Elevation
CP222		1	6.00	5.70 - 6.00		19	4	17/10/2013 - 11/11/2013	0.00	2.42	2.65	2.93	34.117	34.397	34.627
CP(R)203	03/10/2013	1	25.00	7.00 - 25.00		50	4	16/10/2013 - 12/11/2013	1.00	24.47	24.51	24.56	43.355	43.405	43.445
CP(R)203	03/10/2013	2	29.00	0.00 - 29.00		19	4	16/10/2013 - 12/11/2013	4.00						
CP(R)204	03/10/2013	1	20.00	14.00 - 20.00		50	4	17/10/2013 - 12/11/2013	0.00	14.93	15.59	15.90	66.909	67.219	67.879
CP(R)205	04/10/2013	1	19.00	4.00 - 19.00		50	4	16/10/2013 - 11/11/2013	0.00	18.26	18.27	18.28	38.141	38.151	38.161
CP(R)206		1	21.00	9.00 - 21.00		50	4	16/10/2013 - 11/11/2013	0.00	14.63	14.67	14.72	37.116	37.166	37.206
CP(R)206		2	24.00	23.70 - 24.00		19	4	16/10/2013 - 11/11/2013	0.00	14.57	14.67	14.78	37.056	37.166	37.266
CP(R)207	01/10/2013	1	25.00	17.00 - 25.00		50	4	16/10/2013 - 11/11/2013	0.00	24.24	24.38	24.54	38.497	38.657	38.797
CP(R)207	01/10/2013	2	12.10	11.80 - 12.10		19	4	16/10/2013 - 11/11/2013	0.00	10.81	10.85	10.90	52.137	52.187	52.227
CP(R)208	04/10/2013	1	20.00	5.00 - 15.00		50	4	16/10/2013 - 11/11/2013	4.00						
CP/RC 101	06/09/2012	1	27.60	14.00 - 27.60	Standpipe	19	4	16/10/2013 - 11/11/2013	0.00	26.07	26.15	26.20	39.19	39.24	39.32

Key: NDA denotes 'no data available'. Instrument Type Key: SP = Standpipe, SPIE = Standpipe piezometer
Remarks: None

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Contract: **East Midlands Gateway**

GROUNDWATER ELEVATION STATISTICS REPORT

Exploratory Position ID	Installation Date	Pipe Ref	Installation Depth (m)	Response Zone	Installation Type	Instrument Diameter (mm)	Number of Monitoring Rounds	Monitoring Round Date Range	Number of Dry Rounds	Minimum Water Depth (m bgl)	Average Water Depth (m bgl)	Maximum Water Depth (m bgl)	Minimum Water Elevation	Average Water Elevation	Maximum Water Elevation
CP/RC 102	05/09/2012	1	17.20	4.00 - 17.20		19	4	16/10/2013 - 11/11/2013	3.00	4.34	4.34	4.34	50.48	50.48	50.48
CP/RC 103	08/09/2012	1	15.00	12.00 - 15.00		19	4	16/10/2013 - 12/11/2013	2.00	14.56	14.70	14.83	65.73	65.86	66
CP/RC 103	08/09/2012	2	5.00	1.00 - 5.00		19	4	16/10/2013 - 12/11/2013	3.00	3.83	3.83	3.83	76.73	76.73	76.73
CP/RC 104	04/09/2012	1	18.00	16.00 - 18.00	Standpipe piezometer	19	4	16/10/2013 - 12/11/2013	4.00						
CP/RC 104	04/09/2012	2	12.00	7.00 - 14.00	Standpipe piezometer	19	4	16/10/2013 - 12/11/2013	4.00						
CP/RC 105	11/09/2012	1	14.70	1.00 - 14.70	Standpipe	19	4	16/10/2013 - 12/11/2013	3.00	14.44	14.44	14.44	60.61	60.61	60.61
CP/RC 106	10/09/2012	1	16.40	8.00 - 16.50	Standpipe	19	3	24/10/2013 - 12/11/2013	0.00	11.32	11.65	11.84	73.07	73.26	73.59

Key: NDA denotes 'no data available'. Instrument Type Key: SP = Standpipe, SPIE = Standpipe piezometer
Remarks: None

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Contract: **East Midlands Gateway**

AGS

GROUNDWATER MONITORING REPORT

Exploratory Position ID	Installation Date	Installation Depth (mbgl)	Response Zone	Installation Type	Instrument Diameter (mm)	Round	Date & Time of Monitoring	Water Depth (m bgl)	Groundwater Elevation (m AOD)	Remarks
CP205	26/09/2013	4.37	1.00 to 4.30		50	1	16/10/2013 12:13	4.13	52.29	
CP205	26/09/2013	4.37	1.00 to 4.30		50	2	23/10/2013 14:06	4.12	52.30	
CP205	26/09/2013	4.37	1.00 to 4.30		50	3	30/10/2013 09:25	4.19	52.23	
CP205	26/09/2013	4.37	1.00 to 4.30		50	4	12/11/2013 09:45	4.20	52.22	
CP210	26/09/2013	9.05	8.50 to 9.50		50	1	17/10/2013 16:31	5.47	72.54	
CP210	26/09/2013	9.05	8.50 to 9.50		50	2	23/10/2013 09:00	4.77	73.24	Operator: GShaw, Weather: Overcast, Surface Conditions: Wet, General Remarks: 3x well volume purged - full sample obtained.
CP210	26/09/2013	9.03	8.50 to 9.50		50	3	30/10/2013 14:35	3.88	74.13	
CP210	26/09/2013	9.04	8.50 to 9.50		50	4	12/11/2013 12:22	3.27	74.74	
CP211	27/09/2013	6.67	1.00 to 7.00		50	2	24/10/2013 10:40	6.14	74.84	
CP211	27/09/2013	6.67	1.00 to 7.00		50	3	30/10/2013 14:00	6.14	74.84	
CP211	27/09/2013	6.65	1.00 to 7.00		50	4	12/11/2013 12:53	5.96	75.02	
CP212	27/09/2013	3.39	1.00 to 3.30		50	1	17/10/2013 16:56	2.22	66.92	
CP212	27/09/2013	3.39	1.00 to 3.30		50	2	22/10/2013 10:20	2.22	66.92	Operator: GShaw, Weather: Overcast, Surface Conditions: Wet, General Remarks: 3x well volume purged - full sample obtained.
CP212	27/09/2013	3.39	1.00 to 3.30		50	2 / 2	23/10/2013 10:45	1.48	67.66	
CP212	27/09/2013	3.38	1.00 to 3.30		50	3 / 2	30/10/2013 13:55	1.22	67.92	

Key: NDA denotes 'no data available'. Instrument Type Key: SP = Standpipe, SPIE = Standpipe piezometer
Remarks: No data present indicates borehole was dry at the time of the visits

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Compiled By	Date	Checked By	Date	Contract Ref:
K. Foster	3/12/13		28/11/13	312494

Contract: **East Midlands Gateway**

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GROUNDWATER MONITORING REPORT

Exploratory Position ID	Installation Date	Installation Depth (mbgl)	Response Zone	Installation Type	Instrument Diameter (mm)	Round	Date & Time of Monitoring	Water Depth (m bgl)	Groundwater Elevation (m AOD)	Remarks
CP212	27/09/2013	3.37	1.00 to 3.30		50	4 / 2	12/11/2013 13:12	1.04	68.10	
CP213	25/09/2013	4.08	1.00 to 4.20		50	1	17/10/2013 18:00	2.39	62.74	
CP213	25/09/2013	4.08	1.00 to 4.20		50	2	22/10/2013 18:00	2.39	62.74	Operator: GShaw, Weather: Overcast, Surface Conditions: Wet, General Remarks: 3x well volume purged - full sample obtained.
CP213	25/09/2013	4.08	1.00 to 4.20		50	2 / 2	23/10/2013 10:16	2.24	62.89	
CP213	25/09/2013	4.08	1.00 to 4.20		50	3	30/10/2013 12:00	2.18	62.95	
CP213	25/09/2013	4.07	1.00 to 4.20		50	4	12/11/2013 15:46	1.78	63.35	
CP214	25/09/2013	4.08	1.00 to 4.20		50	1	17/10/2013 18:20	3.49	57.48	
CP214	25/09/2013	4.10	1.00 to 4.20		50	2	24/10/2013 13:30	3.38	57.59	
CP214	25/09/2013	4.08	1.00 to 4.20		50	3	30/10/2013 10:35	3.00	57.97	
CP214	25/09/2013	4.07	1.00 to 4.20		50	4	12/11/2013 15:49	2.13	58.84	
CP215	30/09/2013	4.85	1.00 to 4.80		50	1	17/10/2013 17:15	1.72	57.35	
CP215	30/09/2013	4.85	1.00 to 4.80		50	2	24/10/2013 11:15	1.07	58.00	
CP215	30/09/2013	4.85	1.00 to 4.80		50	3	30/10/2013 13:20	0.88	58.19	
CP215	30/09/2013	4.85	1.00 to 4.80		50	4	12/11/2013 13:30	0.55	58.52	

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GROUNDWATER MONITORING REPORT

Exploratory Position ID	Installation Date	Installation Depth (mbgl)	Response Zone	Installation Type	Instrument Diameter (mm)	Round	Date & Time of Monitoring	Water Depth (m bgl)	Groundwater Elevation (m AOD)	Remarks
CP217	01/10/2013	4.64	1.00 to 4.60		50	1	17/10/2013 17:42	2.25	69.26	
CP217	01/10/2013	4.64	1.00 to 4.60		50	2	23/10/2013 11:20	1.70	69.81	
CP217	01/10/2013	4.64	1.00 to 4.60		50	2 / 2	23/10/2013 12:05	1.70	69.81	Operator: GShaw, Weather: Overcast, Surface Conditions: Wet, General Remarks: 3xwell volume purged - full sample obtained
CP217	01/10/2013	4.64	1.00 to 4.60		50	3	30/10/2013 12:56	1.60	69.91	
CP217	01/10/2013	4.62	1.00 to 4.60		50	4	12/11/2013 14:06	1.43	70.08	
CP218	01/10/2013	4.65	1.00 to 4.60		50	4	12/11/2013 14:58	4.63	60.98	
CP219	27/09/2013	7.41	1.00 to 7.50		50	3	30/10/2013 13:10	7.32	47.14	
CP219	27/09/2013	7.43	1.00 to 7.50		50	4	11/11/2013 14:58	7.34	47.12	
CP220	26/09/2013	5.79	0.00 to 5.70		50	1	16/10/2013 13:54	3.04	40.58	
CP220	26/09/2013	5.79	0.00 to 5.70		50	2	22/10/2013 13:28	3.04	40.58	
CP220	26/09/2013	5.80	0.00 to 5.70		50	2 / 2	23/10/2013 09:00	4.40	39.22	Operator: GShaw, Weather: Overcast, Surface Conditions: Wet, General Remarks: 3xwell volume purged - full sample obtained
CP220	26/09/2013	5.80	0.00 to 5.70		50	3	30/10/2013 14:40	2.99	40.63	
CP220	26/09/2013	5.77	0.00 to 5.70		50	4	11/11/2013 14:39	2.08	41.54	
CP221	30/09/2013	10.00	1.00 to 10.70		50	1	16/10/2013 14:30	5.43	36.23	

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GROUNDWATER MONITORING REPORT

Exploratory Position ID	Installation Date	Installation Depth (mbgl)	Response Zone	Installation Type	Instrument Diameter (mm)	Round	Date & Time of Monitoring	Water Depth (m bgl)	Groundwater Elevation (m AOD)	Remarks
CP221	30/09/2013	10.10	1.00 to 10.70		50	2	24/10/2013 14:00	5.50	36.16	
CP221	30/09/2013	10.08	1.00 to 10.70		50	3	30/10/2013 13:10	5.48	36.18	
CP221	30/09/2013	10.07	1.00 to 10.70		50	4	11/11/2013 14:20	5.36	36.30	
CP222		5.68	5.70 to 6.00		19	1	17/10/2013 12:45	2.93	34.12	Weather: Overcast, Surface Conditions: Wet
CP222		5.65	5.70 to 6.00		19	2	22/10/2013 12:48	2.82	34.23	Weather: Overcast, Surface Conditions: Wet
CP222		5.64	5.70 to 6.00		19	3	30/10/2013 15:10	2.44	34.61	Weather: Overcast, Surface Conditions: Wet
CP222		5.69	5.70 to 6.00		19	4	11/11/2013 14:10	2.42	34.63	Weather: Overcast, Surface Conditions: Wet
CP(R)203	03/10/2013	24.78	7.00 to 25.00		50	1	16/10/2013 12:05	24.47	43.45	
CP(R)203	03/10/2013	24.81	7.00 to 25.00		50	2	23/10/2013 13:43	24.56	43.36	
CP(R)203	03/10/2013	24.77	7.00 to 25.00		50	4	12/11/2013 10:31	24.51	43.41	
CP(R)204	03/10/2013	19.80	14.00 to 20.00		50	1	17/10/2013 16:06	15.90	66.91	
CP(R)204	03/10/2013	19.80	14.00 to 20.00		50	2	22/10/2013 15:10	15.80	67.01	
CP(R)204	03/10/2013	19.80	14.00 to 20.00		50	2 / 2	22/10/2013 16:30	15.80	67.01	Operator: GShaw, Weather: Overcast, Surface Conditions: Wet, General Remarks: 3xwell volume purged - full sample obtained
CP(R)204	03/10/2013	19.72	14.00 to 20.00		50	3	30/10/2013 15:36	15.51	67.30	
CP(R)204	03/10/2013	19.81	14.00 to 20.00		50	4	12/11/2013 11:36	14.93	67.88	

Key: NDA denotes 'no data available'. Instrument Type Key: SP = Standpipe, SPIE = Standpipe piezometer
Remarks: No data present indicates borehole was dry at the time of the visits

GROUNDWATER MONITORING REPORT

Exploratory Position ID	Installation Date	Installation Depth (mbgl)	Response Zone	Installation Type	Instrument Diameter (mm)	Round	Date & Time of Monitoring	Water Depth (m bgl)	Groundwater Elevation (m AOD)	Remarks
CP(R)205	04/10/2013	18.41	4.00 to 19.00		50	1	16/10/2013 12:13	18.27	38.15	
CP(R)205	04/10/2013	18.41	4.00 to 19.00		50	2	23/10/2013 14:14	18.28	38.14	
CP(R)205	04/10/2013	18.40	4.00 to 19.00		50	3	30/10/2013 16:55	18.26	38.16	
CP(R)205	04/10/2013	18.40	4.00 to 19.00		50	4	11/11/2013 09:55	18.27	38.15	
CP(R)206		21.17	9.00 to 21.00		50	1	16/10/2013 13:37	14.72	37.12	
CP(R)206		24.04	23.70 to 24.00		19	1	16/10/2013 13:42	14.65	37.19	
CP(R)206		24.08	23.70 to 24.00		19	2	22/10/2013 13:14	14.69	37.15	
CP(R)206		21.18	9.00 to 21.00		50	2	22/10/2013 14:45	14.68	37.16	
CP(R)206		21.18	9.00 to 21.00		50	2 / 2	22/10/2013 14:55	14.68	37.16	Operator: GShaw, Weather: Overcast, Surface Conditions: Wet, General Remarks: 3xwell volume purged - full sample obtained
CP(R)206		21.11	9.00 to 21.00		50	3	30/10/2013 09:53	14.63	37.21	
CP(R)206		23.91	23.70 to 24.00		19	3	30/10/2013 10:28	14.57	37.27	
CP(R)206		21.15	9.00 to 21.00		50	4	11/11/2013 16:45	14.65	37.19	
CP(R)206		24.06	23.70 to 24.00		19	4	11/11/2013 17:02	14.78	37.06	
CP(R)207	01/10/2013	24.66	17.00 to 25.00		50	1	16/10/2013 15:40	24.25	38.79	

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Remarks: No data present indicates borehole was dry at the time of the visits

GROUNDWATER MONITORING REPORT

Exploratory Position ID	Installation Date	Installation Depth (mbgl)	Response Zone	Installation Type	Instrument Diameter (mm)	Round	Date & Time of Monitoring	Water Depth (m bgl)	Groundwater Elevation (m AOD)	Remarks
CP(R)207	01/10/2013	12.18	11.80 to 12.10		19	1	16/10/2013 15:45	10.85	52.19	
CP(R)207	01/10/2013	24.67	17.00 to 25.00		50	2	23/10/2013 15:00	24.24	38.80	
CP(R)207	01/10/2013	12.17	11.80 to 12.10		19	2	23/10/2013 15:05	10.90	52.14	
CP(R)207	01/10/2013	24.64	17.00 to 25.00		50	3	30/10/2013 10:07	24.48	38.56	
CP(R)207	01/10/2013	12.16	11.80 to 12.10		19	3	30/10/2013 10:12	10.82	52.22	
CP(R)207	01/10/2013	24.65	17.00 to 25.00		50	4	11/11/2013 16:14	24.54	38.50	
CP(R)207	01/10/2013	12.17	11.80 to 12.10		19	4	11/11/2013 16:19	10.81	52.23	
CP/RC 101	06/09/2012	27.59	14.00 to 27.60	SP	19	1	16/10/2013 08:56	26.20	39.19	
CP/RC 101	06/09/2012	27.57	14.00 to 27.60	SP	19	2	23/10/2013 13:55	26.16	39.23	
CP/RC 101	06/09/2012	27.57	14.00 to 27.60	SP	19	3	30/10/2013 08:56	26.18	39.21	
CP/RC 101	06/09/2012	27.56	14.00 to 27.60	SP	19	4	11/11/2013 10:09	26.07	39.32	
CP/RC 102	05/09/2012	4.36	4.00 to 17.20		19	4	11/11/2013 16:31	4.34	50.48	
CP/RC 103	08/09/2012	14.81	12.00 to 15.00		19	2	23/10/2013 13:08	14.56	66.00	
CP/RC 103	08/09/2012	14.88	12.00 to 15.00		19	4	12/11/2013 10:59	14.83	65.73	

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Remarks: No data present indicates borehole was dry at the time of the visits

GROUNDWATER MONITORING REPORT

Exploratory Position ID	Installation Date	Installation Depth (mbgl)	Response Zone	Installation Type	Instrument Diameter (mm)	Round	Date & Time of Monitoring	Water Depth (m bgl)	Groundwater Elevation (m AOD)	Remarks
CP/RC 103	08/09/2012	4.13	1.00 to 5.00		19	4	12/11/2013 11:03	3.83	76.73	
CP/RC 105	11/09/2012	14.50	1.00 to 14.70	SP	19	4	12/11/2013 15:11	14.44	60.61	
CP/RC 106	10/09/2012	16.10	8.00 to 16.50	SP	19	2	24/10/2013 08:30	11.84	73.07	General Remarks: Borehole not been located on 1st round of monitoring.
CP/RC 106	10/09/2012	16.09	8.00 to 16.50	SP	19	3	30/10/2013 12:00	11.78	73.13	
CP/RC 106	10/09/2012	16.09	8.00 to 16.50	SP	19	4	12/11/2013 12:06	11.32	73.59	

Key: NDA denotes 'no data available'. Instrument Type Key: SP = Standpipe, SPIE = Standpipe piezometer
Remarks: No data present indicates borehole was dry at the time of the visits

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Compiled By	Date	Checked By	Date	Contract Ref:
K. Foster	3/12/13		28/11/13	312494

Contract: **East Midlands Gateway**

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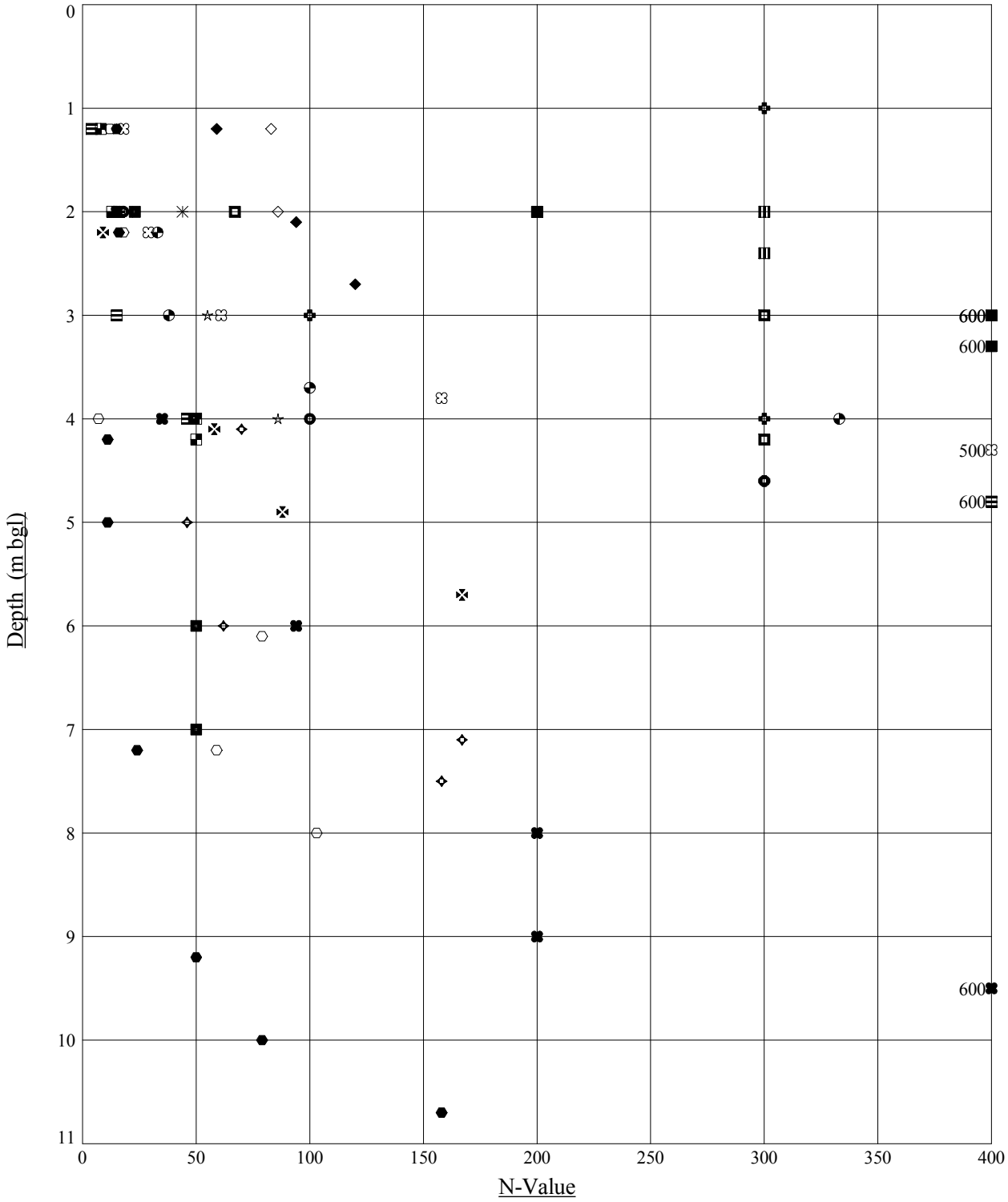
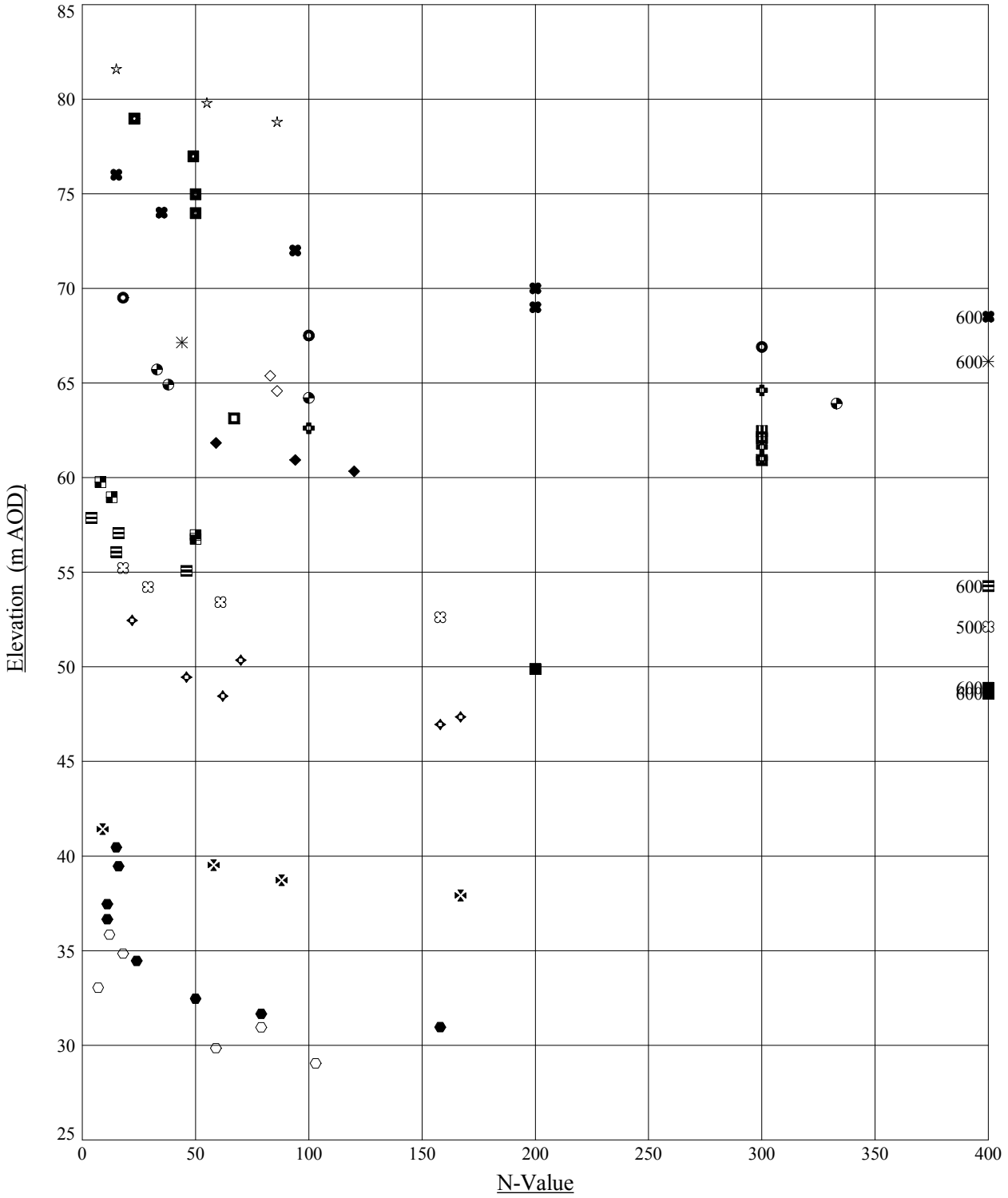
STANDARD PENETRATION TEST (SPT N-Value)
vs
DEPTH



Key: ◔ = CP203, ☆ = CP204, ⊠ = CP205, ■ = CP206, ◆ = CP207, ◇ = CP208, ✖ = CP210, ◘ = CP211, ✳ = CP212, ◻ = CP213, ◪ = CP214, 〓 = CP215, ▥ = CP216, ⭘ = CP217, ✜ = CP218, ⟡ = CP219, ✠ = CP220, ⬟ = CP221, ⬠ = CP222

RSK Environment Ltd Abbey Park Humber Road Coventry CV3 4AQ	Contract **East Midlands Gateway**	Date **10.12.13**	Compiled By KF
	Client **Roxhill Developments Ltd**	Contract Ref: **312494**	AGS

STANDARD PENETRATION TEST (SPT N-Value)
vs
ELEVATION



Key: ◔ = CP203, ☆ = CP204, ⊠ = CP205, ■ = CP206, ◆ = CP207, ◇ = CP208, ✖ = CP210, ◘ = CP211, ✳ = CP212, ◻ = CP213, ◪ = CP214, 〓 = CP215, ▥ = CP216, ⭘ = CP217, ✜ = CP218, ⟡ = CP219, ✠ = CP220, ⬣ = CP221, ⬡ = CP222

RSK Environment Ltd Abbey Park Humber Road Coventry CV3 4AQ	Contract **East Midlands Gateway**	Date **10.12.13**	Compiled By KF
	Client **Roxhill Developments Ltd**	Contract Ref: **312494**	AGS

APPENDIX K
GEOTECHNICAL RISK REGISTER

Preliminary Geotechnical Risk Register

Zone 1 covers an area of approximately 231Ha, the centre of which is defined by the following National Grid co-ordinates: 447330, 326660. The Zone is bound to the east by the A453 road, to the south by the East Midlands Airport; to the west and north there are no physical boundaries other than the hedgerows which form the field boundaries.

Geotechnical Risk Register

The Geotechnical Risk Register has been compiled to show the degree of risk attached to various ground related aspects of the proposed development. The purpose of the register is to provide an assessment of the risk to the project posed by common ground related problems identify suitable mitigation measures the control the risk to an acceptable level. The risk register should be developed and refined as the geotechnical design and assessment progresses such that the register will allow the management of the geotechnical risks.

The inclusion of a risk in the register does not constitute confirmation that the problem actually exists at the site. A probability of 'very unlikely' is indicative of a condition which the available data suggests should not be present. The calculated risk is not the risk that the impact will occur it is the risk that the mitigation will be required to enable the project to progress. For the purposes of this risk register the magnitude of each impact and the resulting severity of risk is measured against that which would could 'normally' be expected for each element. Before incorporation into a project risk register the impacts and risks for each element should be moderated by an assessment of the cost and time implication of individual mitigation measures.

The Geotechnical Risk Register has been developed in general accordance with the guidance presented in ICE/DETR Document 'Managing Geotechnical Risk' (2001) and the HA documents HD41/03 and HD22/02. The degree of risk (R) is determined by combining an assessment of the probability (P) of the hazard occurring with an assessment of the Impact (I) the hazard and associated mitigation will cause if it occurs (R = P x I). The scale against which the probability and impact are measure and the resulting degree of risk determined is presented below.

Probability	(P)
Very Likely (VLk)	5
Likely (Lk)	4
Plausible (P)	3
Unlikely (U)	2
Very Unlikely (VU)	1

x

Impact	(I)
Very High (VH)	5
High (H)	4
Medium (M)	3
Low (Lw)	2
Very Low (VLw)	1

=

(R)	Risk
20 – 25	Severe (Sv)
15 – 19	Substantial (Sb)
10 – 14	Moderate (Md)
5 – 9	Minor (Mn)
1 – 4	None / Negligible (N)

	Site / Ground Conditions	Hazard	Potential Impact	Before Control			Comments and Proposed Mitigation	RR
				P	I	R		
Contaminated Land	Previous site use	Contaminated Ground	Health and safety, environmental damage, pollution requiring Remediation	U 2	H 4	Mn 8	Ground Investigation undertaken has confirmed that the site is primarily Greenfield with the exception of a small area around the farm yard and limited small areas related to the former RAF land in the south west. Site wide testing does not indicate the presence of any significant contamination. See separate Contaminated Land Risk Assessments for further details.	N
Underground Voids	Mine Shafts	Shaft Collapse	Surface deformation, structural damage. Health and Safety	VU 1	H 4	N 4	Site is not within mining area as defined on Coal Authority (CA) gazetteer, web site and in CA scoping response letter. Geology of site confirmed by Ground Investigation.	N
	Shallow Mining	Workings Collapse crown holes, subsidence	Surface deformation, structural damage.	VU 1	H 4	N 4	Site is not within mining area as defined on Coal Authority (CA) gazetteer, web site and in CA scoping response letter. Geology of site confirmed by Ground Investigation.	N
	Deep Mining	Workings Consolidation, subsidence	Surface deformation	VU 1	M 3	N 3	Site is not within mining area as defined on Coal Authority (CA) gazetteer, web site and in CA scoping response letter. Geology of site confirmed by Ground Investigation.	N
	Natural cavities; solution features, Caves and Gulls	Unstable natural ground	Surface deformation, structural damage. Health and Safety	P 3	M 3	Mn 9	Geology not conducive to the formation of major solution features. Gypsum know to occur at depth in very thin veins and nodules but not of sufficient nature for commercial exploitation. Localised minor removal plausible through natural groundwater movements. **Ground Investigation undertaken and no naturally occurring voids indicated to be present.**	N
	Other voids; basements, sumps, tanks, wells and adits etc.	Collapse, subsidence	Surface deformation, structural damage. Health and Safety	P 3	Lw 2	Mn 6	The vast majority of Zone 1 is undisturbed Farm land. These is a possibility of a man made pond feature at Field Farm and the area in the South west of Zone 1 (inaccessible at this time) was formerly part of the RAF base and it is possible that bomb storage within bunkers may have taken place. **Site Walkover and ground investigation required to confirm the ground model and location of any bunkers in this particular area when the land is available. Enabling works will need to take account of the findings to ensure any below ground voids are suitably filled with compacted engineered fill materials.**	Mn

	Condition	Hazard	Impact	P	I	R	Comment / Mitigation	RR
Slopes and Earthworks	Existing steep slopes on site	Slope failure	Site stability; surface deformation at crest, structural damage to services , highways	VU 1	H 4	N 4	There are no significant steep slopes located within Zone 1	N
	Gradient on site	Earthworks or retaining walls required to accommodate layout	Increased cost of development	VLk 5	H 4	Sv 20	Significant cut to fill earthworks will be required to develop the site to form the proposed development plateau, rail freight interchange, landscape bund and access roads. It is envisaged that designed cut slopes will be utilised to achieve the design in Zone 1. Drainage will be important in the design of these slopes. **Ground Investigation confirms the expected ground model are consistent with the envisaged outline design assumptions. Ground modelling and slope stability assessments will be required to confirm designs at detailed design stages.**	Sv
	As-dug cut material unsuitable as fill	Unstable earthworks	Surface deformation, structural damage	P 3	H 4	Md 12	Ground Investigation confirms that the ground model and that natural materials present within the cut areas will be suitable for reuse, however these materials are expected to be sensitive to moisture content change and will need careful handling for reuse within structural fill areas. All materials should be suitable for use within landscape fill areas.	Mn
	Embankment Stability	Slope failure	Site stability; surface deformation at crest, structural damage to services , highways and adjoining property.	P 3	VH 5	Sb 15	**Ground Investigation have been undertaken to confirm the underlying geology and this is in line with expectations. No particularly problematic ground conditions have been identified that would cause concern regarding foundation settlement or bearing failure. Embankments will need to be carefully designed and will need to accommodate suitable drainage systems and take account of the prevailing underlying ground conditions.**	Mn
	Cutting Stability	Slope failure	Site stability; surface deformation at crest, structural damage to services , highways and adjoining property.	P 3	VH 5	Sb 15	Ground Investigation undertaken has confirmed similar conditions proven in preliminary investigation undertaken in 2012. Therefore original cutting stability assessments remain valid. Cut off drains at toe and crest of cut slopes will be required. Additional face drainage is expected to be required to drain subordinate permeable strata to avoid softening of mudstone strata on cut face . Options for steepening the slopes to reduce cutting volumes maybe explored and might include variable slope geometry, top down soil nailing or partial depth retaining structures. No exceptionally difficult ground conditions have been identified.	Md
	Insufficient suitable fill	Import required to achieve design levels	Increased cost of development	VU 1	H 4	N 4	A careful cut to fill balance should be achieved to avoid the unnecessary importation of fill materials. **Ground Investigation has confirmed the expected geology and it appears likely that all materials will be suitable for use under a carefully designed and specified programme of earthworks. Many materials will be highly susceptible to moisture content change so modification or stabilisation may need to be considered to allow reuse of certain materials particularly within structural fill applications although much will depend upon prevailing weather conditions at the time the works are undertaken.**	N

	Condition	Hazard	Impact	P	I	R	Comment / Mitigation	RR
Foundations & Substructures	Loose or soft, compressible soils at shallow depth	Ground unsuitable for conventional shallow footings	Excess settlement or alternative foundations	P 3	H 4	Md 12	Anticipated geology is not anticipated to be particularly susceptible to significant risks of settlement. **Ground Investigation undertaken has confirmed the ground model and strata properties and n**o exceptional foundation solutions are anticipated to be required. In cut areas which will be mainly well into bedrock standard pad and strip foundations are anticipated to be suitable. In fill areas foundation solutions will depend upon a) depth of fill present and b) specification of the engineered fill provided. If a high performance fill is provided shallow pad and strip foundations maybe acceptable, however deepened foundations through shallow fill into underlying natural strata or ground improvement and / or piles might suit where fill is deeper.	Md
	Adjacent Structures	Works on site affecting stability of adjacent structures	Alternative design or altered development layout.	P 3	H 4	Md 12	No buildings are immediately adjacent to the site. However the design of cuttings along the south and east will need to be suitably robust and take account of the proximity and loading from the East Midlands Airport to the south, A453 to the east. **Ground Investigation has confirmed the expected ground model. No exceptionally poor ground conditions have been identified that would cause concern as to the stability of the slopes as designed at this outline stage. Detail design will need to refine these designs and value engineering options could be considered if necessary.**	Md
	Differential Settlement	settlements beneath buildings as a result of cut to fill works.	damage to floors and structures.	P 3	H 4	Md 12	Careful design has to be undertaken to smooth the transition from cut insitu materials to engineered fill materials. Foundation designs will need to take account of the transition and differing solutions may need to be adopted across the building footprint. Floor slabs and ground engineering solutions will need to be carefully designed to accommodate this risk. **Design will need to take account of specification for earthworks.**	Md
	Aggressive Ground Chemistry	Attack of buried concrete	Protection required	Lk 4	M 3	Md 12	Available information suggests that gypsum a naturally occurring sulphate could be present within several strata beneath the site and this will require more resistant concrete mix designs to be used to protect in ground concrete from attack. **Ground Investigation test data has been provided and should be used to design appropriate in ground concrete mix design in accordance with the recommendations of BRE SD1;2005.**	Md

	Condition	Hazard	Impact	P	I	R	Comment / Mitigation	RR
Floor slabs and Road Pavements	Soft and compressible near surface soil	Ground unsuitable for conventional ground bearing slab	Alternative floor design	U 2	M 3	Mn 6	**Based upon available Ground Investigation information some floor slabs are expected to be cast upon bedrock materials in cut areas. It is anticipated that ground bearing slabs should be sufficient, however design needs to take account of any potential softening and heave risk from unloading in these areas. Floor slabs for buildings within areas of fill maybe ground bearing however the need for ground improvement will very much depend upon the earthworks specification and performance of the earthworks fill material as well as the slab performance criteria. Stabilisation of earthworks fills maybe considered where high tolerances are required.**	Md
	Soft and compressible near surface soil	Low CBR due to soft formation	Surface damage or alternative design	U 2	M 3	Mn 6	As the site redevelopment will involve significant earthworks the final formation CBR will very much depend upon the earthworks specification and performance achieved. Initial recompacted CBR testing has been undertaken upon a small number of samples taken from cut areas to provide an indication of likely achievable CBR when compacting natural soils with out improvement or stabilisation. Stabilisation maybe required to improve highway formations.	Mn
	Frost susceptible soils	Frost Heave	Surface damage or alternative design	P 3	M 3	Mn 9	Final floor slabs and road pavement construction thickness design should incorporate this risk.	Mn
Drainage & Flooding	High permeability Strata	Ineffective storm water attenuation ponds/water & ecology features	Ponds need lining if required to retain water.	U 2	M 3	Mn 6	Shallow soils across the majority of the site are anticipated to be cohesive and are likely to retain water. Locally particularly in the north of the site granular soils are anticipated to be present and may allow groundwater to percolate away. **Ground Investigation has confirmed the anticipated ground conditions and preliminary infiltration testing confirms that the majority of insitu shallow soils present are unlikely to be suitable infiltration type drainage due to their mainly cohesive nature with the more granular soils also containing sufficient fines to inhibit infiltration.**	Md
	Low Permeability Strata	Ineffective soakaway	Alternative drainage required	VLk 5	M 3	Sb 15		Sb
	High groundwater	Effects planned plateau and cutting levels and foundation designs and in particular cutting depths.	Alternative vertical alignment/plateau levels required affecting cut fill balance feasibility	Lk 4	H 4	Sb 16	The majority of boreholes were dry as drilled, however limited accumulations of groundwater occurred within the standpipes and piezometers installed. these appear to occur as a result of the various subordinate confined more permeable siltstone and sandstone strata at depth within the bedrock mudstones. This is consistent with the previous findings in 2012 detailed within the Geotechnics Ltd report and discussed within Waterman's Ground Conditions Technical Note.	Sb
	Embankment earthworks and cutting slopes will require drainage.	Insufficient attenuation soakaway and ponds to accommodate earthworks drainage	Flooding	Lk 4	M 3	Md 12	Drainage designs to accommodate expected drainage from earthworks slopes including cut off drains at toe and crests.	Md
	Local watercourse	Flooding	Flood protection required	P 3	H 4	Md 12	Zone 1 is not located within an area at risk of flooding, however specialist flood risk assessment and drainage designs will be required.	TBC by Others

	Condition	Hazard	Impact	P	I	R	Comment / Mitigation	RR
Temporary Works & Construction Issues	Loose or unstable strata at shallow depth	Excavation Instability	Collapse or support required. Health and safety	P 3	H 4	Md 12	Ground Investigation confirmed that the majority of strata across Zone 1 are anticipated to be generally stable in the short term during excavation. The more granular deposits in the very north of Zone 1 are unlikely to be stable and instability particularly in the presence of groundwater. Should man entry of excavations be required suitable support or battering back of excavation sides will be required in all strata and atmospheres will need to be tested.	Sb
	Hard Strata / obstructions at shallow depth	Hard Digging / Hard driving	Increase cost and delay	VLk 5	M 3	Sb 15	Hard strata in the form of bedrock mudstones, sandstones and siltstones are present within Zone 1 at depth and are likely to be encountered as part of the major earthworks cuttings. Heavy plant and machinery will be required to remove these weak rocks.	Sb
	Presence of UNRECORDED sensitive underground services.	Damage during works posing risk to H&S of personnel and public	Increased cost of delay and for unplanned diversions and protection or repair.	U 2	H 4	Mn 8	Vigilance throughout works. Ensure up to date service drawings are obtained and site is scanned before works commence.	Mn
	Shallow Groundwater	Inundation of Excavations	Increase cost and delay. Health and safety	Lk 4	M 3	Md 12	Shallow groundwater tables are anticipated to be present within the shallow River Terrace deposits in the northern portion of the site. Discrete confined groundwater tables maybe expected to be present within the more permeable sandstone and siltstone bands throughout the solid deposits beneath the site and will be intersected by deep cuttings and earthworks. Consideration as to drainage of cut faces will need to be undertaken and either cut off drains behind the crest in the form of vertical band drains or face drainage or steepened slope with interceptor drains may need to be considered to catch these seepages and stop softening of cut faces and degradation of the face slope. It is recommended that cut of drains are installed prior to excavation to minimise effects. Temporary sump pumping maybe suitable in the cohesive soils, although careful design of these must be undertaken particularly in granular soils to avoid loss of fines in surrounding soils and later inundation collapse settlement in surrounding soils.	Sb
	Contaminated Ground	Precautions for Ground workers	Increase cost and delay. Health and	U 2	M 3	Mn 6	Vigilance throughout works. Seek advice of Environmental Engineer if any identified unusual odorous or visually contaminated materials encountered**. No exceptional contamination encountered. Cut to Fill balance obtained so no off site disposal anticipated. See separate Risk Assessment for details**	Mn
	Contaminated Ground	Increased Disposal Costs	Increase cost and delay. Health and safety	U 2	M 3	Mn 6		

Note: The register only considers geotechnical risk other risks may be present on site, including in-ground risks such as; ecology, archaeology, buried services, UXO etc., which are outside the scope of this assessment.

APPENDIX L
HAZARDOUS WASTE ASSESSMENT

As cmpds (AsS), Cd (CdO), CrVI cmpds ($FeCrO_4$), Cu (Cu_2O), Inorg Hg cmpds (HgO), Pb cmpds ($PbSO_4$), Ni ($NiCO_3$), Se cmpds (SeS) and Zn as ZnO. Also Ba ($BaCO_3$), Be cmpds ($BeSO_4$), Co (CoO), Mn (MnO_2) and Mo (MoO_3).

HASWASTE v5.1. Envirolab's Contaminated Land Soil Hazardous Waste Assessment Tool.

Envirolab, Sandpits Business Park, Mottram Road, Hyde, Cheshire SK14 3AR.

312494 East Midlands Gateway Zone 1

TP/WS/BH	TP310	TP314	TP323	TP324	TP316	TP319	TP326	TP328	TP301	TP303	TP352				
Depth (m)	0.80-0.90	0.60-0.70	0.50	0.10-0.20	0.10-0.20	0.10-0.20	0.60-0.70	0.15-0.25	0.50	0.10-0.20	0.50-0.70				
Envirolab reference	13/04787/1	13/04787/2	13/04787/3	13/04787/4	13/04787/5	13/04787/6	13/04787/7	13/04787/8	13/04851/1	13/04851/2	13/04851/3				
	mg/kg	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
Arsenic	3	1	2	4	4	3	2	5	8	3	4				
CrVI or Chromium	1	1	1	1	1	1	1	1	1	1	1				
Copper	10	14	28	19	17	12	16	21	28	14	12				
Lead	11	10	8	25	27	54	9	56	11	27	21				
Nickel	12	28	44	15	21	26	19	22	23	14	10				
Zinc	52	102	77	64	71	76	52	77	45	57	51				
Cadmium	0.5	0.7	1.0	0.5	0.7	0.7	0.5	0.6	0.5	0.5	0.5				
Mercury	0.17	0.22	0.30	0.24	0.21	0.27	0.17	0.37	0.17	0.17	0.17				
Selenium	1	1	1	1	1	1	1	1	1	1	1				
Barium															
Beryllium															
Cobalt															
Manganese															
Molybdenum															
Total USEPA 16 PAHs	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1				
Acenaphthene	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01				
Acenaphthylene	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01				
Anthracene	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02				
Benzo(a)anthracene	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04				
Benzo(a)pyrene	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04				
Benzo(b)fluoranthene	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05				
Benzo(ghi)perylene	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05				
Benzo(k)fluoranthene	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07				
Chrysene	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06				
Dibenzo(ah)anthracene	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04				
Fluoranthene	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08				
Fluorene	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01				
Indeno(123cd)pyrene	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03				
Naphthalene	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03				
Phenanthrene	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04				
Pyrene	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07				
Benzo(j)fluoranthene															
Benzene															
Toluene															
Ethylbenzene															
Xylenes															
Trimethylbenzenes															
Chlorobenzene															
1,2-Dichlorobenzene															
1,3-Dichlorobenzene															
1,4-Dichlorobenzene															
1,2,4-Trichlorobenzene															
2-Chlorotoluene															
4-Chlorotoluene															
Trichloroethene (TCE)															
Total TPH	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1				
Petrol or (C6-C10)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01				
Diesel or (C10-C25) or (conservative C10-C35)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1				
Lube Oil or (C25+) or (conservative C21+)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1				
Kerosene															
Creosote															
pH (soil)	6.36	7.46	7.98	4.96	5.66	8.30	7.00	7.08	8.32	6.26	6.06				
pH (leachate)															
Total Sulphide															
Free Cyanide															
Thiocyanate															
Elemental/Free Sulphur															
PCBs Total (eg EC7/WHO12)															
Phenols Total by HPLC															
Phenol															
Cresols															
Xylenols															
1-Naphthol															
Resourcinol															
2,3,5,6-Tetrachlorophenol															
2,4,5-Trichlorophenol															
2,4,6-Trichlorophenol															
2,4-Dichlorophenol															
4-Chloro-3-methylphenol															
Pentachlorophenol															
Bis(2-ethylhexyl)phthalate															
Butylbenzylphthalate															
Di-n-butylphthalate															
% Moisture															

Consider other individual contaminants on a case by case basis.

Table 3.2 of Annex VI of the CLP Regulation including 3rd ATP where applicable (sometimes called ATSP3).

As cmpds (AsS), Cd (CdO), CrVI cmpds ($FeCrO_4$), Cu (Cu_2O), Inorg Hg cmpds (HgO), Pb cmpds ($PbSO_4$), Ni ($NiCO_3$), Se cmpds (SeS) and Zn as ZnO. Also Ba ($BaCO_3$), Be cmpds ($BeSO_4$), Co (CoO), Mn (MnO_2) and Mo (MoO_3).

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312494 East Midlands Gateway Zone 1

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Envirolab reference	13/04787/1	13/04787/2	13/04787/3	13/04787/4	13/04787/5	13/04787/6	13/04787/7	13/04787/8	13/04851/1	13/04851/2	13/04851/3				
	mg/kg	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
Asbestos in Soil	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**
Asbestos detected in Soil (enter Y or N)		N				N				N					
Asbestos % Composition in Soil (Matrix Loose Fibres only)															
Asbestos Identifiable Pieces detected in the Soil (enter Y or N)															

Hazard Codes	Thresholds														
Irritant H4	≥10%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Irritant H4	≥20%	0.0024	0.0057	0.0089	0.0030	0.0042	0.0053	0.0038	0.0044	0.0046	0.0028	0.0020	0.0000	0.0000	0.0000	0.0000
Harmful H5	≥25%	0.0047	0.0083	0.0129	0.0077	0.0089	0.0120	0.0066	0.0125	0.0089	0.0071	0.0055	0.0000	0.0000	0.0000	0.0000
Toxic H6	≥0.1%	0.00007	0.00010	0.00014	0.00008	0.00010	0.00011	0.00007	0.00011	0.00007	0.00007	0.00007	0.00000	0.00000	0.00000	0.00000
Toxic H6	≥3%	0.00292	0.00598	0.00934	0.00363	0.00486	0.00577	0.00424	0.00515	0.00564	0.00333	0.00262	0.00000	0.00000	0.00000	0.00000
Carcinogenic H7	≥0.1%	0.00242	0.00566	0.00889	0.00303	0.00424	0.00525	0.00384	0.00444	0.00465	0.00283	0.00202	0.00000	0.00000	0.00000	0.00000
Carcinogenic H7	≥1%	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00000	0.00000	0.00000	0.00000
Carcinogenic H7 Total TPH	≥1,000mg/kg	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.00	0.00	0.00	0.00
Carcinogenic H7 Petrol or (C6-C10)	≥1,000mg/kg	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
Carcinogenic H7 Diesel or (C10-C25) or (conservative C10-C35)	≥10,000mg/kg	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.00	0.00	0.00	0.00
Carcinogenic H7 Lube Oil or (C25+) or (conservative C21+)	≥1,000mg/kg	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.00	0.00	0.00	0.00
8 IARC H7 Carcinogenic PAHs marker test (applicable to LRO only)	≥1%	330.000	330.000	330.000	330.000	330.000	330.000	330.000	330.000	330.000	330.000	330.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Carcinogenic H7 % Asbestos in Soil (Fibres)	≥0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Corrosive H8 (Irritant H4)	≥5%H4<10%; H8≥10%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
pH Corrosive H8 (Irritant H4) pH (soil)	≤2 H8 ≥11.5	6.36	7.46	7.98	4.96	5.66	8.30	7.00	7.08	8.32	6.26	6.06	0.00	0.00	0.00	0.00
pH Corrosive H8 (Irritant H4) pH (leachate)	≤2 H8 ≥11.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Toxic for Reproduction H10	≥0.5%	0.00242	0.00566	0.00889	0.00303	0.00424	0.00540	0.00384	0.00560	0.00465	0.00283	0.00210	0.00000	0.00000	0.00000	0.00000
Toxic for Reproduction H10	≥5%	0.00110	0.00100	0.00080	0.00250	0.00270	0.00540	0.00090	0.00560	0.00110	0.00270	0.00210	0.00000	0.00000	0.00000	0.00000
Mutagenic H11	≥0.1%	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00000	0.00000	0.00000	0.00000
Mutagenic H11	≥1%	0.00242	0.00566	0.00889	0.00303	0.00424	0.00525	0.00384	0.00444	0.00465	0.00283	0.00202	0.00000	0.00000	0.00000	0.00000
Produces Toxic Gases H12 Sulphide	≥1,400mg/kg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases H12 Free Cyanide	≥1,200mg/kg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases H12 Thiocyanate	≥2,600mg/kg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H13 Sensitising	≥1%	0.00242	0.00566	0.00889	0.00303	0.00424	0.00525	0.00384	0.00444	0.00465	0.00283	0.00202	0.00000	0.00000	0.00000	0.00000
Ecotoxic H14	≥1.0	0.04815	0.08680	0.09332	0.06667	0.07500	0.08970	0.05532	0.09263	0.06368	0.06048	0.05134	0.00000	0.00000	0.00000	0.00000
Ecotoxic H14 individual substance specific thresholds	≥0.0025%	0.000004	0.000004	0.000004	0.000004	0.000004	0.000004	0.000004	0.000004	0.000004	0.000004	0.000004	0.000000	0.000000	0.000000	0.000000
Ecotoxic H14 individual substance specific thresholds	≥0.025%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Consider other individual contaminants on a case by case basis.

Table 3.2 of Annex VI of the CLP Regulation including 3rd ATP where applicable (sometimes called ATSP3).