Report No. 1175/1
Date: August 2010

GEOENVIRONMENTAL APPRAISAL

of land at

LARCH PLACE, KENDRAY

Prepared for

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LARCH PLACE, KENDRAY (KEEPMOAT HOMES LTD)
- SUMMARY OF GEOENVIRONMENTAL ISSUES

The site is located off Larch Place, approximately 1½ km south-east of Barnsley town centre (NGR SE 360 049). The site occupies an area of approximately 1.1 hectares (2.7 acres). Historically the site has been occupied by housing since 1960, which has recently been demolished. The site currently comprises predominantly rough ground.

Lithos were commissioned by Keepmoat Homes to provide a geoenvironmental appraisal of the site. It is understood that the site is to be redeveloped with housing; a proposed layout is currently available. Lithos's investigation included a review of historical and geological plans together with information from the Local Authority, Environment Agency, Coal Authority and Landmark as well as a ground investigation comprising fifteen trial pits.

A summary of salient geoenvironmental issues is provided in the Table below.

Issue	Remarks
Made Ground	Cohesive Made Ground (0.2m to 0.6m thick) identified across the site comprising sandy gravelly clay with variable amounts of anthropogenic material (brick, concrete etc). Locally, lenses/pockets of Burnt Shale encountered. No existing materials suitable for use as Topsoil were identified at the site. Backfill Material comprising wood, timber, metal etc in a clay matrix encountered in one trial pit to 0.7m depth, believed to have been a vehicle inspection pit within a former domestic garage.
Natural Ground	Typically comprised a sequence of sand and gravel (Completely Weathered Sandstone) overlying Sandstone strata recovered as gravel and cobbles (Weathered Sandstone). Competent rockhead was encountered in the majority of trial pits from 1.3m to 2.7m depth.
Contamination & Remediation	The made ground at the site is essentially clean with the exception of two localised "hot-spots" of inorganic contaminants identified within the Cohesive Made Ground (TP14) and the Backfill Material (TP12). Given the relatively limited volumes of soils affected it is recommended that these materials be excavated and removed from site or isolated beneath areas of hardstand/minimum 600mm clean soil cover.
Hazardous Gas	Radon protective measures are required for all new dwellings. No additional sources of hazardous gas identified.
Mining & Quarrying	The surface stability of the site is not considered to be at risk from shallow underground coal mining or quarrying.
Preparatory Works	Demolition of remaining buildings, general site clearance and excavation/removal of localised inorganic contamination.
Foundations	Conventional reinforced strip footings in natural granular strata placed at a minimum 600mm depth. Where competent rock is encountered this may be reduced to 450mm, however; based on existing site levels competent rock is likely to lie at a depth greater than 450mm.
Groundwater & Excavations	Unlikely that major groundwater flows will be encountered in shallow excavations. Some overbreak is likely to occur in the majority of foundation and service trenches during excavation where cobbles/boulders of sandstone are encountered. Based on the exploratory hole logs, excavation greater than around 2m to 2.5m is likely to prove difficult across the majority of the site due to shallow rockhead.
Flooding & Drainage	Site is not located in a flood risk area, however; Flood Risk Assessment required as site area is greater than 1ha. Soakaways may be a suitable drainage solution for surface water run-off at the site although no in-situ testing has been undertaken.
Highways	Made ground is present across the site to typically less than 0.5m depth. Consequently it is likely that any new highways and parking areas will be founded on natural granular strata which should have a CBR of at least 5%.

Developer abnormals relating to geoenvironmental issues at the site are:

- Demolition of existing buildings/foundations and grubbing up of hardstand.
- Excavation and removal from site/isolation of localised inorganic contamination.
- Import of suitable Topsoil for use in garden and landscaped areas.

Some further work is required, most notably:

- Additional testing of Cohesive Made Ground adjacent to TP14 to delineate area of inorganic contamination.

This brief summary should not be assumed to represent a complete account of all the potential geo-environmental issues that may exist at the site. As such it is strongly recommended that the report be read in its entirety.

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APPENDICES

Appendix A - General Notes

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02	Ground Investigation Fieldwork
03	*Geotechnical Testing*
04	Contamination Laboratory Analysis & Interpretation
05	Hazardous Gas

Appendix B – Drawings

Drawing No.	Title
1175/1	Site Location Plan
1175/2	Proposed Site Layout
1175/3	Existing Site Features & Site Photographs
1175/4	Preliminary Conceptual Site Model
1175/5	Exploratory Hole Location Plan
1175/6	Revised Conceptual Site Model

Appendix C - Commission

Appendix D - Historical OS Plans#

Appendix E - Search Responses#

From	Date	Content
Landmark	24th June 2010	Envirocheck Report
The Coal Authority	29th June 2010	Mining Report
Environment Agency	16th July 2010	Environmental search data
Barnsley Metropolitan Borough Council	19th July 2010	Environmental search data

Appendix F– Exploratory Records

Appendix F	TP1 to TP15

Appendix G – Chemical Test Results*

Some of this data is not included within the paper or PDF copies of this report; it is all included on the CD.

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FOREWORD (Geoenvironmental Investigation Report)

This report has been prepared for the sole internal use and reliance of the Client named on page 1. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Lithos Consulting Limited (Lithos); such authorisation not to be unreasonably withheld. If any unauthorised third party comes into possession of this report, they rely on it at their peril and the authors owe them no duty of care and skill.

The report presents observations and factual data obtained during our site investigation, and provides an assessment of geoenvironmental issues with respect to information provided by the Client regarding the proposed development. Further advice should be sought from Lithos prior to significant revision of the development proposals.

The report should be read in its entirety, including all associated drawings and appendices. Lithos cannot be held responsible for any misinterpretations arising from the use of extracts that are taken out of context. However, it should be noted that in order to keep the number of sheets of paper in the hard copy to a minimum, some information (e.g. laboratory test certificates) is only included within the "electronic", PDF Report on the accompanying CD.

The findings and opinions conveyed in this report (including review of any third party reports) are based on information obtained from a variety of sources as detailed within this report, and which Lithos believes are reliable. All reasonable care and skill has been applied in examining the information obtained. Nevertheless, Lithos cannot and does not guarantee the authenticity or reliability of the information it has relied upon.

The report represents the findings and opinions of experienced geo-environmental consultants. Lithos does not provide legal advice and the advice of lawyers may also be required.

Intrusive investigation can only investigate shallow ground beneath a small proportion of the total site area. It is possible therefore that the intrusive investigation undertaken by Lithos, whilst fully appropriate, may not have encountered all significant subsurface conditions. Consequently, no liability can be accepted for conditions not revealed by the exploratory holes. Any opinion expressed as to the possible configuration of strata between or below exploratory holes is for guidance only and no responsibility is accepted as to its accuracy

It should be borne in mind that the timescale over which the investigation was undertaken may not allow the establishment of equilibrium groundwater levels. Particularly relevant in this context is that groundwater levels are susceptible to seasonal and other variations and may be higher during wetter periods than those encountered during this commission.

Where the report refers to the potential presence of invasive weeds such as Japanese Knotweed, or the presence of asbestos containing materials, it should be noted that the observations are for information only and should be verified by a suitably qualified expert.

This report assumes that ground levels will not change significantly from those existing at present and that houses will be of two storey construction. If this is not to be the case, then some modification to this report may be required.

Lithos Consulting Limited cannot be responsible for the consequences of changing practices, revisions to waste management legislation etc that may affect the viability of proposed remedial options.

Lithos reserve the right to amend their conclusions and recommendations in the light of further information that may become available.

GEOENVIRONMENTAL APPRAISAL

of land at

LARCH PLACE, KENDRAY

1 INTRODUCTION

1.1 The Commission and Brief

1.1.1 Lithos Consulting Limited, were commissioned by Keepmoat Homes Limited (Keepmoat) to carry out a geoenvironmental appraisal of land at Larch Place, Kendray.

1.1.2 Correspondence regarding Lithos's appointment, including the brief for this investigation, is included in Appendix C. The agreed scope of works included:

- a site walkover and inspection
- an assessment of the land use history
- determination of the site's environmental setting
- an intrusive ground investigation comprising fifteen trial pits
- assessment of the geotechnical properties of the near surface deposits to enable provision of foundation and highway recommendations
- a qualitative assessment of contamination risks, with respect to potential receptors
- the provision of recommendations with respect to site preparatory and remedial works

1.2 The Proposed Development

1.2.1 It is understood that consideration is being given to redevelopment of the site with thirty-five traditional two storey domestic dwellings with associated gardens; a proposed layout (referenced QD-LPK-SK01, Rev A) has been provided which is reproduced as Drawing No. 1175/2 in Appendix B to this report.

1.3 Report Format and Limitations

1.3.1 All standard definitions, procedures and guidance are contained within Appendix A, which includes background, generic information on:

- Assessment of the site's environmental setting
- Ground investigation fieldwork
- Geotechnical Testing
- Contamination Testing

1.3.2 General notes and limitations relevant to all Lithos geoenvironmental investigations are described in the Foreword and should be read in conjunction with this report. The text of the report draws specific attention to any modification to these procedures and to any other special techniques employed.

1.3.3 Primary aims of this investigation were to identify salient geoenvironmental issues affecting the site to enable the Client to obtain budget costs for the necessary site preparatory and remedial works.

2 SITE DESCRIPTION

2.1 General

2.1.1 The site location is shown on Drawing No. 1175/1 presented in Appendix B to this report. Site details are summarised in the Table below.

Detail	Remarks
Location	2 km south-east of Barnsley town centre
NGR	SE 360 049
Approximate Area	1.1ha (2.7 acres)
Known services	Underground electric, gas water & sewer: Overhead telecom.

2.2 Site Features

2.2.1 A Lithos engineer completed a walkover survey of the site on 21st July 2010.

2.2.2 The majority of the buildings at the site have been demolished with only two vacant plots remaining adjacent to Cypress Road in the west.

2.2.3 The former road (Larch Place) remains at the site together with an area of tarmac hardstand in the south (former private garages with concrete slab bases) and in the north (providing vehicle access to the rear of plots on Swanee Road).

2.2.4 A pedestrian footpath enters the site from the north-west from Swanee Road, with a second footpath in the south-east joining the main site area to the additional land off Masons Way.

2.2.5 Either side of the road (Larch Place) at the access with Swanee Road is currently grassed over. The remainder of the site comprises rough ground with occasional patches of vegetation.

2.2.6 At the time of the investigation, part of the additional land in the south-east was in use as a compound area for the storage of site cabins and builders materials.

2.2.7 Existing salient features together with a photographic record of the site at the time of the walkover survey are presented on Drawing No. 1175/3 in Appendix B to this report.

Feature	Remarks
Current Access	Off Swanee Road to the north, with additional land in south-east accessed from Masons Way
Topography	Gentle fall in level from north-west to south-east
Approximate areas	7,530m^2 rough overgrown areas 3,000m^2 tarmac hardstand/roads/footpaths 380m^2 grass 90m^2 buildings
Nature of boundaries	Predominantly various types of garden fencing.
Surrounding land uses	The site is surrounded by residential dwellings on all sides, with a chip shop beyond the far south-east corner.

2.3 Japanese Knotweed

2.3.1 During the site walkover, we did not notice the presence of any Japanese Knotweed. However, it should be noted that we are not qualified ecologists and as such cannot guarantee the absence of Knotweed or other invasive vegetation.

3 SITE HISTORY

3.1.1 In order to investigate the development history and previous land uses at the site and immediate surrounding land, site centred extracts from Ordnance Survey (OS) plans dating back to 1854 were examined. Some of these plans are presented in Appendix D to this report.

3.1.2 The Table below provides a summary of the salient points relating to the history of the site with respect to the proposed end use. It is not the intention of this report to describe in detail all the changes that have occurred on or adjacent to the site. Significant former uses/operations are highlighted in bold text for ease of reference.

Date(s)	Site	Surrounding Land
1854	Agricultural fields	Yews Farm to south-west
1932		Significant residential development to north-east immediately adjacent to Parliamentary Divisional County Boundary
1960	Site developed with housing	Further gradual urbanisation of surrounding areas
2010	Several of the buildings at the site absent	

3.1.3 Since publication of the latest OS plan the majority of the former dwellings at the site have been demolished.

4 ENVIRONMENTAL SETTING

4.1 General

4.1.1 Notes describing how the site's environmental setting has been assessed are included in Appendix A to this report. The responses received from Landmark, the Coal Authority, Barnsley Metropolitan Borough Council and the Environment Agency are presented in Appendix E. These responses are summarised below, together with the findings of our own "desk study" investigation.

Issue	Data reviewed	Summary
Geology	1:50,000 BGS map (Sheet 87 Barnsley) 1:10,000 BGS map (Sheet SE 30 SE)	Drift – None shown. Solid - Coal Measures strata (Oaks Rock Sandstone). No coal seams at shallow depth. Strata Dip – not shown. Faults – crossing north-west to south-east across the south of the site, downthrow to the north-east.
Mining	Coal Authority Report BGS maps	Past and present workings - The property is in the likely zone of influence from workings in 7 seams of coal at 260m to 560m depth, and last worked in 1974. Any ground movement from these coal workings should have stopped by now. Mine entries – None at or within 20m of the site. Opencast – None at or adjacent to the site.
Quarrying	Local Authority search Historical OS Plans	No quarries shown at or adjacent to the site.
Radon	BRE Report BR211	Basic measures required.
Hydrogeology	Environment Agency Groundwater Vulnerability map (Sheet 11 South Pennines)	Source Protection Zone – None. Minor Aquifer (Solid). Groundwater abstractions – None within 1km. Soil leaching potential – High (U). Pollution incidents – None at or relating to the site.
Hydrology	Environment Agency Landmark Report	Nearest watercourse(s) – un-named stream ½km to west, Measeborough Dyke 1km to north. Water quality – not provided. Pollution incidents – None at or relating to the site. Abstractions – None within 1km. Discharge consents – Nearest located 285m to south-east, sewerage discharges to tributaries of the River Don.
Flood Risk	Environment Agency	The site lies in Flood Zone 1, where the risk of flooding from rivers or the sea is classified as low. The site area is greater than 1 hectare, therefore a Flood Risk Assessment, focused on the management of surface water run-off, will be required. Development that increases the amount of impermeable surfaces can result in an increase in surface water run-off, which in turn can result in increased flood risk both on site and elsewhere within the catchment.

4.2 Landfills

4.2.1 Known or suspected areas of landfill in the vicinity of the proposed development site are summarised below:

Landfill Sites

Location	NGR (proximity to site)	Remarks	Source of data
Highfield Farm	SE 356 048 (240m to south-west)	Excavation and spoil material, classified as Category 4, ie material that would not be expected to give rise to landfill gas in substantial quantities. License granted in 1981, site now closed.	Landmark LA

4.2.2 Given the distance from the site and the nature of the landfilled waste, it is considered unlikely that the landfill will be capable of generating significant quantities of hazardous gas which could affect the site.

5 GROUND INVESTIGATION DESIGN

5.1 Anticipated Ground Conditions & Potential Issues

5.1.1 Based on the data reviewed in Section 4 (Environmental Setting), anticipated ground conditions are expected to comprise:-

Anticipated Condition	Remarks
Made Ground	No significant made ground anticipated
Natural Soils	Residual soils from weathering of rock
Bedrock	Likely to lie at shallow depth
Mineworkings	None anticipated at shallow depth below the site
Groundwater	Likely to lie at depth within the sandstone strata

5.1.2 Based on the data above and that in Sections 2 (Site Description) and 3 (History), potential ground-related issues associated with this site are likely to include:

Type of Issue	Specific Issue	Remarks
Potential on-site contamination sources	1. made ground from demolition of former dwellings	1. significant contamination considered unlikely
Potential off-site contamination sources	1. none identified	
Potential geotechnical hazards	1. buried obstructions	1. relict foundations
Other potential constraints	1. underground and/or overhead utilities	1. existing services

5.2 Preliminary Conceptual Site Model

5.2.1 A preliminary conceptual site model, presented as Drawing No 1175/4 in Appendix B, has been prepared after consideration of all the data presented in Sections 2 to 5.1 inclusive, of this report.

5.2.2 Potential pollutant linkages are shown on the preliminary conceptual site model.

- human health (end-users and site workers)
- vegetation (proposed planting)
- controlled waters (Solid - Minor Aquifer)

5.2.3 Potential contaminant pathways include:

- ingestion
- dermal contact
- inhalation of contaminated particulates
- surface water run-off, including existing drainage infrastructure
- downward infiltration of leachable/mobile contaminants to groundwater

5.3 Ground Investigation Design & Strategy

5.3.1 The preliminary conceptual site model was used as a basis for design of an appropriate ground investigation, the scope of which is summarised below.

Initial Ground Investigation Strategy

Exploratory Holes	Purpose
TPs 1 to 15	To determine the general nature of soils underlying the site, including the: • nature, distribution and thickness of made ground • nature, degree and extent of contamination • proportion of undesirable elements eg biodegradable matter, foundations etc • suitability of the ground for founding structures and highways

5.3.2 Proposed exploratory hole locations have been selected to provide a representative view of the strata beneath the site and to target potential areas of interest identified in Section 5.1 above. A nominal 50m grid spacing is proposed. Additional exploratory locations will probably be scheduled by the site engineer in light of the ground conditions actually encountered.

5.3.3 The number of representative samples taken will be reflective of the geological complexity actually encountered. However, in general about three samples will be taken from most trial pits.

5.3.4 An assessment of potential contaminants associated with the former uses has been undertaken with reference to CLR8. As a consequence of this assessment, anticipated potential contaminants, within soil and/or groundwater include:

- metals (within made ground)
- leachable metals (within made ground)

6 FIELDWORK

6.1 Objectives

6.1.1 The original investigation strategy is outlined in Section 5.2 above.

6.2 Exploratory Hole Location Constraints

6.2.1 No access was available in the far west due to existing buildings, in the grassed areas in the far-north-east due to underground services, in the north in the tarmac access area or in the far south-east due to the storage compound.

6.3 Scope of Works

6.3.1 Fieldwork was supervised by Lithos on 19th July 2010 and comprised the exploratory holes listed in the Table on page 7.

Scope of Ground Investigation Works

Technique	Exploratory holes	Final depth(s)	Remarks
Trial pitting (machine dug)	TPs-1 to 15.	1.3m to 2.7m	No drift deposits identified

6.3.2 Notes describing ground investigation techniques, in-situ testing and sampling are included in Appendix A to this report.

6.3.3 Exploratory hole logs are presented in Appendix F to this Report. These logs include details of the:

- Samples taken
- Descriptions of the solid strata, and any groundwater encountered.
- Results of the in-situ testing

6.3.4 Exploratory hole locations are shown on Drawing No.1175/5 presented in Appendix B.

7 GROUND CONDITIONS

7.1 General

7.1.1 A complete record of strata encountered beneath the proposed development site is given on the various exploratory hole records, presented in Appendix F.

7.1.2 Typical ground conditions encountered at the site are described below in Sections 7.2 (made ground) and 7.4 (natural ground) and are summarised in the Table on page 8

7.2 *Made Ground*

7.2.1 Cohesive Made Ground (0.2m to 0.6m thick) was identified across the majority of the site comprising sandy gravelly clay with variable amounts of anthropogenic material (brick, concrete, plastic etc).

7.2.2 It is unlikely that this material would be suitable as Topsoil, however; after removal of oversize (brick, concrete, plastic etc) the Cohesive Made Ground may be suitable for re-use as subsoil subject to laboratory testing.

7.2.3 Backfill Material comprising wood, timber, metal etc in a clay matrix was encountered in one trial pit (TP12) to 0.7m depth, believed to have been a vehicle inspection pit within a former domestic garage.

7.2.4 Locally (TP's 1, 11 & 13), pockets/lenses of Burnt Shale were identified within the Cohesive Made Ground.

7.2.5 Whilst not encountered during this investigation, the possibility of asbestos sheeting, used as shuttering, and/or fragments of asbestos sheeting within the hardcore beneath concrete slabs (former garage bases, remaining dwellings), cannot be entirely discounted.

7.3 Obstructions

7.3.1 It is apparent from a review of historical OS Plans (see Section 3) that buildings have been present on about 50% of the site area.

7.3.2 Several trial pits were excavated within the footprints of the former dwellings.

7.3.3 However, no significant relict foundations were encountered and as such it is considered likely that former foundations were removed as part of the demolition works.

Summary of Ground Conditions - Larch Place, Kendray

Hole ID	Depth to Base of Hole (m)	Depth to Base of Made Ground (m)	Depth to Base of Natural Strata (m)	Depth to Rockhead (m)	Remarks
			Sand/Gravel	(penetration mm)	
TP01	2.10	0.40	1.90	1.90 (200)	Unable to excavate below 2.10m depth
TP02	1.80	0.50	1.30	1.30 (500)	Unable to excavate below 1.80m depth
TP03	2.60	0.50	2.20	2.20 (400)	Unable to excavate below 2.60m depth
TP04	2.70	0.60	2.30	2.30 (400)	
TP05	1.30	0.40		0.40 (900)	Unable to excavate below 1.30m depth
TP06	2.50	0.30		0.30 (2,200)	Unable to excavate below 2.50m depth
TP07	1.90	0.30		0.30 (1,600)	Unable to excavate below 1.90m depth
TP08	2.00	0.20	1.70	1.70 (300)	Unable to excavate below 2.00m depth
TP09	1.80	0.30		0.30 (1,500)	Unable to excavate below 1.80m depth
TP10	1.60	0.40	0.70	0.70 (1,700)	Unable to excavate below 1.60m depth
TP11	2.40	0.40	2.00	2.00 (400)	Unable to excavate below 2.40m depth
TP12	2.10	0.70	2.00	2.00 (100)	Unable to excavate below 2.10m depth
TP13	2.70	0.50		0.50 (2,200)	Unable to excavate below 2.70m depth
TP14	2.10	0.30	1.30	1.30 (800)	Unable to excavate below 2.10m depth
TP15	2.00	0.40	1.20	1.20 (800)	

7.4 Natural Ground

7.4.1 Natural ground was encountered in all of the exploratory holes, and typically comprised a sequence of sand and gravel (Completely Weathered Sandstone) overlying Sandstone strata recovered as gravel and cobbles (Weathered Sandstone).

7.4.2 Competent rockhead was encountered in the majority of the trial pits from 1.3m to 2.7m depth.

7.5 Visual & Olfactory Evidence of Organic Contamination

7.5.1 No visual or olfactory evidence of significant organic contamination was noted in any of the trial pits.

7.5.2 However, made ground was encountered at the site and as such selected samples were scheduled for chemical testing to determine the extent of any contamination present and their suitability for re-use, see Section 8.

7.6 Groundwater

7.6.1 No significant inflows of groundwater were encountered during the investigation in any of the exploratory holes.

7.7 Stability

7.7.1 Stability of excavations within both the made and natural ground was generally good, however; complete collapse occurred in TP13 on completion of excavation.

7.8 Revised Conceptual Ground Model (Ground Conditions)

7.8.1 The Preliminary Conceptual Site Model has been revised in light of data obtained during the ground investigation, most notably with respect to:

- the nature and distribution of made ground, including the presence of significant buried obstructions
- constraints/difficulties associated with existing services etc
- the strength, nature and depth of underlying natural strata
- the nature and distribution of contamination (based on visual/olfactory evidence only)

7.8.2 The revised Conceptual Site Model is presented in Appendix B, as Drawing No. 1175/6.

7.8.3 Further refinement of the Conceptual Site Model is presented in Section 9, where the results of laboratory testing for contaminants have been considered.

8 CONTAMINATION (ANALYSIS)

8.1 General

8.1.1 Notes outlining current guidance with respect to the interpretation of analytical data are included in Appendix A to this report.

8.1.2 In the context of risks to human health associated with residential redevelopment, the Tier 1 Soil Screening Values referenced in this report have been derived via the CLEA default conceptual site model (CSM) used for generating SGV's, but amended, where appropriate, to be more specific to redevelopment within the planning process (see Generic Note 04 in Appendix A for further details).

8.1.3 This site is brownfield and underlain by Cohesive Made Ground which comprises reworked natural soils with some anthropogenic material. However, no significant contamination is anticipated given the former use of the site (residential).

8.1.4 Therefore, for organic compounds, the Tier 1 Soil Screening Values used in this report have been derived with reference to a CSM that assumes no clean cover will be placed in gardens/landscaped areas. In the event that determinands exceed these Tier 1 Values, the results will be reassessed with reference to a values derived using a CSM with a minimum 600mm soil cover.

8.2 Testing Scheduled

8.2.1 Based on the above assessment, a Lithos Engineer submitted a test schedule (summarised in the table below) to a UKAS accredited laboratory.

Type of Sample	No. of Samples	Determinands
Made Ground	10	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc)
	5	Leachable metals: arsenic, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc
	4	Speciated PAH
Natural Soil	6	pH and water soluble sulphate

8.2.2 Notes describing the various organics analyses are included in Appendix A to this report.

8.2.3 Laboratory test certificates as received from the laboratory are presented in Appendix G to this report.

8.3 Soluble Sulphate and pH Results

8.3.1 In accordance with BRE Special Digest 1:2005, this site has been classified as brownfield with a mobile groundwater regime.

8.3.2 It is envisaged foundations will extend to depths of about 1m through made ground and natural strata and samples taken from this depth range have been submitted for pH and water-soluble sulphate (2:1 soil/water extract).

8.3.3 The concentrations of sulphate in the aqueous natural soil extracts of six samples were determined using the gravimetric method. The pH value of each sample was determined by the electrometric method.

8.3.4 The highest water-soluble sulphate concentration and the lowest pH value for each soil type analysed are shown in the Table below. The average values of pH were all above 5.5, therefore concentrations of chloride and nitrate are considered insignificant.

Summary of Sulphate and pH results

Soil type	Lowest pH values	Highest Soluble Sulphate Concentration (g/l)
Completely Weathered Sandstone	5.6	<0.1

8.3.5 Therefore, in accordance with Table C2 of SD1, sub-surface concrete should be Design Sulphate Class DS-1, with the site allocated an ACEC Classification of AC-2z.

8.4 Soil Contamination Results

8.4.1 The soil contamination test results are summarised in the Tables on pages 11 and 12.

Summary of Degree of Ground Contamination (Inorganics).

Hole ID	Depth (m)	Material	Concentrations in mg/kg unless otherwise stated. Results are quoted to 1 decimal place if <10, and whole numbers if >10. Trigger Level Concentrations are Shown in Brackets and assume a **residential with gardens** end-use.										
			pH	As (32)	Cd (5)	Cr (3,000)x	Pb (450)#	Hg (169)*	Se (350)	B (5)~	Cu ♣$	Ni (127)	Zn (200)$
TP4	0.4	Cohesive Made Ground	7.8										
TP5	0.2	Cohesive Made Ground	6.9										
TP3	0.2	Cohesive Made Ground	7.3										
TP7	0.2	Cohesive Made Ground	6.6										
TP10	0.3	Cohesive Made Ground	7.3										
TP13	0.3	Cohesive Made Ground	7.7										
TP14	0.2	Cohesive Made Ground	7.7	34	9		490				440		1,200
TP13	0.4	Burnt Shale	8.0										
TP11	0.3	Burnt Shale	7.9										
TP12	0.5	Backfill Material	8.2										670

Key		Source of Guidance Trigger Level	
	Parameter tested for but not found to be in excess of threshold concentration	With the exception of those annotated with one of the symbols below, all Soil Screening Values in brackets above have been derived using CLEA v1.06. Values assume a source located in a sandy loam, with 6% soil organic matter (SOM).	
	Parameter not tested for		
♣	Tier 1 Value is pH dependent	#	Former CLEA SGV value.
x	Assumes Cr is CrIII. If demonstrated Cr is CrVI screen would be 4mg/kg	$	Dept of Environment Code of Practice for Agricultural use of Sewage Sludge 1996
*	Assumes mercury present as an inorganic compound (cf elemental metal or within organic compound). See Science Report SC050021/Mercury SGV.	◊	BRE Special Digest 1, Concrete in aggressive ground (2005)
~	Engineering judgement (Lithos). Boron is a phytotoxic, although most phytotoxic compounds can pose a risk to human health if sufficient concentrations are present. However, plants represent the most sensitive receptor, and a Tier 1 value which is protective of flora is therefore also protective of human health.		

Summary of the Leachability Testing

Hole ID	Depth (m)	Material	Concentration in µg/litre unless otherwise Shown. Results are quoted to 1 decimal place if <10, and whole numbers if >10. Trigger Level Concentrations are Shown in Brackets.										
			pH	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn	Se	B
				(10)*	(5)*	(50)*	(2000)*	(25)*	(1)*	(20)*	(5,000)*	(10)*	(1000)*
TP4	0.4	Cohesive Made Ground	8.1	1.0	<0.02	2.0	0.8	<0.3	<0.05	1.0	4.0	<0.5	<0.01
TP3	0.2	Cohesive Made Ground	8.5	0.9	<0.02	<1.0	0.6	<0.3	<0.05	<1.0	3.0	<0.5	<0.01
TP10	0.3	Cohesive Made Ground	8.6	0.8	<0.02	4.0	0.8	<0.3	<0.05	3.0	3.0	<0.5	<0.01
TP14	0.2	Cohesive Made Ground	8.7	1.0	0.04	2.0	6.7	1.6	<0.05	1.0	10	<0.5	<0.01
TP12	0.5	Backfill Material	10.1	1.1	<0.02	4.4	4.3	0.7	<0.05	2.0	5.0	<0.5	<0.01

Key		Source of Guidance Trigger Level	
-	Parameter tested for but not found to be in excess of trigger concentration	*	Water Supply (Water Quality) Regulations 1989, as amended in 2000
	Parameter not tested for		

Summary of Degree of Ground Contamination (Organics)

Hole ID	Depth (m)	Material	Concentrations in mg/kg. Results are quoted to 1 decimal place if <10, and whole numbers if >10. Trigger Level Concentrations are shown in brackets and assume a **residential with gardens and no cover** end use.	
			PAH	
			B(a)P	Naphthalene
			(5)	(4)
TP4	0.4	Cohesive Made Ground		
TP7	0.2	Cohesive Made Ground		
TP13	0.3	Cohesive Made Ground		
TP14	0.2	Cohesive Made Ground		

Key		Source of Guidance Trigger Level
-	Parameter tested for but not found to be in excess of trigger concentration	All Soil Screening Values in brackets above have been derived using CLEA v1.06. Values assume a source located in a sandy loam, with 6% soil organic matter (SOM).
	Contaminant not tested for	

Inorganic Determinands

8.4.2 Of the ten samples of made ground analysed for inorganic parameters, eight of the samples can be classified as uncontaminated and two could be classified as contaminated.

8.4.3 These samples are classified by comparison of concentrations with Lithos Soil Screening Values for an end use including domestic gardens and any area where plants are to be grown (the most sensitive of the proposed end-uses).

8.4.4 The most common contaminants are arsenic, lead, cadmium, copper and zinc identified in one sample of Cohesive Made Ground together with elevated zinc in a sample of the Backfill Material.

8.4.5 Statistical analysis of the Cohesive Made Ground has been carried out in general accordance with the methods outlined in "*Guidance on Comparing Soil Contamination Data with a Critical Concentration*" CIEH\CL:AIRE (2008) (see comments in Appendix A, Contamination Testing) and the results are summarised below.

8.4.6 No statistical analysis of the Backfill Material has been undertaken as an insufficient number of samples were recovered due to the low volume of material encountered.

8.4.7 All of the elevated determinands identified in the sample of Cohesive Made Ground recovered from TP14 failed the outlier test.

8.4.8 An outlier may indicate a localised area of contamination (quite possibly associated with an isolated fragment), or simply be the result of a measurement or recording error; but in any event, CLR 7 suggests it flags up the need for further investigation.

8.4.9 It is possible that this concentration is simply a result of a small amount of metal rich material in the sample and therefore not significant. Further sampling of the Cohesive Made Ground in this vicinity could be undertaken to determine whether this is the case, or whether significant inorganic contamination is more widespread.

Results of Statistical Analysis of Soil Contamination Data

Stratum	US_{95} Values for Contaminants that have yielded one or more Tier 1 exceedances for a given made ground type				
	Arsenic (20)	Cadmium (3)	Lead (450)	Copper (200)	Zinc (200)
Cohesive Made Ground	18 (23)	1 **(4)**	95 (169)	41 **(207)**	132 **(572)**

Notes: Values are bolded where the US_{95} value exceeds the relevant Tier 1 value.
Values in brackets are US_{95} values inclusive of any outliers.
n/a = none of the samples retrieved from this made ground type yielded a concentration in excess of the relevant Tier 1 value.

8.4.10 This statistical analysis indicates that the upper 95th percentile bound values (US_{95}) for arsenic, cadmium, lead, copper and zinc in the Cohesive Made Ground are not elevated in comparison with relevant Lithos Soil Screening Values.

8.4.11 Zinc and copper are phytotoxic metals, not considered toxic to human health, and consequently it is not a CLEA contaminant with an SGV. Encia refer to guidance issued by MAFF - The Soil Code (Rev. 1998), which presents maximum permissible concentrations of potentially toxic elements in soil after the addition of sewage sludge to agricultural land.

8.4.12 The methods of statistical analysis outlined in CLR7 relate to Soil Guideline Values and are not therefore strictly applicable to phytotoxic metals. However in theory there is no reason why the tests cannot be applied to these contaminants.

Leachables

8.4.13 Of the leachability tests conducted on five samples of made ground, none had concentrations of leachable contaminants above the maximum permissible concentrations as defined in the Water Supply (Water Quality) Regulations 1989, as amended in 2000.

Organic Determinands

8.4.14 Samples have been classified by comparison with Lithos risk-derived Tier 1 screening values (see Generic Notes 04 in Appendix A).

Polycyclic Aromatic Hydrocarbons (PAH)

8.4.15 Speciated analysis has confirmed the absence of naphthalene and benzo(a)pyrene in the Cohesive Made Ground beneath this site.

9 CONTAMINATION (QUALITATIVE RISK ASSESSMENT & REMEDIATION)

9.1 Summary of Significant Contamination

9.1.1 Cohesive Made Ground, typically <0.5m thick is present across the majority of the site. Testing suggests the majority of this material is suitable for re-use as subsoil in garden and landscaped areas subject to removal of unsuitable material (eg brick, concrete, plastic) which would generally be considered undesirable as a near-surface material in garden areas.

9.1.2 Locally, elevated concentrations of inorganic contaminants were encountered within the Cohesive Made Ground (TP14) and the Backfill Material (TP12).

9.1.3 No elevated concentrations of organic contamination were identified in any of the samples tested.

9.2 Revised Conceptual Ground Model (Contamination)

9.2.1 The Preliminary Conceptual Site Model has been amended in light of data obtained during the ground investigation, most notably with respect to the distribution of made ground and contaminants.

9.2.2 A revised Conceptual Site Model is presented as Drawing No. 1147/6 in Appendix B. The Model includes the contaminant sources described in Section 9.1 above, and potential pollutant linkages (summarised below in Section 9.3) to receptors.

9.3 Environmental Setting & End Use

9.3.1 As discussed in Section 9.1 above, contamination exists in the soils beneath this site. In order to assess the significance of this contamination, consideration must be given to the site's environmental setting and the proposed end use.

9.3.2 The underlying sandstone strata is classified as a minor aquifer. The nearest surface watercourse is an unnamed stream, approximately 500m beyond the site's western boundary. Therefore, the site's environmental setting is considered to be of low sensitivity.

9.3.3 With respect to human health, the proposed end use (residential) is considered sensitive. Transient risks to construction workers can be addressed by the adoption of appropriate health and safety measures, see Section 12.3.

9.4 Pollutant Linkages

9.4.1 In terms of a proposed redevelopment of this site, plausible pollutant linkages can be summarised as follows.

Sources

9.4.2 Contaminant sources have been summarised in Section 9.1 above.

Pathways

9.4.3 Potential contaminant pathways include:

- ingestion
- dermal contact
- inhalation of contaminated particulates
- surface water run-off, including existing drainage infrastructure

Receptors

9.4.4 Potential contaminant receptors include:

- the environment – minor aquifer, vegetation
- end users of the site (residents)

9.4.5 It can be concluded that there are plausible pathways between actual contaminant sources and potential receptors. Consequently, some remedial action will be required, either treatment/removal of the source, or "breakage" of the pathway.

9.5 Potential Remedial Options

General

9.5.1 Approval of the recommendations given below should be sought from the appropriate regulatory authorities prior to commencement of site redevelopment.

Inorganic contamination

9.5.2 Localised elevated concentrations of inorganic contaminants were identified in two samples, Cohesive Made Ground (TP14) and Backfill Material (TP12).

9.5.3 Statistical analysis has shown that the elevated concentrations identified in TP14 are outliers and are not consistent with the site wide results of the testing. In addition, the Cohesive Made Ground was only 300mm thick at this location.

9.5.4 The Backfill Material was only identified in one location (within a backfilled vehicle inspection pit) and as such is not extensive across the site.

9.5.5 Consequently, given the limited extent of these materials it is recommended that they are excavated and removed from site to a suitably licensed landfill.

9.5.6 Alternatively the contaminated materials could be isolated beneath areas of hardstand or a minimum 600mm of clean inert soil.

9.5.7 Such isolation could be achieved by excavating clean natural materials prior to placing the contaminated soils in the base of the excavation. The clean soils could then simply be placed over the contaminated soils, ensuring a total 600mm cover thickness.

9.5.8 This cover will break potential pollutant linkages between the contaminated made ground and future end-users.

9.5.9 In order to delineate the extent of inorganic contamination identified in TP14 it is recommended that additional samples are recovered from the immediate vicinity and submitted to the laboratory for testing.

9.5.10 Given the limited access in this area (adjacent to footpath, existing highway and former garage bases) it is recommended that this testing be undertaken as part of the remedial works.

9.5.11 The remaining Cohesive Made Ground identified across the site is essentially clean and subject to removal of oversize materials (brick, concrete, plastic etc) is considered suitable for re-use as subsoil.

9.5.12 No significant Topsoil materials were identified at the site, consequently there will be a need for some soil import. The upper 150mm in garden and landscaped areas should comprise suitable imported Topsoil.

Waste Classification

9.5.13 Disposal of the made ground off site is not considered appropriate, economically viable, nor in line with current Government philosophy regarding sustainable development. However, some excess arisings may be generated by excavations for foundations, sewers etc.

9.5.14 Disposal to landfill may be the most practical solution, if redistribution and retention on site is not feasible.

9.5.15 Notes outlining the interpretation of analytical data with respect to waste classification are included in Appendix A to this report, together with notes about Waste Acceptance Criteria (WAC).

9.5.16 Soil arisings generated by excavations at this site are likely to be classified as follows:

Soil Type	Waste Classification	Remarks
Localised inorganic contamination	Non-hazardous	Identified in Cohesive Made Ground (TP14) and Backfill Material (TP12)
Cohesive Made Ground	Inert	
Natural Soils	Inert	

9.6 Summary of Potential Pollutant Linkages & Mitigation

9.6.1 In terms of the proposed redevelopment plausible pollutant linkages, and feasible remediation options, can be summarised as follows:

Receptors	Pathways	Contaminants	Remediation Options
Human Health (Future residents) ◊	Consumption of contaminated vegetables	Inorganics identified in the made ground (TP's 12 & 14)	Excavation and removal of affected soils from site or isolation beneath minimum 600mm clean cover or hardstand
	Ingestion		
	Inhalation (dust and/or vapours)		
	Dermal contact		
Buildings	Contact with "aggressive" soil and/or groundwater	Sulphate in the made ground	Design Sulphate Class DS-1, ACEC Classification of AC-2z
Plants	Uptake of phytotoxic elements	Cu & Zn in the made ground (TP's 12 & 14)	Excavation and removal of affected soils from site or isolation beneath minimum 600mm clean cover or hardstand

Receptors	Pathways	Contaminants	Remediation Options
Groundwater	Surface water run-off	Inorganics identified in the made ground (TP's 12 & 14)	Excavation and removal of affected soils from site or isolation beneath minimum 600mm clean cover or hardstand

◇ transient risks to construction workers will be addressed by the adoption of appropriate health and safety measures in accordance with the Health and Safety at Work Act 1974 and regulations made under the Act including for example the COSHH Regulations.

10 HAZARDOUS GAS

10.1.1 Information from historical OS plans, the Environment Agency and Local Authority indicates that there are no known former landfill sites at or within 250m of the site capable of generating significant quantities of hazardous gas. As such it is unlikely that the site will be affected by landfill gas.

10.1.2 The site is neither underlain by shallow mineworkings nor located in an area considered susceptible to mines gas emissions.

10.1.3 However, the site is located in an area, which does require basic radon protection measures. These should comprise:

- use of 1200 gauge polyethylene DPM\DPC, with suspended concrete floors or ground bearing floor slabs
- continuous membrane across cavity walls
- cavity tray in external walls
- fully sealed service entries/exits

11 GEOTECHNICAL ISSUES

11.1 Conceptual site Model

11.1.1 A revised Conceptual Site Model is presented as drawing No. 1175/6 in Appendix B to this report.

11.2 Mining & Quarrying

11.2.1 The site is not underlain by any coal seams at shallow depth and there are no recorded quarries at or adjacent to the site.

11.2.2 It is therefore considered unlikely that the surface stability of the site will be affected by shallow underground coal mining or quarrying.

11.3 Foundation Recommendations

General

11.3.1 It is understood that consideration is being given to redevelopment of the site with thirty-five traditional domestic dwellings with associated gardens; a proposed layout (referenced QD-LPK-SK01, Rev A) has been provided which is reproduced as Drawing No. 1175/2 in Appendix B to this report.

11.3.2 Foundation recommendations assume that development will be two storey and that line loads will not exceed 70kN/m run. If this is not the case significant alteration to these recommendations will be required.

11.3.3 We have also assumed that final development levels will not differ significantly from ground levels existing at the time of investigation. Any digital terrain modelling undertaken, or commissioned by Keepmoat Homes should consider implications for the foundation recommendations outlined below.

11.3.4 Made ground (0.2m to 0.6m thick) was identified across the site comprising sandy gravelly clay with variable amounts of anthropogenic material (brick, concrete, plastic etc).

11.3.5 Backfill Material comprising wood, timber, metal etc in a clay matrix was encountered in one trial pit to 0.7m depth, believed to have been a vehicle inspection pit within a former domestic garage.

11.3.6 Made ground is not considered a suitable foundation material and foundations should therefore be taken through these materials into underlying natural strata of adequate bearing capacity.

11.3.7 A suspended floor construction should be used wherever the depth of made ground or infill beneath a plot exceeds 600mm. This is likely to affect relatively few of the proposed plots at the site based on existing ground levels.

11.3.8 Natural ground typically comprised a sequence of Sand and Gravel (Completely Weathered Sandstone) overlying Sandstone strata recovered as gravel and cobbles (Weathered Sandstone).

11.3.9 Competent rockhead was encountered in the majority of the trial pits from 1.3m to 2.7m depth.

11.3.10 Based on the findings of the fieldwork, conventional reinforced strip footings are considered the most suitable foundation solution option for two storey residential properties constructed on this site and these are discussed below.

Strip/Trench Fill Footings

11.3.11 It is considered that strip footings/trench fill will be the most suitable foundation solution for the majority of two or three storey houses constructed at the site. This solution is viable where the made ground is less than about 2.5m thick, and sand/gravel (Completely Weathered Sandstone) or gravel/cobbles (Weathered Sandstone) is the founding material.

11.3.12 Foundations in natural granular strata may be placed at a minimum 600mm depth. In accordance with NHBC Standards where competent rock is encountered this may be reduced to 450mm, however; based on existing site levels competent rock is likely to lie at a depth greater than 450mm.

11.3.13 Founding depths are from original or finished ground level, whichever is the lower, to the underside of the footing.

11.3.14 The sand/gravel/cobble strata are generally considered to have a safe bearing capacity of at least 150kN/m^2.

11.3.15 Assuming a strip foundation of 10m length and 0.6m width, founding from a minimum 0.6m depth, and a maximum line load of 70kN/m run, settlements of less than 25mm would be anticipated. This is considered likely to be acceptable, however; further advice should be sought from the Structural Engineer responsible for foundation design.

11.3.16 Where the ground is found to comprise varying and significant amounts of coarse granular (cobbly/bouldery) weathered rock or varying soil types, reinforcement of footings is recommended as a precaution against differential settlement. Reinforcement is likely to be required in all foundations constructed at the site.

11.3.17 For a standard 600mm wide, 225mm thick footing, a suitable reinforcement would be one layer of B385 mesh placed 75mm above the base of the footing. For other footing dimensions further advice should be sought from the Structural Engineer responsible for foundation design.

11.3.18 Reinforcement, as a precaution against differential settlement, is recommended only where foundation excavations encounter significant lateral and vertical variations in strata. For a standard footing, a suitable reinforcement would be one layer of B385 mesh placed 75mm above the base of the footing. For other footing dimensions further advice should be sought from the Structural Engineer.

11.3.19 Where rock is encountered at shallow depth foundations on rock should be placed entirely on rock and not partially on rock and partially on residual soil. This may, depending on surface gradient, necessitate significant overdeepening of foundations.

11.3.20 Overdeepened foundations should be stepped in accordance with NHBC Standards, Chapter 4.4.

11.3.21 Foundations will be required to be placed below a line drawn up at 45° from the base of any service or similar excavation.

11.3.22 In order to minimise loosening of granular soils, it is recommended that as soon as formation level is reached, it should be blinded. The blinding should consist of concrete with as low a water:cement ratio as possible.

11.3.23 Sub-surface concrete in contact at the site should be Design Sulphate Class DS-1, with the site allocated an ACEC Classification of AC-2z.

11.3.24 Whilst strip or trench fill footings generally represent a simple and inexpensive foundation solution disposal of arisings will be required. If these cannot be retained on site then disposal to landfill will be required (see Section 9.5.16).

11.3.25 In addition, some overbreak is likely to occur in the majority of foundation trenches during excavation where cobbles/boulders of sandstone are encountered resulting in higher concrete takes.

11.3.26 Keepmoat Homes should also review proposed plot designs and layouts, since deeper excavations for trench fill are likely to be unstable where the centre-lines of parallel trenches are closer than about 2m (assuming 600mm widths). Keepmoat Homes should supervise their groundworker to ensure footings are excavated in a controlled and safe manner.

11.3.27 Keepmoat Homes or their groundworker should seek further advice from Lithos if unexpected ground conditions are encountered in foundation or sewer excavations, including any conflict between soft ground associated with a backfilled trial pit excavation and the line of a proposed footing.

Summary of Foundation Recommendations

11.3.28 In summary, the following foundation solutions are likely to be most appropriate (subject to Client preferences regarding site preparatory works, final levels & costs associated with each foundation option).

Plot Nos	Foundation Solution(s)	Remarks (influencing factors)
1 - 35	Reinforced Strips	From 450mm in competent rock, minimum 600mm in sands/gravels.

11.3.29 The foundation solutions outlined in the above table assume that ground levels will not change significantly from those existing at present. If this is not to be the case, further advice should be sought from Lithos.

11.4 Designated Concrete Mixes

11.4.1 The following designated mixes in accordance with BRE Special Digest SD1 and BS 8500: Part1: 2006 will be suitable for use on this site.

Application	DS-1 conditions ACEC Class AC-2z
Reinforced strip/ trench fill footings (mesh reinforcement)	FND2z
Reinforced strip/ trench fill footings (rebar etc)	FND2z
In situ reinforced concrete floor slabs	RC28/35

11.5 Excavations

11.5.1 Based on the results of the investigation it is unlikely that major groundwater flows will be encountered in shallow excavations.

11.5.2 Excavations at the site should remain stable in the short term but if left open for any significant period of time, may require shoring, most notably in the made ground.

11.5.3 In addition, some overbreak is likely to occur in the majority of foundation and service trenches during excavation where cobbles/boulders of sandstone are encountered.

11.5.4 Rockhead was encountered in the majority of the exploratory holes. Based on the exploratory hole logs, excavation greater than around 2m to 2.5m is likely to prove difficult across the majority of the site. It would therefore be prudent to allow for excavation of hard rock in any deep excavations such as those that may be required for service trenches etc.

11.6 Drainage

11.6.1 The site slopes gently from north-west to south-east.

11.6.2 Groundwater was not encountered in any of the exploratory holes during the investigation.

11.6.3 Soakaways constructed in granular strata (Completely Weathered Sandstone) or in sandstone strata (Weathered Sandstone) may provide a suitable drainage solution for surface water run-off at the site.

11.6.4 However, it should be noted that no in-situ testing has been undertaken at this stage and the effectiveness of soakaways in such strata will be dependent on the amount of fines within the granular strata and the openness of fractures within the rock.

11.6.5 Any damage to the existing land drainage system caused by foundation or sewer excavations should be made good; this may require diversion and re-connection.

11.6.6 It is recommended that the developer contact Yorkshire Water Services with respect to capacity in existing foul and surface water sewers in the vicinity of the development area.

11.7 Highways

11.7.1 The former highway (Larch Place) remains at the site although the construction of the highway is not known. However, it is possible that Larch Place is already adopted and as such enquiries should be made with the adopting authority regarding retention of this road.

11.7.2 However, some revision to the highway layout is proposed, with construction of a new access to the site from Cypress Road in the west.

11.7.3 Made ground is present across the site to typically less than 0.5m depth. Consequently it is likely that any new highways and parking areas will be founded on natural granular strata which should have a CBR of at least 5%.

11.7.4 Where deeper made ground is encountered it is recommended that the full thickness of made ground be excavated and either:

- replaced with suitable aggregate in accordance with Series 600 (Earthworks) of The Highways Agency (HA) "Specification for Highway Works" 1998, or
- subject to screening, selection and replacement (in accordance with Series 600) of suitable material in engineered layers. Unsuitable materials include any soft or wet materials, biodegradables including topsoil, wood, scrap metal, frozen material and oversize.

11.7.5 Where the made ground is re-engineered it is considered that a CBR value of 5% should be achievable, however, this should be verified by field trials.

11.7.6 It is strongly recommended that consultation regarding the specification of the highways should be made with the adopting authority prior to redevelopment.

11.8 External Works

11.8.1 Any digital terrain modelling undertaken, or commissioned by Keepmoat Homes should be made available to their *Engineering Designer* prior to issue of an External Works Drawing.

12 REDEVELOPMENT ISSUES

12.1 General

12.1.1 This report has presented options with respect to foundation solutions, treatment of contamination etc that are considered technically feasible and in line with current good practice. Consequently, we would expect to obtain regulatory approval for whichever option is adopted, although this cannot be guaranteed. Copies of this report should be forwarded to the relevant regulatory authorities (NHBC & Local Authority) for their comment/approval.

12.2 Remedial Strategy

12.2.1 Redevelopment of this site will almost certainly be subject to planning conditions relating to remediation and validation. Once a specific, preferred development strategy has been decided, Lithos could liaise with local Planning Authority and NHBC and prepare a detailed Remediation Strategy document for approval.

12.2.2 The Remediation Strategy document would include:

- General background information, including site location, site description and a summary of ground investigation data
- An overview of existing constraints on development and the aims of the proposed remedial works
- Specific details of the anticipated site remedial/preparatory works
- Details of site supervision and verification
- A summary of implications for redevelopment

12.2.3 The anticipated remediation works are summarised below:

- General site clearance
- Demolition of remaining dwellings adjacent to Cypress Road

- Removal of unsuitable materials (brick, concrete, plastic etc) from Cohesive Made Ground prior to re-use as subsoil
- Excavation and removal from site/isolation beneath 600mm soil cover of locally identified contaminated soils (TP's 12 & 14)
- Import of suitable Topsoil materials for use in garden and landscaped areas (minimum 150mm)
- Supervision of the works by a suitably qualified consultant to include detailed records, testing requirements, etc
- Validation of the remediated site in the form of a detailed Verification Report

12.2.4 It is strongly recommended that the demolition contractor should chase-out all significant buried structures, and survey-in the resultant excavations before making them safe by backfilling.

12.2.5 At the very least, relevant features should be surveyed-in before "hiding" them beneath a veneer of rubble. Similarly, it would be prudent to complete a drainage survey prior to blading rubble across the site to leave it safe and secure.

12.3 Health & Safety Issues - Construction Workers

12.3.1 The bulk of the made ground has been retained on site. This made ground is essentially clean, with only localised contaminants identified (TP's 12 & 14).

12.3.2 Although workers will only be exposed to the contaminated soil for a relatively short time during excavations for foundations, drainage, utilities etc, the contaminants represent a risk, and simple precautionary measures are required, i.e. good personal hygiene and basic personnel protective equipment.

12.4 Control of Excavation Arisings

12.4.1 Excavations into made ground (TP's 12 & 14) are likely to yield contaminated arisings. The groundworker should carefully segregate (and stockpile separately) made ground arisings from these areas from arisings of "clean" made ground and natural soils from across the remainder of the site, in order that an excessive volume of unsuitable material is not generated.

12.4.2 Contaminated made ground arisings from TP's 12 & 14 could be:

- redistributed beneath concrete oversite, or areas of hardstanding, where they would be satisfactorily isolated from end users.
- isolated beneath at least 600mm thick cover layer in garden or landscaped areas by burying such materials beneath clean made ground or natural soils.
- exported from site to a suitably licensed landfill facility

12.5 New Utilities

12.5.1 Should the contaminated soils be retained on site it is recommended that where trenches for services including site drainage and water supply encounter such soils that these are cut over size in order to isolate pipe materials from potential contaminants and to enable maintenance to be conducted in "clean" material.

12.5.2 It is strongly recommended that all statutory service bodies are consulted at an early stage with respect to the ground conditions within which they will lay services in order to enable them to assess at an early stage any potential abnormal costs.

12.6 Potential Development Constraints

12.6.1 The existing services at the site present a potential development constraint unless they can be relocated. Additional enquiries are required to ascertain the feasibility of such diversionary works and the particular easement required by each service undertaker if they remain in-situ.

12.6.2 Although the majority of these utilities are likely to have served the former housing at the site and as such are no longer in use it is likely that they also serve existing dwellings to the east of Larch Place.

12.6.3 As such provision will need to be made to retain services to these properties both during and after redevelopment of the site.

13 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

13.1 General

13.1.1 It is understood that consideration is being given to redevelopment of the site with thirty-five traditional two storey domestic dwellings with associated gardens.

13.1.2 Made ground (0.2m to 0.6m thick) was identified across the site comprising sandy gravelly clay with variable amounts of anthropogenic material (brick, concrete, plastic etc). Locally, lenses/pockets of Burnt Shale were encountered.

13.1.3 Backfill Material comprising wood, timber, metal etc in a clay matrix was encountered in one trial pit to 0.7m depth, believed to have been a vehicle inspection pit within a former domestic garage.

13.1.4 Natural ground typically comprised a sequence of Sand and Gravel (Completely Weathered Sandstone) overlying Sandstone strata recovered as gravel and cobbles (Weathered Sandstone).

13.1.5 *Competent rockhead was encountered in the majority of the trial pits from 1.3m to* 2.7m depth.

13.2 Hazardous Gas

13.2.1 The site is located in an area which does require basic radon protection measures. No additional sources of hazardous gas have been identified.

13.3 Mining & Quarrying

13.3.1 The surface stability of the site is not considered to be at risk from shallow underground coal mining or quarrying.

13.4 Contamination & Remediation

13.4.1 The made ground at the site is essentially clean with the exception of two localised "hot-spots" of inorganic contaminants identified within the Cohesive Made Ground (TP14) and the Backfill Material (TP12).

13.4.2 Given the relatively limited volumes of soils affected it is recommended that these materials be excavated and removed from site or isolated beneath areas of hardstand/minimum 600mm clean soil cover.

13.5 Foundations

13.5.1 Conventional reinforced strip footings are considered the most suitable foundation solution option for two storey residential properties constructed on this site.

13.5.2 Foundations in natural granular strata may be placed at a minimum 600mm depth. Where competent rock is encountered this may be reduced to 450mm, however; based on existing site levels competent rock is likely to lie at a depth greater than 450mm.

13.6 Flooding

13.6.1 The EA indicate that the site is not located within an indicative floodplain.

13.7 Drainage & Highways

13.7.1 Soakaways constructed in granular strata (Completely Weathered Sandstone) or in sandstone rockhead (Weathered Sandstone) may provide a suitable drainage solution for surface water run-off at the site.

13.7.2 However, it should be noted that no in-situ testing has been undertaken at this stage.

13.7.3 It is not known if the existing highway is to be retained as part of the development. However; it is proposed to construct additional access from Cypress Road to the west.

13.7.4 Made ground is present across the site to typically less than 0.5m depth. Consequently it is likely that any new highways and parking areas will be founded on natural granular strata which should have a CBR of at least 5%.

13.8 Further Works

13.8.1 In order to delineate the extent of inorganic contamination identified in TP14 it is recommended that additional samples are recovered and submitted to the laboratory for testing.

13.8.2 Given the limited access in this area (adjacent to footpath, existing highway and former garage bases it is recommended that this testing be undertaken as part of the remedial works.

APPENDIX A

GENERAL NOTES

01	Environmental Setting
02	Ground Investigation Fieldwork
03	Geotechnical Testing
04	Contamination Laboratory Analysis & Interpretation
05	Hazardous Gas

01 - Environmental Setting

General
Third party information obtained from the British Geological Survey (BGS), the Coal Authority, the Local Authority etc is presented in the Correspondence Appendix of this Geoenvironmental Report.

Geology, Mining & Quarrying
In order to establish the geological setting of a site, Lithos refer to BGS maps for the area, and the relevant geological memoir. A coal mining report is obtained from the Coal Authority. Further information is sourced from the Local Authority and by reference to current and historical OS plans.

Landfills
Lithos obtain data from the Landmark Information Group, the Environment Agency and the Local Authority with respect to known areas of landfilling within 250m of the proposed development site. Reference is also made to historical OS plans, which are inspected for evidence of backfilled quarries, railway cuttings, colliery spoil tips etc.

Radon
Radon is a colourless, odourless gas, which is radioactive. It is formed in strata that contain uranium and radium (most notably granite), and can move though fissures eventually discharging to atmosphere, or the spaces under and within buildings. Where radon occurs in high concentrations, it can pose a risk to health.

In order to assess potential risks associated with radon gas, Lithos refer to BRE Report BR211, 2007: "*Radon: guidance on protective measures for new buildings*". The level of protection needed is site-specific and is determined by reference to the maps contained in Annex A of BR211. These maps are derived from the Radon Atlas of England and Wales (2007), and indicate the highest radon potential within each 1km grid square.

If the site falls within a light grey square on the relevant map in Annex A then basic radon protection should be installed in new buildings; if the site falls within a dark grey square then full radon protection should be installed. **If the site is in an un-shaded square then no radon protection is needed.**

BR211 provides a preliminary indication of the measures required for a particular site, but it is also often beneficial to request a BR211 Radon Report from the BGS. The Annex A maps indicate the highest geological radon potential within each 1km grid square, but in many cases the radon potential varies considerably within the grid square. The BR211 Radon Report gives definitive guidance on the requirement for radon protective measures, and therefore may allow the adoption of a lower level of protection than that indicated in the Annex A maps.

Lithos typically obtain a BR211 Radon Report for all sites that fall within a shaded square on the relevant Annex A map. When requesting a BR211 Radon Report from the BGS Lithos select the search radius carefully, since too large a search radius may result in the inclusion of areas of higher geological radon potential, and therefore in the recommendation of too high a level of protection. Further details of the protective measures required are provided in the Hazardous Gas section of this Geoenvironmental Report.

Hydrogeology
Lithos obtain information from the Environment Agency (EA) and the Landmark Information Group with respect to:

- groundwater quality
- recorded pollution incidents
- licensed groundwater abstractions

From April 2010 the EA's Groundwater Protection Policy uses aquifer designations that are consistent with the Water Framework Directive. These designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply), but also their role in supporting surface water flows and wetland ecosystems. The aquifer designation data is based on geological mapping provided by the British Geological Survey. The maps are split into two different type of aquifer designation:

- Superficial (Drift) - permeable unconsolidated (loose) deposits. For example, sands and gravels.
- Bedrock -solid permeable formations e.g. sandstone, chalk and limestone.

The maps display the following aquifer designations:

Principal Aquifers: These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

Secondary Aquifers: These include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into two types:

> **Secondary A** - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers;
>
> **Secondary B** - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.
>
> **Secondary Undifferentiated** - has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

Unproductive Strata: These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Note: The maps are only display the principal and secondary aquifers as coloured areas. All uncoloured areas on the bedrock designation map will be unproductive strata. However, for uncoloured areas on the superficial (drift) designation map it is not possible to distinguish between areas of unproductive strata and areas where no drift is present. To do this, it is necessary to consult the published geological survey maps.

Generic Notes –Geoenvironmental Investigations

For the purposes of our Groundwater Protection Policy the following default position applies, unless there is site specific information to the contrary:

- if no superficial (drift) aquifers are shown, we will use the bedrock designation;
- in areas where the bedrock designation shows unproductive strata (the uncoloured areas) we will use the superficial (drift) designation;
- in all other areas, we will use the more sensitive of the two designations (e.g. if secondary drift overlies principal bedrock, we will adopt an overall designation of principal)

The EA have also designated Source Protection Zones, which are based on proximity to a groundwater source (springs, wells and abstraction boreholes). The size of a Source Protection Zone is a function of the aquifer, volume of groundwater abstracted and the effective rainfall, and may vary from tens to several thousand hectares.

Hydrology
Lithos obtain information from the Environment Agency and the Landmark Information Group with respect to:

- surface water quality
- recorded pollution incidents
- licensed abstractions (groundwater & surface waters)
- licensed discharge consents
- site susceptibility to flooding

The EA have set **water quality** targets for all rivers. These targets are known as River Quality Objectives (RQOs). The water quality classification scheme used to set RQO planning targets is known as the River Ecosystem scheme. The scheme comprises five classes (RE1 to RE5) which reflect the chemical quality requirements of communities of plants and animals occurring in our rivers.

General Quality Assessment (GQA) grades reflect actual water quality. They are based on the most recent analytical testing undertaken by the EA. There are six GQA grades (denoted A to F) defined by the concentrations of biochemical oxygen demand, total ammonia and dissolved oxygen.

The susceptibility of a site to **flooding** is assessed by reference to a Flood Map on the Environment Agency's website. These maps provide show natural floodplains - areas potentially at risk of flooding if a river rises above its banks, or high tides and stormy seas cause flooding in coastal areas.

There are two different kinds of area shown on the Flood Map:

1. Dark blue areas could be flooded by the sea by a flood that has a 0.5% (1 in 200) or greater chance of happening each year, or by a river by a flood that has a 1% (1 in 100) or greater chance of happening each year
2. Light blue areas show the additional extent of an extreme flood from rivers or the sea. These outlying areas are likely to be affected by a major flood, with up to a 0.1% (1 in 1000) chance of occurring each year.

These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements

The maps also show all flood defences built in the last five years to protect against river floods with a 1% (1 in 100) chance of happening each year, or floods from the sea with a 0.5% (1 in 200) chance of happening each year, together with some, but not all, older defences and defences which protect against smaller floods.

The Agency's assessment of the likelihood of flooding from rivers and the sea at any location is based on the presence and effect of all flood defences, predicted flood levels, and ground levels.

It should also be noted that as the floodplain shown is the 1 in 100 year (or 1 in 200 year as appropriate), areas outside this may be flooded by more extreme floods (e.g. the 1 in 1000 year flood). Also, parts of the areas shown at risk of flooding will be flooded by lesser floods (e.g. the 1 in 5 year flood). In some places due to the shape of the river valley, the smaller floods will flood a very similar extent to larger floods but to a lesser depth.

If a site falls within a floodplain, it is recommended that a flood survey be undertaken by a specialist consultant who can advise on appropriate mitigating measures; ie raising slab levels, provision of storage etc.

COMAH & Explosive Sites
Lithos obtain information from the Landmark Information Group with respect to COMAH or explosive sites within 1km of the proposed development site. Lithos's report refers to any that are present, and recommends that the Client seeks further advice from the HSE.

Areas around COMAH sites (chemical plants etc) are zoned with respect to the implementation of emergency plans. The HSE are a statutory consultee to the local planning authority for all COMAH sites. The COMAH site may have to revise it's emergency action plan if development occurs. This might be quite straightforward or could entail significant expenditure. Consequently, the COMAH site may object to a proposed development (although it is the Local Authority who have final say, and they are likely to place more weight on advice from the HSE).

Preliminary Conceptual Ground Model
The site's environmental setting (and proposed end use) is used by Lithos to assess the significance of any contamination encountered during the subsequent ground investigation

Assessment of contaminated land is based on an evaluation of pollutant linkages (source-pathway-receptor). Contaminants within the near surface strata represent a potential source of pollution. The environment (most notably groundwater), site workers and end users are potential targets.

Potential pollutant linkages are shown on a preliminary conceptual site model, presented as a Drawing in an Appendix to this Geoenvironmental Report. The preliminary model is revised in light of data arising from the subsequent ground investigation.

02 - Ground Investigation Fieldwork

General
Lithos Ground Investigations are undertaken in accordance with current UK guidance including:

- BS5930:1999 "Code of practice for site investigation"
- BS10175:2001 "Code of practice for the identification of potentially contaminated sites".
- "Technical Aspects of Site Investigation" – EA R&D Technical Report P5-065/TR (2000)
- "Development of appropriate soil sampling strategies for land contamination" – EA R&D Technical Report P5-066/TR (2001)
- Contaminated Land Reports 1 to 6, most notably CLR Report No. 4 "Sampling strategies for contaminated land"
- "Guidance on the protection of housing on contaminated land" – NHBC & EA R&D Publication 66 (2000)
- AGS: 1996 "Guide to the selection of Geotechnical Soil Laboratory Testing"

Exploratory hole logs are presented in Appendices to this Geoenvironmental Report. These logs include details of the:

- Investigation technique adopted
- Samples taken
- Descriptions of the solid strata, and any groundwater encountered.
- Results of any in-situ testing
- Any gas\groundwater monitoring well installed

Exploratory Hole Locations
Exploratory hole locations are selected by Lithos, prior to commencement of fieldwork, to provide a representative view of the strata beneath the site and to target potential contaminant sources identified during the preliminary investigation (desk study). Additional exploratory locations are often determined by the site engineer in light of the ground conditions actually encountered; this enables better delineation of the depth and lateral extent of organic contamination, poor ground, relict structures etc.

Investigation Techniques
Ground conditions can be investigated by a number of techniques; the procedures used are in general accordance with BS5930: 1999 and BS1377: 1990. Techniques most commonly used by Lithos include:

- Machine excavated trial pits, usually equipped with a backactor and a 0.6m wide bucket.
- Cable percussive (Shell & Auger) boreholes, typically using 150mm diameter tools and casing.
- Window or Windowless Sampling boreholes. Constraints associated with existing buildings, operations and underground service runs can render some sites partly or wholly inaccessible to a mechanical excavator. In such circumstances, window sampling is often the most appropriate technique. A window sampling drilling rig can be manoeuvred in areas of restricted access and results in minimal disturbance of the ground (a 150mm diameter tarmac/concrete core can be lifted and put to one side). However, it should be noted that window sampling allows only a limited inspection of the ground (especially made ground with a significant proportion of coarse material).
- Rotary percussive open-hole probeholes are typically drilled using a tricone rock roller bit with air as the flushing medium. Probeholes are generally lined through made ground with temporary steel casing to prevent hole collapse.

Where installed, gas\groundwater monitoring wells typically comprise a lower slotted section, surrounded by a filter pack of 10 mm non-calcareous gravel and an upper plain section surrounded in part by a bentonite seal and in part by gravel or arisings. The top of the plain pipe is cut off below ground level and the monitoring well protected by a square, stopcock type manhole cover set in concrete, or the plain pipe is cut off just above ground level and the well protected by 100mm diameter steel borehole helmet set in concrete. Monitoring well details, including the location of the response zone and bentonite seal are presented on the relevant exploratory hole logs.

In-situ Testing
Where relative densities of granular materials given on the trial pit and window sample logs are based on visual inspection only, they do not relate to any specific bearing capacities. However, wherever possible Lithos employ a Mackintosh probe to assess relative density. Mackintosh probe results can be related to approximate allowable bearing capacities.

The relative densities of granular materials encountered in cable percussive boreholes are based on Standard Penetration Test (SPT) results. SPTs are carried out boreholes, in accordance with BS 1377 1990, Part 9 Section 3.3. Where full penetration (600mm) is not possible, N values are calculated by linear extrapolation and are shown on the logs as N* = x. The strength of cohesive deposits is determined using a hand shear vane.

Shear strength test results reported on trial pit logs are considered to be more reliable than those reported on window sample logs. Significant sample disturbance occurs during window sampling and consequently shear strength results on disturbed window samples are generally lower than results obtained during trial pitting, in-situ or in large excavated blocks.

Sampling
Typically Lithos collect at least three soil samples from each exploratory hole, although in practice a greater number are often taken. The collection of a sufficient number of samples provides a sound basis upon which to schedule laboratory analysis, ensuring:

- a sufficient number of samples from each (common) site material are tested;
- horizontal and vertical coverage of the site is adequate, thereby providing a robust data set for use in the conceptual ground model;
- any localised, significant, but non-pervasive conditions are considered.

Made ground and natural soils encountered in the field during a ground investigation often contain a significant proportion of coarse grained material (e.g. brick etc). Soil samples obtained during most investigations are often only truly representative of the in-situ soil mass where there is an absence of particles coarser than medium gravel; i.e the entire soil mass would pass a 20mm sieve.

Generic Notes – Geoenvironmental Investigations

Representative bulk samples of the **soil mass** are retrieved from coarse soils for specific geotechnical tests (most notably grading and compaction); this typically requires the collection of at least 10kg of soil, and occasionally >50kg. However, in the context of assessing land contamination, it is generally accepted that samples should be representative of the **soil matrix** of the stratum from which they are taken. Consequently, truly representative samples of coarse soils for subsequent contaminant analysis are not obtained - only the finer fraction is placed in sample containers. Coarse constituents not sampled would typically comprise any 'particles' with an average diameter greater than about 20mm (i.e. coarse gravel, cobble and boulder).

At present, neither ISO/IEC 17025 nor MCERTS specify sample pre-treatment with respect to stone removal. Unsurprisingly therefore UKAS accredited testing laboratories do not adopt the same approach to stones[1] – some crush and test the "as received" soil, whilst others sieve out stones and analyse only the residual soil (the sieve size used varies depending on the laboratory).

In essence, samples taken from coarser soils for contaminant analysis are "screened" by the geoenvironmental engineer in the field, and often sieved again by the laboratory during sample preparation. Geoenvironmental engineers do not typically re-calculate soil mass contaminant concentrations by taking account of the unsampled coarse fraction. Likewise, laboratories that remove stones typically report contaminant concentrations based on the dry weight of soil passing the sieve. In the context of land contamination and human health risk assessment, this is considered reasonable, because it is the soil matrix which is of greatest concern. Stones are unlikely to:

- Provide a significant source for plant uptake (consumption of vegetables);
- Remain on vegetables after washing (consumption of vegetables);
- Be eaten (accidentally by an adult, or deliberately by a child);
- Be whipped-up by the wind for dust generation (inhalation);
- Stick to the skin for any length of time (dermal contact);
- Yield toxic vapour (inhalation).

Consequently, Lithos instruct labs to remove all stones >10mm, and to report the results as dry-weight based on the mass of matrix tested. However, the laboratory are given site-specific instruction where coarse stones are coated in say oil, or impregnated with mobile contaminants such as diesel. Where the stones are predominantly natural, or inert (e.g. brick, concrete etc), removal will clearly result in higher reported concentrations, than if the stones were crushed and added to the matrix.

Where the stones include a significant proportion of contaminant-rich material (e.g. slag, fragments of galvanised metal etc) an argument could be made for crushing and analysing. However, provided the stones are stable (i.e. unlikely to disintegrate or degrade) they should not pose a significant risk to human health for the reasons stated above.

Sometimes it is necessary to obtain samples that are not representative of the wider soil matrix, for example when investigating localised, significant, but non-pervasive conditions. Any such unrepresentative samples are annotated with the suffix '*' (eg 2D*, or 4G*). Lithos's site engineer describes both the unrepresentative sample, and the soil mass from which it was been taken.

Sample Containers (for contaminant analysis). Samples of soil for contaminant testing are placed into appropriate containers (see below). Soil samples for organic analysis are stored in cool boxes, at a temperature of approximately 4ºC, until delivery to the selected laboratory.

Anticipated testing	**Container(s)**
pH & metals only	1 kg plastic tub
organics (TPH, PAH) etc only	500ml wide-necked glass jar. Vial required if TPH is to include GRO.
VOCs (incl. naphthalene and\or GRO) only	glass vial & 1kg plastic tub
pH & metals, and organics	1 litre wide-necked glass jar & 1kg plastic tub
pH & metals, and organics (incl. VOCs or GRO)	glass vial; 1 litre wide-necked glass jar; & 1kg plastic tub

Sample Containers (for geotechnical analysis). The majority of samples are only scheduled for PI and sulphate testing, for which 500g of sample is required (a full 0.5-litre plastic tub). However, bulk bags are taken where scheduling of compaction or grading tests is proposed.

Groundwater
Where encountered during fieldwork, groundwater is recorded on exploratory hole logs. If monitoring wells are installed, groundwater levels are also recorded on one or more occasions after completion of the fieldwork. Long-term monitoring of standpipes or piezometers is always recommended if water levels are likely to have a significant effect on earthworks or foundation design.

It should be borne in mind that the rapid excavation rates used during a ground investigation may not allow the establishment of equilibrium water levels. Water levels are likely to fluctuate with season/rainfall and could be substantially higher at wetter times of the year than those found during this investigation.

Description of Strata
Soils encountered during an Lithos investigation are described (logged) in general accordance with BS 5930. The descriptions and depth of strata encountered are presented on the exploratory hole logs and summarised in the Ground Conditions section within the main body of text. The materials encountered in the trial pits are logged, samples taken, and tests performed on the in-situ materials in the excavation faces, to depths of up to 1.2m; below this depth these operations are conducted at the surface on disturbed samples recovered from the excavation.

Key to Exploratory Hole Logs
Keys to logs are presented in the Appendix(ces) containing the logs. There are two Keys – Symbols & Legends and Terms & Definitions.

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[1] *Mark Perrin. Stoned – Sample Preparation for Soils Analysis. Ground Engineering, April 2007.*

03 - Geotechnical Laboratory Tests

General
Soil samples are delivered to the laboratory for testing along with a schedule of testing drawn up by Lithos. All tests are carried out in accordance with BS 1377:1990. The following laboratory testing are routinely carried out on a selection of samples:

- Atterberg limits & moisture contents
- Soluble sulphate & pH

The additional tests are typically only scheduled where significant earthworks regrade is anticipated:

- Grading.
- Compaction tests
- Particle density.

The test results are presented as received in an Appendix to this Geoenvironmental Report.

Atterberg Limits & Moisture Content
The Liquid and Plastic Limits of samples of natural in-situ clay are determined using the cone penetrometer method and the rolling thread test. These tests enable determination of an average Plasticity Index (PI) for each "type" of clay, although judgement is applied where variable results are reported.

PI can be related to shrinkability (low, medium or high) and then to minimum founding depth. Lithos typically only consider a soil to be shrinkable if the proportion finer than 63μm is >35%. PI results are compared against guidance given in the NHBC Standards, Chapter 4.2 (revised April 2003), which advocates the use of modified Plasticity Index (I'p), defined as:

I'p = Ip * (%< 425μm/100)

ie if PI is 30%, but the soil contains 80% < 425μm, then: I'p = 30 * 80/100 = 24%.

It should be noted that in accordance with the requirements of BS 1377, the % passing the 425μm sieve is routinely reported by testing labs. Lithos apply engineering judgment where PI results are spread over a range of classifications. Consideration is given to:

- the average values for each particular soil type (ie differentiate between residual soil and alluvium),
- the number of results in each class and
- the actual values.

Unless the judgment strongly indicates otherwise, Lithos typically adopt a conservative approach and recommend assumption of the higher classification.

Soluble Sulphate and pH
Sulphates in soil and groundwater are the chemical agents most likely to attack sub-surface concrete, resulting in expansion and softening of the concrete to a mush. Another common cause of concrete deterioration is groundwater acidity.

The rate of chemical attack depends on the concentration of aggressive ions and their replenishment at the reaction surface. The rate of replenishment is related to the presence and mobility of groundwater.

Lithos refer to BRE Special Digest 1 (SD1) "Concrete in aggressive ground. Part 1: Assessing the aggressive chemical environment" (2005). SD 1 provides definitions of:

- the nature of the site (greenfield, brownfield or pyritic)
- the groundwater regime (static, mobile or highly mobile)
- the Design Sulphate Class (DC Class) and
- the Aggressive Chemical Environment for Concrete (ACEC Class)

Lithos reports clearly state each of the above for the site being considered.

The concentrations of sulphate in aqueous soil/fill extracts are determined in the laboratory using the gravimetric method. The results are expressed in terms of SO_4 for direct comparison with BS 5328:1997. The pH value of each sample was determined by the electrometric method.

SD1 also discusses determination of "representative" sulphate concentration from a number of tests. Essentially if <10 samples of a given soil-type have been tested, the highest measured sulphate concentration should be taken. If >10 samples have been tested, the mean of the highest 20% of the sulphate test results can be taken. With respect to groundwater, the highest sulphate concentration should always be taken.

With respect to pH (soil & groundwater) the value used is the lowest value if <10 samples have been tested and the mean of the lowest 20% if >10 samples have been tested.

04 - Contamination Analysis & Interpretation (including WAC)

Waste Classification & WAC
In the context of waste soils generated by remediation and\or groundworks activities on brownfield sites, the following definitions (from the Landfill Regulations 2002) apply:

- Inert (e.g. uncontaminated 'natural' soil, bricks, concrete, tiles & ceramics).
- Non-Hazardous (e.g. soil excavated from a contaminated site which contains dangerous substances, but at concentrations below prescribed thresholds).
- Hazardous (e.g. soil excavated from a contaminated site which contains dangerous substances at concentrations above prescribed thresholds).

Dangerous substances include compounds containing a variety of determinants commonly found in contaminated soils on brownfield sites, for example arsenic, lead, chromium, benzene etc.

Landfill operators require Waste Acceptance Criteria (WAC) laboratory data, if soil waste is classified as **hazardous**, and such waste must have been subjected to pre-treatment. However, subject to WAC testing it may be possible to classify it as stable, non-reactive hazardous waste, which can be placed within a dedicated cell within the non-hazardous landfill.

Lithos typically only include WAC analysis in site investigation proposals and reports, if significant off-site disposal (of soil classified as hazardous waste) is anticipated, for example where redevelopment proposals include basement construction etc. If off-site disposal of soils classified as hazardous waste during redevelopment is anticipated, then WAC analysis should be scheduled at an early stage in the remediation programme. However, organic compounds (BTEX, TPH, PAH etc) are the most common contaminants that result in soils being classed as hazardous, and these contaminants can often be dealt with by alternative technologies (eg by bioremediation or stabilisation) and consequently retention on site is often possible.

It should be noted that **non-hazardous** soil waste can go to a non-hazardous landfill facility; no further testing (eg WAC) is required.

Contamination Laboratory Analysis & Interpretation
An assessment of potential contaminants associated with the former usages of the site is undertaken with reference to CLR 8 "*Potential contaminants for the assessment of land*" and the relevant DETR Industry Profile(s).

Current UK Guidance
The UK approach to contaminated land is set out in Contaminated Land Report No. 11 (2004) "*Model Procedures for the Management of Land Contamination*". The approach is based upon risk assessment, where risk is defined as the combination of the probability of occurrence of a defined hazard and the magnitude of the consequences of the occurrence.

In the context of land contamination, there are three essential elements to any risk: (1) a contaminant source, (2) a receptor (eg controlled water or people) and (3) a pathway linking the (1) and (2). Risk can only exist where all three elements combine to create a pollutant linkage. Risk assessment requires the formulation of a conceptual model which supports the identification and assessment of pollutant linkages.

Lithos adopt a tiered approach to risk assessment, consistent with UK guidance and best practice. The initial step of such a risk assessment (or Tier 1) is the comparison of site data with appropriate UK guidance levels, Lithos risk-derived screening values, or remedial targets. It should be noted that exceedance of Tier 1 does not necessarily mean that remedial action will be required.

Tier 1 **groundwater** risk assessments are undertaken by comparing leachate or groundwater concentrations with the appropriate water quality standard. Depending upon the specific characteristics and environmental setting of the site the appropriate standard is likely to be one of the following:

- Water Supply (Water Quality) Regulations 1989
- Environmental Quality Standards (for Freshwater)
- The Surface Waters (Abstraction for Drinking Water) Regulations

Tier 1 risk assessment of **hazardous gas** is undertaken through reference to the following documents (and further information is presented in Generic Note No. 5 – Hazardous Gas):

- Approved Document C, Building Regulations 2000
- Boyle & Witherington (2007) – Guidance on evaluation on development proposals on sites where methane and carbon dioxide are present, incorporating "traffic lights". Report Ref. 10627-R01-(02), for NHBC
- CIRIA C665 (2006) – Assessing risks posed by hazardous ground gases to buildings
- BS 8485:2007 – Code of Practice for the characterisation & remediation from ground gas in affected developments

With respect to the assessment of potential **phytotoxic effects** of contaminants, Lithos refer to "*The Soil Code*" (MAFF, 1998) for copper and zinc. The CLEA SGV is adopted for nickel due to its human health effects.

The potential risk to **building materials** is considered through reference to relevant BRE Digests, with particular emphasis on BRE Special Digest 1, 'Concrete in aggressive ground', 2005.

With respect to the interpretation of the **calorific values**, at present there are no accepted methods to assess whether a sample is combustible and under what circumstances it might smoulder. Some guidance is given in ICRCL Note 61/84 "Notes on the fire hazards of contaminated land" which states that:

"*In general.....it seems likely that materials whose CV's exceed 10MJ/kg are almost certainly combustible, while those with values below 2MJ/kg are unlikely to burn*".

Soil Screening Values derived by Lithos

In March 2002 DEFRA and the Environment Agency published a series of technical papers (R&D Publications CLR 7, 8, 9 and 10) outlining the UK approach to the assessment of risk to human health from land contamination. In 2008 CLR 7, 9 and 10 and all corresponding SGV and Tox reports were withdrawn and superseded by new guidance including:

- Guidance on Comparing Soil Contamination Data with a Critical Concentration - CL:AIRE and CIEH, May 2008
- Evaluation of models for predicting plant uptake of chemicals from soil - Science Report – SC050021/SR
- Human health toxicological assessment of contaminants in soil - Science Report: SC050021/SR2
- Updated technical background to the CLEA model - Science Report: SC050021/SR3
- CLEA Software (Version 1.05) Handbook Science report: SC050021/SR4
- Compilation of data for priority organic pollutants for derivation of Soil Guideline Values - Science Report: SC050021/SR7

The approach set out in these documents represents current scientific knowledge and thinking; and includes the Contaminated Land Exposure Model (CLEAv1.06). The Environment Agency are in the process of using this updated approach to regenerate a selection of Soil Guideline Values (SGVs).

CLEA SGVs were derived for standard land use scenarios predominantly in the context of Part IIA, using a conceptual site model (CSM) defined in SR3. Lithos have incorporated amendments to the CSM used to derive SGVs, that more accurately reflect redevelopment within the planning regime; consequently, Lithos have not adopted any published SGV as a screening value.

The CLEA conceptual site model assumes a source located in a sandy loam, with 6% soil organic matter (SOM) - equivalent to 3.5% total organic carbon (TOC). Lithos consider it reasonable to adopt the CLEA default TOC for made ground. However, where the average TOC value for a particular soil type is significantly lower than the 3.5%, evaluation of Lithos Screening Values should be undertaken and a site specific risk assessment will usually be required. Other CLEA default characteristics adopted by Lithos are:

Sandy loam characteristics (Source)	**Default values adopted.**
Total porosity (fraction)	0.53
Water filled porosity (fraction)	0.33
Air filled porosity (fraction)	0.2

Lithos have derived Screening Values for four different CSMs (Scenarios); these are:

- A - Residential with gardens, but no cover (or only up to 300mm)
- B - Residential with gardens and 600mm 'clean' cover
- C – Residential apartments with landscaping (i.e. no home grown produce)
- D - Commercial/industrial with landscaping.

The exposure pathways considered for each scenario are detailed in the Table below.

Scenario	**Land use**	**Pathways**	**Justification**
A	Residential with garden, but no cover (or only up to 300mm)	• Direct ingestion of soil • Dermal contact • Consumption of vegetables and soil attached to vegetables • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	Minimal cover – insufficient to break any pathways therefore all exposure pathways are relevant
B	Residential with garden minimum 600mm cover	• Inhalation of indoor vapours • Inhalation of outdoor vapours	The 600mm cover removes the risk from all pathways other than inhalation.
C	Residential apartments with landscaped areas and minimum 300mm cover	• Direct ingestion of soil • Dermal contact • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	All pathways applicable due to possible exposure from landscaped areas. However consumption of home grown produce not included as unlikely to be grown in landscaped areas. Where vegetables are to be grown site specific QRA may be required.
D	Commercial/ industrial with landscaped areas no cover	• Direct ingestion of soil • Dermal contact • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	All pathways applicable due to possible exposure from landscaped areas. Assumed the commercial development consists of offices to provide a conservative assessment.

Lithos have assumed the source of contamination is directly below the building foundations i.e. a depth to source of 0.15m as opposed to the CLEA default of 0.65m. This assumption provides for a more conservative approach than the UK default. This adjustment has been included to account for sites where made ground is re-engineered to enable new buildings to be established on raft foundations. In such situations contamination may lie directly beneath the foundation.

The Soil Screening Values referred to in this document are **not** intended to be used when considering potential risks associated with:

- existing land uses in the context of Part IIA of the Environment Protection Act 1990;
- end uses such as allotments, sports fields, children's playgrounds, care homes, hospitals etc; and
- controlled waters.

Generic Notes –Geoenvironmental Investigations

With respect to **inorganic** determinands, Lithos derived Tier 1 values for the four Scenarios A to D are presented below:

Inorganic Contaminant	Source	Tier 1 Assessment Criteria (mg/kg) for Scenarios A to D					Comments/Notes
		SGV (Resi)	A	B	C	D	
As	CLEA	32	32	Use (A) in SI Report for initial "screen". If >5 x A, then consider increase of cover to 1,000mm	35	635	
Cd	CLEA	10	5		17	230	
Cr	CLEA		3,000		3,000	30,000	Assumes Cr is CrIII.
Pb	CLEA		450		450	750	Based on former SGV
Ni	CLEA	130	127		127	1,700	Assessment of health risk only
Se	CLEA	350	350		595	13,000	
Hg	CLEA	170	169		238	3,640	Assumes in an inorganic compound.
B	Lithos		5		5	5	Based on phytotoxic risks as plants are the more sensitive receptor (Cu is pH dependant)
Cu	DoE		80-200		80-200	80-200	
Zn	DoE		200		200	200	
Cyanide	CLEA		527		530	14,000	

With respect to **organic** determinands, Lithos derived Tier 1 values for the four Scenarios A to D are presented below:

Organic Contaminant (all sourced via CLEA)	Tier 1 Assessment Criteria (mg/kg) for Scenarios A to D					Comments/Notes
	SGV (Resi)	A	B	C	D	
Benzene	0.33	0.3	0.5	0.6	100	
Toluene	610	497	1,440	1,690	4,360	
Ethyl Benzene	350	240	416	498	2,840	
Xylenes	240	127	146	183	2,620	
Phenol	420	412	2,360	557	38,700	
PCBs		1.7	1.8	1.8	1.8	Based on toxicity of EC7.
Benzo(a)pyrene		5	25	5	25	Where source is **not** a coal tar
Naphthalene		4	4	5	430	
Gasoline Range Organics		15	16	21	1,000	See **3-step** assessment of TPH below.
Diesel Range Organics		151	153	232	5,000	
Lubricating Range Org		1,000	5,000	1,000	5,000	

Note: **PAH** cannot be assessed as a single "total" value, as each individual PAH compound has different toxicity and mobility in the environment. Speciated analysis is required to determine the concentrations of the various compounds, most notably the key PAHs: Benzo(a)Pyrene (considered the most toxic of the PAHs); and Naphthalene (the most mobile and volatile of the PAHs).

Similarly, **TPH** cannot be assessed as a single "total" value, and reference has been made to the Environment Agency's document P5-080/TR3, "*The UK approach for evaluating human health risks from petroleum hydrocarbons in soils*". This document supports the assumptions and recommendations made by the US Total Petroleum Hydrocarbons Criteria Working Group (TPHCWG). The TPHCWG have broken down "TPH" into thirteen representative constituent fractions or "EC Bandings". The TPHCWG have derived a series of physiochemical and toxicological parameters for each of the thirteen bandings. The significance of speciated TPH results can be assessed by following the 3 steps outlined in Table 3 below.

Step	Result	Action
1. Consider indicator compounds: Are BTEX, Naphthalene, Benzo(a)pyrene (and the other toxic PAHs) above their respective Tier 1 screening values?	Yes	DQRA required
	No	Proceed to Step 2
2. Consider individual TPH fractions: are they above respective screening values?	Yes	DQRA required
	No	Proceed to Step 3
3. Assess Cumulative effects: Is the calculated Hazard Index for each source >1	Yes	DQRA required
	No	TPH compounds pose no significant risk

Step 1 *- Assessing indicator compounds*

TPH fraction Indicator compound	End use specific screening value (mg/kg)			
	A: Residential no cover	B: Residential with 600mm cover	C: Residential no gardens	D: Commercial/ Industrial
Benzene	0.3	0.5	0.6	100
Toluene	497	1,400	1,690	4,360
Ethylbenzene	240	416	498	2,840
Xylene	127	146	183	2,620
Naphthalene	4	4	5	430
Benzo(a)pyrene	5	25	5	25

Step 2 *- Assessing individual TPH fractions*

TPH fraction		End use specific screening value (mg/kg)			
		A: Residential no cover	B: Residential with 600mm cover	C: Residential with no gardens	D: Commercial/ industrial
Aliphatic 5-6	GRO	41	41	63	5,000^
Aliphatic 6-8	GRO	123	123	191	
Aliphatic 8-10	GRO	30	31	48	
Aliphatic 10-12	DRO	151	153	232	
Aliphatic 12-16	DRO	500^	500^	500^	
Aliphatic 16-21	DRO	1,000^	5,000#	1,000^	
Aliphatic 21-35	LRO	1,000^	5,000#	1,000^	
Aromatic 5-7	GRO	52	56	72	
Aromatic 7-8	GRO	15	16	21	1,000^
Aromatic 8-10	GRO	47	50	77	5,000^
Aromatic 10-12	DRO	212	282	390	
Aromatic 12-16	DRO	683	1,000*	1,000*	
Aromatic 16-21	DRO	1,000^	5,000#	1,000^	
Aromatic 21-35	LRO	1,000^	5,000#	1,000^	

* Calculated Screening Value exceeded soil saturation limit and could indicate free product, therefore calculated soil saturation limit adopted as a target

^ Calculated Screening Value close to soil saturation limit, screening value selected by Lithos considering visual and olfactory impacts.

#. Five times the screening value for Scenario A.

Step 3 *- Assessing Cumulative Effects*

$$HI = \sum_{F_i=1}^{16} HQ\,F_i = \frac{Measured\ concentration\ F_i\ (mg\,kg^{-1})}{SGV\ F_i\ (mg\,kg^{-1})}$$

where HI = Hazard Index
HQ = Hazard Quotient
F_i = Fraction $_i$
SGV = Soil Guideline Value

Possible Action in event of Tier 1 exceedance

Should any of the Tier 1 criteria detailed above be exceeded, then three potential courses of action are available. (The first is only applicable in terms of human health, but the second and third could also be applied to groundwater or landfill gas).

- Undertake further statistical analysis following the approach set out in *"Guidance on Comparing Soil Contamination Data with a Critical Concentration - CL:AIRE and CIEH, May 2008"* in order to determine whether contaminant concentrations of inorganic contaminants within soil\fill actually present a risk (only applicable to assessing the risk to human health).
- Carry out a more detailed quantitative risk assessment in order to determine whether contamination risks actually exist.
- Based on a qualitative risk assessment, advocate an appropriate level of remediation to "break" the pollutant linkage - for example the removal of the contaminated materials or the provision of a clean cover.

Prior to undertaking any statistical analysis the issue of the **averaging area** requires further consideration. The CL:AIRE\CIEH still refers to CLR 7, which suggests averaging area should reflect receptor behaviour and therefore might be a single garden, or an open area used by the local community as a play area. This approach to averaging areas is considered applicable within the context of Part IIA of the Environmental Protection Act (EPA) 1990, in terms of an existing residential development.

However, Lithos consider the concept of a single garden as an averaging area to be inappropriate with respect to brownfield redevelopment, which is regulated by the planning regime. In this context, contamination across the entire site needs to be characterised by reference to the Conceptual Site Model. Consequently, Lithos gather and analyse sample results by fill type, and\or by former use in a given sub-area of the site, before undertaking statistical analysis; ie the averaging area is associated with the extent of a particular fill type, or an area affected by spillage\leakage.

In terms of brownfield redevelopment, this is considered a more appropriate methodology which provides a more representative sample population for statistical analysis. As such the entire site is considered in terms of the proposed end use, be this residential with, or without gardens.

Analysis by soil\fill type is appropriate for essentially immobile contaminants associated with a particular fill type, for example arsenic in colliery spoil, metals in ash & clinker, sulphate in plaster-rich demolition rubble etc.

Analysis by former use is appropriate where more mobile contaminants have entered the ground, for example diesel associated with leakage from a former fuel tank, downward migration of leachable metals through granular materials, various soluble contaminants present in a wastewater leaking into the ground via a fractured sewer etc. In these circumstances, it may be appropriate to undertake statistical analysis of sample results from a variety of different soil\fill types. However, consideration would have to be given to factors such as porosity which might influence impregnation of a mobile contaminant into the soil mass; ie contamination would normally be more pervasive and significant in granular soils than cohesive soils.

05 - Hazardous Gas

General
Hazardous gas is considered to be any mixture of potentially explosive, toxic or asphyxiating gases, most notably methane, carbon dioxide and oxygen (deficiency). In addition, radon, a naturally occurring radioactive gas is also considered. Further information about radon is included in Notes 1. – Environmental Setting.

Assessment of potential risks associated with hazardous gas are based on a review of data obtained from the Landmark Information Group, the Environment Agency and the Local Authority and the British Geological Survey. Reference is also made to historical OS plans, which are inspected for evidence of backfilled quarries, railway cuttings, colliery spoil tips etc.

Where landfilling has occurred within 250m of the site boundary, the Local Planning Authority may request a landfill gas investigation in accordance with the Town and Country Planning General Development Order, 1988.

Sources
Potential sources of hazardous gas are:

- Landfill sites
- Made ground, especially where significant depths are present
- Shallow mineworkings associated with coal extraction
- Geological strata, including peat, organic silts, coal-bearing strata and limestone (reaction with acidic waters), granite (radon)
- Groundwater can sometimes act as a "carrier" for hazardous gas.
- Leakages from pipelines or storage tanks
- Sewers, septic tanks and cess pits

Generation
Wherever biodegradable material is deposited, landfill gas (principally a mixture of methane and carbon dioxide) is likely to be generated by microbial activity. Carbon dioxide is an asphyxiant and toxic; methane is flammable and a mixture containing between 5% and 15% methane by volume in air is explosive. Landfill gas in the ground is unlikely in itself to pose a significant risk, though it may damage vegetation. However, infiltration of landfill gas into confined spaces (e.g. cellars, services, etc) may give rise to considerable risk.

There is no typical figure for the length of time that landfill gas will be evolved, but at many sites significant gas generation continues for at least 15 years after the last deposit of waste.

Migration
Gas migration from a landfill site may occur in several ways. It may migrate through adjacent strata; the distance of migration being dependent on the pressure gradients, volume of gas and permeability of the strata. Where there are faults, cavities and fissures within the strata, gas may move considerable distances. Other migration pathways for gas include man-made features such as mine shafts, roadways and underground services.

Gas migration is influenced by a number of climatic factors, such as atmospheric pressure variations, water table level variations and the influence of a covering of snow or ice over the surface of the site and surrounding area.

Gas Monitoring Procedure
Lithos adopt a standard gas monitoring procedure, in accordance with CIRIA guidance. This procedure involves the measurement, in the following order of:

- Atmospheric temperature, pressure and ambient oxygen concentration on site immediately prior to and on completion of monitoring.
- Gas emission rate.
- Methane, oxygen and carbon dioxide concentrations using an infra-red gas analyser.
- Standing water level using a dipmeter.

In addition, ground conditions at each sampling location are recorded together with prevailing weather conditions and any other observations such as any vandalism. Where samples of gas are required for laboratory analysis, Gresham Tubes are used. Gas concentrations in the well are typically recorded immediately before and after retrieval of a sample.

Current Guidance
CIRIA Report 151 (1995)[i] identified that there was inadequate guidance on trigger concentrations for ground gases. CIRIA concluded that the most important aspect of a gas regime below or adjacent to a site was the surface emission rate, i.e. how quickly the gas is coming out of the ground. The lower the surface emission rate the lower the risk. CIRIA Report C665 (2006)[ii] advocates two methodologies for characterising sites:

A – All developments except low rise housing. The advocated methodology is that proposed by Wilson & Card, 1999[iii].

B – Low rise housing. An alternative (traffic light) methodology, derived by Boyle and Witherington, 2006[iv] for NHBC

Both methodologies refer to Gas Screening Values (GSV); previously referred to as limiting borehole gas volume flow.

A – All developments except low rise housing.
(Wilson & Card, 1999)[v] revised Table 28 of CIRIA 149[v] in terms of borehole gas volume flow rate (now GSV) in order to achieve a more consistent design of protection measures. This was done to reflect the importance of recognising the gas surface emission rate. Wilson & Card then developed a method for classifying gassing sites (Table 1 below), which took into account the combined gas concentration and GSV.

Table 1 – Site Classification (Wilson & Card)

Characteristic Situation (W&C, 1999)	Gas Screening Value, CH_4 or CO_2 (l/hr)	Additional limiting factors	Typical source of generation
1	<0.07	Methane not to exceed 1% v/v and carbon dioxide not to exceed 5% v/v	Natural soils with low organic content
2	<0.7	Borehole air flow rate not to exceed 70 litre/hr otherwise increase to Characteristic Situation 3	Natural soil, high peat/organic content
3	<3.5		Old landfill, inert waste, mineworking flooded.
4	<15	Quantitative Risk Assessment required to evaluate scope of protection measures.	Mineworking – susceptible to flooding, completed landfill, inert waste (WMP 26B criteria)
5	<70		Mineworking unflooded, inactive
6	>70		Recent landfill site

Notes:

Borehole flow rate = volume of gas (regardless of composition) which is escaping from well (l/hr). Gas Screening Value (litre/hour) = gas concentration (%) / 100 x borehole flow rate (l/hr). To facilitate design implementation, the limiting values for both methane and carbon dioxide are identical.

B – Low rise housing.

NHBC have developed a characterisation system similar to that of Wilson & Card above, but specific to low-rise housing development (Boyle and Witherington[xii]) (Table 8.7). This approach compares measured gas emission rates with generic "Traffic Lights". The Traffic Lights include "Typical Maximum Concentrations" for initial screening, and risk-based Gas Screening Values (GSVs) for consideration of situations where the Typical Maximum Concentrations are exceeded. Calculations are carried out for both methane and carbon dioxide and the worse case adopted in order to establish the appropriate protection measures.

Table 8.7 *NHBC Traffic light system for 150 mm void*

Traffic light	Methane[1]		Carbon dioxide[1]	
	Typical maximum concentration[2] (% v/v)	Gas screening value $(GSV)^{2.4.6}$ (litres per hour	Typical maximum concentration[2] (% v/v)	Gas screening value $(GSV)^{3.5.6}$ (litres per hour
Green	1	**0.16**	5	**0.78**
Amber 1	5	**0.63**	10	**1.56**
Amber 2	20	**1.56**	30	**3.13**
Red				

Notes:

1. The **worst gas-regime** identified at the site, either methane or carbon dioxide, recorded from monitoring in the worst temporal conditions, will be the decider for which Traffic Light and GSV is allocated.
2. Generic GSVs are based on guidance contained within "The Building Regulations: Approved Document C" (2004) and assume a **sub-floor void** of 150 mm thickness.
3. The **small room** is considered to be a downstairs toilet, with dimensions of 1.50 × 1.50 × 2.50 m, with a soil pipe passing into the sub-floor void.
4. The **GSV**, in litres per hour, is as defined in Wilson and Card (1999) as the borehole flow rate multiplied by the concentration in the air stream of the particular gas being considered.
5. The Typical Maximum Concentrations can be exceeded in certain circumstances should the conceptual site model indicate it is safe to do so. This is where professional **judgment** will be required, based on a thorough understanding of the gas regime identified at the site where monitoring in the worst temporal conditions has occurred.
6. The GSV thresholds should not generally be exceeded without completion of a detailed gas risk assessment taking into account site-specific conditions.

---

i Harries CR, Witherington PJ and McEntee JM (1995). Interpreting measurements of gas in the ground. CIRIA Report 151

ii CIRIA (2006) – Assessing risks posed by hazardous ground gases to buildings.

iii Wilson SA and Card GB (February 1999). Reliability and Risk in Gas Protection Design. Ground Engineering.

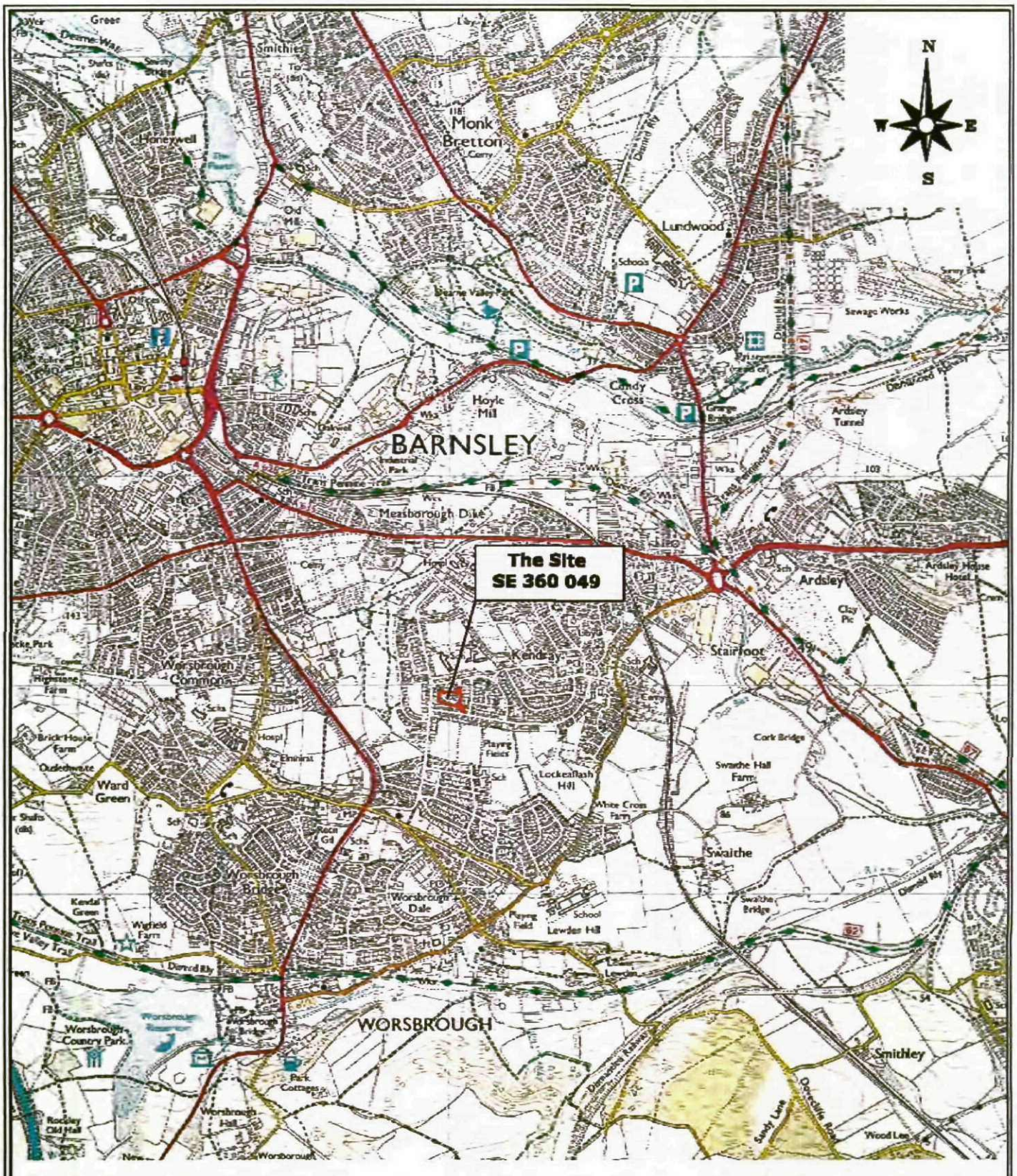
iv Boyle & Witherington (2006) – Guidance on evaluation on development proposals on sites where methane and carbon dioxide are present, incorporating "traffic lights". Report Ref. 10627-R01-(02), for NHBC

v Wilson SA and Card GB (February 1999). Reliability and Risk in Gas Protection Design. Ground Engineering.

APPENDIX B

DRAWINGS

Drawing No.	Title
1175/1	Site Location Plan
1175/2	Proposed Site Layout
1175/3	Existing Site Features & Site Photographs
1175/4	Preliminary Conceptual Site Model
1175/5	Exploratory Hole Location Plan
1175/6	Revised Conceptual Site Model



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LITHOS CONSULTING info@lithosconsulting.co.uk www.lithosconsulting.co.uk Tel 0845 680 9781	KEEPMOAT HOMES LIMITED	LARCH PLACE, KENDRAY	SITE LOCATION PLAN	DRAWN: ASw — DATE: 24/06/2010 CHECKED: RJH — DATE: 25/06/2010 STATUS: FOR COMMENT ☐ FOR APPROVAL ☐ DRAFT ☐ FINAL ☑ SCALE: 1:25,000 — SIZE: A4 — DRAWING NO.: 1175/1 — REVISION: A



NOTES

TP = Trial Pit Location

= Approximate Site Boundary

Reproduced from Queensbury Architects Drawing ref QD-LPK-SK01, Rev A, Dated May 2010

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

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CLIENT

KEEPMOAT HOMES LIMITED

JOB TITLE

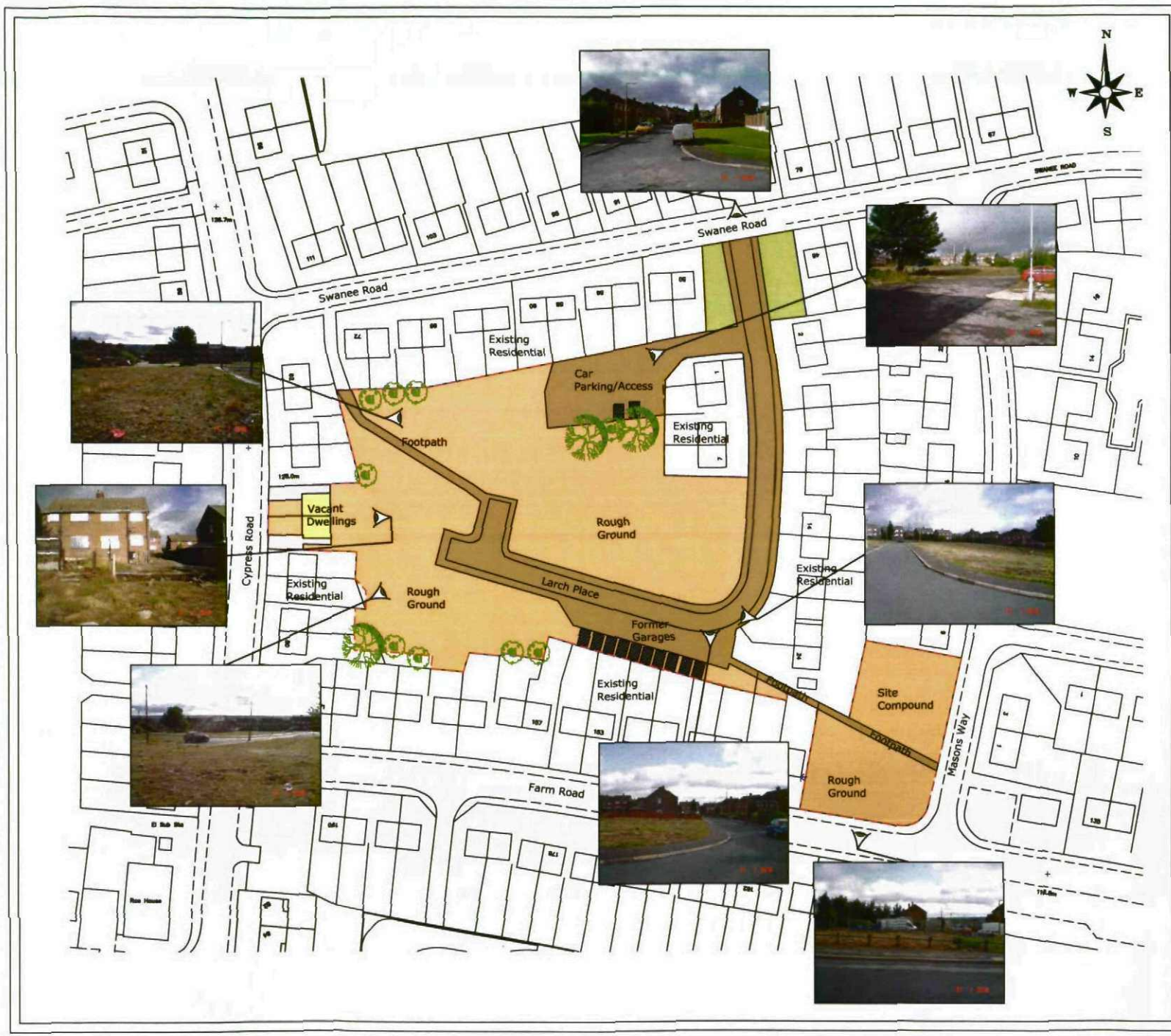
LARCH PLACE, KENDRAY

DRAWING TITLE

PROPOSED SITE LAYOUT

DRAWN	DATE	STATUS
ASw	22 07 10	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
RJH	22 07 10	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1,000	A3	1175/2	A



NOTES

- = Grassed Areas
- = Existing Building
- = Overgrown/Rough Ground
- = Tarmac Surfacing
- = Former Garage Base (Concrete)
- = Approximate Site Boundary
- = Location And Orientation of Photograph

REV.	DESCRIPTION	DATE

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KEEPMOAT HOMES LIMITED

JOB TITLE

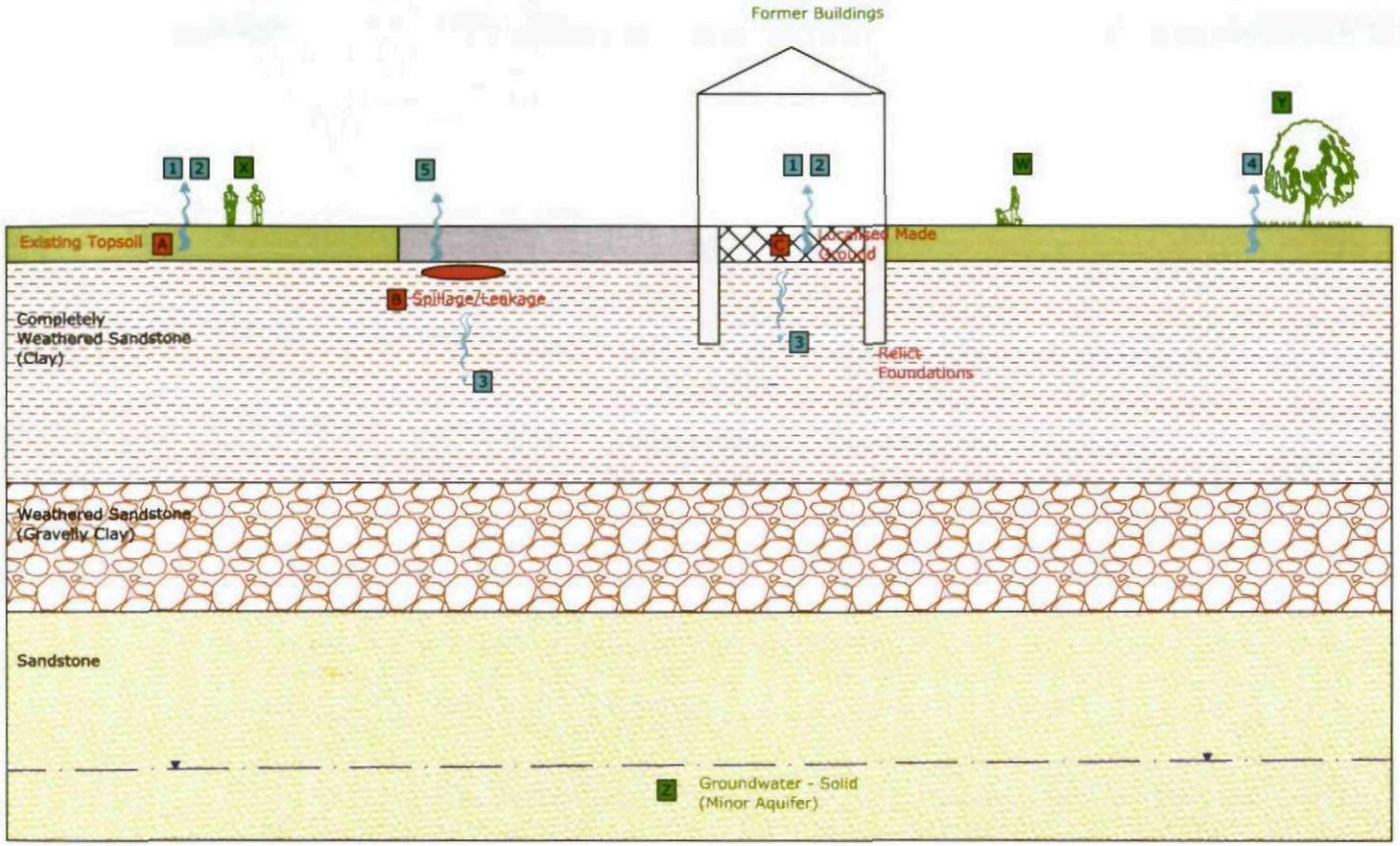
LARCH PLACE, KENDRAY

DRAWING TITLE

EXISTING SITE FEATURES PLAN

DRAWN	DATE	STATUS
ASw	22 07 10	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
RJH	22 07 10	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1,000	A3	1175/3	A



KEY
Made Ground
Existing Topsoil
Clay
Gravelly Clay
Sandstone

SOURCES
A Existing Topsoil (inorganics)
B Leakage/spillage (organics)
C Made Ground (inorganics)

PATHWAYS
1 Dermal Contact
2 Ingestion/Inhalation
3 Leaching of Mobile Contaminants
4 Uptake by Plants
5 Volatilisation of Organic Contaminants

RECEPTORS
W End Users (Residents)
X Site Workers
Y Vegetation (existing/proposed)
Z Controlled Waters (Ground)

NOTES

REV.	DESCRIPTION	DATE

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JOB TITLE
LARCH PLACE, KENDRAY

DRAWING TITLE
PRELIMINARY CONCEPTUAL SITE MODEL

DRAWN	DATE	STATUS
ASw	19 07 10	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
RJH	19 07 10	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
Not to scale	A3	1175/4	A



NOTES

TP = Trial Pit Location

= Approximate Site Boundary

REV.	DESCRIPTION	DATE

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JOB TITLE

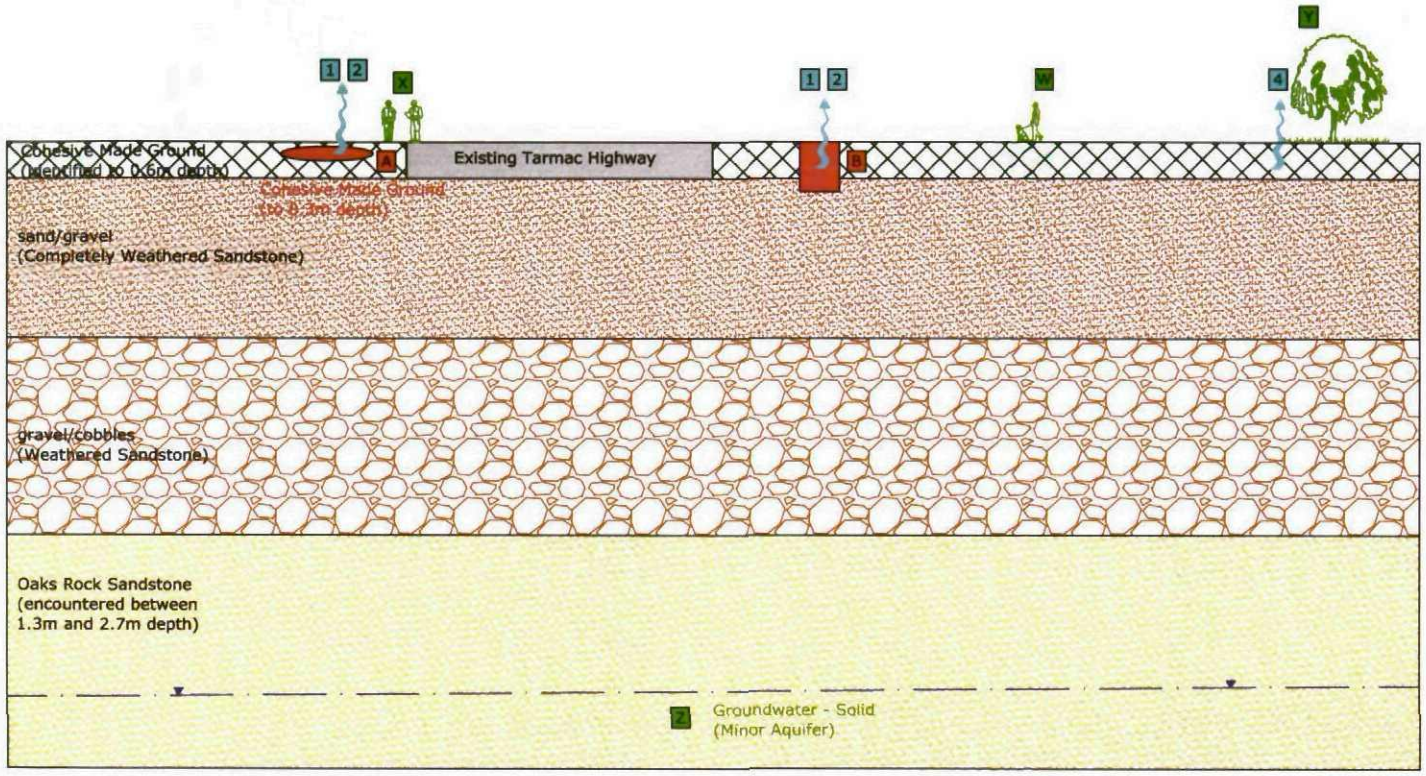
LARCH PLACE, KENDRAY

DRAWING TITLE

EXPLORATORY HOLE LOCATION PLAN

DRAWN	DATE	STATUS
ASw	22 07 10	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
RJH	22 07 10	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1,000	A3	1175/5	A



KEY

- Made Ground
- sand/gravel (Completely Weathered Sandstone)
- gravel/cobbles (Weathered Sandstone)
- Oaks Rock Sandstone

SOURCES

- A Cohesive Made Ground 'Hot-spot' (inorganics)
- B Backfill Material (inorganics)

PATHWAYS

- 1 Dermal Contact
- 2 Ingestion/Inhalation
- 3 Leaching of Mobile Contaminants
- 4 Uptake by Plants

RECEPTORS

- W End Users (Residents)
- X Site Workers
- Y Vegetation (existing/proposed)
- Z Controlled Waters (Ground)

NOTES

REV.	DESCRIPTION	DATE

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JOB TITLE

LARCH PLACE, KENDRAY

DRAWING TITLE

REVISED CONCEPTUAL SITE MODEL

DRAWN	DATE	STATUS
ASw	05 08 10	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
RJH	05 08 10	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
Not to scale	A3	1175/6	A

APPENDIX C

COMMISSION

20th June 2010

1175/003/RJH/rjh

Please reply to
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LS25 5AF

T 01977 684 801
E info@lithosconsulting.co.uk

Mr P Rice
Keepmoat Homes Limited
The Waterfront
Lakeside Boulevard
Doncaster
DN4 5PL

Dear Peter

Larch Place, Kendray

Further to your recent invitation and our subsequent meeting, please find attached our revised proposal for undertaking a site investigation on the above land. We understand that your proposed development will include thirty-five traditional two storey domestic dwellings with associated gardens; a proposed layout (referenced QD-LPK-SK01, Rev A) has been provided.

Review of drawings supplied with your correspondence dated 4th June 2010, suggests that the site consists of a single parcel of land of approximately 1.06 hectares to the north, south and west of Larch Place with a small area accessed from Masons Way.

The site most recently comprised six blocks of one and two storey houses that have recently been demolished. Housing has occupied the site since at least the mid 1960's. No former uses are shown at the site prior to construction of the housing.

Brief examination of the relevant geological map suggests the site is underlain by Coal Measures strata (Oaks Rock Sandstone).

Our site investigation proposal allows for the following works:

Desk Study: An examination of historical Ordnance Survey plans will be made to determine whether any past land uses have had any effect on the proposed development. Additionally, published geological plans of the area will be examined and enquiries will be made of the Environment Agency, Coal Authority and the Local Authority.

Fieldwork: We have allowed for one day's trial pitting. No allowance has been made for soakaway testing at this stage. If required, or considered feasible based on ground conditions encountered, soakaway tests could be undertaken for an additional fee of about £1,600. All trial pits will be supervised and logged by an experienced geoenvironmental engineer.

Representative soil samples of natural and man-made ground, including any contaminated samples, will be taken during the works. In-situ shear strengths of any cohesive soils encountered will be determined by the use of a hand-held shear vane.

We will make every effort to compact arisings and 'sweep' them over each pit. However, you should be aware that on completion of the investigation, "graves" of spoil (each about 3m long by 1m wide) unsuitable for trafficking, will be left at each trial pit location. At this stage, no allowance has been made for reinstatement of the hardstanding.

Accredited Contractor

This proposal has been put together without a visit to the site and it has been assumed that access is available for a JCB-type excavator.

The desk study may highlight other potential problems with the site such as landfill gas, quarrying, shallow mining or soil contamination. It may therefore be necessary to carry out additional works, but we will inform you prior to undertaking any such work and provide revised a cost estimate.

Soils Testing: This will comprise routine geotechnical soils analysis, typical of that normally required for greenfield sites. Although no allowance has been for in-situ or laboratory CBR testing, CBR values will be estimated from the strata descriptions and classification test results, where appropriate (i.e. if no significant regrading or reworking of made ground is proposed).

The site is understood to be essentially Greenfield (having only been occupied by houses since the 1960's), and therefore testing of potentially contaminated samples should only be required if made ground is encountered in the exploratory holes. However, we have allowed for analysis of topsoil to confirm its suitability for re-use.

Reporting & Timescales: In order to provide you with sufficient information to enable assessment of abnormal costs at the earliest opportunity we will issue a concise overview report within three days of fieldwork completion.

On completion of the desk study, fieldwork and laboratory testing a comprehensive bound, factual and interpretative report will be issued. This will contain detailed engineering records, laboratory test results, copies of all relevant correspondence and drawings of the site. The report will include qualitative risk assessment with respect to both controlled waters and human health.

The report will also provide technically feasible options for redevelopment of the site with housing, including consideration of foundation types and treatment\removal of contamination.

Fieldwork could be commenced within two weeks of receipt of your written instruction to proceed. Our comprehensive geoenvironmental appraisal report (1 bound hard copy, and 1 electronic PDF on CD) will be issued within 4 weeks of fieldwork completion.

Copies of the final report(s) will be issued to the relevant regulatory authorities on receipt of written instruction from yourselves.

Invoicing: The attached proposal provides a breakdown of the costs associated with this project. This breakdown is for information only and the proposal can be regarded as a lump sum price of £**** plus VAT. Variation will only occur in the event that a given item is not undertaken or that substantial additional works are recommended, in which case we will inform you immediately, provide costs for the required works, and seek your prior consent.

Our proposal allows for submission of the report to the Local Authority and NHBC, and for submission of a single piece of subsequent correspondence with each regulator to address any queries they may have. Any further meetings, correspondence etc, would be chargeable.

We will submit our invoice for this project with the final report.

Underground Services: Utility plans are required in order to protect operatives from the hazards associated with striking buried services and avoid potentially substantial disruption\repair costs. We will make every effort not to damage any services (including review of utility plans and use of a CAT detector).

Most developers have copies of the necessary utility plans (including electricity, gas, water, drainage & telecom), and it would be appreciated if you could forward these prior to the proposed fieldworks.

In the event that you do not have the necessary plans, or they are not current (older than 3 months), Lithos will obtain them direct from each of the utility companies. However, this may delay fieldwork by up to three weeks, and there will be an additional charge of £100 to cover our time and utility company charges.

Terms & Conditions: This work will be undertaken in accordance with our Standard Terms and Conditions, a copy of which are enclosed.

It is hoped the above is sufficient for your present needs. However, should you require any further information, please contact the undersigned.

Yours sincerely



Richard Hey
Director
for and on behalf of
LITHOS CONSULTING LIMITED

enc

Terms and Conditions for the Appointment of Lithos Consulting Limited

V002.10

1 DEFINITIONS AND INTERPRETATION

1.1 In this Agreement, unless the context otherwise requires, the following words and expressions have the following meanings:

"Agreement" shall mean these Terms (entitled "Terms and Conditions for the Appointment of Lithos Consulting"), the Proposal, any document recording the Client's unequivocal acceptance of the Proposal and any other documents or parts of other documents expressly referred to in any of the foregoing;

"Client" shall mean the party for whom the Services are being provided by Lithos;

"Documents" shall mean all documents of any kind and includes plans, drawings, reports, programmes, specifications, Bills of Quantities, calculations, letters, e-mails, faxes, memoranda, films and photographs (including negatives), or any other form of record prepared or provided or received by, or on behalf of Lithos, and whether in paper form or stored electronically or on disk, or otherwise;

"Lithos" shall mean Lithos Consulting Limited whose registered office is at 45 High Street, South Milford, North Yorkshire, LS25 5AF.

"Intellectual Property" includes all rights to, and any interests in, any patents, designs, trade marks, copyright, know-how, trade secrets and any other proprietary rights or forms of intellectual property (protectable by registration or not) in respect of any technology, concept, idea, data, programme or other software (including source and object codes), specification, plan, drawing, schedule, minutes, correspondence, scheme, programme, design, system, process logo, mark, style, or other matter or thing, existing or conceived, used, developed or produced by any person;

"Parties" shall mean the Client and Lithos

"Project" shall mean the project described in the Proposal and any enquiry from the Client on which Lithos has based its Proposal;

"Proposal" means the offer document prepared by Lithos in response to an enquiry or otherwise, in connection with the proposed provision of the Services;

"Services" means the work and services relating to the Project to be provided by Lithos pursuant to the Agreement and as set out in the Proposal and shall include any additions or amendments thereto made in accordance with these Terms;

"Terms" means these terms entitled "Lithos Consulting Terms of Appointment";

1.2 Words importing the singular only shall also include the plural and vice versa, where the context requires.

1.3 Words importing persons or parties shall include firms, corporations and any organisation having legal capacity and vice versa, where the context requires; and words importing a particular gender include all genders.

1.4 The sub-headings to the clauses of these Terms are for convenience only and shall not affect the construction of the Agreement.

1.5 A reference to legislation includes that legislation as from time to time amended, re-enacted or substituted and any Orders in Council, orders, rules, regulations, schemes, warrants, by-laws, directives or codes of practice issued under any such legislation.

1.6 In the event of conflict between the documents forming part of the Agreement, the Proposal shall prevail, followed by the Terms.

2 APPOINTMENT

2.1 The Client agrees to engage Lithos and Lithos agrees to provide the Services in accordance with the provisions of the Agreement.

3 OBLIGATIONS OF LITHOS

3.1 Lithos shall perform the Services using the reasonable standard of skill and care normally exercised by similar professional Environmental firms in performing similar services under similar conditions.

3.2 Lithos shall use all reasonable endeavours to perform the Services in accordance with all relevant environmental and safety legislation.

4 OBLIGATIONS OF THE CLIENT

4.1 Throughout the period of this Agreement the Client shall afford to Lithos or procure the affording to Lithos of access to any site where access is required for the performance of the Services.

4.2 The Client accepts responsibility for ensuring that Lithos is notified in writing of all special site and/or plant conditions, including without prejudice to the generality of the foregoing, the existence and precise location of all underground services, cables, pipes, drains or underground buildings, constructions or any hazards known or suspected by the Client, which the Client shall clearly mark on the ground or identify on accurate location plans supplied to Lithos prior to the commencement of the Services. The Client shall also inform Lithos in writing of any relevant operating procedures including any site safe operating procedures and any other regulations relevant to the carrying out of the Services. The Client shall indemnify Lithos against all costs, claims, demands and expenses arising as a result of any non-disclosure in this respect, including but not limited to indemnification against any action brought by the owner of the land or otherwise.

4.3 If the Client discovers any conflict, defect or other fault in the information or designs provided by Lithos pursuant to the Agreement, he will advise Lithos in writing of such defect, conflict or other fault and Lithos shall have the right to rectify the same or where necessary, to design the solution for rectification of any works carried out by others pursuant the conflicting, defective or in any other way faulty information or designs.

5 INTELLECTUAL PROPERTY

5.1 The copyright in all Intellectual Property prepared by or on behalf of Lithos in connection with the Project for delivery to the Client shall remain vested in Lithos.

5.2 The Client shall have a non-exclusive licence to copy and use such Intellectual Property for purposes directly related to the Project. Such licence shall enable the Client to copy and use the Intellectual Property but solely for its own purposes in connection with the Project and such use shall not include any licence to reproduce any conceptual designs or professional opinions contained therein nor shall it include any license to amend any drawing, design or other Intellectual Property produced by Lithos.

5.3 Should the Client wish to use such Intellectual Property in connection with any other works or for any other purpose not directly related to the Project or wish to pass any Intellectual Property to any third party, it must obtain the prior written consent of Lithos. The giving of such consent shall be at the discretion of Lithos and shall be upon such terms as may be required by Lithos. Lithos shall not be liable for the use by any person of such Intellectual Property for any purpose other than that for which the same were prepared by or on behalf of Lithos.

5.4 Ownership of any proposals submitted to the Client that are not subsequently confirmed as part of the Services to be provided for the Client remain with Lithos and such proposals must not be used as the basis for any future work undertaken by the Client or a third party and no liability can be accepted howsoever arising from such proposals.

5.5 In the event of the Client being in default of payment of any fees or other amounts due, Lithos may suspend further use of the licence on giving 2 days' notice of the intention to do so. Use of the licence may be resumed on receipt of the outstanding amounts

6 TITLE

6.1 Lithos shall transfer only such title or rights in respect of the Documents as it has, and if any part is purchased from a third party Lithos shall transfer only such title or rights as that party had and has transferred to Lithos.

6.2 Title in the Documents shall remain with and shall not pass to the Client until the amount due under the invoice(s) (including interest and costs) has been paid in full.

6.3 Until title passes, the Client shall hold the Documents as bailee for Lithos and shall store or mark them so that they can at all times be indentified as the property of Lithos.

6.4 At any time before title passes (save and except where payment is not due), but only after prior consultation with the Client, Lithos may without any liability to the Client repossess and use or sell all or any of part of the Documents and by doing so terminate the right of the Client to use, sell or otherwise deal in the Documents.

6.5 Lithos may maintain an action for the price of the Documents notwithstanding that title in them has not passed to the Client.

7 CONFIDENTIALITY

7.1 Lithos undertakes not to divulge or disclose to any third party without the written consent of the Client information which is designated confidential by the Client or which can reasonably be considered to be confidential and arises during the performance of the Services unless required to do so by law or necessary in the proper performance of its duties in relation to the Project, or in order to make full frank and proper disclosure to its insurers or intended insurers, or to obtain legal or accounting advice.

7.2 Subject to the above, Lithos shall be permitted to use information related to the Services it provides in connection with the Project for the purposes of marketing its services and in proposals for work of a similar type.

8 THIRD PARTIES

8.1 The Agreement or any part thereof or any benefit or interest thereunder may not be assigned by the Client without the prior written consent of Lithos. The giving of such consent shall be at the discretion of Lithos and Lithos will only agree to an assignment on its terms and in return for payment of a fee by the Client to Lithos to cover Lithos's legal and other costs associated with any assignment.

8.2 The Agreement shall not confer and shall not purport to confer on any third party any benefit or any right to enforce any term of this Agreement for the purposes of the Contracts (Rights of Third Parties) Act 1999 or otherwise.

8.3 Lithos will consider and may consent to any request from the Client for Lithos to enter a collateral warranty with a third party with regard to the Services provided under the Agreement. The giving of such consent shall be at the discretion of Lithos and Lithos will only enter a collateral warranty on its terms and in return for payment of a fee by the Client to Lithos to cover Lithos's legal and other costs associated with any collateral warranty.

9 INSURANCE

9.1 Lithos warrants to the Client that there is in force a policy of Professional Indemnity insurance covering its liabilities for negligence under this Agreement, with a limit of indemnity of £5,000,000 (FIVE MILLION POUNDS) in the aggregate. This policy is annually renewable and whilst renewal is not automatic, Lithos agrees to use reasonable endeavours to maintain such insurance at all times until six years from the date of the completion (or termination) of the Services under the Agreement, provided such insurance is available at commercially reasonable rates having regard, inter alia, to premiums required and policy terms obtainable.

9.2 If for any period such insurance is not available at commercially reasonable rates, Lithos shall forthwith inform the Client and shall obtain in respect of such period such reduced level of Professional Indemnity insurance as is available and as would be fair and reasonable in the circumstances for Lithos to obtain.

10 LIMITATIONS ON LIABILITY

10.1 Unless otherwise agreed in writing, Lithos's liability under or in connection with the Agreement whether in contract, tort, negligence, breach of statutory duty or otherwise (other than in respect of personal injury or death) shall be limited to and shall not exceed the lesser of either five million pounds in the aggregate or 10 times the total value of invoices issued to the Client for consultancy work instructed under the Agreement.

10.2 No action or proceedings under or in respect of the Agreement whether in contract, tort, negligence, under statute or otherwise shall be commenced against Lithos after the expiry of a period of six years from the date of the completion (or termination) of the Services under the Agreement.

10.3 Whilst Lithos will scan all potential exploratory locations with a Cable Avoidance Tool, Lithos shall not be liable for any damage to underground services, cables, pipes, drains or underground buildings, constructions and the like which were either not marked on site or for which accurate plans were not provided.

10.4 Lithos shall not be liable for the cost of rectifying any defect, conflict or other fault in the information or designs provided by Lithos or for the cost of designing a solution for and rectifying any subsequent works carried out by others pursuant to the conflicting, defective or in any other way faulty information or designs, unless Lithos has been advised in writing of the same by the Client and has been given the opportunity to rectify the same or where necessary, to design the solution for rectification of any subsequent works carried out by others pursuant to the same.

11 PAYMENT

11.1 Invoices for services rendered will be submitted for payment in accordance with the Proposal.

11.2 The due date for payment is the date of the invoice and the final date for payment is 28 days from the date of the invoice.

11.3 If the Client disputes the amount included for payment in an invoice a written notice must be served on Lithos by the Client not later than 14 days before the final date for payment. If no notice is given the amount due shall be the amount stated in the invoice.

11.4 In the event of failure on the part of the Client to pay any monies in accordance with the foregoing payment provisions, Lithos will be entitled to charge interest on any monies owed to it by the Client, such interest to be at a rate of 8% above the base rate of a clearing bank from time to time calculated from the final date for payment to the date of actual payment on a compound basis.

12 DELAY

12.1 Lithos will comply with any timescale agreed for completion of the Services unless delayed or prevented by circumstances beyond its reasonable control and in the event of any such circumstances arising Lithos undertakes to complete the Services within a reasonable period, but will not be liable to the Client for any delay as a result.

13 TERMINATION

13.1 The Agreement may be determined by either party in the event of the other making a composition or arrangement with its creditors, becoming bankrupt, or being a company, making a proposal for a voluntary arrangement for a composition of debts, or has a provisional liquidator appointed, or has a winding-up order made, or passes a resolution for voluntary winding-up (except for the purposes of a bona fide scheme of amalgamation or reconstruction), or has an administrator or an administrative receiver appointed to the whole or any part of its assets. Notice of determination must be given to the party which is insolvent by the other party.

13.2 If for any reason the performance of the Services by Lithos is suspended for a period in excess of three calendar months then Lithos shall be entitled to determine its appointment in respect of the Services by seven days written notice to the Client.

13.3 If the Client shall fail to pay in full any sum due under the terms of the Agreement by the final date for payment for that sum and no effective notice of intention to withhold payment has been issued, Lithos may serve written notice on the Client demanding payment within 14 days of such notice. If the Client shall fail to comply with such notice, Lithos shall be entitled to terminate its employment under the Agreement forthwith.

13.4 Any determination of the appointment of Lithos howsoever caused shall be without prejudice to the right of Lithos to require payment for all services performed up to the date of such determination including but not limited to payment of a fair and reasonable proportion of any figure identified in the Proposal or otherwise for fees in respect of a particular service which Lithos has started, but not completed.

14 NOTICES

14.1 Any notice provided for in the Agreement shall be in writing and shall be deemed to be properly given if delivered by hand or sent by first class post to the address of the relevant party as may have been notified by each party to the other or, in the absence of notification, to the address of Lithos set out above or to the registered address of the Client.

14.2 Such notice shall be deemed to have been received on the day of delivery if delivered by hand or on the second working day after the day of posting if sent by first class post.

15 ENTIRE AGREEMENT

15.1 The Agreement constitutes the complete and entire agreement between the Client and Lithos with respect to the Services and supersedes any prior oral and/or written warranties, terms, conditions, communications and representations, whether express or implied and any claim against Lithos in respect of the Services can only be made in contract under the provisions of the Agreement and not otherwise under the law or tort or otherwise.

15.2 No amendments, modifications or variation of the Agreement shall be valid unless made in writing and agreed to by both the Client and Lithos; such agreement must be recorded in writing by at least one of the Parties.

15.3 Lithos will not be bound by any standard or printed terms or conditions furnished by the Client in any of its documents unless Lithos specifically states in writing separately from such documents that it intends such terms and conditions to apply.

16 DISPUTES AND GOVERNING LAW

16.1 The Agreement shall be governed by and construed in accordance with English law and the Parties irrevocably and unconditionally submit to the jurisdiction of the English Courts.

16.2 Where the Housing Grants, Construction and Regeneration Act 1996 applies, any dispute between the Parties may be referred to adjudication in accordance with The Scheme for Construction Contracts Regulations 1998 or any amendment or modification thereof being in force at the time of the dispute, as applicable to England, Wales, Scotland and Northern Ireland.

Richard

From: Peter Rice [Peter.Rice@keepmoathomes.co.uk]
Sent: 21 June 2010 09:14
To: Richard
Cc: Stacey Chappell
Subject: RE: Larch Place, Kendray

Good Morning Richard,

Thank you for the revised quotation dated 20 June 2010 , please take this e mail as our official instruction to carry out the works all as detailed in our initial enquiry of 4 June 2010 and your quotation.

I am awaiting instruction from Stacey Chappell as to what if any Indemnity form requires completing before you carry out the works on site.Should Stacey not get back to me before tomorrow afternoon , I shall leave instruction with him to contact you as necessary.

Kind regards,

Peter

Peter Rice
Technical Manager
Keepmoat Homes Ltd
Yorkshire

Office The Waterfront, Lakeside Boulevard, Doncaster DN4 5PL
Tel 01302 347600
Fax
Web www.keepmoathomes.co.uk

Keepmoat Homes Ltd. Registered in England No. 2207338
Registered Office: The Waterfront, Lakeside Boulevard, Doncaster DN4 5PL.

Keepmoat Group highly commended for Customer Excellence in 2007 National Business Awards.

From: Richard [mailto:Richard@lithosconsulting.co.uk]
Sent: 20 June 2010 22:45
To: Peter Rice
Subject: Larch Place, Kendray

Peter,

Revised proposal attached; hope this meets with your satisfaction.

As discussed on Friday we will deal with the NHBC on Woodcock Street and the NHBC on

APPENDIX D

HISTORICAL OS PLANS



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LITHOS CONSULTING

Yorkshire

Published 1854 - 1855

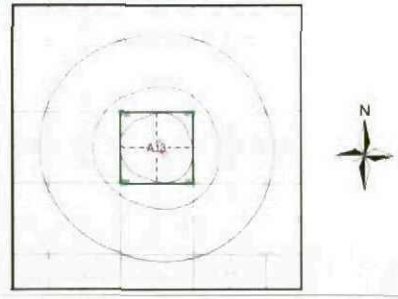
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The *published date given therefore is* often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A

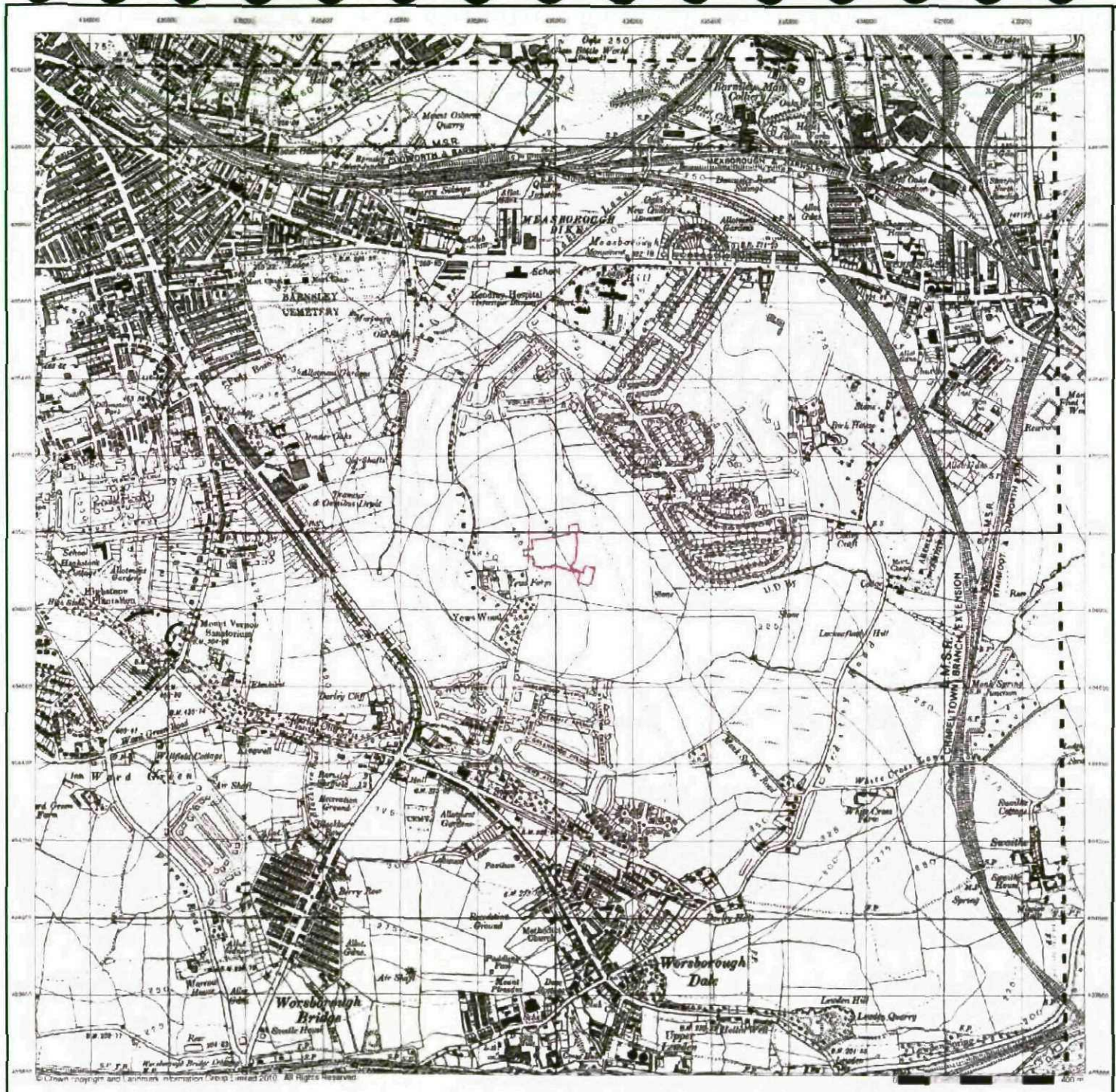


Order Details

Order Number:	31665317_1_1
Customer Ref:	PO5194/1175/RJH
National Grid Reference:	436020, 404940
Slice:	A
Site Area (Ha):	1.13
Search Buffer (m):	1000

Site Details

1 Larch Place, Kendray, BARNSLEY, South Yorkshire, S70 3DG



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LITHOS CONSULTING

Yorkshire

Published 1938

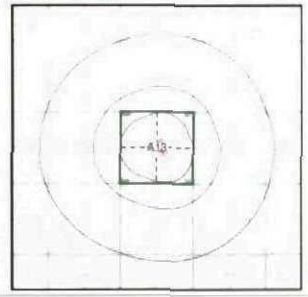
Source map scale - 1:10,560

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Map Name(s) and Date(s)



Historical Map - Slice A

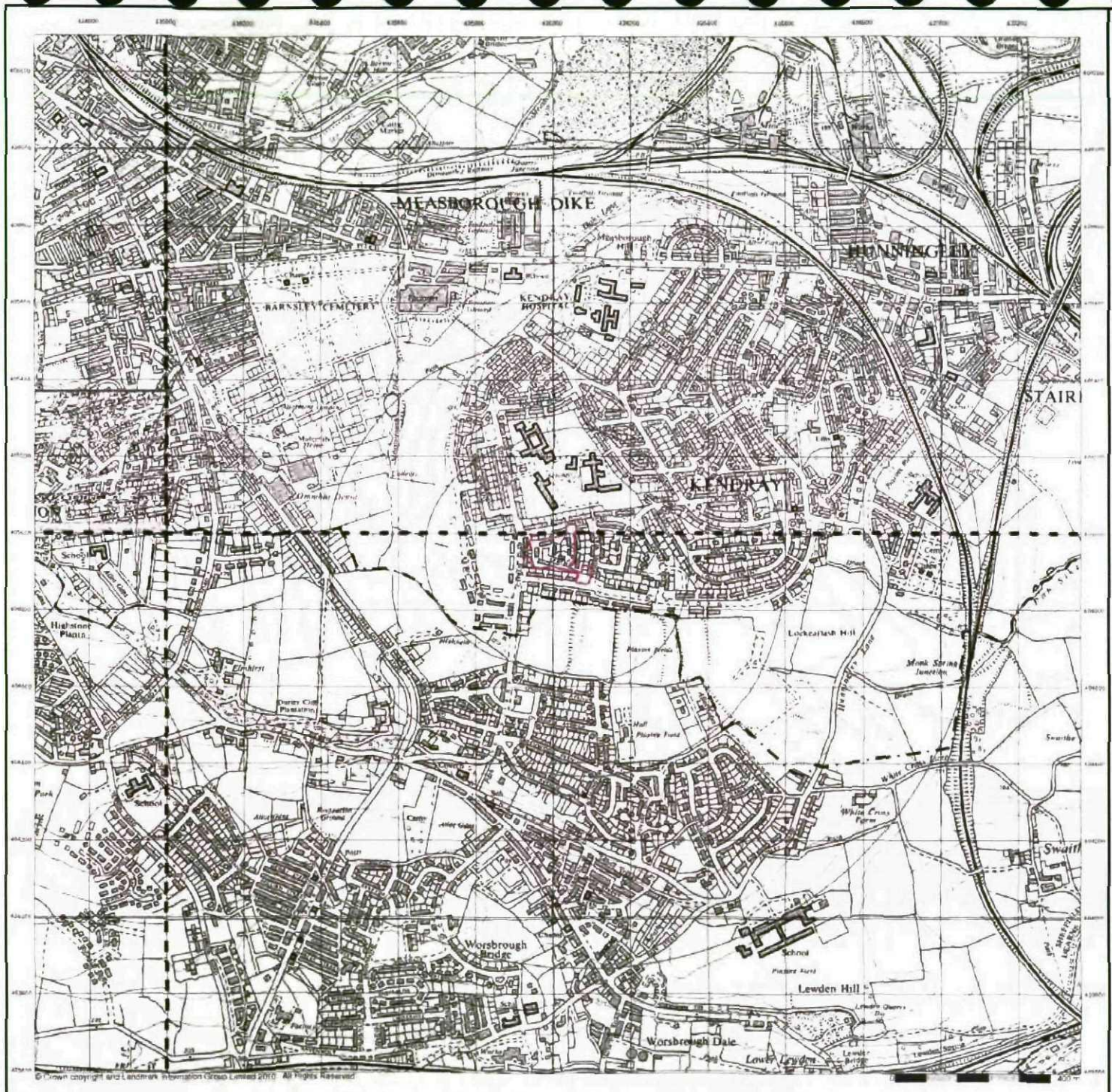


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LITHOS CONSULTING

Ordnance Survey Plan

Published 1965 - 1966

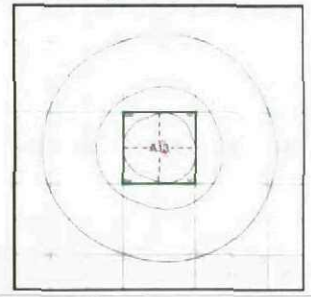
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The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas, these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear *unfinished - with all military camps and other strategic sites removed*. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

SE30NW 1966 1:10,560	SE30NE 1966 1:10,560
SE30SW 1965 1:10,560	SE30SE 1966 1:10,560

Historical Map - Slice A



Order Details

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Site Details

1 Larch Place, Kendray, BARNSLEY, South Yorkshire, S70 3DG

Landmark
Tel 0844 844 9952
Fax 0844 844 9951
Web www.envirocheck.co.uk



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LITHOS CONSULTING

Ordnance Survey Plan

Published 1980 - 1984

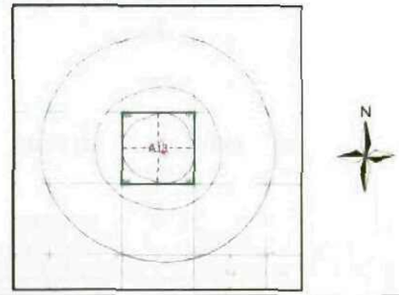
Source map scale - 1:10,000

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Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

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Slice:	A
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Site Details

1 Larch Place, Kendray, BARNSLEY, South Yorkshire, S70 *3DG*

Landmark

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



LITHOS CONSULTING

10k Raster Mapping

Published 2010

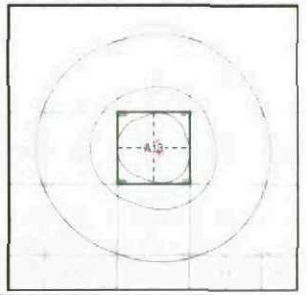
Source map scale - 1:10,000

The historical maps shown were produced from the Ordnance Survey's 1:10,000 colour raster mapping. These maps are derived from Landplan which replaced the old 1:10,000 maps originally published in 1970. The data is highly detailed showing buildings, fences and field boundaries as well as all roads, tracks and paths. Road names are also included together with the relevant road number and classification. Boundary information depiction includes county, unitary authority, district, civil parish and constituency.

Map Name(s) and Date(s)



Historical Map - Slice A



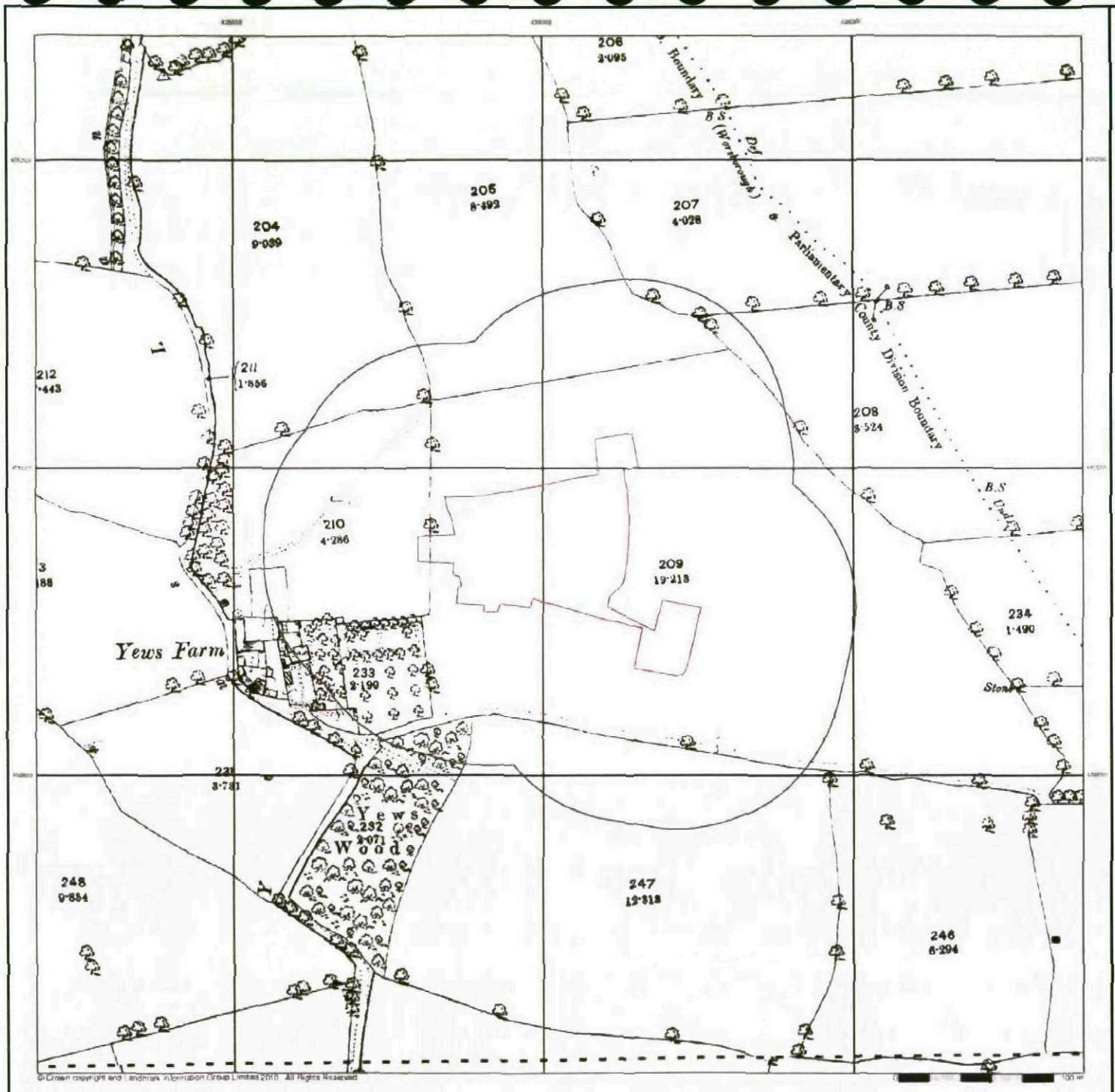
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Site Area (Ha):	1.13
Search Buffer (m):	1000

Site Details

1 Larch Place, Kendray, BARNSLEY, South Yorkshire, S70 3DG

Landmark
Tel 0844 844 9952
Fax 0844 844 9951
Web www.envirocheck.co.uk



LITHOS CONSULTING

Yorkshire

Published 1892

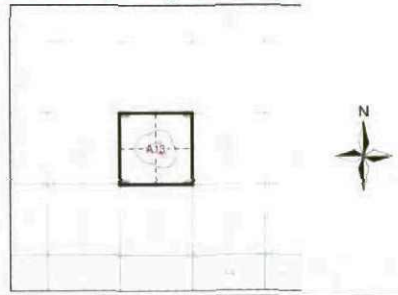
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. *The published date given below is often some years later than the* surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	*31665317_1_1*
Customer Ref:	PO5194/1175/RJH
National Grid Reference:	436020, 404940
Slice:	A
Site Area (Ha):	1.13
Search Buffer (m):	100

Site Details

1 Larch Place, Kendray, BARNSLEY, South Yorkshire, S70 3DG

Landmark
Tel 0844 844 9952
Fax 0844 844 9951
Web www.envirocheck.co.uk



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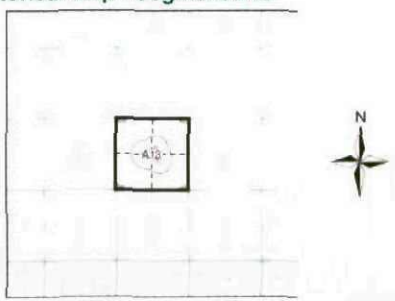
Ordnance Survey Plan
Published 1960 - 1973
Source map scale - 1:1,250

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13

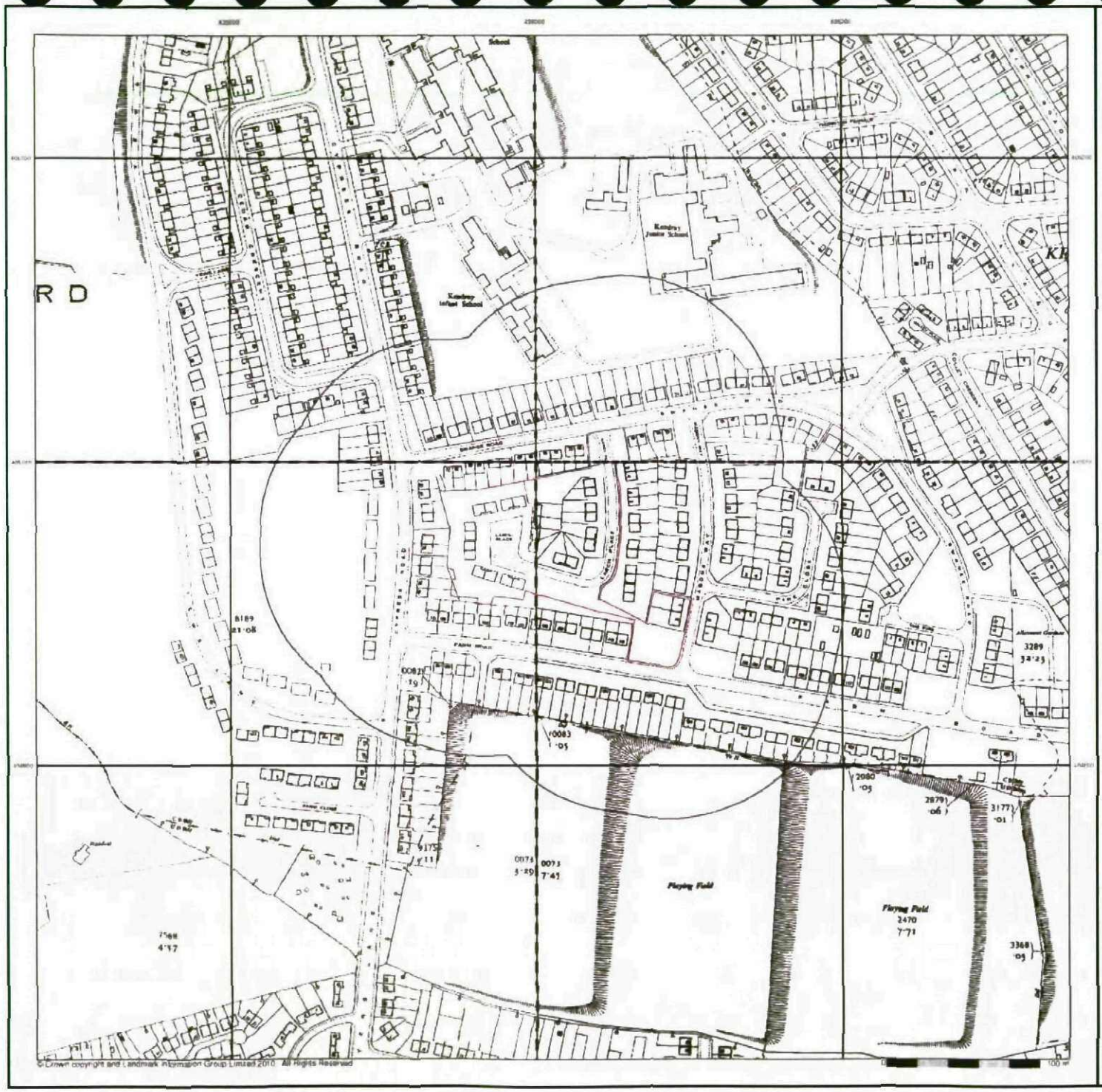


Order Details

Order Number:	31665317_1_1
Customer Ref:	PO5194/1175/RJH
National Grid Reference:	436020, 404940
Slice:	A
Site Area (Ha):	1.13
Search Buffer (m):	*100*

Site Details

1 Larch Place, Kendray, BARNSLEY, South Yorkshire, S70 3DG



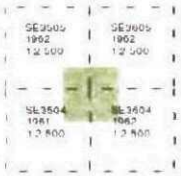
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LITHOS CONSULTING

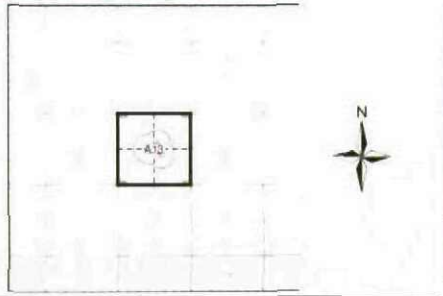
Ordnance Survey Plan
Published 1961 - 1962
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	31665317_1_1
Customer Ref:	PO5194/1175/RJH
National Grid Reference:	436020, 404940
Slice:	A
Site Area (Ha):	1.13
Search Buffer (m):	100

Site Details

1 Larch Place, Kendray, BARNSLEY, South Yorkshire, S70 3DG



LITHOS CONSULTING

Large-Scale National Grid Data

Published 1993

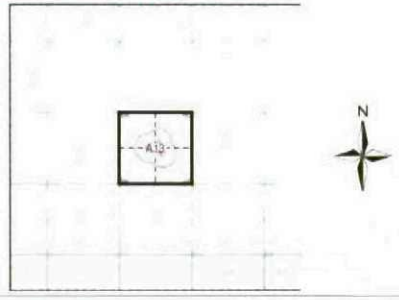
Source map scale - 1:1,250

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	31665317_1_1
Customer Ref:	PO5194/1175/RJH
National Grid Reference:	436020, 404940
Slice:	A
Site Area (Ha):	1.13
Search Buffer (m):	100

Site Details

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Landmark
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Web www.envirocheck.co.uk

APPENDIX E

SEARCH RESPONSES

From	Date	Content
Landmark	24th June 2010	Envirocheck Report
The Coal Authority	29th June 2010	Mining Report
Environment Agency	16th July 2010	Environmental search data
Barnsley Metropolitan Borough Council	19th July 2010	Environmental search data

Our Ref: RFI/2010/14485

Your Ref: 1175

Dear Richard

RE: Larch Place, Kendray

Thank you for your enquiry dated 25th June 2010.

Waste Regulation

There are no areas of landfilling (closed or operational) within 250m radius of the site. Please see the attached map showing this.

Water Resources and Quality

There are no surface water courses with 250m radius of the site.

We have no records of any pollution incidents within 250m of the site.

Authorisation/Licensing (Water Resources)

There are no Abstarction Licences within 250m radius of the site.

There are no discharge consents within 250m radius of the site.

Please see the attached map showing this.

Groundwater

There are no groundwater source protection zones within the vicinity of this site.

There are no major, minor and non-aquifers within the vicinity of this site.

Flood Defence/Conservation, Ecology and Recreation

There are no main rivers is the vicity of this site so therefore there are no flood defence in place.

There are no records of protected species within the vicinity of the site.

This information is provided subject to the attached notice which you should read.

If you require any further help, please do not hesitate to contact me.

Yours sincerely,

Stacey Riley
External Relations Officer (Yorkshire Area)

Tel: 0113 395 4506 (Internal 7 28 4506)
Email: neyorkshire@environment-agency.gov.uk

Environment Agency
Phoenix House
Global Avenue
Leeds LS11 8PG

Part of the Environment Agency's Yorkshire and North East Region

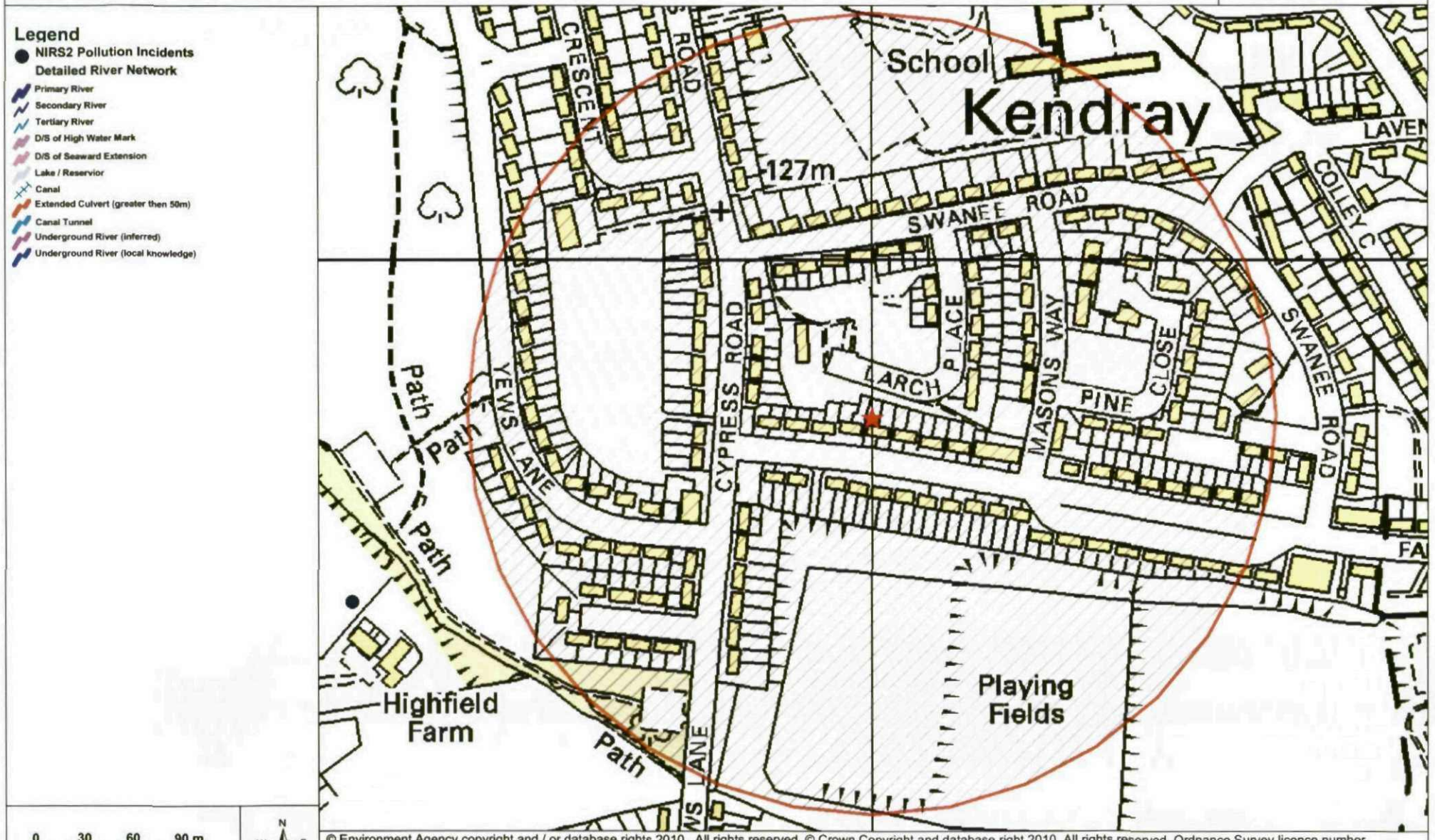
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map showing details of watercourses within 250m radius of the site

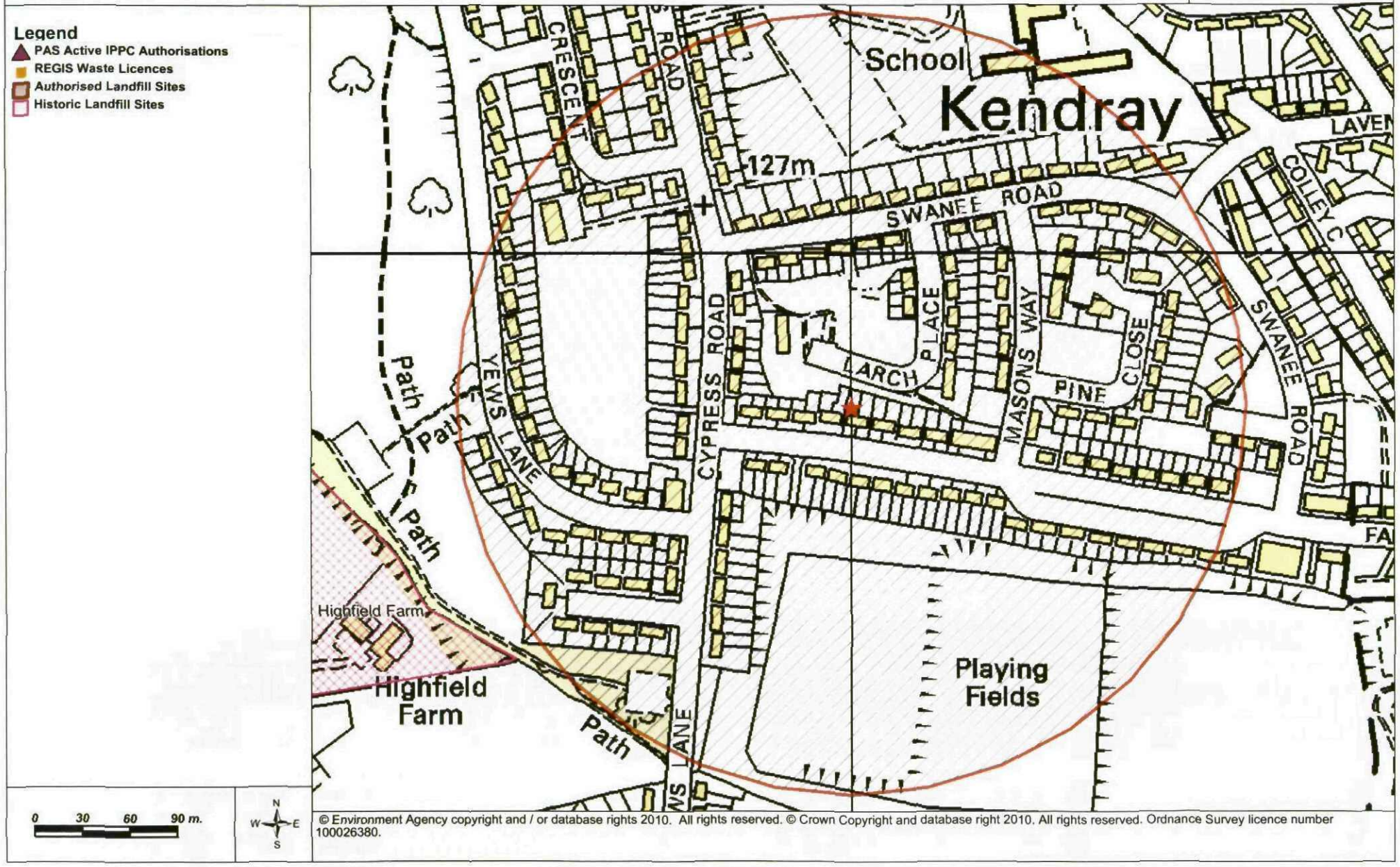
Environment Agency



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Map showing any areas of landfilling within 250 m of SE360049

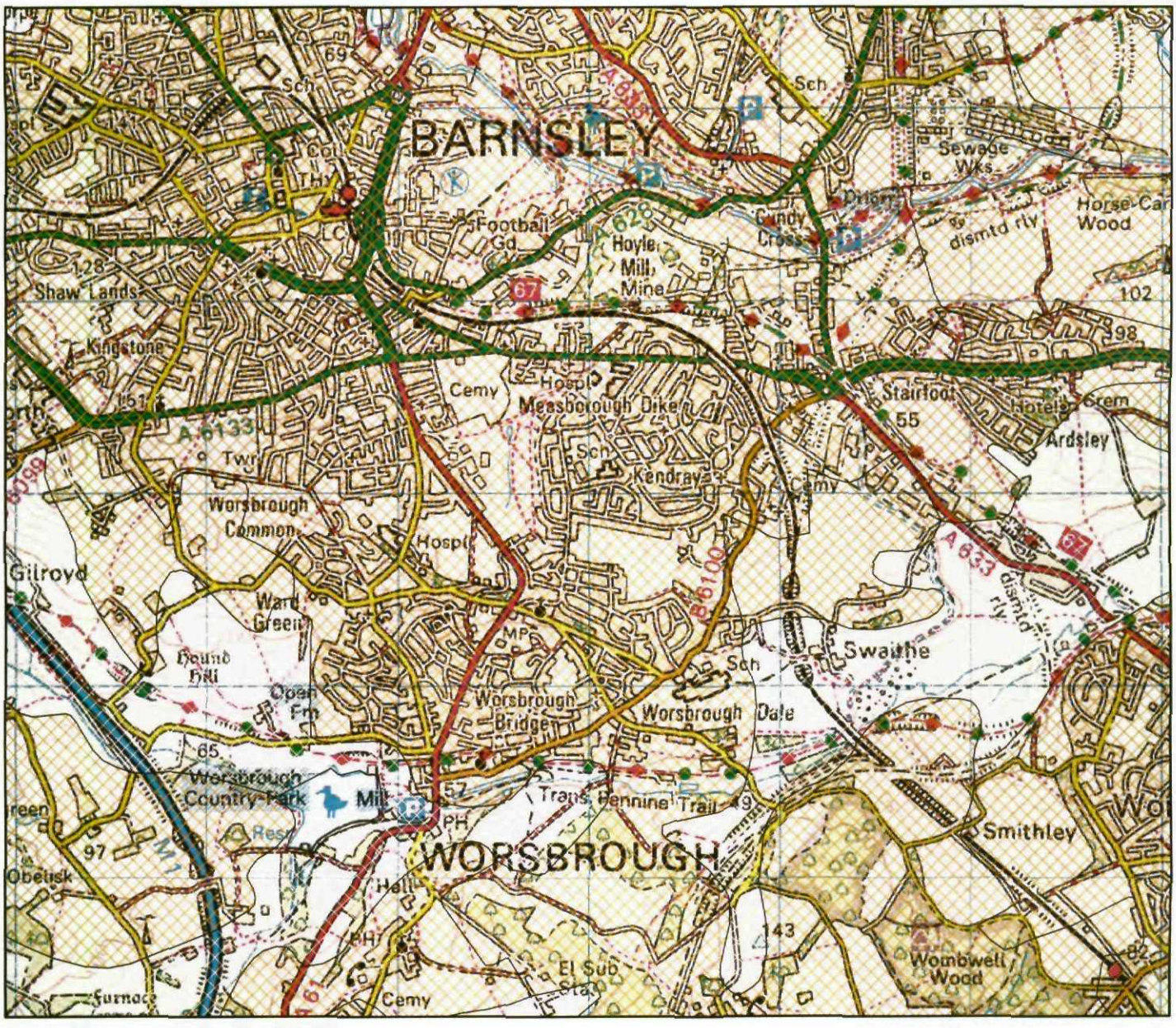
Environment Agency



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Groundwater Vulnerability and Source Protection Zone map for grid reference SE 360 049

Environment Agency



Kilometers

0 0.5 1 2

Legend

Groundwater Vulnerability

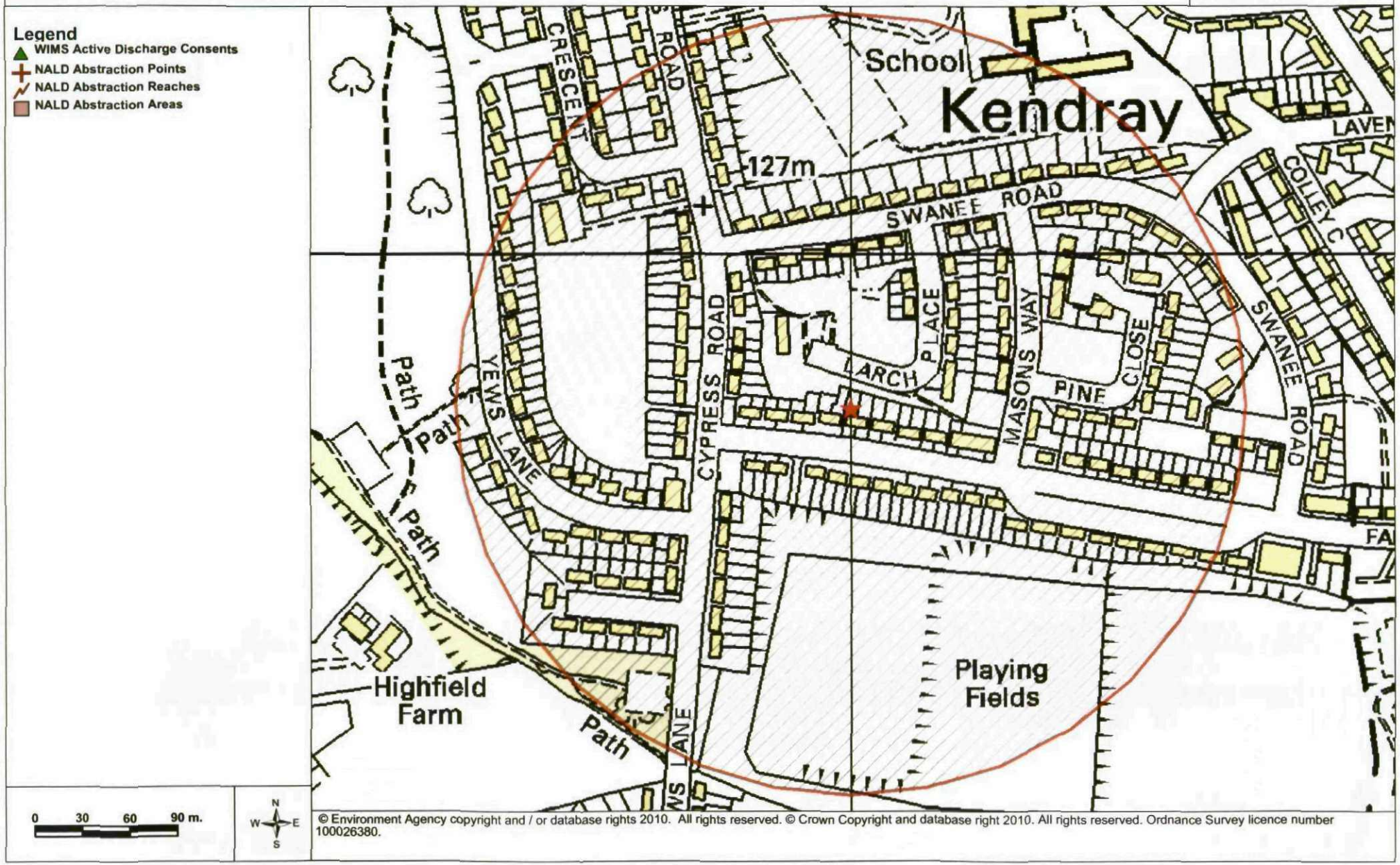
- Unproductive Strata
- *Principal Aquifer* - High leachability soils
- Principal Aquifer - Intermediate leachability soils
- Principal Aquifer - Low leachability soils
- Secondary Aquifer - High Leachability soils
- Secondary Aquifer - Intermediate leachability soils
- Secondary Aquifer - Low leachability soils

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Map showing any Abstraction & Discharges within 250m of site

Environment Agency



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The Coal Authority

Issued by:
The Coal Authority, Mining Reports Office, 200 Lichfield Lane, Berry Hill, Mansfield, Nottinghamshire NG18 4RG
ON-Line Service: www.groundstability.com - Phone: 0845 762 6848 - DX 716176 MANSFIELD 5

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DEVON,
EX2 7HY

Person dealing with this matter:	**Darren Moody**
Our reference:	**00028255-10**
Your reference:	31665317
Electronic Ref:	EME_00014059190007_005
RRUID:	005.00014059190007
Date of your enquiry:	**24 June 2010**
Date we received your enquiry:	**24 June 2010**
Date of issue:	**29 June 2010**

This report is for the property described in the address below and the attached plan.

Coal and Brine Report

Site At, Larch Place, Kendray, Barnsley, South Yorkshire

This report is based on and limited to the records held by, the Coal Authority, and the Cheshire Brine *Subsidence Compensation* Board's records, at the time we answer the search.

Coal mining	Yes
Brine Compensation District	No

Information from the Coal Authority

Underground Coal Mining

Past

The property is in the likely zone of influence from workings in 7 seams of coal at 260m to 560m depth, and last worked in 1974.

Any ground movement from these coal workings should have stopped by now.

Present

The property is not in the likely zone of influence of any present underground coal workings.

Future

The property is not in an area for which the Coal Authority is determining whether to grant a licence to remove coal using underground methods.

The property is not in an area for which a licence has been granted to remove coal using underground methods.

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The property is not in an area that is likely to be affected at the surface from any planned future workings.

However reserves of coal exist in the local area which could be worked at some time in the future.

No notice of the risk of the land being affected by subsidence has been given under section 46 of the Coal Mining Subsidence Act 1991.

Mine entries

There are no known coal mine entries within, or within 20 metres of, the boundary of the property.

Coal-mining geology

The Authority is not aware of any evidence of damage arising due to geological faults or other lines of weakness that have been affected by coal mining.

Opencast Coal Mining

Past

The property is not within the boundary of an opencast site from which coal has been removed by opencast methods.

Present

The property does not lie within 200 metres of the boundary of an opencast site from which coal is being removed by opencast methods.

Future

The property is not within 800 metres of the boundary of an opencast site for which the Coal Authority is determining whether to grant a licence to remove coal by opencast methods.

The property is not within 800 metres of the boundary of an opencast site for which a licence to remove coal by opencast methods has been granted.

Coal-mining subsidence

The Coal Authority has not received a damage notice or claim for the property since 1 January 1984. There is no current Stop Notice delaying the start of remedial works or repairs to the property.

The Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

Mine gas

There is no record of a mine gas emission requiring action by the Coal Authority within the boundary of the property.

Hazards related to coal mining

The property has not been subject to remedial works, by or on behalf of the Authority, under its Emergency Surface Hazard Call Out procedures.

Withdrawal of Support

The property is not in an area for which a notice of entitlement to withdraw support has been published.

The property is not in an area for which a notice has been given under section 41 of the Coal Industry Act 1994, revoking the entitlement to withdraw support.

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Working Facilities Orders

The property is not in an area for which an Order has been made under the provisions of the Mines (Working Facilities and Support) Acts 1923 and 1966 or any statutory modification or amendment thereof.

Payments to Owners of Former Copyhold Land

The property is not in an area for which a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

Information from the Cheshire Brine Subsidence Compensation Board

The property lies outside the Cheshire Brine Compensation District.

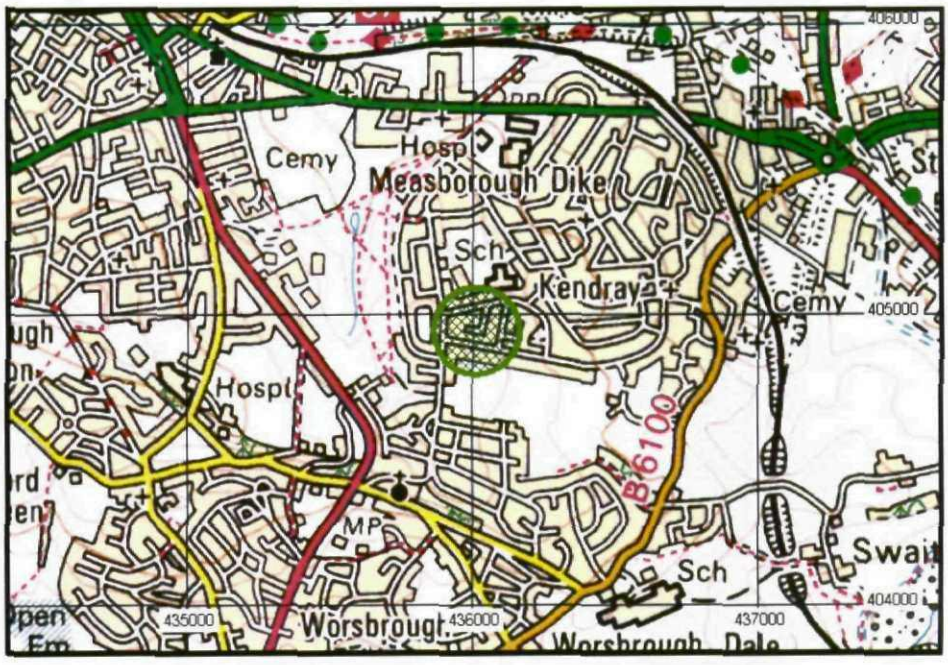
Additional remarks

This report is prepared in accordance with the Law Society's Guidance Notes 2006, the User Guide 2006 and the Coal Authority and Cheshire Brine Board's Terms and Conditions 2006. The report is compliant with Home Information Pack requirements.

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Location map

Approximate position of property

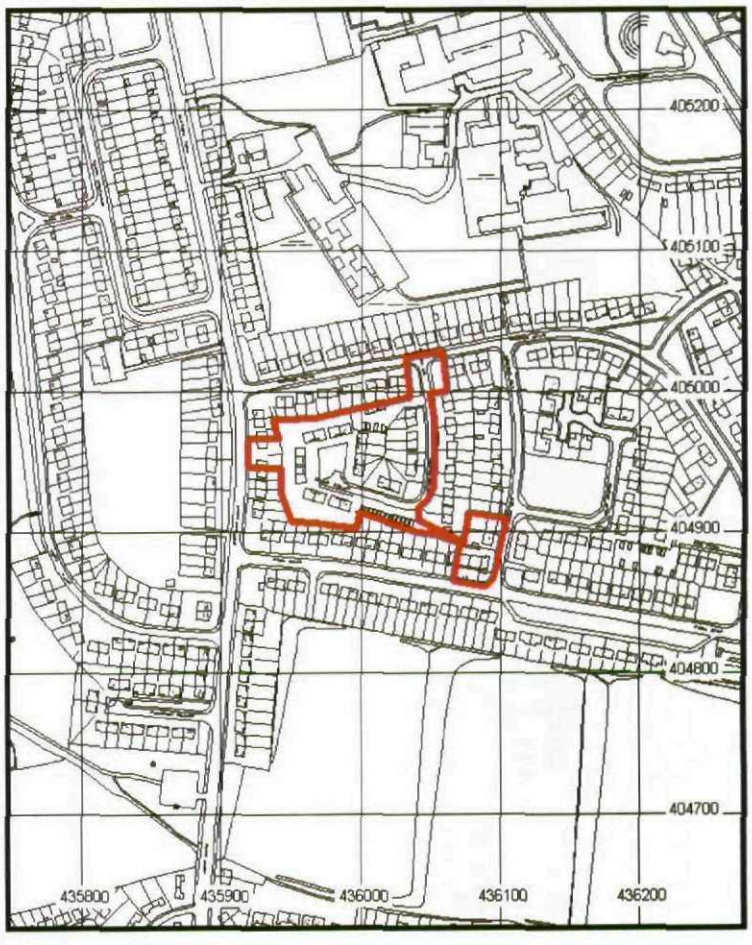


Enquiry boundary

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Key

Approximate position of enquiry boundary shown



Mapping sourced from Ordnance Survey

BARNSLEY
Metropolitan Borough Council

Regulatory Services
Assistant Director: Ken Eastwood, BSc (Hons), MCIEH
PO Box 602, Barnsley S70 9FB

Mr Richard Hey
Lithos Consulting Ltd
45 High Street
South Milford
Leeds
LS25 5AF

My Ref: JSC231500
Your Ref: 1175
Enquiries to: regulatoryservices@barnsley.gov.uk
Dial Direct: (01226) 772456
Fax: (01226) 775699
Date: 19 July 2010

Dear Sir

Re: Larch Place, Kendray

Further to your e-mail requesting information in respect of the above site, I can now supply you with the information we hold regarding this site.

Closed Landfill Sites
There is one closed landfill within 250m of the above site, the details of which are listed below;

Reference – 78
Address – Highfield Farm, Knowle Road, Barnsley
Planning Application – B/79/0658/BA
Site Operator – RJ Norman
Landfill Material – Excavation and Spoil Material
Date Commenced – Jan 1981
Final End Use – Domestic Curtilage
Distance and Direction – 240m, South West
This landfill has been classified as Category 4, meaning the Waste Disposal Site Licence indicates the site has been licensed to accept material that would not be expected to give rise to landfill gas in substantial quantities.

Contaminated Land
Under the provisions of the Environmental Protection Act 1990, we have a duty to inspect the borough for contaminated land. As part of this work, records of potential sources of contamination have been compiled through the use of historical Ordnance Survey maps and local knowledge

In respect of the above site, the information that we have collated has shown that there is no previous contaminative uses, and as such we are not planning to inspect the above site under Part 2A of the Environmental Protection Act 1990.

LAIPPC Authorised Processes
There are no LAIPPC Authorised Processes operating on, or within 250m of, the above site.

Nuisance Complaints

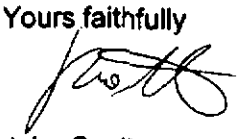
We have no records on our system of any complaints regarding the above site over the last three year period.

Reported Incidents
We have no records of any pollution incidents relating to this site. However, I recommend you contact the Environment Agency in respect of this matter, as they receive more reports on this matter.

This information is submitted as being the position to-date and other information may be available in records not held by this Authority at the present time. The Borough Council cannot, therefore accept liability or be prejudiced by the views expressed.

Should you wish to discuss this correspondence further, please don't hesitate to contact me;

Yours faithfully



John Scott
Contaminated Land Officer

APPENDIX F

EXPLORATORY RECORDS

Appendix F	TP1 to TP15

TRIAL PIT LOG

LITHOS CONSULTING

CLIENT Keepmoat Homes Ltd

SITE Larch Place, Kendray

TP1

DATE 21/07/2010 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
			MADE GROUND: Brown slightly sandy slightly gravelly clay. Gravel is angular to subrounded fine to coarse of mixed lithologies including brick. (COHESIVE MADE GROUND) Between 0.2m and 0.4m depth in south face, angular tabular fine to coarse gravel of burnt shale with occasional bricks.	0.40			
			Orange-brown clayey very sandy angular to subangular fine to coarse GRAVEL of sandstone. (COMPLETELY WEATHERED SANDSTONE)				
1D	0.90						
			Orange-brown medium to coarse grained SANDSTONE. Recovered as slightly sandy gravelly angular cobbles. (WEATHERED SANDSTONE) Slow to excavate below 1.9m depth, unable to excavate below 2.1m depth.	1.90			
			End of trial pit at 2.10 m	2.10			

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods	Logged by	JOB	FIGURE
JCB 3CX with 0.6m wide toothed bucket.	ASw	1175	

TRIAL PIT LOG

LITHOS CONSULTING

CLIENT Keepmoat Homes Ltd

SITE Larch Place, Kendray

TP2

DATE 21/07/2010 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
			MADE GROUND: Brown sandy slightly gravelly clay with occasional bricks, timber and paving slabs. Gravel is angular to subrounded fine to coarse of mixed lithologies including brick. (COHESIVE MADE GROUND)				
				0.50			
1D	0.70		Orange-brown clayey fine to coarse SAND and angular to subangular fine to coarse GRAVEL of sandstone. (COMPLETELY WEATHERED SANDSTONE)				
				1.30			
			Orange-brown medium to coarse grained SANDSTONE. Recovered as slightly sandy angular fine to coarse gravel with occasional angular cobbles. (WEATHERED SANDSTONE)				
			Unable to excavate below 1.8m depth.				
			End of trial pit at 1.80 m	1.80			

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods	Logged by	JOB	FIGURE
JCB 3CX with 0.6m wide toothed bucket.	ASw	1175	

TRIAL PIT LOG

LITHOS CONSULTING

CLIENT Keepmoat Homes Ltd

SITE Larch Place, Kendray

TP3

DATE 21/07/2010 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1D 2J	0.20		MADE GROUND: Brown slightly sandy gravelly clay. Gravel is angular to subrounded fine to coarse of mixed lithologies including brick and concrete. (COHESIVE MADE GROUND) At 0.4m depth, 1no. uPVC window frame.	0.50			
			Orange-brown sandy gravelly angular COBBLES of sandstone with rare angular boulders (<0.5m diameter) of sandstone. Gravel is angular to subangular fine to coarse of sandstone. (COMPLETELY WEATHERED SANDSTONE)	2.20			
			Orange-brown medium to coarse grained SANDSTONE. Recovered as slightly sandy slightly gravelly angular cobbles with occasional boulders (<0.5m diameter). (WEATHERED SANDSTONE) Unable to excavate below 2.6m depth. End of trial pit at 2.60 m	2.60			

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods	Logged by	JOB	FIGURE
JCB 3CX with 0.6m wide toothed bucket.	ASw	1175	

TRIAL PIT LOG

LITHOS CONSULTING

CLIENT Keepmoat Homes Ltd

SITE Larch Place, Kendray

TP4

DATE 21/07/2010 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1D 2J	0.40		MADE GROUND: Brown slightly sandy slightly gravelly clay with occasional bricks. Gravel is angular to subrounded fine to coarse of mixed lithologies including brick. (COHESIVE MADE GROUND)				
			Orange-brown slightly clayey sandy angular to subangular fine to coarse GRAVEL of sandstone with occasional angular cobbles. (COMPLETELY WEATHERED SANDSTONE)	0.60			
			Orange-brown very sandy angular to subangular fine to coarse GRAVEL of sandstone with rare angular cobbles. (COMPLETELY WEATHERED SANDSTONE)	1.00			
			Below 1m depth, some overbreak in sides of trial pit during excavation				
			Orange-brown medium to coarse grained SANDSTONE. Recovered as sandy gravelly angular cobbles. (WEATHERED SANDSTONE)	2.30			
			End of trial pit at 2.70 m	2.70			

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods	Logged by	JOB	FIGURE
JCB 3CX with 0.6m wide toothed bucket.	ASw	1175	

TRIAL PIT LOG

LITHOS CONSULTING

CLIENT Keepmoat Homes Ltd

SITE Larch Place, Kendray

TP5

DATE 21/07/2010 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1D 2J	0.20		MADE GROUND: Brown slightly sandy slightly gravelly clay. Gravel is angular to subrounded fine to coarse of mixed lithologies including brick and concrete. (COHESIVE MADE GROUND)				
			Orange-brown medium to coarse grained SANDSTONE. Recovered as sandy gravelly angular cobbles with occasional angular boulders (<0.5m diameter). (WEATHERED SANDSTONE) Below 0.4m depth, some overbreak in sides of trial pit during excavation	0.40			
			Unable to excavate below 1.3m depth.				
			End of trial pit at 1.30 m	1.30			

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods	Logged by	JOB	FIGURE
JCB 3CX with 0.6m wide toothed bucket.	ASw	1175	

TRIAL PIT LOG

LITHOS CONSULTING

CLIENT Keepmoat Homes Ltd

SITE Larch Place, Kendray

TP6

DATE 21/07/2010 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
			MADE GROUND: Grey-brown slightly sandy slightly gravelly clay. Gravel is angular to subrounded fine to coarse of mixed lithologies including brick and concrete. (COHESIVE MADE GROUND)	0.30			
			Orange-brown medium to coarse grained SANDSTONE. Recovered as sandy very gravelly angular cobbles with occasional angular boulders (<0.5m diameter). (WEATHERED SANDSTONE) Below 0.3m depth, some overbreak in sides of trial pit during excavation				
1D	1.00						
			Unable to excavate below 2.5m depth.	2.50			
			End of trial pit at 2.50 m				

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods	Logged by	JOB	FIGURE
JCB 3CX with 0.6m wide toothed bucket.	ASw	1175	

TRIAL PIT LOG

LITHOS CONSULTING

CLIENT Keepmoat Homes Ltd

SITE Larch Place, Kendray

TP7

DATE 21/07/2010 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1D 2J	0.20		MADE GROUND: Brown slightly sandy clay. (COHESIVE MADE GROUND)	0.30			
			Orange-brown medium to coarse grained SANDSTONE. Recovered as sandy angular fine to coarse gravel with occasional angular cobbles. (WEATHERED SANDSTONE) Below 0.5m depth, some overbreak in sides of trial pit during excavation				
			Unable to excavate below 1.9m depth.				
			End of trial pit at 1.90 m	1.90			

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods	Logged by	JOB	FIGURE
JCB 3CX with 0.6m wide toothed bucket.	ASw	1175	

TRIAL PIT LOG

LITHOS CONSULTING

CLIENT Keepmoat Homes Ltd

SITE Larch Place, Kendray

TP8

DATE 21/07/2010 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
			MADE GROUND: Brown slightly sandy slightly gravelly clay. Gravel is angular to subrounded fine to coarse of mixed lithologies. (COHESIVE MADE GROUND)	0.20			
1D	1.00		Orange-brown slightly clayey very sandy angular to subangular fine to coarse GRAVEL of sandstone with occasional angular cobbles. (COMPLETELY WEATHERED SANDSTONE) From 0.2m to 0.4m depth, concrete slab of 1m x 1.5m x 0.2m.	1.70			
			Orange-brown medium to coarse grained SANDSTONE. Recovered as sandy angular fine to coarse gravel with rare angular cobbles. (WEATHERED SANDSTONE) Unable to excavate below 2.0m depth.	2.00			
			End of trial pit at 2.00 m				

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods	Logged by	JOB	FIGURE
JCB 3CX with 0.6m wide toothed bucket.	ASw	1175	

TRIAL PIT LOG

LITHOS CONSULTING

CLIENT Keepmoat Homes Ltd

SITE Larch Place, Kendray

TP9

DATE 21/07/2010 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
			MADE GROUND: Brown gravelly clay. Gravel is angular to subrounded fine to coarse of mixed lithologies including brick and concrete. (COHESIVE MADE GROUND)	0.30			
1D	0.60		Orange-brown medium to coarse grained SANDSTONE. Recovered as very sandy very gravelly angular cobbles with occasional angular boulders (<0.5m diameter). (WEATHERED SANDSTONE) Below 0.3m depth, some overbreak in sides of trial pit during excavation				
			Unable to excavate below 1.8m depth. End of trial pit at 1.80 m	1.80			

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods	Logged by	JOB	FIGURE
JCB 3CX with 0.6m wide toothed bucket.	ASw	1175	

TRIAL PIT LOG

LITHOS CONSULTING

CLIENT Keepmoat Homes Ltd

SITE Larch Place, Kendray

TP10

DATE 21/07/2010 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1D 2J	0.30		MADE GROUND: Brown gravelly clay. Gravel is angular to subrounded fine to coarse of mixed lithologies. Rare gravel size fragments of glass. (COHESIVE MADE GROUND)				
			MADE GROUND: Brown slightly sandy clay. (RELICT SUBSOIL)	0.40			
			Orange-brown medium to coarse grained SANDSTONE. Recovered as very sandy very gravelly angular cobbles. (WEATHERED SANDSTONE) Below 0.7m depth, some overbreak in sides of trial pit during excavation	0.70			
			Unable to excavate below 1.6m depth.				
			End of trial pit at 1.60 m	1.60			

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods	Logged by	JOB	FIGURE
JCB 3CX with 0.6m wide toothed bucket.	ASw	1175	

TRIAL PIT LOG

LITHOS CONSULTING

CLIENT Keepmoat Homes Ltd

SITE Larch Place, Kendray

TP11

DATE 21/07/2010 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1D	0.30		MADE GROUND: Brown gravelly clay. Gravel is angular to subrounded fine to coarse of mixed lithologies including brick and concrete. Occasional pockets of angular tabular fine to coarse gravel of burnt shale. (COHESIVE MADE GROUND)	0.40			
2D	0.80		Orange-brown very sandy angular to subangular fine to coarse GRAVEL of sandstone with occasional angular cobbles. (COMPLETELY WEATHERED SANDSTONE)	2.00			
			Orange-brown medium to coarse grained SANDSTONE. Recovered as sandy gravelly angular cobbles with occasional angular boulders (<0.5m diameter). (WEATHERED SANDSTONE) Unable to excavate below 2.4m depth.	2.40			
			End of trial pit at 2.40 m				

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation, with complete collapse of south face on completion of excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods	Logged by	JOB	FIGURE
JCB 3CX with 0.6m wide toothed bucket.	ASw	1175	

TRIAL PIT LOG

LITHOS CONSULTING

CLIENT Keepmoat Homes Ltd

SITE Larch Place, Kendray

TP12

DATE 21/07/2010 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
			MADE GROUND: Comprising bricks, plastic, metal and timber in a sandy clay matrix. (BACKFILL MATERIAL)				
1D	0.50						
			Cemented orange-brown clayey coarse SAND. (COMPLETELY WEATHERED SANDSTONE)	0.70			
2D	1.20						
			Cemented orange-brown coarse SAND and angular fine to coarse GRAVEL of coarse grained sandstone. (COMPLETELY WEATHERED SANDSTONE) Slow to excavate below 1.5m depth.	1.50			
			Orange-brown medium to coarse grained SANDSTONE. Recovered as slightly sandy slightly gravelly angular tabular cobbles. (WEATHERED SANDSTONE) Unable to excavate below 2.1m depth.	2.00			
			End of trial pit at 2.10 m	2.10			

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods	Logged by	JOB	FIGURE
JCB 3CX with 0.6m wide toothed bucket.	ASw	1175	

TRIAL PIT LOG

LITHOS CONSULTING

CLIENT Keepmoat Homes Ltd

SITE Larch Place, Kendray

TP13

DATE 21/07/2010 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1D 2J 3D	0.30 0.40		MADE GROUND: Brown slightly sandy gravelly clay with occasional bricks. Gravel is angular to subrounded fine to coarse of mixed lithologies including brick. Occasional pockets of angular tabular fine to coarse gravel of burnt shale. (COHESIVE MADE GROUND)				
				0.50			
			Orange-brown medium to coarse grained SANDSTONE. Recovered as slightly sandy slightly gravelly angular tabular cobbles with occasional angular boulders (<0.5m diameter). (WEATHERED SANDSTONE) Below 0.5m depth, some overbreak in sides of trial pit during excavation				
			Unable to excavate below 2.7m depth.	2.70			
			End of trial pit at 2.70 m				

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods	Logged by	JOB	FIGURE
JCB 3CX with 0.6m wide toothed bucket.	ASw	1175	

TRIAL PIT LOG

LITHOS CONSULTING

CLIENT Keepmoat Homes Ltd

SITE Larch Place, Kendray

TP14

DATE 21/07/2010 Co-ords Sheet 1 of 1

Ground Level *Scale* 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1D 2J	0.20		MADE GROUND: Brown slightly sandy clay. (COHESIVE MADE GROUND)				
				0.30			
			Orange-brown sandy angular to subangular fine to coarse GRAVEL of sandstone with occasional angular cobbles. (COMPLETELY *WEATHERED SANDSTONE*)				
3D	1.10						
				1.30			
			Orange-brown medium to coarse grained SANDSTONE. Recovered as slightly sandy very gravelly angular tabular cobbles. (WEATHERED SANDSTONE) Below 1.3m depth, some overbreak in sides of trial pit during excavation				
			Unable to excavate below 2.1m depth.				
			End of trial pit at 2.10 m	2.10			

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods	*Logged by*	JOB	FIGURE
JCB 3CX with 0.6m wide toothed bucket.	ASw	1175	

TRIAL PIT LOG

LITHOS CONSULTING

CLIENT Keepmoat Homes Ltd

SITE Larch Place, Kendray

TP15

DATE 21/07/2010 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1D	0.30		MADE GROUND: Orange-brown sandy angular fine to coarse gravel of sandstone and brick. Some bricks and half bricks. (GRANULAR MADE GROUND)				
				0.40			
			Orange-brown sandy angular to subangular fine to coarse GRAVEL of sandstone with occasional angular cobbles. (COMPLETELY WEATHERED SANDSTONE)				
2D	1.00						
				1.20			
	-		Orange-brown medium to coarse grained SANDSTONE. Recovered as slightly sandy gravelly angular tabular cobbles. (WEATHERED SANDSTONE) Slow to excavate below 1.2m depth.				
				2.00			
			End of trial pit at 2.00 m				

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods	Logged by	JOB	FIGURE
JCB 3CX with 0.6m wide toothed bucket.	ASw	1175	

APPENDIX G

CHEMICAL TEST RESULTS

Scientific Analysis Laboratories is a limited company registered in England and Wales (No 2514788) whose address is at Hadfield House, Hadfield Street, Manchester M16 9FE

Scientific Analysis Laboratories

Certificate of Analysis

Hadfield House
Hadfield Street
Combrook
Manchester
M16 9FE
Tel : 0161 874 2400
Fax : 0161 874 2468

Report Number: 207304-1

Date of Report: 03-Aug-2010

Customer: Lithos Consulting Ltd.
45 High Street
South Milford
Leeds
LS25 5AF

Customer Contact: Mr Steve James

Customer Job Reference: 1175
Customer Purchase Order: PO5240/1175/ASw
Customer Site Reference: Larch Place, Kendray
Date Job Received at SAL: 23-Jul-2010
Date Analysis Started: 27-Jul-2010
Date Analysis Completed: 03-Aug-2010

The results reported relate to samples received in the laboratory
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
Tests covered by this certificate were conducted in accordance with SAL SOPs

UKAS TESTING 1549

mCERTS

Report checked and authorised by :
Amelia McVennon
Project Manager

Issued by :
Mr Ross Walker
Customer Services Manager

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Index to symbols used in 207304-1

Value	Description
10:1	Leachate
M40	Analysis conducted on sample assisted dried at no more than 40C. Results are reported on a dry weight basis.
M105	Analysis conducted on an "as received" aliquot. Results are reported on a dry weight basis where moisture content was determined by assisted drying of sample at 105C
AR	As Received
M	Analysis is MCERTS accredited
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Notes

Fill samples are outside the scope of MCERTs accreditation. Results are UKAS only.

Method Index

Value	Description
T281	ICP/MS (Filtered)
T85	Calc
T207	GC/MS(MCERTS)
T7	Probe
T162	Grav (1 Dec) (105 C)
T6	ICP/OES
T277	Grav (1 Dec) (40 C)
T2	Grav

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
pH	T7	AR			M	001-002,004-007,009-010,012-013,016-017,022,024,026
SO4(2:1)	T6	AR	0.1	g/l	N	001,005-006,009,012,016,026
As (Dissolved)	T281	10:1	0.2	µg/l	U	002,007,013,022,024
Boron	T6	10:1	0.01	mg/l	N	002,007,013,022,024
Cd (Dissolved)	T281	10:1	0.02	µg/l	U	002,007,013,022,024
Cr (Dissolved)	T281	10:1	1	µg/l	U	002,007,013,022,024
Cu (Dissolved)	T281	10:1	0.5	µg/l	U	002,007,013,022,024
Pb (Dissolved)	T281	10:1	0.3	µg/l	U	002,007,013,022,024
Hg (Dissolved)	T281	10:1	0.05	µg/l	U	002,007,013,022,024
Ni (Dissolved)	T281	10:1	1	µg/l	U	002,007,013,022,024
Se (Dissolved)	T281	10:1	0.5	µg/l	U	002,007,013,022,024
Zn (Dissolved)	T281	10:1	2	µg/l	U	002,007,013,022,024
pH	T7	10:1			U	002,007,013,022,024
Arsenic	T6	M40	2	mg/kg	M	002,004,007,010,013,017,022,024
Arsenic	T6	M40	2.0	mg/kg	U	019-020
Boron (water-soluble)	T6	AR	1	mg/kg	N	002,004,007,010,013,017,019-020,022,024
Cadmium	T6	M40	1	mg/kg	M	002,004,007,010,013,017,022,024
Cadmium	T6	M40	1.0	mg/kg	U	019-020
Chromium	T6	M40	1	mg/kg	M	002,004,007,010,013,017,022,024
Chromium	T6	M40	1.0	mg/kg	U	019-020
Chromium (trivalent)	T85	AR	2	mg/kg	N	002,004,007,010,013,017,019-020,022,024
Chromium VI	T6	AR	1	mg/kg	N	002,004,007,010,013,017,019-020,022,024
Copper	T6	M40	1	mg/kg	M	002,004,007,010,013,017,022,024
Copper	T6	M40	1.0	mg/kg	U	019-020
Lead	T6	M40	1	mg/kg	M	002,004,007,010,013,017,022,024
Lead	T6	M40	1.0	mg/kg	U	019-020
Mercury	T6	M40	1	mg/kg	M	002,004,007,010,013,017,022,024
Mercury	T6	M40	1.0	mg/kg	U	019-020
Nickel	T6	M40	1	mg/kg	M	002,004,007,010,013,017,022,024
Nickel	T6	M40	1.0	mg/kg	U	019-020
Selenium	T6	M40	3	mg/kg	M	002,004,007,010,013,017,022,024
Selenium	T6	M40	3.0	mg/kg	U	019-020
Zinc	T6	M40	1	mg/kg	M	002,004,007,010,013,017,022,024

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Zinc	T6	M40	1.0	mg/kg	U	019-020
pH	T7	AR			U	019-020
Acenaphthene	T207	M105	0.1	mg/kg	M	003,011,018,025
Acenaphthylene	T207	M105	0.1	mg/kg	U	003,011,018,025
Anthracene	T207	M105	0.1	mg/kg	U	003,011,018,025
Benzo(a)Anthracene	T207	M105	0.1	mg/kg	M	003,011,018,025
Benzo(a)Pyrene	T207	M105	0.1	mg/kg	M	003,011,018,025
Benzo(b)fluoranthene	T207	M105	0.1	mg/kg	M	003,011,018,025
Benzo(ghi)Perylene	T207	M105	0.1	mg/kg	M	003,011,018,025
Benzo(k)fluoranthene	T207	M105	0.1	mg/kg	M	003,011,018,025
Chrysene	T207	M105	0.1	mg/kg	M	003,011,018,025
Dibenzo(ah)Anthracene	T207	M105	0.1	mg/kg	M	003,011,018,025
Fluoranthene	T207	M105	0.1	mg/kg	M	003,011,018,025
Fluorene	T207	M105	0.1	mg/kg	M	003,011,018,025
Indeno(123-cd)Pyrene	T207	M105	0.1	mg/kg	M	003,011,018,025
Naphthalene	T207	M105	0.1	mg/kg	M	003,011,018,025
Phenanthrene	T207	M105	0.1	mg/kg	M	003,011,018,025
Pyrene	T207	M105	0.1	mg/kg	M	003,011,018,025
PAH(total)	T207	M105	0.1	mg/kg	U	003,011,018,025
Moisture	T277	AR	0.1	%	N	001-007,009-013,016-020,022,024-026
Moisture @ 105 C	T162	AR	0.1	%	N	001-007,009-013,016-020,022,024-026
Retained on 10mm sieve	T2	AR	0.1	%	N	001-007,009-013,016-020,022,024-026

SAL Reference: 207304
Project Site: Larch Place, Kendray
Customer Reference: 1175

Soil — Analysed as Soil
MCERTS Preparation

				SAL Reference	207304 001	207304 002	207304 003	207304 004	207304 005	207304 006	207304 007
				Customer Sample Reference	TP01 D1 0.90	TP04 D1 0.4	TP04 J2 0.4	TP05 D1 0.2	TP05 J2 0.2	TP06 D1 1.0	TP03 D1 0.2
				Depth	0.90	0.4	0.2	0.2	0.2	1.0	0.2
Determinand	Method	Test Sample	LOD	Units							
Moisture	T277	AR	0.1	%	<0.1	13	<0.1	18	<0.1	<0.1	11
Moisture @ 105 C	T162	AR	0.1	%	11	13	13	20	15	11	11

SAL Reference: 207304
Project Site: Larch Place, Kendray
Customer Reference: 1175

Soil — Analysed as Soil
MCERTS Preparation

				SAL Reference	207304 009	207304 010	207304 011	207304 012	207304 013	207304 016	207304 017
				Customer Sample Reference	TP02 D1 0.7	TP07 D1 0.2	TP07 J2 0.2	TP08 D1 1.0	TP10 D1 0.3	TP09 D1 0.6	TP13 D1 0.3
				Depth	0.7	0.2	0.2	1.0	0.3	0.6	0.3
Determinand	Method	Test Sample	LOD	Units							
Moisture	T277	AR	0.1	%	<0.1	21	<0.1	<0.1	14	<0.1	11
Moisture @ 105 C	T162	AR	0.1	%	11	21	21	12	13	8.5	15

SAL Reference: 207304
Project Site: Larch Place, Kendray
Customer Reference: 1175

Soil — Analysed as Soil
MCERTS Preparation

				SAL Reference	207304 018	207304 019	207304 020	207304 022	207304 024	207304 025	207304 026
				Customer Sample Reference	TP13 J2 0.3	TP13 D3 0.4	TP11 D1 0.3	TP12 D1 0.5	TP14 D1 0.2	TP14 J2 0.2	TP14 D3 1.1
				Depth	0.3	0.4	0.3	0.5	0.2	0.2	1.1
Determinand	Method	Test Sample	LOD	Units							
Moisture	T277	AR	0.1	%	<0.1	10	9.1	14	17	14	8.9
Moisture @ 105 C	T162	AR	0.1	%	20	11	7.2	13	18	16	8.8

SAL Reference: 207304
Project Site: Larch Place, Kendray
Customer Reference: 1175

Soil — Analysed as Soil
Retained on 10mm sieve

				SAL Reference	207304 001	207304 002	207304 003	207304 004	207304 005	207304 006	207304 007
				Customer Sample Reference	TP01 D1 0.90	TP04 D1 0.4	TP04 J2 0.4	TP05 D1 0.2	TP05 J2 0.2	TP06 D1 1.0	TP03 D1 0.2
				Depth	0.90	0.4	0.2	0.2	0.2	1.0	0.2
Determinand	Method	Test Sample	LOD	Units							
Retained on 10mm sieve	T2	AR	0.1	%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

SAL Reference: 207304
Project Site: Larch Place, Kendray
Customer Reference: 1175

Soil Analysed as Soil
Retained on 10mm sieve

				SAL Reference	207304 009	207304 010	207304 011	207304 012	207304 013	207304 016	207304 017
				Customer Sample Reference	TP02 D1 0.7	TP07 D1 0.2	TP07 J2 0.2	TP08 D1 1.0	TP10 D1 0.3	TP09 D1 0.6	TP13 D1 0.3
				Depth	0.7	0.2	0.2	1.0	0.3	0.6	0.3
Determinand	Method	Test Sample	LOD	Units							
Retained on 10mm sieve	T2	AR	0.1	%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

SAL Reference: 207304
Project Site: Larch Place, Kendray
Customer Reference: 1175

Soil Analysed as Soil
Retained on 10mm sieve

				SAL Reference	207304 018	207304 019	207304 020	207304 022	207304 024	207304 025	207304 026
				Customer Sample Reference	TP13 J2 0.3	TP13 D3 0.4	TP11 D1 0.3	TP12 D1 0.5	TP14 D1 0.2	TP14 J2 0.2	TP14 D3 1.1
				Depth	0.3	0.4	0.3	0.5	0.2	0.2	1.1
Determinand	Method	Test Sample	LOD	Units							
Retained on 10mm sieve	T2	AR	0.1	%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

SAL Reference: 207304
Project Site: Larch Place, Kendray
Customer Reference: 1175

Soil Analysed as Soil
Miscellaneous

				SAL Reference	207304 001	207304 002	207304 004	207304 005	207304 006
				Customer Sample Reference	TP01 D1 0.90	TP04 D1 0.4	TP05 D1 0.2	TP05 J2 0.2	TP06 D1 1.0
				Depth	0.90	0.4	0.2	0.2	1.0
Determinand	Method	Test Sample	LOD	Units					
pH	T7	AR			8.1	7.8	6.9	6.9	7.3
SO4(2:1)	T6	AR	0.1	g/l	<0.1	-	-	<0.1	<0.1

SAL Reference: 207304
Project Site: Larch Place, Kendray
Customer Reference: 1175

Soil Analysed as Soil
Miscellaneous

				SAL Reference	207304 007	207304 009	207304 010	207304 012	207304 013
				Customer Sample Reference	TP03 D1 0.2	TP02 D1 0.7	TP07 D1 0.2	TP08 D1 1.0	TP10 D1 0.3
				Depth	0.2	0.7	0.2	1.0	0.3
Determinand	Method	Test Sample	LOD	Units					
pH	T7	AR			7.3	5.6	6.6	6.9	7.3
SO4(2:1)	T6	AR	0.1	g/l	-	<0.1	-	<0.1	-

SAL Reference: 207304
Project Site: Larch Place, Kendray
Customer Reference: 1175

Soil Analysed as Soil
Miscellaneous

				SAL Reference	207304 016	207304 017	207304 022	207304 024	207304 026
				Customer Sample Reference	TP09 D1 0.6	TP13 D1 0.3	TP12 D1 0.5	TP14 D1 0.2	TP14 D3 1.1
				Depth	0.6	0.3	0.5	0.2	1.1
Determinand	Method	Test Sample	LOD	Units					
pH	T7	AR			7.2	7.7	8.2	7.7	7.8
SO4(2:1)	T6	AR	0.1	g/l	<0.1	-	-	-	<0.1

SAL Reference: 207304
Project Site: Larch Place, Kendray
Customer Reference: 1175

Soil Analysed as Soil
Lithos pH and metals

				SAL Reference	207304 002	207304 004	207304 007	207304 010	207304 013
				Customer Sample Reference	TP04 D1 0.4	TP05 D1 0.2	TP03 D1 0.2	TP07 D1 0.2	TP10 D1 0.3
				Depth	0.4	0.2	0.2	0.2	0.3
Determinand	Method	Test Sample	LOD	Units					
Arsenic	T6	M40	2	mg/kg	13	19	12	20	12
Boron (water-soluble)	T6	AR	1	mg/kg	<1	<1	<1	<1	<1
Cadmium	T6	M40	1	mg/kg	<1	1	<1	<1	<1
Chromium	T6	M40	1	mg/kg	26	18	27	21	17
Chromium (trivalent)	T85	AR	2	mg/kg	26	18	27	21	17
Chromium VI	T6	AR	1	mg/kg	<1	<1	<1	<1	<1
Copper	T6	M40	1	mg/kg	45	33	37	39	34
Lead	T6	M40	1	mg/kg	75	110	61	88	42
Mercury	T6	M40	1	mg/kg	<1	<1	<1	<1	<1
Nickel	T6	M40	1	mg/kg	23	20	22	21	25
Selenium	T6	M40	3	mg/kg	<3	<3	<3	<3	<3
Zinc	T6	M40	1	mg/kg	140	140	100	100	110
pH	T7	AR			7.8	6.9	7.3	6.6	7.3

SAL Reference: 207304
Project Site: Larch Place, Kendray
Customer Reference: 1175

Soil Analysed as Soil
Lithos pH and metals

				SAL Reference	207304 017	207304 019	207304 020	207304 022	207304 024
				Customer Sample Reference	TP13 D1 0.3	TP13 D3 0.4	TP11 D1 0.3	TP12 D1 0.5	TP14 D1 0.2
				Depth	0.3	0.4	0.3	0.5	0.2
Determinand	Method	Test Sample	LOD	Units					
Arsenic	T6	M40	2	mg/kg	12	11	25	20	34
Boron (water-soluble)	T6	AR	1	mg/kg	<1	<1	<1	<1	<1
Cadmium	T6	M40	1	mg/kg	<1	<1	<1	3	9
Chromium	T6	M40	1	mg/kg	23	21	30	31	77
Chromium (trivalent)	T85	AR	2	mg/kg	23	21	30	31	77
Chromium VI	T6	AR	1	mg/kg	<1	<1	<1	<1	<1
Copper	T6	M40	1	mg/kg	39	35	45	160	440
Lead	T6	M40	1	mg/kg	78	66	81	370	490
Mercury	T6	M40	1	mg/kg	<1	<1	<1	<1	<1
Nickel	T6	M40	1	mg/kg	17	17	54	48	110
Selenium	T6	M40	3	mg/kg	<3	<3	<3	<3	<3
Zinc	T6	M40	1	mg/kg	110	130	160	670	1200
pH	T7	AR			7.7	8.0	7.9	8.2	7.7

SAL Reference: 207304
Project Site: Larch Place, Kendray
Customer Reference: 1175

Soil — Analysed as Soil
Lithos Speciated PAH

		SAL Reference	207304 003	207304 011	207304 018	207304 025
		Customer Sample Reference	TP04 J2 0.4	TP07 J2 0.2	TP13 J2 0.3	TP14 J2 0.2
		Depth	0.2	0.2	0.3	0.2
Determinand	Method	Test Sample	LOD	Units		
Acenaphthene	T207	M105	0.1	mg/kg	0.9	0.1	0.6	<0.1
Acenaphthylene	T207	M105	0.1	mg/kg	0.2	<0.1	0.2	<0.1
Anthracene	T207	M105	0.1	mg/kg	3.5	0.4	1.2	<0.1
Benzo(a)Anthracene	T207	M105	0.1	mg/kg	4.9	1.6	4.3	0.3
Benzo(a)Pyrene	T207	M105	0.1	mg/kg	4.4	1.5	4.7	0.3
Benzo(b)fluoranthene	T207	M105	0.1	mg/kg	5.1	1.8	4.8	0.4
Benzo(ghi)Perylene	T207	M105	0.1	mg/kg	2.8	0.8	2.4	0.3
Benzo(k)fluoranthene	T207	M105	0.1	mg/kg	3.0	0.8	3.0	0.3
Chrysene	T207	M105	0.1	mg/kg	5.1	1.5	4.5	0.4
Dibenzo(ah)Anthracene	T207	M105	0.1	mg/kg	0.6	0.1	0.5	<0.1
Fluoranthene	T207	M105	0.1	mg/kg	14	3.5	11	0.8
Fluorene	T207	M105	0.1	mg/kg	1.1	0.1	0.5	<0.1
Indeno(123-cd)Pyrene	T207	M105	0.1	mg/kg	2.3	0.7	2.1	0.2
Naphthalene	T207	M105	0.1	mg/kg	0.3	0.1	0.3	0.1
Phenanthrene	T207	M105	0.1	mg/kg	8.5	1.2	5.0	0.4
Pyrene	T207	M105	0.1	mg/kg	12	3.1	9.3	0.7
PAH(total)	T207	M105	0.1	mg/kg	69	17	54	4.2

SAL Reference: 207304
Project Site: Larch Place, Kendray
Customer Reference: 1175

Leachate — Analysed as Water
Lithos pH and metals

		SAL Reference	207304 002	207304 007	207304 013	207304 022	207304 024
		Customer Sample Reference	TP04 D1 0.4	TP03 D1 0.2	TP10 D1 0.3	TP12 D1 0.5	TP14 D1 0.2
		Depth	0.4	0.2	0.3	0.5	0.2
Determinand	Method	Test Sample	LOD	Units					
As (Dissolved)	T281	10:1	0.2	µg/l	1.0	0.9	0.8	1.1	1.0
Boron	T6	10:1	0.01	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
Cd (Dissolved)	T281	10:1	0.02	µg/l	<0.02	<0.02	<0.02	<0.02	0.04
Cr (Dissolved)	T281	10:1	1	µg/l	2	<1	4	4	2
Cu (Dissolved)	T281	10:1	0.5	µg/l	0.8	0.6	0.8	4.3	6.7
Pb (Dissolved)	T281	10:1	0.3	µg/l	<0.3	<0.3	<0.3	0.7	1.6
Hg (Dissolved)	T281	10:1	0.05	µg/l	<0.05	<0.05	<0.05	<0.05	<0.05
Ni (Dissolved)	T281	10:1	1	µg/l	1	<1	3	2	1
Se (Dissolved)	T281	10:1	0.5	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5
Zn (Dissolved)	T281	10:1	2	µg/l	4	3	3	5	10
pH	T7	10:1			8.1	8.5	8.6	10.1	8.7

Encia Job No.	**1147**
Site Name	**Larch Place, Kendray**
Engineer	**ASw**

Analytical Data

Material Type	Data (mg/kg)	Log Data
Cohesive Made Ground	**13.00**	1.1139
	19.00	1.2788
	12.00	1.0792
	20.00	1.3010
	12.00	1.0792
	12.00	1.0792
	34.00	1.5315

Mean Value Test

n	t	t value
2	6.3138	
3	2.9200	
4	2.3534	
5	2.1318	
6	2.0150	
7	1.9432	1.943
8	1.8946	
9	1.8595	
10	1.8331	
11	1.8125	
12	1.7959	
13	1.7823	
14	1.7709	
15	1.7613	
16	1.7531	
17	1.7459	
18	1.7396	
19	1.7341	
20	1.7291	
21	1.7247	
22	1.7207	
23	1.7171	
24	1.7139	
25	1.7109	
26	1.7081	
27	1.7056	
28	1.7033	
29	1.7011	
30	1.6991	
31	1.6973	
32	1.6955	
33	1.6939	
34	1.6924	
35	1.6909	
36	1.6896	
37	1.6883	
38	1.6871	
39	1.6860	
40	1.6849	
41	1.6839	
42	1.6829	
43	1.6820	
44	1.6811	
45	1.6802	
46	1.6794	
47	1.6787	
48	1.6779	
49	1.6772	
50	1.6766	

Outlier Test

T_{crit} 10%	T_{crit} V
1.425	
1.602	
1.729	
1.828	1.828
1.909	
1.977	
2.036	
2.088	
2.134	
2.176	
2.213	
2.248	
2.279	
2.309	
2.336	
2.361	
2.385	
2.408	
2.429	
2.449	
2.468	
2.486	
2.503	
2.520	
2.536	
2.551	
2.565	
2.579	
2.592	
2.605	
2.618	
2.630	
2.641	
2.652	
2.663	
2.674	
2.684	
2.694	
2.704	
2.713	
2.722	
2.731	
2.739	
2.748	
2.756	
2.764	
2.772	

Determinand:	**Arsenic**
No. of samples:	7
SGV:	32
t value:	1.943
mean (x):	17.43
st.dev (s):	8.08
95% ile:	**23**

Is the Mean Value Test Higher or Lower than the SGV?	
Higher or Lower	**Lower**
Y max:	1.531
Y mean:	1.209
Y st.dev.:	0.172
T value	1.878
Comparator	1.828

Maximum Value Test Result:	
Outlier Test?	**Maximum is an Outlier**

Outlier Values	Sample Number

Encia Job No.	**1147**
Site Name	**Larch Place, Kendray**
Engineer	**ASw**

Analytical Data

Material Type	Data (mg/kg)	Log Data
Cohesive Made Ground	**13.00**	1.1139
	19.00	1.2788
	12.00	1.0792
	20.00	1.3010
	12.00	1.0792
	12.00	1.0792

Mean Value Test

n	t	t value
2	6.3138	
3	2.9200	
4	2.3534	
5	2.1318	
6	2.0150	2.015
7	1.9432	
8	1.8946	
9	1.8595	
10	1.8331	
11	1.8125	
12	1.7959	
13	1.7823	
14	1.7709	
15	1.7613	
16	1.7531	
17	1.7459	
18	1.7396	
19	1.7341	
20	1.7291	
21	1.7247	
22	1.7207	
23	1.7171	
24	1.7139	
25	1.7109	
26	1.7081	
27	1.7056	
28	1.7033	
29	1.7011	
30	1.6991	
31	1.6973	
32	1.6955	
33	1.6939	
34	1.6924	
35	1.6909	
36	1.6896	
37	1.6883	
38	1.6871	
39	1.6860	
40	1.6849	
41	1.6839	
42	1.6829	
43	1.6820	
44	1.6811	
45	1.6802	
46	1.6794	
47	1.6787	
48	1.6779	
49	1.6772	
50	1.6766	

Outlier Test

T_{crit} 10%	T_{crit} V
1.425	
1.602	
1.729	1.729
1.828	
1.909	
1.977	
2.036	
2.088	
2.134	
2.176	
2.213	
2.248	
2.279	
2.309	
2.336	
2.361	
2.385	
2.408	
2.429	
2.449	
2.468	
2.486	
2.503	
2.520	
2.536	
2.551	
2.565	
2.579	
2.592	
2.605	
2.618	
2.630	
2.641	
2.652	
2.663	
2.674	
2.684	
2.694	
2.704	
2.713	
2.722	
2.731	
2.739	
2.748	
2.756	
2.764	
2.772	

Determinand:	**Arsenic**
No. of samples:	6
SGV:	32
t value:	2.015
mean (x):	14.67
st.dev (s):	3.78
95% ile:	**18**

Is the Mean Value Test Higher or Lower than the SGV?

Higher or Lower	**Lower**
Y max:	1.301
Y mean:	1.155
Y st.dev.:	0.105
T value	1.383
Comparator	1.729

Maximum Value Test Result:

Outlier Test?	**Maximum is within a Normal Distribution**

Outlier Values	Sample Number
34	**TP14 @ 0.2m depth**

Encia Job No.	1147
Site Name	Larch Place, Kendray
Engineer	ASw

Note SGV is pH dependent; if a given material yields variable pH values, assume worst-case SGV. Eg if pH values are in range 7 to 8 assume SGV=2.

Analytical Data			Mean Value Test			Outlier Test	
Material Type	Data (mg/kg)	Log Data	n	t	t value	T_{crit} 10%	T_{crit} V
Cohesive Made Ground	1.00	0.0000	2	6.3138			
	1.00	0.0000	3	2.9200			
	1.00	0.0000	4	2.3534		1.425	
	1.00	0.0000	5	2.1318		1.602	
	1.00	0.0000	6	2.0150		1.729	
	1.00	0.0000	7	1.9432	1.943	1.828	1.828
	9.00	0.9542	8	1.8946		1.909	
			9	1.8595		1.977	
			10	1.8331		2.036	
			11	1.8125		2.088	
			12	1.7959		2.134	
			13	1.7823		2.176	
			14	1.7709		2.213	
			15	1.7613		2.248	
			16	1.7531		2.279	
			17	1.7459		2.309	
			18	1.7396		2.336	
			19	1.7341		2.361	
			20	1.7291		2.385	
			21	1.7247		2.408	
			22	1.7207		2.429	
			23	1.7171		2.449	
			24	1.7139		2.468	
			25	1.7109		2.486	
			26	1.7081		2.503	
			27	1.7056		2.520	
			28	1.7033		2.536	
			29	1.7011		2.551	
			30	1.6991		2.565	
			31	1.6973		2.579	
			32	1.6955		2.592	
			33	1.6939		2.605	
			34	1.6924		2.618	
			35	1.6909		2.630	
			36	1.6896		2.641	
			37	1.6883		2.652	
			38	1.6871		2.663	
			39	1.6860		2.674	
			40	1.6849		2.684	
			41	1.6839		2.694	
			42	1.6829		2.704	
			43	1.6820		2.713	
			44	1.6811		2.722	
			45	1.6802		2.731	
			46	1.6794		2.739	
			47	1.6787		2.748	
			48	1.6779		2.756	
			49	1.6772		2.764	
			50	1.6766		2.772	

Determinand:	Cadmium
No. of samples:	7
SGV:	10
t value:	1.943
mean (x):	2.14
st.dev (s):	3.02
95% ile:	4

Is the Mean Value Test Higher or Lower than the SGV?	
Higher or Lower	Lower
Y max:	0.954
Y mean:	0.136
Y st.dev.:	0.361
T value	2.268
Comparator	1.828

Maximum Value Test Result:	
Outlier Test?	Maximum is an Outlier

Outlier Values	Sample Number

Encia Job No.	**1147**
Site Name	**Larch Place, Kendray**
Engineer	**ASw**

Note SGV is pH dependent; if a given material yields variable pH values, assume worst-case SGV. Eg if pH values are in range 7 to 8 assume SGV=2.

Analytical Data			Mean Value Test			Outlier Test	
Material Type	Data (mg/kg)	Log Data	n	t	t value	T_{crit} 10%	T_{crit} V
Cohesive Made Ground	1.00	0.0000	2	6.3138			
	1.00	0.0000	3	2.9200			
	1.00	0.0000	4	2.3534		1.425	
	1.00	0.0000	5	2.1318		1.602	
	1.00	0.0000	6	2.0150	2.015	1.729	1.729
	1.00	0.0000	7	1.9432		1.828	
			8	1.8946		1.909	
			9	1.8595		1.977	
			10	1.8331		2.036	
			11	1.8125		2.088	
			12	1.7959		2.134	
			13	1.7823		2.176	
			14	1.7709		2.213	
			15	1.7613		2.248	
			16	1.7531		2.279	
			17	1.7459		2.309	
			18	1.7396		2.336	
			19	1.7341		2.361	
			20	1.7291		2.385	
			21	1.7247		2.408	
			22	1.7207		2.429	
			23	1.7171		2.449	
			24	1.7139		2.468	
			25	1.7109		2.486	
			26	1.7081		2.503	
			27	1.7056		2.520	
			28	1.7033		2.536	
			29	1.7011		2.551	
			30	1.6991		2.565	
			31	1.6973		2.579	
			32	1.6955		2.592	
			33	1.6939		2.605	
			34	1.6924		2.618	
			35	1.6909		2.630	
			36	1.6896		2.641	
			37	1.6883		2.652	
			38	1.6871		2.663	
			39	1.6860		2.674	
			40	1.6849		2.684	
			41	1.6839		2.694	
			42	1.6829		2.704	
			43	1.6820		2.713	
			44	1.6811		2.722	
			45	1.6802		2.731	
			46	1.6794		2.739	
			47	1.6787		2.748	
			48	1.6779		2.756	
			49	1.6772		2.764	
			50	1.6766		2.772	

Determinand:	**Cadmium**
No. of samples:	6
SGV:	10
t value:	2.015
mean (x):	1.00
st.dev (s):	0.00
95% ile:	**1**

Is the Mean Value Test Higher or Lower than the SGV?	
Higher or Lower	**Lower**
Y max:	0.000
Y mean:	0.000
Y st.dev.:	0.000
T value	#DIV/0!
Comparator	1.729

Maximum Value Test Result:	
Outlier Test?	**#DIV/0!**

Outlier Values	Sample Number
9	TP14 @ 0.2m depth

Encia Job No.	**1147**
Site Name	**Larch Place, Kendray**
Engineer	**ASw**

Analytical Data

Material Type	Data (mg/kg)	Log Data
Cohesive Made Ground	**75.00**	1.8751
	110.00	2.0414
	61.00	1.7853
	88.00	1.9445
	42.00	1.6232
	78.00	1.8921
	490.00	2.6902

Mean Value Test

n	t	t value
2	6.3138	
3	2.9200	
4	2.3534	
5	2.1318	
6	2.0150	
7	1.9432	1.943
8	1.8946	
9	1.8595	
10	1.8331	
11	1.8125	
12	1.7959	
13	1.7823	
14	1.7709	
15	1.7613	
16	1.7531	
17	1.7459	
18	1.7396	
19	1.7341	
20	1.7291	
21	1.7247	
22	1.7207	
23	1.7171	
24	1.7139	
25	1.7109	
26	1.7081	
27	1.7056	
28	1.7033	
29	1.7011	
30	1.6991	
31	1.6973	
32	1.6955	
33	1.6939	
34	1.6924	
35	1.6909	
36	1.6896	
37	1.6883	
38	1.6871	
39	1.6860	
40	1.6849	
41	1.6839	
42	1.6829	
43	1.6820	
44	1.6811	
45	1.6802	
46	1.6794	
47	1.6787	
48	1.6779	
49	1.6772	
50	1.6766	

Outlier Test

T_{crit} 10%	T_{crit} V
1.425	
1.602	
1.729	
1.828	1.828
1.909	
1.977	
2.036	
2.088	
2.134	
2.176	
2.213	
2.248	
2.279	
2.309	
2.336	
2.361	
2.385	
2.408	
2.429	
2.449	
2.468	
2.486	
2.503	
2.520	
2.536	
2.551	
2.565	
2.579	
2.592	
2.605	
2.618	
2.630	
2.641	
2.652	
2.663	
2.674	
2.684	
2.694	
2.704	
2.713	
2.722	
2.731	
2.739	
2.748	
2.756	
2.764	
2.772	

Determinand:	**Lead**
No. of samples:	7
SGV:	450
Log SGV:	2.653
t value:	1.943
mean of log data (x):	1.979
st.dev of log data (s):	0
95% ile of log data:	2.228
95% ile:	**169.24**

Is the Mean Value Higher or Lower than the SGV?	
Higher or Lower	**Lower**
Y max:	2.690
Y mean:	1.979
Y st.dev.:	0.340
T value	2.093
Comparator	1.828

Maximum Value Test Result:	
Outlier Test?	**Maximum is an Outlier**

Outlier Values	Sample Number

Encia Job No.	**1147**
Site Name	**Larch Place, Kendray**
Engineer	**ASw**

Analytical Data

Material Type	Data (mg/kg)	Log Data
Cohesive Made Ground	**75.00**	1.8751
	110.00	2.0414
	61.00	1.7853
	88.00	1.9445
	42.00	1.6232
	78.00	1.8921

Mean Value Test

n	t	t value
2	6.3138	
3	2.9200	
4	2.3534	
5	2.1318	
6	2.0150	2.015
7	1.9432	
8	1.8946	
9	1.8595	
10	1.8331	
11	1.8125	
12	1.7959	
13	1.7823	
14	1.7709	
15	1.7613	
16	1.7531	
17	1.7459	
18	1.7396	
19	1.7341	
20	1.7291	
21	1.7247	
22	1.7207	
23	1.7171	
24	1.7139	
25	1.7109	
26	1.7081	
27	1.7056	
28	1.7033	
29	1.7011	
30	1.6991	
31	1.6973	
32	1.6955	
33	1.6939	
34	1.6924	
35	1.6909	
36	1.6896	
37	1.6883	
38	1.6871	
39	1.6860	
40	1.6849	
41	1.6839	
42	1.6829	
43	1.6820	
44	1.6811	
45	1.6802	
46	1.6794	
47	1.6787	
48	1.6779	
49	1.6772	
50	1.6766	

Outlier Test

T_{crit} 10%	T_{crit} V
1.425	
1.602	
1.729	1.729
1.828	
1.909	
1.977	
2.036	
2.088	
2.134	
2.176	
2.213	
2.248	
2.279	
2.309	
2.336	
2.361	
2.385	
2.408	
2.429	
2.449	
2.468	
2.486	
2.503	
2.520	
2.536	
2.551	
2.565	
2.579	
2.592	
2.605	
2.618	
2.630	
2.641	
2.652	
2.663	
2.674	
2.684	
2.694	
2.704	
2.713	
2.722	
2.731	
2.739	
2.748	
2.756	
2.764	
2.772	

Determinand:	**Lead**
No. of samples:	6
SGV:	450
Log SGV:	2.653
t value:	2.015
mean of log data (x):	1.860
st.dev of log data (s):	0
95% ile of log data:	1.978
95% ile:	**95.13**

Is the Mean Value Higher or Lower than the SGV?	
Higher or Lower	**Lower**
Y max:	2.041
Y mean:	1.860
Y st.dev.:	0.143
T value	1.262
Comparator	1.729

Maximum Value Test Result:	
Outlier Test?	**Maximum is within a Normal Distribution**

Outlier Values	Sample Number
490.00	**TP14 @ 0.2m depth**

Encia Job No.	**1147**
Site Name	**Larch Place, Kendray**
Engineer	**ASw**

Note SGV is pH dependent; if a given material yields variable pH values, assume worst-case SGV. Eg if pH values are in range 7 to 9 assume SGV=200.

Analytical Data			Mean Value Test			Outlier Test	
Material Type	Data (mg/kg)	Log Data	n	t	t value	T_{crit} 10%	T_{crit} V
Cohesive Made Ground	45.00	1.6532	2	6.3138			
	33.00	1.5185	3	2.9200			
	37.00	1.5682	4	2.3534		1.425	
	39.00	1.5911	5	2.1318		1.602	
	34.00	1.5315	6	2.0150		1.729	
	39.00	1.5911	7	1.9432	1.943	1.828	1.828
	440.00	2.6435	8	1.8946		1.909	
			9	1.8595		1.977	
			10	1.8331		2.036	
			11	1.8125		2.088	
			12	1.7959		2.134	
			13	1.7823		2.176	
			14	1.7709		2.213	
			15	1.7613		2.248	
			16	1.7531		2.279	
			17	1.7459		2.309	
			18	1.7396		2.336	
			19	1.7341		2.361	
			20	1.7291		2.385	
			21	1.7247		2.408	
			22	1.7207		2.429	
			23	1.7171		2.449	
			24	1.7139		2.468	
			25	1.7109		2.486	
			26	1.7081		2.503	
			27	1.7056		2.520	
			28	1.7033		2.536	
			29	1.7011		2.551	
			30	1.6991		2.565	
			31	1.6973		2.579	
			32	1.6955		2.592	
			33	1.6939		2.605	
			34	1.6924		2.618	
			35	1.6909		2.630	
			36	1.6896		2.641	
			37	1.6883		2.652	
			38	1.6871		2.663	
			39	1.6860		2.674	
			40	1.6849		2.684	
			41	1.6839		2.694	
			42	1.6829		2.704	
			43	1.6820		2.713	
			44	1.6811		2.722	
			45	1.6802		2.731	
			46	1.6794		2.739	
			47	1.6787		2.748	
			48	1.6779		2.756	
			49	1.6772		2.764	
			50	1.6766		2.772	

Determinand:	**Copper**
No. of samples:	7
SGV:	200
t value:	1.943
mean (x):	95.29
st.dev (s):	152.06
95% ile:	**207**

Is the Mean Value Test Higher or Lower than the SGV?	
Higher or Lower	**Higher**
Y max:	2.643
Y mean:	1.728
Y st.dev.:	0.406
T value	2.254
Comparator	1.828

Maximum Value Test Result:	
Outlier Test?	**Maximum is an Outlier**

Outlier Values	Sample Number

Encia Job No.	**1147**
Site Name	**Larch Place, Kendray**
Engineer	**ASw**

Note SGV is pH dependent; if a given material yields variable pH values, assume worst-case SGV. Eg if pH values are in range 7 to 9 assume SGV=200.

Analytical Data			Mean Value Test			Outlier Test	
Material Type	Data (mg/kg)	Log Data	n	t	t value	T_{crit} 10%	T_{crit} V
Cohesive Made Ground	45.00	1.6532	2	6.3138			
	33.00	1.5185	3	2.9200			
	37.00	1.5682	4	2.3534		1.425	
	39.00	1.5911	5	2.1318		1.602	
	34.00	1.5315	6	2.0150	2.015	1.729	1.729
	39.00	1.5911	7	1.9432		1.828	
			8	1.8946		1.909	
			9	1.8595		1.977	
			10	1.8331		2.036	
			11	1.8125		2.088	
			12	1.7959		2.134	
			13	1.7823		2.176	
			14	1.7709		2.213	
			15	1.7613		2.248	
			16	1.7531		2.279	
			17	1.7459		2.309	
			18	1.7396		2.336	
			19	1.7341		2.361	
			20	1.7291		2.385	
			21	1.7247		2.408	
			22	1.7207		2.429	
			23	1.7171		2.449	
			24	1.7139		2.468	
			25	1.7109		2.486	
			26	1.7081		2.503	
			27	1.7056		2.520	
			28	1.7033		2.536	
			29	1.7011		2.551	
			30	1.6991		2.565	
			31	1.6973		2.579	
			32	1.6955		2.592	
			33	1.6939		2.605	
			34	1.6924		2.618	
			35	1.6909		2.630	
			36	1.6896		2.641	
			37	1.6883		2.652	
			38	1.6871		2.663	
			39	1.6860		2.674	
			40	1.6849		2.684	
			41	1.6839		2.694	
			42	1.6829		2.704	
			43	1.6820		2.713	
			44	1.6811		2.722	
			45	1.6802		2.731	
			46	1.6794		2.739	
			47	1.6787		2.748	
			48	1.6779		2.756	
			49	1.6772		2.764	
			50	1.6766		2.772	

Determinand:	**Copper**
No. of samples:	6
SGV:	200
t value:	2.015
mean (x):	37.83
st.dev (s):	4.31
95% ile:	**41**

Is the Mean Value Test Higher or Lower than the SGV?	
Higher or Lower	**Lower**

Y max:	1.653
Y mean:	1.576
Y st.dev.:	0.049
T value	1.600
Comparator	1.729

Maximum Value Test Result:	
Outlier Test?	**Maximum is within a Normal Distribution**

Outlier Values	Sample Number
440	**TP14 @ 0.2m depth**

Encia Job No.	**1147**
Site Name	**Larch Place, Kendray**
Engineer	**ASw**

Note SGV is pH dependent; if a given material yields variable pH values, assume worst-case SGV. Eg if pH values are in range 7 to 9 assume SGV=300.

Analytical Data			Mean Value Test			Outlier Test	
Material Type	Data (mg/kg)	Log Data	n	t	t value	T_{crit} 10%	T_{crit} V
Cohesive Made Ground	140.00	2.1461	2	6.3138			
	140.00	2.1461	3	2.9200			
	100.00	2.0000	4	2.3534		1.425	
	100.00	2.0000	5	2.1318		1.602	
	110.00	2.0414	6	2.0150		1.729	
	110.00	2.0414	7	1.9432	1.943	1.828	1.828
	1200.00	3.0792	8	1.8946		1.909	
			9	1.8595		1.977	
			10	1.8331		2.036	
			11	1.8125		2.088	
			12	1.7959		2.134	
			13	1.7823		2.176	
			14	1.7709		2.213	
			15	1.7613		2.248	
			16	1.7531		2.279	
			17	1.7459		2.309	
			18	1.7396		2.336	
			19	1.7341		2.361	
			20	1.7291		2.385	
			21	1.7247		2.408	
			22	1.7207		2.429	
			23	1.7171		2.449	
			24	1.7139		2.468	
			25	1.7109		2.486	
			26	1.7081		2.503	
			27	1.7056		2.520	
			28	1.7033		2.536	
			29	1.7011		2.551	
			30	1.6991		2.565	
			31	1.6973		2.579	
			32	1.6955		2.592	
			33	1.6939		2.605	
			34	1.6924		2.618	
			35	1.6909		2.630	
			36	1.6896		2.641	
			37	1.6883		2.652	
			38	1.6871		2.663	
			39	1.6860		2.674	
			40	1.6849		2.684	
			41	1.6839		2.694	
			42	1.6829		2.704	
			43	1.6820		2.713	
			44	1.6811		2.722	
			45	1.6802		2.731	
			46	1.6794		2.739	
			47	1.6787		2.748	
			48	1.6779		2.756	
			49	1.6772		2.764	
			50	1.6766		2.772	

Determinand:	**Zinc**
No. of samples:	7
SGV:	300
t value:	1.943
mean (x):	271.43
st.dev (s):	409.81
95% ile:	**572**

Is the Mean Value Test Higher or Lower than the SGV?	
Higher or Lower	**Higher**
Y max:	3.079
Y mean:	2.208
Y st.dev.:	0.389
T value	2.239
Comparator	1.828

Maximum Value Test Result:	
Outlier Test?	**Maximum is an Outlier**

Outlier Values	Sample Number

Encia Job No.	**1147**
Site Name	**Larch Place, Kendray**
Engineer	**ASw**

Note SGV is pH dependent; if a given material yields variable pH values, assume worst-case SGV. Eg if pH values are in range 7 to 9 assume SGV=300.

Analytical Data			Mean Value Test			Outlier Test	
Material Type	Data (mg/kg)	Log Data	n	t	t value	T_{crit} 10%	T_{crit} V
Cohesive Made Ground	140.00	2.1461	2	6.3138			
	140.00	2.1461	3	2.9200			
	100.00	2.0000	4	2.3534		1.425	
	100.00	2.0000	5	2.1318		1.602	
	110.00	2.0414	6	2.0150	2.015	1.729	1.729
	110.00	2.0414	7	1.9432		1.828	
			8	1.8946		1.909	
			9	1.8595		1.977	
			10	1.8331		2.036	
			11	1.8125		2.088	
			12	1.7959		2.134	
			13	1.7823		2.176	
			14	1.7709		2.213	
			15	1.7613		2.248	
			16	1.7531		2.279	
			17	1.7459		2.309	
			18	1.7396		2.336	
			19	1.7341		2.361	
			20	1.7291		2.385	
			21	1.7247		2.408	
			22	1.7207		2.429	
			23	1.7171		2.449	
			24	1.7139		2.468	
			25	1.7109		2.486	
			26	1.7081		2.503	
			27	1.7056		2.520	
			28	1.7033		2.536	
			29	1.7011		2.551	
			30	1.6991		2.565	
			31	1.6973		2.579	
			32	1.6955		2.592	
			33	1.6939		2.605	
			34	1.6924		2.618	
			35	1.6909		2.630	
			36	1.6896		2.641	
			37	1.6883		2.652	
			38	1.6871		2.663	
			39	1.6860		2.674	
			40	1.6849		2.684	
			41	1.6839		2.694	
			42	1.6829		2.704	
			43	1.6820		2.713	
			44	1.6811		2.722	
			45	1.6802		2.731	
			46	1.6794		2.739	
			47	1.6787		2.748	
			48	1.6779		2.756	
			49	1.6772		2.764	
			50	1.6766		2.772	

Determinand:	**Zinc**
No. of samples:	6
SGV:	300
t value:	2.015
mean (x):	116.67
st.dev (s):	18.62
95% ile:	**132**

Is the Mean Value Test Higher or Lower than the SGV?	
Higher or Lower	**Lower**
Y max:	2.146
Y mean:	2.063
Y st.dev.:	0.067
T value	1.241
Comparator	1.729

Maximum Value Test Result:	
Outlier Test?	**Maximum is within a Normal Distribution**

Outlier Values	Sample Number
1,200	**TP14 @ 0.2m depth**