LITHOS

Land at Clacton Road, Weeley Heath

For LNT Care Developments Ltd

Report no: 4762/1

Date: August 2023

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SUMMARY OF GEOENVIRONMENTAL ISSUES

Job No.	4762	**Site area/ha**	0.85
Client:	LNT Care Developments Ltd	**NGR:**	TM 156 220
Site:	Clacton Road, Weeley Heath	**Nearest postcode:**	CO16 9EF

The site is located off Clacton Road, approximately 5.7km north of Clacton-on-Sea, and currently comprises a 2 storey domestic dwelling and 1.5 storey annex in the north, with associated gardens and out-buildings in the centre and south. The site was occupied by agricultural land before being developed with the existing house in the early 1920s.

Lithos were commissioned by LNT to provide a geoenvironmental appraisal of the site, which it is understood is to be redeveloped with a 3-storey care home, with associated parking and landscaped areas. Lithos' investigation included a review of the site's history and environmental setting, and a ground investigation comprising 6 trial pits, with soakaway testing in 3 pits, and 5 hand excavated pits to recover shallow soil samples.

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

Issue	Remarks
Made ground	Made Ground Topsoil is present in the north to 0.2m depth which contains anthropogenic materials including brick, concrete, glass, etc. Although not encountered during this investigation, a veneer of made ground is likely to be present in the vicinity of existing buildings and obstructions (foundations & floor slabs) should be anticipated.
Natural ground	Topsoil is present across the majority of the site to 0.2m depth, underlain by Cohesive Drift (firm to stiff clay) to c. 1.5m depth and Granular Residual Soil (clayey/silty sand).
Contamination	The Topsoil locally contains asbestos-containing-materials (ACMs) which will require visual inspection and hand picking prior to stockpiling for re-use. Further testing of the topsoil should be undertaken once stockpiled to confirm the absence of any further asbestos contamination. Made Ground Topsoil is chemically suitable for re-use although contains anthropogenic materials (brick, concrete, glass, etc) which are considered unsuitable in garden/landscaped areas. Therefore, this material should be isolated beneath a 450mm thick surface cover of "clean" soil.
Mining & quarrying	This site is located beyond the CA's defined coalfields. There are no known quarries on, or within 50m of the site.
Hazardous gas	The site is in an area where less than 1% of homes are estimated to be above the radon action level. There are no known or suspected areas of landfilling within 250m, and the site is not in area considered susceptible to mines gas, nor is it underlain by shallow mineworkings. As such, no special precautions against methane / carbon dioxide gas are required.
Preparatory works	General site clearance including demolition of existing buildings and removal of vegetation. Topsoil strip, inspection and stockpile for re-use, with segregation of Made Ground Topsoil present in the north. Backfill of the existing pond.
Foundations	Depending on final loadings and tolerable settlements, the proposed care home could be constructed on widened strip/trench-fill footings at a minimum depth of 0.9m in Cohesive Residual Soil. Foundations will require deepening where necessary due to tree influence. Foundation excavations should be kept as shallow as possible (where sufficient bearing capacity can be achieved) to minimise issues surrounding constructability associated with groundwater inflows in deeper granular soils.
Groundwater & excavations	Based on the results of the investigation it is considered unlikely that major groundwater flows will be encountered in shallow excavations (<1.2m). However, groundwater is likely to be encountered in any excavations deeper than 2.0m. Shallow excavations in cohesive soils should remain stable in the short term but if left open for any significant period of time may require shoring. However, deeper excavations into saturated sand are likely to be unstable and therefore allowance should be made for shoring.
Flooding & drainage	The site lies in Flood Zone 1, where the risk of flooding from rivers or the sea is classified as low. Due to very slow infiltration rates and high groundwater levels, soakaways are very unlikely to provide a suitable drainage solution for surface water run-off at the site. Consequently, it will be necessary to consider alternative sustainable drainage systems (SuDS), and there may be a need for surface water balancing.

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Issue	Remarks
Access road & car parking	Based on visual inspection of the shallow natural materials and published guidance, the shallow Cohesive Drift soils should provide a CBR value of at least 2%. This value should be verified prior to or during construction. However, the existing house/annex is located over the proposed car park area and therefore made ground is likely to be present. This should be excavated and either replaced with suitable aggregate, or screened, to allow selection of suitable material, before being replaced in engineered layers. Where the made ground is re-engineered it is considered that a CBR value of at least 3% should be achievable. However, this should be verified by field trials.

Significant developer abnormals relating to geoenvironmental issues at the site are:

Demolition of existing buildings/foundations and grubbing up of hardstand.

Possible foundation abnormals associated with conflict of proposed care home and existing pond.

Some further work is required, most notably:

A simple post-demolition trial pit investigation will be required in order to remove residual uncertainties with respect to ground, and provide more definitive recommendations with respect to contamination and foundations.

Depending on final loadings and tolerable settlements, Cone Penetration Testing (CPT) may be required to determine the density of underlying sands to inform foundation design.

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APPENDICES

Appendix A - General notes

01	Environmental setting
02	Ground investigation fieldwork
03	Geotechnical testing
04	Contamination laboratory analysis & interpretation
06	Soakaways

Appendix B - Drawings

Drawing	Revision	Title
4762/1	-	Site location plan
4762/2	-	Proposed site layout
4762/3	-	Site features
4762/4	-	Site photographs
4762/5	-	Preliminary conceptual site model
4762/6	-	Exploratory hole locations
4762/7	-	Revised conceptual site model

Appendix C - Commission

Appendix D - Historical OS plans#

Appendix E- Search responses#

From	Date	Content
Landmark	12th June 2023	Environmental search data
Landmark	12th June 2023	Mining and ground stability report
British Geological Society	14th – 17th July 1989	BGS Borehole records

Appendix F- Exploratory records

Appendix F	TP01 to TP06

Appendix G - Soakaway calculation sheets

Appendix H - Chemical test results

Appendix I - Geotechnical test results

Some of this data is not included within the paper or PDF copies of this report but can be provided on request.

FOREWORD (GEOENVIRONMENTAL APPRAISAL 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.

This report has been reviewed by a Competent Person, as defined in the National Planning Policy Framework. We ensure that all projects are managed by individuals with necessary experience, relevant qualifications, and current membership of a relevant professional organisation. Records of engineers, project managers and reviewers involved in this project are maintained by us. Lithos QA/QC procedures for all our work forms an integral part of our ISO9001 accreditation and as such is regularly audited.

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 pages to a minimum, some information (e.g. full copy of the Landmark/Groundsure Report) is not included in the PDF; by request it can be provided on a 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. 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.

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.

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

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

GEOENVIRONMENTAL APPRAISAL
of land at
CLACTON ROAD, WEELEY HEATH

1 INTRODUCTION

1.1 The commission and brief

1.1.1 Lithos Consulting Limited were commissioned by LNT Care Developments Ltd to carry out a geoenvironmental appraisal of land off Clacton Lane, Weeley Heath.

1.1.2 Correspondence regarding Lithos' 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 6 trial pits, with soakaway testing in 3 pits, and 5 hand excavated pits to recover shallow soil samples
- Assessment of the geotechnical properties of the near surface deposits to enable provision of foundation and car park recommendations
- A qualitative assessment of contamination risks
- Recommendations for the necessary site preparatory

1.1.3 Primary aims of this investigation were to identify salient geoenvironmental issues affecting the site to support the submission of a planning application, and also to enable LNT to obtain budget costs for: foundations; gas protection measures; site preparatory works and possible remediation.

1.2 The proposed development

1.2.1 It is understood that consideration is being given to redevelopment of the site with a two storey care home with landscaped areas and car parking.

1.2.2 A proposed site layout has been provided by LNT (Drawing reference CO16 9EP –F.01, dated 30 03 2023) which is reproduced as Drawing 4762/2 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
- Soakaways

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 In accordance with the agreed scope of works, the ground investigation reported here is not fully compliant with Eurocode 7 (EC7) and this report does not purport to be a Ground Investigation Report, nor a Geotechnical Design Report as defined by EC7. The ground appraisal, parametric assessment and preliminary design guidance presented are intended to assist others as they prepare the design of the proposed works.

2 SITE DESCRIPTION

2.1 General

2.1.1 The site's location is shown on Drawing 4762/1 presented in Appendix B to this report. Site details are summarised in the table below.

Detail	Remarks
Location	5.7 km north of Clacton-on-Sea
NGR	TM 156 220
Approximate area	0.8ha (2.0 acres)
Known services	Underground electric, gas, water & sewer Overhead telecoms

2.2 Site features

2.2.1 Lithos completed a walkover survey of the site on 2nd July 2023.

2.2.2 Existing salient site features, at the time of the walkover are presented on Drawing 4762/3 in Appendix B to this report and summarised in the table below. A selection of site photographs is included on Drawing 4762/4.

Feature	Remarks
Current access	Off Clacton Road in the north (via a gravel track)
Topography	Relatively flat
Approximate areas	7,100m^2 grassed and overgrown areas (shrubs and trees) 450m^2 buildings (house, annex, sheds/greenhouses and livestock shelters) 250m^2 gravel hardstand 150m^2 paving 50m^2 pond
Nature of boundaries	All –wooden fencing lined with dense vegetation (trees/bushes)
Surrounding land uses	Northeast –Clacton Road with housing beyond Northwest and southeast –housing Southwest –open fields

2.2.3 The site is access off Clacton Road in the northeast or far north and currently comprises a two storey house and 1.5 storey annex building in the north with associated gardens and outbuildings.

2.2.4 The house and annex buildings are of brick construction with tile roofs, with a double garage present in the annex. Some household items (furniture, washing machine, vacuum cleaners, etc) are stored to the rear of the house.

2.2.5 A gravel track runs along the northwest boundary to rear of the annex building where 6 cars are stored. A small green house is present on the northwest boundary in which old bicycles and motorbikes are stored. Further to the south within the garden area are two caravans along with a variety of garden items (trampoline, BBQs, furniture, lawn mower, etc).

2.2.6 The garden areas in the centre and north appear to be well-kept with small bushes, trees and mown grass. A pond is present in the centre south. Land in the south is largely overgrown with significant areas of dense vegetation. A number of tree stumps were noted in the south during the walkover which appear to have been recently felled based on aerial photographs (see Section 3).

2.2.7 In the southwest corner of the site are 4 roughly square disused sheds and 1 rectangular shed used to house sheep. The sheds are of metal frame construction with sheet timber walls. Surrounding the sheds are a number of trailers, a stack of hay bales and a number of old water troughs.

3 SITE HISTORY

3.1 Site centred extracts from Ordnance Survey (OS) plans dating back to 1874 have been examined. Some of these plans are presented in Appendix D to this report.

3.2 The table below provides a summary of the salient points relating to the history of the site. 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	Site	Surrounding land
1874	Comprises an open field.	Colchester Road directly north. Weeleygate Farm c. 30m north. 'Old barn' labelled c. 180m southeast. Buildings labelled 'Refectory' c. 180m southwest. Several buildings along Colchester Road from c. 200m.
1923	Single **residential dwelling** shown in the centre north.	Residential dwellings east and west along Clacton Road. Weeleygate Farm now labelled 'Gate Farm'. **Well** labelled c. 50m southwest. Nursery and associated buildings/greenhouses shown c. 100m northeast. Old barn no longer labelled.
1958	No significant changes.	Nursery labelled 'Kidbys Nurseries' and expanded with more greenhouses. Houses shown directly north. Ponds and woodland shown c. 140m southeast.
1972	Residential dwelling labelled 'The Oaks'.	Building c. 160m southeast labelled 'Barnfields'. Colchester Road now called 'Clacton Road'. Depot labelled c. 260m west. Well to the southwest no longer shown.
1994	No significant changes.	Building associated with residential dwelling directly east shown c. 10m southeast.
1996	Out building constructed to the west of the main residential building.	Buildings shown c. 120m southwest.
1999 (Aerial)	Possible building/greenhouse shown in the southeast Small **pond** shown in the east	No significant changes.
2023 (Aerial)	Several small buildings shown in the southwest. Felled trees in the southeast	Property directly northwest expanded in size. Kidbys Nurseries replaced by residential dwellings off new road (Kidby Way).

4 ENVIRONMENTAL SETTING

4.1 General

4.1.1 Notes describing how the site's environmental setting have been assessed and are included in Appendix A to this report. Reference has been made to publicly available Government held digital data via QGIS (an Open Source Geographic Information System). Extracts from the response received from Landmark 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 224/242) 1:10,000 BGS map (Sheet TM12SE) BGS Borehole (Ref: TM12SE 16 & 21)	Drift soils –Cover loam mapped at 1:50,000 (variable pebbly sandy clay) with Brickearth (silty clay) mapped at 1:10,000 scale Solid (bedrock) –Thames Group (silty clay) Strata dip –Not mapped Faults –None
Mining	Coal Authority	This site is located beyond the Coal Authority's defined coalfields
Quarrying	Historical OS plans	No quarries shown within 250m
Landfills	Envirocheck	No known landfills within 250m
Radon	UK Health Security Agency	The site lies in an area where less than 1% of homes are estimated to be above the action level
Hydrogeology	Environment Agency electronic open data via QGIS Envirocheck	Groundwater Source Protection Zone - No Aquifer –Unknown (Drift); Unproductive Strata (Solid) Groundwater abstractions - None of significance Soil leaching potential - Low Pollution incidents –Category 3 (minor) incident 315m southwest with diesel entering a tributary of Holland Brook
Hydrology		Nearest watercourses –Unnamed drain c. 380m southeast flowing southeast Water quality –Site located within Holland Brook catchment area currently rated as ecologically moderate and chemically failing Pollution incidents –None of significance Abstractions –1 related to the former Kidbys nurseries 185m northwest (likely decommissioned) with a further 4 related with Botany Farm between 370m and 480m northeast and southwest Discharge consents –None of significance
Flood risk		The site lies in Flood Zone 1, where the risk of flooding from rivers or the sea is classified as low

4.2 Geology

4.2.1 BGS borehole records are available for a number of exploratory holes located around 4500m southwest of the site, with two of these summarised in the table below and copies included in Appendix E.

BGS Borehole (m away)	Ground conditions encountered	Remarks
TM12SE 16 (c. 430m)	Topsoil to 0.5m Firm slightly gravelly very silty Clay to 1.6m Silty Sand with occasional clay pockets to 3.4m	Trial pit log
TM12SE 20 (c. 460m)	Topsoil to 0.3m Slightly gravelly, clayey Sand with occasional rootlets to 1.4m Slightly clayey, silty Sand with occasional clay pockets to 6.0m Firm to Stiff very silty Clay with silt partings and black organic material to 10m Stiff to very stiff indistinctly laminated fissured very silty Clay to 12m	Advanced by cable percussion drilling

4.3 Ground stability

4.3.1 Given the underlying natural strata (cover sands and Thames Group), it was considered prudent to obtain a Mining and Ground stability report in order to check whether or not the underlying soils or associated extractive processes pose a potential geotechnical hazard.

4.3.2 The Mining and Ground Stability report (copy included in Appendix E) provides an indication of the potential for natural ground instability to occur within, and within 50m, of a site. It is auto-generated from BGS's GeoSure dataset. The Report assigns hazard levels for shrink-swell (clays), landslides (slope instability), soluble rocks (dissolution), compressible ground, collapsible deposits and running sand, but it does not include mining related subsidence. Hazards are graded on a scale from very low to high.

4.3.3 The report also includes records of mining and natural cavities as well as historical land uses which are potentially related to extractive industries or potentially pose a ground stability issue.

4.3.4 The Mining and Ground stability report states that there is:

No potential for compressible ground stability hazards;
Low potential for collapsible ground stability hazards;
Very Low potential for landslide ground stability hazards;
No potential for ground dissolution stability hazards;
Very Low potential for running sand ground stability hazards; and
Moderate potential for shrinking/swelling clay ground stability hazards.

4.3.5 The report indicates the site lies within an area where there is a 'Moderate' risk relating to the 'Shrink-Swell' of cohesive soils. This issue is discussed in further detail in Section 14.3, where the results of testing to determine plasticity index are considered.

4.3.6 The report also includes reference to two records of extractive industries/potential excavations in close proximity to the site. A well is recorded 45m southwest with a pond 65m north, neither of which are considered to pose a significant risk to ground stability.

5 PRELIMINARY CONCEPTUAL SITE MODEL

5.1.1 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:

Inorganics (metals in topsoil and associated with made ground)
Asbestos &/or ACMs within the made ground associated with the existing buildings etc
PAHs (associated with made ground)

5.1.2 A preliminary conceptual site model, presented as Drawing 4762/5 in Appendix B, has been prepared after consideration of all the data presented in Sections 2 to 4. inclusive of this report.

5.1.3 The site has not undergone significant changes throughout its history, only seeing the addition of a residential dwelling and outbuildings. Given this history, no significant soil contamination is anticipated within residential garden areas.

5.1.4 Potential contaminant linkages are shown on the preliminary conceptual site model.

5.1.5 The conceptual model will likely be subject to modification in light of data arising from the proposed intrusive ground investigation; see Section 11.2.

6 GROUND INVESTIGATION DESIGN

6.1 Anticipated ground conditions & potential issues

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

Anticipated condition	Remarks
Made ground	Anticipated around the footprint of the house and any auxiliary buildings and hardstand/ driveways to shallow depths.
Natural soils	Drift soils of variable nature (clay, silt, sand) overlying residual soils.
Bedrock	Thames Group (clay) at depth.
Groundwater	Groundwater likely at depth in bedrock, with localised pocket in drift deposits.

6.1.2 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. Reworked topsoil (inorganics, organics) 2. Former/ current buildings 3. Made ground	1. Associated with residential and small holding use 2. Asbestos &\or ACMs 3. Inorganic and organic contamination
Potential off-site contamination sources	1. None	
Potential geotechnical hazards	1. Deep made ground / buried obstructions 2. Shrinkable soils	1. Associated with existing buildings 2. Clays which may shrink/swell with changes in moisture
Other potential constraints	1. Pond 2. Residential dwelling and outbuildings 3. Underground and overhead utilities	1. Requires backfilling prior to redevelopment 2. Post demolition investigation required 3. Serving existing house

6.2 Ground investigation design & strategy

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

Exploratory holes	Purpose
6 Trial Pits	To determine the general nature of soils underlying the site, including the: Nature, distribution and thickness of shallow soils, including any made ground Suitability of the ground for founding structures and road/car parking
Within 3 Trial Pits	To determine whether soakaways could be utilised for storm water drainage

6.2.2 Proposed exploratory hole locations were selected to provide a representative view of the strata beneath the site. A nominal 40m grid spacing was proposed, however due to the current use and condition of the site exploratory holes will be placed in accessible locations. Additional exploratory locations might be scheduled by the site engineer in light of the ground conditions actually encountered.

6.2.3 The number of representative samples taken will be reflective of the geological complexity actually encountered. However, in general about 3 samples will be taken from most trial pits.

7 FIELDWORK

7.1 Objectives

7.1.1 The original investigation strategy is outlined in Section 6.2 above.

7.1.2 The additional exploratory holes listed below were advanced in light of ground conditions actually encountered.

Exploratory holes	Purpose
Hand excavated pits (HPs 01 to 05)	To obtain additional topsoil samples from areas with restricted access

7.2 Exploratory hole location constraints

7.2.1 No access was available in the north and southwest due to the presence of existing buildings (house and annex) and livestock shelters respectively.

7.3 Scope of works

7.3.1 Fieldwork was supervised by Lithos between 3rd & 5th July 2023 and comprised the exploratory holes listed below.

Technique	Exploratory holes	Final depth(s)	Remarks
Trial pitting (machine dug)	TPs 01 to 06	2.1m to 2.8m	Vane tests in cohesive soils Soakaway testing undertaken in TPs 01 to 03
Trial pitting (hand dug)	HPs 01 to 05	0.1m	To obtain topsoil samples

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

7.3.3 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

7.3.4 Exploratory hole locations are shown on Drawing 4762/6 presented in Appendix B; trial pit positions are based on data from a hand-held GPS (typically +/- 3m accuracy) and have not been surveyed in.

8 GROUND CONDITIONS

8.1 General

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

8.1.2 Typical ground conditions encountered at the site are described below in Sections 8.2 (made ground) and 8.4 (natural ground), with a summary provided in the table on page 9.

8.2 Made ground

8.2.1 Made Ground was only encountered in TP01 in the north comprising **Made Ground Topsoil** to 0.2m depth. This contained a significant proportion of anthropogenic materials including gravel of brick, concrete and glass.

8.2.2 Although no significant made ground has been encountered to date, it is considered likely that a veneer of made ground will be present in the vicinity of the existing buildings in the north and southwest.

8.2.3 Whilst not encountered during this investigation, the possibility of 'burial pits' and/or fragments of asbestos sheeting within the hardcore beneath concrete, cannot be entirely discounted.

8.3 Obstructions

8.3.1 It is apparent from a review of historical OS Plans (see Section 3) and the site visit that buildings have been present on approximately 5% of the total site area. Drawing 4762/3 shows the footprints of the existing structures.

8.3.2 Constraints associated with existing buildings, ongoing use and underground utilities have prevented trenching to identify and assess the nature/extent of buried obstructions. However, the existing buildings will have foundations (likely strips), and other below ground structures should be anticipated.

8.4 Natural ground

8.4.1 Natural ground was encountered in the majority of the exploratory holes, and typically comprised:

Topsoil: clay was identified across the site to a typical depth of 0.2m.

Cohesive Drift: typically comprising firm to stiff, slightly sandy/gravelly Clay encountered across the site to between 1.0m and 1.9m depth (average 1.5m)

Granular Drift: encountered beneath the Cohesive Drift as clayey/silty Sand typically to beyond the base of each trial pit.

Ground conditions summary table

Hole	Final depth (m)	Depth to Base of Made Ground (m)	Depth to Base of (m)					Depth to Groundwater (m)
			Made Ground	Natural Soils				
			Made Ground Topsoil	Topsoil	Cohesive Drift	Granular Drift	Cohesive Drift	
TP01	2.1	0.2	0.2	-	1.0	>2.1	-	-
TP02	2.2	-	-	0.2	1.8	>2.2	-	2.2
TP03	2.4	-	-	0.2	1.9	>2.4	-	2.3
TP04	2.5	-	-	0.2	1.2	2.10	>2.5	-
TP05	2.6	-	-	0.2	1.6	>2.6	-	2.5
TP06	2.8	-	-	0.2	1.4	>2.8	-	2.2

8.5 Visual & olfactory evidence of organic contamination

8.5.1 No evidence of significant organic contamination was noted, a fragment of suspected asbestos containing material (ACM) was noted in the topsoil within TP05.

8.5.2 Selected samples of potentially contaminated materials were scheduled for chemical testing to confirm the suitability of existing topsoil for re-use; see Section 10.

8.6 Groundwater & stability

8.6.1 Groundwater seepages/inflows, locally with running sands, were encountered in the majority of trial pits at between 2.2m and 2.5m depth (average 2.3m).

8.6.2 Groundwater was noted to rise approximately 50mm in two of the soakaway test pits (TPs 02 & 03) after significant rainfall overnight on 4th July. This suggests a fairly rapid recharge rate following rainfall events.

8.6.3 Stability of shallow excavations within cohesive soils was generally good. However, collapse of trial pit walls occurred in a number of pits in the deeper granular soils, typically where running sand was encountered.

8.7 Revised conceptual ground model (ground conditions)

8.7.1 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
- The strength, nature and depth of underlying natural strata
- The nature and distribution of contamination (based on visual/olfactory evidence only)

8.7.2 Further refinement of the Conceptual Site Model is presented in Sections 11.2, where the results of laboratory testing for contaminants have been considered.

9 SOAKAWAY TEST RESULTS

9.1 UK guidance

9.1.1 General notes about soakaways, including their location, design, and Lithos' test methodology are presented in Appendix A.

9.1.2 CIRIA C753[1] recommends that soakaways should not be constructed 'in ground where the water table reaches a level within 1m below the base of the soakaway at any time of the year'.

9.1.3 BRE Digest 365[2] "Soakaway Design" advises that each soakaway pit should be filled and allowed to drain three times to near empty on the same or consecutive days.

9.2 Field tests

9.2.1 Soakaway tests were carried out in general accordance with BRE Digest 365 "Soakaway Design". The locations of the soakaways are shown on Drawing 4762/6 presented in Appendix B to this report.

9.2.2 Infiltration rates for each soakaway test have been calculated (where possible) in accordance with BRE Digest 365. This design takes into account time for the water level to fall from 75% to 25% of its effective depth. The effective depth is the difference between the starting water level and the soakaway pit base depth.

9.2.3 Water levels in a number of tests plateaued above the 25% effective depth and therefore it was not possible to extrapolate the data to calculate an infiltration rate. Consequently, these are considered to be unsuccessful tests.

9.2.4 Where the water level did not quite reach the 25% effective depth, the data has been extrapolated in order to derive a representative infiltration rate; this was the case for the test 2 in TP01.

9.2.5 Three filling cycles were undertaken in TP01, but relatively slow drainage meant that only two filling cycles were possible in TPs 02 & 03.

9.2.6 Calculated infiltration rates for each test are summarised in the table below, and copies of the associated calculations are presented in Appendix G to this report.

Hole	Test	Stratum	Infiltration rate (m/s)	Remarks
TP01	1	Cohesive Drift (0.5m to 1.0m) and Granular Drift (1.0m to 2.1m)	1.20×10^{-6}	
	2		1.75×10^{-6}	Results extrapolated
	3		1.07×10^{-6}	
TP02	1	Cohesive Drift (0.5m to 1.8m) and Granular Drift (1.8m to 2.2m)	7.59×10^{-7}	
	2		N/A	Test plateaued at c. 28% full
TP03	1	Cohesive Drift (0.5m to 1.9m) and Granular Drift (1.9m to 2.4m)	N/A	Test plateaued at c. 35% full
	2		N/A	Test plateaued at c. 38% full rising to 41% full after heavy rainfall

9.3 Discussion & conclusions

9.3.1 Drainage Engineers could use the infiltration rates reported above to determine the feasibility of soakaways as a solution for the discharge of surface water run-off. However, regard must be made to seasonal groundwater levels; UK guidance indicates that the seasonally high groundwater table must be at least 1m below the base the soakaway.

[1] *CIRIA C753. The SuDS Manual (2015).*
[2] *BRE Digest 365. Soakaway Design (1991).*

9.3.2 Groundwater was encountered in a number of trial pits at between 2.2m and 2.5m depth (average 2.3m). During monitoring of the soakaway tests, heavy rainfall occurred overnight on 4th July which resulted in groundwater levels rising by c. 50mm (based on level of plateau in the TPs 02 & 03).

9.3.3 Soakaways are generally only considered to provide a satisfactory solution for the disposal of surface water where the vast majority of tests yield reasonable infiltration rates, which is not the case at this site.

9.3.4 Consequently, soakaways are unlikely to provide a suitable drainage solution and there may be a need for surface water balancing.

9.3.5 Drainage solutions are discussed further in Section 14.7.

9.3.6 If LNT's appointed drainage designer considers soakaways to be a viable option for surface water disposal, consideration should be given to the installation of groundwater wells to depths of around 6m in 3 boreholes, and subsequent groundwater level monitoring over about 12 months.

10 CONTAMINATION (ANALYSIS)

10.1 General

10.1.1 The site is currently occupied by a residential dwelling with associated outbuildings and gardens which is likely to have given rise to some ground contamination.

10.1.2 However, given constraints associated with current use, no investigation has been undertaken in the north and southwest where buildings are present. Sampling of the topsoil in the garden areas has been undertaken to confirm its suitability for re-use.

10.1.3 An assessment of potential contaminants associated with the former uses has been undertaken; see Section 5.

10.1.4 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 SGVs, but amended, where appropriate, to be more specific to redevelopment within the planning process.

10.1.5 Where available, Category 4 Screening Levels (C4SL) have also been referenced.

10.1.6 The site is intended to be redeveloped as a care home, which will include landscaped areas, but no formal private gardens. Lithos Scenario C generic screening values have been adopted for the assessment of material for potential retention and reuse on site. Scenario C assumes ground floor apartments for indoor inhalation (smaller footprint (individual apartments) than a private house), with a reduced outdoor exposure and duration (when compared to a private garden), and no allowance for home grown produce.

10.1.7 The critical receptor is still a 0 –6yr old female child, since it is not unreasonable to assume residents could have young children visiting, who could reasonably spend time in the outdoor space. Using a child as the receptor provides a conservative assessment.

10.1.8 Whilst some residents may enjoy working in the landscaped areas, this is unlikely to be representative of all residents and exposure in Scenario C should be sufficiently precautionary to account for this.

10.1.9 There is also a low possibility that residents may opt to start a shared 'allotment' style garden. However, the current layout does not allow for this and previous experience of such schemes suggests these usually adopt raised planters to aid access. Such a scheme would require import of subsoil and topsoil, which is beyond the scope of this assessment.

10.1.10 Generic Note 04 in Appendix A provides further details with respect to current guidance and the interpretation of analytical data.

10.2 Testing scheduled

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

Type of sample	No. of samples	Determinands
Made Ground Topsoil	2	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc) & Asbestos ID TOC & Speciated Polycyclic Aromatic Hydrocarbons (PAH)
Topsoil	10	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc) & Asbestos ID TOC & Speciated Polycyclic Aromatic Hydrocarbons (PAH)
	3	Clay/sand/silt content and visible contaminants, sharps (glass etc) to check compliance with BS3882:2015
Natural soil	3	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc) & Asbestos ID TOC, Speciated Polycyclic Aromatic Hydrocarbons (PAH), Banded Total Petroleum Hydrocarbons (TPH) Inert WAC

10.3 Waste Acceptance Criteria (WAC)

10.3.1 Lithos typically only include WAC analysis during a site investigation if significant off-site disposal (of soil likely to be classified as hazardous waste) is anticipated and the 'source' area (e.g. a proposed basement) is known. Furthermore, WAC analysis is typically more appropriate following excavation and stockpiling of surplus soils (cf in-situ soils), because the samples taken will be more representative of the material to be exported.

10.3.2 However, LNT have requested WAC analysis on in-situ soils as part of this site investigation because constraints associated with the site's small size mean that temporary stockpiling will not be possible. Therefore, the majority of excavated soils will be directly exported from site.

10.3.3 Lithos have scheduled 3 samples of natural ground for an analysis suite to allow formal waste classification to be undertaken and for WAC analysis. The results are included in Appendix H. This data will be required if the material is to be deposited in a landfill.

10.3.4 Further advice regarding waste classification is provided in Section 11.7.

10.4 Soil contamination results

10.4.1 The soil contamination test results are summarised in the tables on pages 13 & 14.

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

Summary of degree of soils contamination (inorganics)

Expl Hole	Depth (m)	Material	Concentrations in mg/kg unless otherwise stated. Results are quoted to 1 decimal place if <10, and whole numbers if >1 Trigger Level Concentrations are shown in BLUE and assume a **residential apartment with landscaped areas** end-use.											
			pH	As ∞	B~	Cd ∞	Cr x	Cu♣$	Pb ∞	Hg*	Ni	Se	Vn	Zn$	Asbestos
				40	5	149	4000	100	314	244	123	596	586	200	
TP01	0.1	Made Ground Topsoil	7.0	12	1.3	0.9	15	28	110	0.1	15	< 0.5	32	**460**	N.D.
TP01	0.2	Made Ground Topsoil	7.1	11	1.3	0.9	17	28	120	0.1	15	< 0.5	32	**490**	N.D.
TP02	0.1	Topsoil	6.0	9.1	0.6	0.4	17	21	84	0.1	11	< 0.5	33	190	N.D.
TP03	0.1	Topsoil	5.6	8.3	1.0	0.2	17	12	36	0.1	10	< 0.5	34	76	N.D.
TP04	0.1	Topsoil	5.7	7.7	1.1	0.2	16	18	47	0.1	9.7	< 0.5	31	66	N.D.
TP05	0.1	Topsoil	5.8	8.1	0.7	0.2	17	17	49	0.2	10	< 0.5	32	110	**Chrysotile present**
TP06	0.1	Topsoil	5.8	7.1	0.4	0.2	16	14	62	0.5	10	< 0.5	32	82	N.D.
HP01	0.1	Topsoil	5.7	7.5	0.5	0.4	18	20	43	0.1	12	< 0.5	32	180	N.D.
HP02	0.1	Topsoil	5.8	7.4	0.6	0.2	16	18	54	0.1	9.7	< 0.5	33	69	N.D.
HP03	0.1	Topsoil	6.5	7.3	0.6	0.2	14	18	74	0.1	10	< 0.5	28	83	N.D.
HP04	0.1	Topsoil	6.9	6.8	2.0	0.9	16	38	130	0.1	11	< 0.5	29	170	N.D.
HP05	0.1	Topsoil	5.2	6.5	1.1	0.1	14	14	38	0.1	8.1	< 0.5	29	52	N.D.
TP02	0.5	Cohesive Drift	6.6	9.7	0.6	< 0.1	24	14	22	< 0.1	13	< 0.5	43	53	N.D.
TP06	0.8	Cohesive Drift	7.5	12	0.4	0.1	29	23	15	< 0.1	32	< 0.5	59	45	N.D.
TP05	1.6	Granular Drift	6.3	7.8	< 0.2	< 0.1	14	7.2	5.1	< 0.1	13	< 0.5	29	18	N.D.

Key	
36	Parameter tested for and found to be in excess of Tier 1 value.
179	Parameter tested for and found to be > 5 x Tier 1 value.
12	Parameter tested for but not found to be in excess of Tier 1 value.
-	Parameter not tested for.
♣	Tier 1 Value is pH dependent.
x	Assumes Cr is CrIII. If demonstrated Cr is CrVI Tier 1 would be 21mg/kg.
N.D.	No fibres detected (asbestos screen)

Source of guidance trigger level	
With the exception of those annotated with one of the symbols below (∞, $, ~), all Soil Screening Values in brackets above have been derived using CLEA v1.071.	
∞	Category 4 Screening Level –SP1010, December 2013 (CL:AIRE/Defra).
$	MAFF. Code of Practice for Agricultural Practice for the Protection of Soil, 1998.
~	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.
*	Assumes mercury present as an inorganic compound (cf elemental metal or within organic compound). See Science Report SC050021/Mercury SGV.

Summary of degree of soils contamination (organics)

Expl Hole	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 BLUE and assume a **residential apartment with landscaped areas** end use					
				PAH		TPH - C6 to C40		
			% TOC	B(a)P ∞	Naphthalene	GRO~ C_6 to C_{10}	DRO◊ C_{10} to C_{21}	LRO C_{21} to C_{40}
				5	1	6	37	3829
TP01	0.1	Made Ground Topsoil	4.1	1.3	0.1	-	-	-
TP01	0.2	Made Ground Topsoil	2.9	0.1	< 0.1	-	-	-
TP02	0.1	Topsoil	2.5	0.8	< 0.1	-	-	-
TP03	0.1	Topsoil	2.4	< 0.1	< 0.1	-	-	-
TP04	0.1	Topsoil	2.7	0.1	< 0.1	-	-	-
TP05	0.1	Topsoil	2.3	0.3	< 0.1	-	-	-
TP06	0.1	Topsoil	2.1	0.1	< 0.1	-	-	-
HP01	0.1	Topsoil	3.1	0.2	< 0.1	-	-	-
HP02	0.1	Topsoil	2.6	0.4	< 0.1	-	-	-
HP03	0.1	Topsoil	2.6	0.4	< 0.1	-	-	-
HP04	0.1	Topsoil	6.2	0.1	< 0.1	-	-	-
HP05	0.1	Topsoil	6.1	0.1	< 0.1	-	-	-
TP02	0.5	Cohesive Drift	0.7	< 0.1	< 0.1	< 0.1	< 10	< 10
TP06	0.8	Cohesive Drift	< 0.5	< 0.1	< 0.1	< 0.1	< 10	< 10
TP05	1.6	Granular Drift	< 0.5	< 0.1	< 0.1	< 0.1	< 10	< 10

Key		Source of guidance trigger level	
60	Parameter tested for and in excess of Tier 1 concentration.	All Soil Screening Values in brackets above have been derived using CLEA v1.071. Values assume contaminants located in a sandy loam, with 6% soil organic matter (SOM).	
0.3	Parameter tested for but not in excess of Tier 1 concentration.	~	Assumes all GRO is aromatic fraction C7 to C8.
-	Contaminant not tested for.	◊	Assumes all DRO is aliphatic fraction C10 to C12.
		∞	Category 4 Screening Level –SP1010, December 2013 (CL:AIRE/Defra).

Inorganic determinands

10.4.3 Of the 15 samples of Topsoil and natural ground analysed for inorganic parameters, 13 can be classified as uncontaminated and 2 could be classified as contaminated.

10.4.4 These samples have been classified by comparison with Tier 1 Soil Screening Values for an end use assuming ground floor apartments with outdoor landscaped space and no formal private gardens.

10.4.5 Both samples of Made Ground Topsoil tested yielded elevated concentrations of zinc.

10.4.6 Zinc is a phytotoxic metal; phytotoxicity describes the inhibitive and toxic effect high concentrations of some substances can have on plant growth.

10.4.7 Most substances are harmful to human health at lower concentrations than would be detrimental to plant growth. However, there are three notable exceptions - boron, copper and zinc. Plants are the more sensitive receptor to these elements i.e. detrimental effects are seen in plants at concentrations which do not present a risk to human health. Consequently, for zinc, consideration and protection of flora would also be protective of human health.

10.4.8 Allowable concentrations of heavy metals in arable soils are set out in Defra's Code of Good Agricultural Practice 2009[3]. The value for zinc is 200mg/kg, and is based on a continued annual application of heavy metal rich fertiliser (sludge); as such it is not representative of activity in a standard UK garden and highly precautionary.

10.4.9 Lithos have also derived a value for zinc in relation to risks to human health, using the CLEA model, assuming a residential end use with consumption of home grown produce in a sandy loam soil with 6% SOM. The reported value is 2,170mg/kg, ten times greater than the potential phytotoxic concentration.

10.4.10 On balance, given the context of a residential apartment development and the relatively low concentrations recorded, zinc is not considered significant and no special remedial measures are considered necessary.

10.4.11 Current UK guidance regarding the statistical analysis of soil contamination data obtained during a site investigation is provided by CL:AIRE[4], and uses two-way confidence intervals and graphical summaries, to assist assessors when determining whether or not a dataset is adequate to answer the question posed; e.g. "is existing site topsoil suitable for retention & re-use?". To answer such a question, it is necessary to recover and test a large number of samples (a minimum of 10; ideally 20+) in order to undertake meaningful statistical analysis.

10.4.12 However, in the context of site investigation to assess the significance of contamination on brownfield sites which are typically underlain by heterogenous made ground, some remediation is almost always required (placement of soil cover, excavation of gross contamination etc). Consequently, in such circumstances, it is not usually necessary to demonstrate that made ground soils are "clean" and therefore there is no need to test large numbers of samples and undertake statistical analysis. Heterogenous made ground sample results can simply be compared directly with appropriate screening values (e.g. Lithos Tier 1 va lues).

10.4.13 The difference between the old and new approaches, including how Lithos apply the statistical assessment is detailed in Generic Note 04, included as Appendix A to this report.

[3] *Defra – Protecting our Water, Soil & Air – A Code of Good Agricultural Practice for farmers, growers and land managers. 2009*
[4] *CL:AIRE, 2020.Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration.*

10.4.14 Lithos can confirm that statistical assessment of the Made Ground Topsoil and drift soils is not appropriate because:

Made Ground is considered too heterogenous
There are insufficient samples from each strata to allow representative statistical assessment to be undertaken.

10.4.15 However, Lithos can confirm that statistical assessment of the Topsoil is appropriate because:

There is a well understood, robust CSM which identifies possible source areas
Sampling locations are relatively evenly spread across the site and only random sample data has been included in the assessment
A minimum of 10 samples have been taken from each strata

10.4.16 Statistical analysis assumes that a given stratum is reasonably homogenous in terms of composition, the distribution of contaminants and the degree of contamination; the CSM indicates that this is a reasonable assumption at this site.

10.4.17 The Dot and Box Plots are presented in Appendix H and the results are summarised below.

Natural Ground - Topsoil

Contaminant	Critical concentration	Mean	Upper confidence level (95%)	Lower confidence level (5%)	Range of 'true' mean	Mean lies above critical concentration (Y/N)
Arsenic	40.0	7.6	8.1	7.1	7.1 to 8.1	N
Lead	314.0	57.1	77.5	39.4	39.4 to 77.5	N
Benzo(a)pyrene	5.0	0.2	0.4	0.1	0.1 to 0.4	N

All concentrations are in mg/kg

10.4.18 Statistical analysis indicates that the true mean for all determinands in Topsoil are not elevated compared with relevant Lithos tier 1 screening values.

Asbestos

10.4.19 A broken fragment of suspected asbestos-cement sheeting was noted in the Topsoil in TP05.

10.4.20 Screening for asbestos identified fibres in a single sample of Topsoil (TP05) which also confirmed the fragment of cement sheeting contained asbestos. Subsequently, asbestos quantification was undertaken by the laboratory which yielded a total mass % asbestos of 0.201%, although the fragment of cement sheet accounted for 0.200% of this total.

Organic determinands

10.4.21 The Tier 1 Soil Screening Values for organic determinands used in this report have been derived with reference to a CSM that assumes a residential apartment with landscaped areas (Lithos Scenario C).

10.4.22 Lithos have used the CLEA model to derive risk-based screening values for hydrocarbons, in accordance with the methodology detailed by the TPHCWG, and reviewed by a UK workshop of experts with respect to UK adoption of the method.

10.4.23 However, these screening values assume a Soil Organic Matter (SOM) of 6% (equivalent to a TOC of 3.5%). Many organic contaminants are more mobile when the SOM is lower, and consequently comparison of soil results with lower screening values may be required.

10.4.24 In order to check the validity of Lithos' Tier 1 Soil Screening Values, the average TOC for each common fill type (beyond any areas of obvious hydrocarbon impact) have been determined.

Fill type	Typical TOC (%)	Comparison of soil results with revised screening value necessary?
Made Ground Topsoil	3.5	No.
Topsoil	3.3	
Drift soil	<0.5	Yes, but no significant organic contamination was recorded in this soil type. All determinands well below "6%" screening value; most below limit of detection.

Hydrocarbons (TPH & PAH)

10.4.25 Given the likely need for off-site disposal of natural ground arising (e.g. from foundation excavations), a simple banded TPH (cf full speciation) was initially scheduled on 3 samples of the drift soils.

10.4.26 Assessment of TPH associated with a fuel/oil source would normally be undertaken in accordance with a 3-step approach, (outlined in Generic Note 04 in Appendix A) on fully speciated TPH results. However, although only banded TPH analysis has been scheduled here, none of the fractions exceed their respective Tier 1 criteria, even if it is conservatively assumed all of each fraction is either aliphatic or aromatic.

10.4.27 Consequently, no significant petroleum hydrocarbon concentrations have been identified, and there is no risk to human health from these hydrocarbons.

Polycyclic Aromatic Hydrocarbons (PAH)

10.4.28 There are numerous PAH compounds. The USEPA identified 16 PAHs that are considered to represent the most problematic in terms of toxicology, fate and behaviour. The UK have also focused on these 16 and these are included in the laboratory report where speciated PAH analysis has been scheduled.

10.4.29 Speciated PAH analysis has been undertaken in order to determine concentrations of the key "marker" compounds: benzo(a)pyrene (considered the most toxic of the PAHs); and naphthalene (the most mobile and volatile of the PAHs).

10.4.30 Speciated analysis has confirmed the absence of significant concentrations of both benzo(a)pyrene and naphthalene in the soils beneath this site.

10.5 Topsoil

BS3882 Topsoil testing

10.5.1 The presence of visible contaminants, sharps (glass etc) was assessed by the Engineer in the field (inspection of initial trial pit arisings); none were identified beyond TP01. BS3882 considers visual contaminants to comprise 'undesirable potentially injurious foreign object(s) visible to the naked eye'.

10.5.2 The clay/sand/silt content of 3 topsoil samples have been determined to check compliance with BS3882[5] requirements.

10.5.3 It should be noted that this is a reduced suite of analysis, and no N-P-K etc. testing has been undertaken.

[5] *BS3882:2015. Specification for topsoil. Published by BSI Standards Limited.*

10.5.4 The results are summarised below:

Parameter	BS3882 Specification	TP02, 0.15m	TP03, 0.15m	TP05, 0.15m
Retained on 2mm sieve	< 30%	3	4	3
Retained on 20mm sieve	< 10%	0	2	0
Retained on 50mm sieve	0%	0	0	0
Clay content	5 to 35%	27	30	29
Silt content	0 to 65%	39	45	45
Sand content	0 to 90%	31	21	23
Visible contaminants	< 0.5%	0	0	0

10.5.5 The above results suggest that the topsoil at this site complies to the standards set out in BS3882. In terms of textural classification, the topsoil falls into the 'clay loam' class.

11 CONTAMINATION (QUALITATIVE RISK ASSESSMENT & REMEDIATION)

11.1 Summary of significant contamination

11.1.1 To date, no investigation has been possible in the north or southwest and limited access was available to other areas of the site. The following Sections may require revision in light of additional testing (post-demolition).

11.1.2 Topsoil, typically 200mm thick underlies the majority of the site. No significant inorganic or organic contamination has been identified in the Topsoil to date.

11.1.3 However, asbestos-containing-material (fragment of cement sheet) was identified in TP05 resulting in a total mass percentage of 0.201% although loose asbestos fibres accounted for less than 0.001% of this value.

11.1.4 Consequently, some remedial work is required (visual inspection and hand picking of ACMs) to render the Topsoil suitable for re-use.

11.1.5 Made Ground Topsoil in the north (TP01) has been found to be essentially "clean" (i.e. it has not yielded elevated concentrations of any contaminants), but it does include "unsuitable" materials (e.g. they contain a significant proportion of brick, concrete, glass etc.)

11.1.6 Therefore, where residual made ground remains beneath garden and landscaped areas (i.e. not beneath hardstanding) a 450mm thick surface cover of "clean" soil is recommended. This thickness is in accordance with NHBC Standards, Chapter 10.2.

11.2 Revised conceptual ground model (contamination)

11.2.1 The Preliminary Conceptual Site Model has been amended in light of data obtained during the ground investigation.

11.2.2 A revised Conceptual Site Model is presented as Drawing 4762/7 in Appendix B. The Model includes the contaminants described in Section 11.1 above, and potential contaminant linkages (summarised below in Section 11.4) to receptors.

11.3 Environmental setting & end use

11.3.1 It is apparent from Section 11.1 above, that only limited contamination has been identified to date in the soils beneath this site. However, a supplementary post-demolition investigation will be required, until complete, it is assumed that made ground is present in the north of the site, beneath and adjacent to the existing buildings.

11.3.2 The underlying drift and bedrock are classified as unproductive aquifers. The nearest surface watercourse is an unnamed drain, which flows southeast, approximately 380m beyond the site's southeast boundary. Therefore, the site's environmental setting is considered to be low sensitivity.

11.3.3 With respect to human health, the proposed end use (residential) is considered sensitive.

11.3.4 Transient risks to construction workers can be addressed by the adoption of appropriate health and safety measures, see Section 15.6.

11.4 Contaminant linkages

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

Contaminants

11.4.2 Contaminants have been summarised in Section 11.1 above.

Pathways

11.4.3 Potential contaminant pathways include:

Inhalation of contaminated particulates

Receptors

11.4.4 Potential contaminant receptors include:

End users of the site (residents)

11.4.5 Based on the existing data it can be concluded that there are plausible pathways between the soil contaminants summarised in Section 11.1 above and potential receptors. Consequently, some remediation will be required; either treatment/removal of the contaminant, or "breakage" of the pathway.

11.4.6 Further revision of the Conceptual Site Model may be required upon completion of the post demolition site investigation.

11.5 Potential remediation options

General

11.5.1 Given the constraints discussed in Section 7.2 (existing buildings across the majority of the site), a simple post-demolition trial pit investigation will be required before definitive recommendations are provided. However, at this stage it is considered unlikely that anything more than hand-pick of ACMs and placement of soil cover in garden areas will be required.

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

Asbestos

11.5.3 CL:AIRE has published a Joint Industry Working Group (JIWG) guidance[6] document with the support of the Health & Safety Executive which provides an explanation of how legal requirements of the Control of Asbestos Regulations 2012 have been interpreted to be more directly applicable to the risks associated with asbestos contaminated soil and construction & demolition materials.

11.5.4 Samples of soil and/or construction & demolition material recovered from brownfield sites may exhibit a wide range of concentrations of asbestos contamination. Due consideration should therefore be given to the interpretation of any 'trace' concentrations in the wider context of the site. Guidance prepared by the JIWG asbestos suggests that judgements on the nature, degree and significance of contamination present should not be made on the basis of individual samples alone.

11.5.5 As discussed in Section 10.2, an asbestos ID (screen) was scheduled on 12 samples of made ground/Topsoil, with fibres and ACMs identified in a single sample of Topsoil (TP05). Supplementary analysis (asbestos quantification) yielded a result of 0.201%, with the ACM accounting for 0.2% of this. Quantification indicates the asbestos fibres are below the limit of measurement (<0.001%).

11.5.6 Nonetheless, made ground soils with only a trace of asbestos still have the potential to be hazardous to human health. This is because soil with a low asbestos content of say 0.001% may contain thousands, possibly hundreds of thousands, of potentially respirable asbestos fibres per gram of soil. However, asbestos fibres only pose a risk if they are allowed to become airborne, and release from soil to air can only occur if the soil is dry and then agitated (e.g. by vehicle movement, excavation, wind etc).

11.5.7 Provided soils are kept damp the risk of airborne fibre release, even during disturbance associated with excavation, should be negligible, and certainly below the control limit (as set by the Control of Asbestos Regulations 2012) of 0.1 f/cm3 airborne fibres averaged over a 4-hour period.

11.5.8 In our experience, damp soils do not allow the release of asbestos fibres, even from soils that contain concentrations in excess of the hazardous waste threshold (0.1%).

11.5.9 There may be transient risks during the excavation of made ground soils. Exposure to asbestos of personnel involved in these excavation works is considered likely to be sporadic and of low intensity (provided soils are kept damp). Therefore, in accordance with Regulation 3(2) of the Control of Asbestos Regulations (2012), exemption from Regulations: 9 (notification of work with asbestos); 18(1)(a) (asbestos areas); and 22 (health records and medical surveillance) should apply, provided it is 'clear from a suitable and sufficient risk assessment that the control limit of 0.1 f/cm3 airborne fibres averaged over a 4-hour period will not be exceeded'.

11.5.10 Nonetheless, risks must be mitigated by appropriate measures (principally damping down), working procedures, and PPE. Method Statements and Risk Assessments should be prepared by the Contractor, and then be reviewed by the Client and Lithos.

11.5.11 Given the presence of confirmed ACMs in the Topsoil in the vicinity of TP05, Topsoil should be stripped under the supervision of a suitably qualified Engineer and visually inspected to check for the presence of any further ACMs.

[6] *Control of Asbestos Regulations 2012: Interpretation for Managing and Working with Asbestos in Soil and Construction & Demolition materials: Industry Guidance. CL:AIRE, 2016.*

11.5.12 Any fragments of asbestos cement sheeting encountered during the excavation works, should be gathered by hand and placed in double sealed bags. Personnel involved in this activity must be equipped with an appropriate respirator (i.e. a FFP3 or better), in addition to their "standard" PPE. The bags of asbestos waste should be placed in a sealed skip for off-site disposal at a suitably licensed landfill site; such material will be classified as hazardous waste.

11.5.13 Once stripped and stockpiled, additional samples of Topsoil should be screened for asbestos to confirm the absence of any further significant asbestos contamination.

11.5.14 It should be noted that ACMs were commonly used as shuttering beneath concrete slabs, and to form ducts, and it is important that this is kept in mind when breaking through concrete slabs.

11.5.15 Made ground where asbestos has been positively identified and considered representative of near-surface soils, should ultimately be isolated beneath hardstand (parking areas) or floor slabs (buildings) and therefore there will be no risk of release of asbestos fibres from the ground.

11.5.16 Consequently, in line with the principles of sustainable development, there should be no need to export any soil from site.

11.5.17 New utilities should be laid in trenches reinstated with 'clean' backfill in order to prevent exposure to maintenance workers in the future.

11.5.18 See also comments in the 'Waste Classification' Section below.

Inorganic contamination

11.5.19 The Made Ground Topsoil has been found to be essentially "clean" (i.e. it has not yielded elevated concentrations of any contaminants), but it does include "unsuitable" materials (e.g. they contain a significant proportion e.g. demolition rubble, colliery spoil, brick, clayware, and locally tin, rope, timber and plastic etc.). Therefore, where residual made ground remains beneath garden and landscaped areas (i.e. not beneath hardstanding) a 450mm thick surface cover of "clean" soil is recommended. This thickness is in accordance with NHBC Standards, Chapter 10.2.

Organic contamination

11.5.20 No areas of gross organic contamination were encountered during the site works. However, localised areas of more onerous contamination than that identified to date may be present on site.

11.5.21 However, given the comments made in Section 7.2 above (fieldwork constraints associated with existing use), it would be prudent to allow for the off-site disposal of some grossly contaminated soil. Further advice should be sought from a specialist contractor, with experience of brownfield remediation, regarding an appropriate contingency.

11.6 Summary of potential contaminant linkages & mitigation

11.6.1 In terms of the proposed redevelopment based on the existing data, plausible contaminant linkages, and feasible remediation options, can be summarised as follows:

Receptors	Pathways	Contaminants	Plausible contaminant linkage? (and remediation options where required)
Human health (Future residents) ◊	Inhalation (dust and/or vapours)	Asbestos-containing-materials (ACMs) in Topsoil	Yes –visual inspection during stripping and hand picking of ACMS for off-site disposal

◊ 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.

11.7 Waste classification

11.7.1 Disposal of the made ground off site is generally 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. Disposal to landfill (or an appropriate soil / aggregate transfer station) may be the most practical solution, if redistribution and retention on site is not feasible.

11.7.2 Following excavation and stockpiling, sampling will be required prior to disposal.

11.7.3 As there is no WRAP protocol for soils, the characterisation, sampling and classification of soils arising from brownfield sites has been incorporated within the Environment Agency's Technical Guidance WM3[7]. Classification of soils as non-hazardous or hazardous in accordance with WM3 is quite a complex process, although it ultimately results in a simple classification as hazardous or non-hazardous. Note: inert is not a class under WM3; WAC testing is required to determine whether a waste soil can be considered inert.

11.7.4 If waste soil is classed as hazardous following classification under WM3, and destined for landfill, waste acceptance criteria (WAC) leachate testing will need to be undertaken. Similarly, if waste soil destined for landfill is classed as non-hazardous under WM3, and suspected to be inert, WAC leachate testing will need to be undertaken. However, non-hazardous soil waste can go to a non-hazardous landfill facility; no further testing (e.g. WAC) is required.

11.7.5 WAC analysis is different to the 'routine' laboratory testing (such as that included earlier in this Section) undertaken in order to determine hazardous properties. Lithos typically only include WAC analysis if significant off-site disposal (of soil classified as hazardous waste) is anticipated.

11.7.6 It is critical if material is to be exported from site that this is allocated an appropriate waste code, following the steps within WM3. Waste carriers transporting, and sites accepting, this material should have a corresponding code within their permits. It is the responsibility of those generating the waste (i.e. the Developer), to ensure that the waste is handled and disposed of appropriately.

11.7.7 Three samples of natural soil were submitted for waste acceptance criteria (WAC) testing with test results included in Appendix H to this report.

11.7.8 It should be noted that WAC analysis is different to the 'routine' laboratory testing (such as that outlined above in Section 10). Routine testing is undertaken to determine hazardous properties; hazardous properties of a waste cannot be determined by WAC testing.

11.7.9 Lithos can carry out waste classification in accordance with WM3 based on the laboratory data included within this report. However, it should be noted that waste classification is usually undertaken once the soils destined for disposal have been stockpiled with subsequent characterisation and sampling.

[7] *Technical Guidance WM3 – Guidance on the classification and assessment of waste. Environment Agency 2015*

11.7.10 Soil treatment facilities (STFs) provide an alternative to landfill. STFs are regulated by the Environment Agency and allow soils to be treated and screened (effectively recycled to be used at other sites). Export to an STF does not require WAC testing and suitability of various soil types will be dependent on material waste codes, which may be allocated after consideration of the data in Section 11 but will often need supplementing with further testing after soils have been stockpiled (see also advice in Section 15.3).

11.7.11 Most STFs are permitted to accept soils with waste code 17 05 04 (i.e. soils which do not exhibit hazardous properties). Lithos has a list of permitted STFs and can help identify one local to this development site.

11.7.12 With respect to asbestos, waste soils will be classed hazardous if the soil mass contains more than 0.1% asbestos fibres that are free and dispersed. However, WM3 states that where the waste contains identifiable pieces of asbestos (i.e. any particle of a size that can be identified as potentially being asbestos by a competent person if examined by the naked eye), then the waste is hazardous if the concentration of asbestos in the pieces alone is 0.1%. If a stockpile of soil contained rare fragments of broken asbestos-cement sheeting, the whole stockpile would be classed as hazardous unless all the fragments could be picked-out (even though the concentration of asbestos in the soil mass might be orders of magnitude less than 0.1%).

11.7.13 Contractors exporting waste from the site should review the site investigation data and make their own assessment. Alternatively, Lithos could undertake this assessment once exported waste streams have been identified.

12 HAZARDOUS GAS

12.1 Methane & carbon dioxide

12.1.1 The site is not believed to be affected by sources of hazardous gas generation as it is:

Not located within 250m of a known former or current landfill site or backfilled feature (e.g. quarry, pond, canal etc)
Neither underlain by shallow mineworkings nor located in an area considered susceptible to mines gas emissions
Not underlain by a significant thickness of made ground
Not underlain by peat or shallow chalk deposits

12.2 Radon

12.2.1 Requirements with respect radon measures are set out in Building Regulations Approved Document C. Probability bandings (based on the proportion of properties in a given area that exceed the Action Level; currently 200 $Bq.m^{-3}$) are used to determine whether a property requires no, basic or full measures.

12.2.2 At present Approved Document C advocates basic measures for the probability banding 3% to 10% (full measures if >10%). However, the UK Health Security Agency (HSA) would like to see all new build include basic measures.

12.2.3 In December 2022, the British Geological Survey (BGS), deployed a revised dataset which increased accuracy and also the number of properties falling within radon affected areas. This revised dataset is now referenced by maps on the HSA website.

12.2.4 Information from the HSA website indicates that the site lies in an area where less than 1% of homes are estimated to be above the action level.

12.2.5 As such, no special precautions against radon are required on this site.

13 GEOTECHNICAL TESTING

13.1 General

13.1.1 A total of 13 samples of natural soil were delivered to a suitably accredited laboratory with a schedule of geotechnical testing drawn up by Lithos.

13.1.2 The geotechnical laboratory test results are presented in Appendix I to this report.

13.2 Atterberg limits

13.2.1 The plasticity indices of 12 samples of cohesive soil have been determined; results are summarised below.

Soil type	No. samples tested	Moisture content range % (average)	Range of Plasticity Indices %* (average)	Shrinkability
Cohesive Drift	10	10 to 21 (15)	12 to 28 (20)	Low to medium
Granular Drift	2	10 to 39 (25)	Non-plastic	N/A

* Modified where appropriate in accordance with Chapter 4.2 of the NHBC Standards.

Note. The term Shrinkability is equivalent to the term Volume Change Potential used in Chapter 4.2.

13.2.2 For the purposes of foundation design, it is recommended that all cohesive soils be regarded as being of medium shrinkability.

13.3 Particle size distribution

13.3.1 The grading of two samples of Granular Drift has been determined by wet sieving and the results are summarised in the table below:

Sample & depth	Field description	% passing 37.5mm sieve	% passing 20mm sieve	% passing 2mm sieve	% fines	Material description (based on grading & plasticity)
TP01, 1.2m	Very clayey SAND	100	100	100	20	Clayey SAND
TP06, 1.5m	Slightly gravelly clayey SAND	100	100	96	17	Slightly gravelly clayey SAND

13.3.2 NHBC Chapter 4.2 considers shrinkable soils to be those containing more than 35% fines and having a Modified Plasticity Index greater than 10%.

13.3.3 Fines (silt and clay) were found to comprise between 17% and 20% (average 18%) of the material sampled. Therefore, the clayey sand encountered on this site can therefore be regarded as non-shrinkable.

13.4 Soluble sulphate and pH

13.4.1 In accordance with BRE SD1[8], this site has been classified as brownfield with a mobile groundwater regime.

13.4.2 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).

13.4.3 The concentrations of sulphate in the aqueous natural soil extracts of 13 samples were determined. The pH value of each sample has also been determined.

[8] *BRE Special Digest 1 (2005) – Concrete in aggressive ground.*

13.4.4 The highest water-soluble sulphate concentration and the lowest pH value for each soil type analysed are shown in the table below.

Soil type	No. samples tested	Lowest pH values	Highest soluble sulphate concentration (mg/l)
Cohesive Drift	8	6.0	120
Granular Drift	5	7.7	88

13.4.5 pH values were all above 5.5, therefore concentrations of chloride and nitrate are considered insignificant.

13.4.6 In accordance with Tables C1 and C2 of SD1, sub-surface concrete should be Design Sulphate Class DS-1, with the site allocated an ACEC Classification of AC-2z.

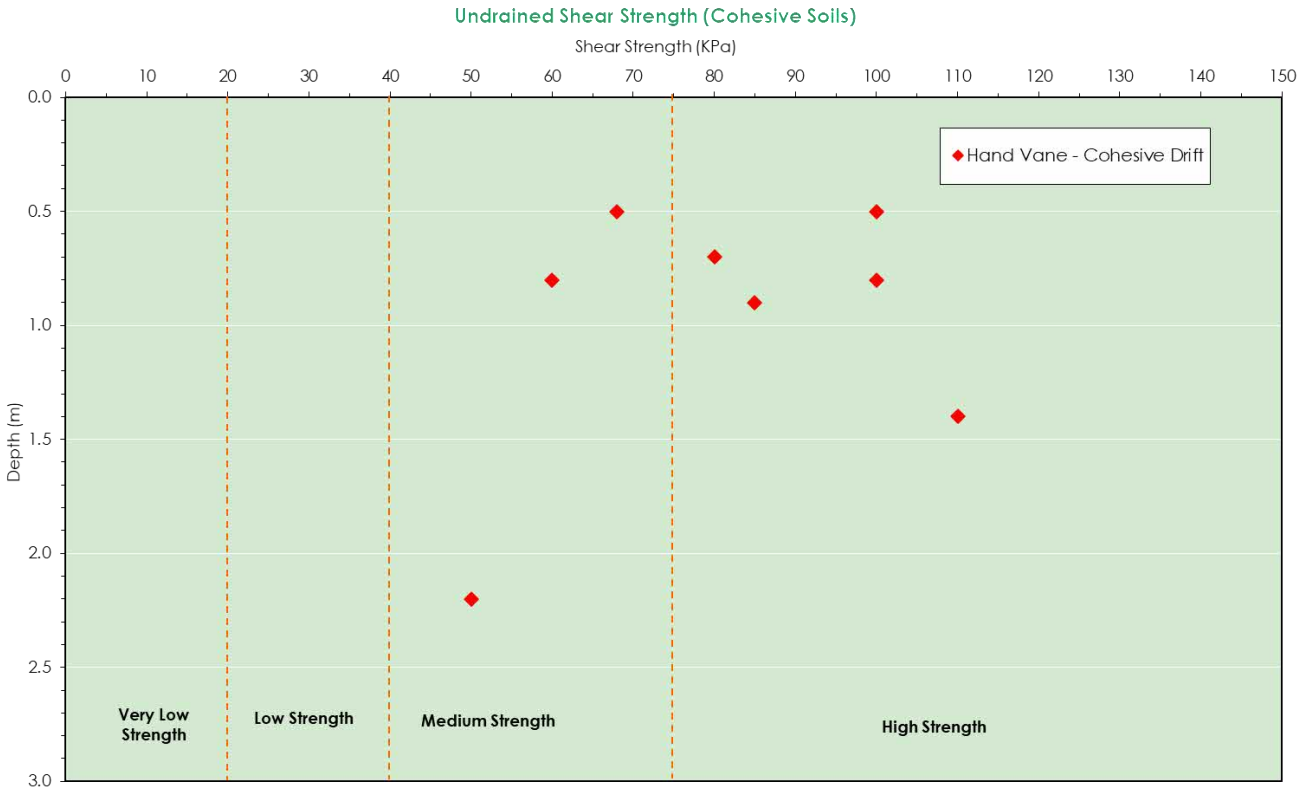
13.5 Undrained shear strength testing

Hand shear vane testing

13.5.1 Hand shear vane testing was undertaken within trial pits in-situ to around 1.2m depth and from larger blocks of excavated clay below that depth.

13.5.2 The results are summarised within the plot below which shows the undrained shear strength (Su) of the Cohesive Drift is typically greater than 55kPa.

13.5.3 The plot below provides a summary of undrained shear strengths.



14 GEOTECHNICAL ISSUES

14.1 Conceptual site model

14.1.1 No significant made ground has been encountered to date although buildings are present in the north and southwest and therefore some made ground is anticipated.

14.1.2 Natural ground comprises Cohesive Drift (firm to stiff sandy Clay) to between 1.0m an d1.9m depth (average 1.5m) underlain by Granular Drift (clayey/silty Sand) to depth. Bedrock has not been encountered during this investigation.

14.1.3 Groundwater is present in the Granular Drift at between 2.2m and 2.5m depth, which was noted to rise by c. 50mm in soakaway test pits after heavy rainfall. This suggests a fairly rapid recharge rate following rainfall events.

14.2 Mining & quarrying

14.2.1 This site is located beyond the CA's defined coalfields.

14.2.2 There are no known quarries on, or within 50m of the site.

14.3 Foundation recommendations

General

14.3.1 It is understood that consideration is being given to redevelopment of the site with a two storey care home with landscaped areas and car parking. A site layout has been provided by LNT (Drawing reference CO16 9EP –F.01, dated 30 03 2023) which is reproduced as Drawing 4762/2 in Appendix B to this report.

14.3.2 The current layout suggests the proposed care home building conflicts with an existing pond which may have significant implications for foundation abnormals and the recommendations provided below. It would be considered prudent ascertain the depth of the pond at the earliest opportunity and consider revising the layout to avoid building over the pond.

14.3.3 At the time of writing exact line loads for the proposed care home are not known. Meaningful foundation recommendations require details of anticipated line loads and floor loadings, together with tolerable settlements. However, preliminary recommendations are given below.

14.3.4 Foundation recommendations assume that development will be two or three storey construction and that line loads will not exceed 115kN/m run. If this is not the case significant alteration to these recommendations will be required.

14.3.5 Further investigation should be commissioned if any higher line loads are proposed. Such investigation would include cable percussion boreholes and geotechnical analysis (triaxial and oedometer testing) of recovered, undisturbed samples.

14.3.6 We have 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 LNT should consider implications for the foundation recommendations outlined below.

14.3.7 Foundation excavations should be kept as shallow as possible (where sufficient bearing capacity can be achieved) to minimise issues surrounding constructability associated with groundwater inflows in deeper granular soils.

14.3.8 It would be prudent to allow flexibility in the groundworks programme to take advantage of any prolonged dry\warm weather (typically between May and September) to enable footings to be cast and blockwork brought up to DPC level well in advance of the build programme (i.e. so it is never necessary to dig deep footings in winter/early spring, when the groundwater table is likely to be higher).

14.3.9 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.

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

14.3.11 It is considered widened strip/trench-fill foundations will be most suitable for the proposed care home to be constructed on this site with further details below.

Strip/trench fill footings

14.3.12 It is considered that shallow strip or deepened trench fill footings will be the most suitable foundation solution for the care home constructed at the site. Footings will be founded in firm/stiff clay or underlying sand.

14.3.13 Reinforcement, as a precaution against differential settlement, is recommended only where foundation excavations encounter significant lateral and vertical variations in strata. One layer of B385 mesh placed 75mm above the base of the footing is likely to provide suitable reinforcement, but further advice should be sought from the Structural Engineer.

14.3.14 Where existing buildings are to be demolished, all concrete slabs and service ducts will require breaking out prior to re-development. However, relict foundations could probably be left in-situ and an allowance made for local breaking out, or (probably better) chased-out and removed during the necessary site preparatory works; see Section 15.2.

14.3.15 Foundations of plots placed over relict foundations should be taken to greater depth than the relict foundations and into natural ground of adequate bearing capacity.

14.3.16 Foundations will be required to be placed below a line drawn up at 45^{o} from the base of any service or similar excavation.

14.3.17 Deepened foundations should be stepped in accordance with NHBC Standards, Chapter 4.3.

14.3.18 In order to minimise softening and swelling of cohesive soils or loosening of granular soils, it is recommended that footings are cast as soon as formation level is reached (or alternatively formation could be blinded using concrete with as low a water:cement ratio as possible).

14.3.19 LNT 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.

Cohesive Drift (clay)

14.3.20 Atterberg tests suggest that natural cohesive soils at the site are of medium shrinkability. A minimum founding depth of 900mm (not accounting for any existing or proposed vegetation) is therefore required for all soils on the site where strip footings are proposed.

14.3.21 In accordance with NHBC Standards, founding depths in cohesive soils should be taken from original or finished ground level, whichever is the lower, to the underside of the footing.

14.3.22 Foundations should be deepened near trees in accordance with NHBC Standards Chapter 4.2. It is estimated that the majority of the site may be affected by trees.

14.3.23 The current layout suggests the care home will be built on ground from which existing trees will be removed. Consequently, it would be prudent to commission a tree survey at the earliest opportunity.

14.3.24 In theory, if mature Hawthorn is removed from within the footprint of a plot, founding depth (in medium shrinkability clay) would be >2.5m.

14.3.25 Trench fill foundations should be designed in accordance with NHBC Standards, Chapter 4.2. Heave precautions (a suitable approved compressible void former) should be used on the internal face of all external walls where the foundation is within the zone of influence of trees and greater than 1.5m deep.

14.3.26 Any trench fill foundation deeper than 2.5m will need to be designed by a Chartered Engineer.

14.3.27 It would therefore be prudent to prepare a detailed foundation schedule and seek approval from NHBC in order to determine likely foundation abnormals.

14.3.28 A safe bearing capacity of around 140kPa, allowing a maximum foundation line load of 115kN/m run, can be assumed if the following are true

A foundation length of 20m
A foundation breadth of 0.9m
A foundation thickness of 225mm
A foundation depth of 0.9m depth
An undrained shear strength of 55kPa for the firm clay (typical minimum recorded on site)

14.3.29 If a lower maximum line load is anticipated (c. 90kN/m), a safe bearing capacity of around 150kPa can be assumed for a foundation breadth of 0.6m at a depth of 0.9m.

14.3.30 Assuming the foundation geometry detailed above, 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.

Granular Drift (sand)

14.3.31 The granular soils are assumed to have a relative density of at least medium dense (in accordance with BS5930). However, it may be considered prudent to undertake some Cone Penetration Testing (CPT) to determine the in-situ density.

14.3.32 A safe bearing capacity of around 160kPa, allowing a maximum foundation line load of 115kN/m run, can be assumed if the following are true:

A foundation length of 20m
A foundation breadth of 0.75m
A foundation thickness of 225mm
A foundation depth of 1.3m
Groundwater lies in excess of 1.5m bgl
An angle of shearing resistance of =28° for the granular deposits

14.3.33 Assuming the foundation geometry detailed above, 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.

14.3.34 In accordance with NHBC Standards, a minimum founding depth of 450mm is required in the granular soil (due to potential frost susceptibility). This depth should be taken from finished ground level to the underside of the footing. If finished ground level is to be above existing ground level then the foundation excavation simply needs to ensure that there is sufficient depth of excavation to allow casting of the footing entirely within natural ground (not made ground or topsoil).

14.3.35 However, if the excavation is dug from original ground level in cold conditions when freezing is expected, then foundation depth should be taken from the existing, not finished, ground level.

14.3.36 It should also be noted that the footing may require deepening or stepping in order to allow plot drainage to exit the plot footprint (either over or under the footing).

14.3.37 Where plots are underlain by granular soil and within the influence of existing trees, footings can be cast in the granular soil at a "standard" depth of 1.3m, provided that all the following conditions are satisfied:

Consistent ground across the plot

The depth of granular soil is greater than ¾ of the depth which would be computed if founding in shrinkable clay

The thickness of granular soil beneath the footing is equal to or greater than the foundation width (i.e. usually >600mm)

14.3.38 Good control/supervision of groundworks will be essential because there is a significant risk that over-excavation into granular soils (especially below the water table) will result in unstable trenches and collapse which may render the ground unsuitable and necessitate a piled solution.

14.4 Floor slabs

14.4.1 The following general comments relating to floor slabs are provided for guidance and final design will depend on loadings, tolerable settlements, etc. Further advice should be sought from the Structural Engineer.

14.4.2 The natural ground beneath this site includes cohesive soils and is therefore subject to seasonal variation in moisture content. If a ground bearing slab was constructed on desiccated soil, heave of the slab would occur on re-hydration of the ground.

14.4.3 Therefore, careful consideration of floor slab design is required to prevent heave or settlement which would likely result in cracking.

14.4.4 It is considered that existing shallow ground conditions (medium shrinkable clay within the influence of trees) are not suitable for the adoption of a cast in-situ ground bearing floor slab and therefore an alternative will be required. Depending on final design, loadings and tolerable settlements, this could comprise:

Excavation of the shrinkable soil (clay) and replacement with suitable aggregate, subjected to appropriate compaction, to facilitate a ground bearing slab;

A suspended floor slab, with sub-floor void;

A cast in-situ suspended slab constructed on piled foundations.

14.4.5 Given the proposed development, a cast in-situ suspended floor slab is likely to be prohibitively costly due to the need for piled foundations.

14.4.6 If a ground bearing slab is to be utilised, NHBC guidance indicates the depth of engineered stone below a ground bearing slab should not exceed 600mm. However, this should be reviewed in light of final design details (loadings etc). Ground bearing slabs should not be cast on topsoil.

14.4.7 It should be noted that NHBC have suffered a significant number of claims resulting from the use of ground bearing floor slabs. Consequently, if a ground bearing slab is proposed, care should be taken to ensure correct and careful construction.

14.5 Designated concrete mixes

14.5.1 Designated mixes are considered in BRE SD1[9] and BS 8500[10]. However, in addition to soil chemistry (sulphate class), there are a number of other considerations relating to structural design that need to be taken into account when determining an appropriate concrete mix.

14.5.2 Consequently, LNT should seek advice from their appointed Structural Engineer.

14.6 Excavations

14.6.1 Based on the results of the investigation it is considered unlikely that major groundwater flows will be encountered in shallow excavations (<1.2m). However, groundwater is likely to be encountered in any excavations deeper than 2.0m and therefore groundwater control over and above normal site pumping practices may be required for such excavations.

14.6.2 Groundwater should be controlled in accordance with CIRIA Report R113[11].

14.6.3 Shallow excavations in cohesive soils should remain stable in the short term but if left open for any significant period of time may require shoring. However, deeper excavations into saturated sand are likely to be unstable and therefore allowance should be made for shoring.

14.6.4 Where sand is encountered (especially running sand), beware of over-digging and creating a “large hole”. It is generally prudent to stop excavation and "probe" to check thickness of sand. If in doubt, please seek advice from Lithos. “Blowing” sand is caused by excess water heads, and it may be prudent to fill the excavation and ensure groundwater control measures are effective.

14.7 Drainage

14.7.1 Based on the results of in-situ testing and depth to groundwater, soakaways are very unlikely to provide a suitable drainage solution for surface water run-off at the site. Consequently, it will be necessary to consider alternative sustainable drainage systems (SuDS), and there may be a need for surface water balancing.

14.7.2 Whilst the site does not lend itself to the adoption of discrete soakaways, ground may have the capacity to absorb surface water run-off, and systems which spread infiltration over a wider area (e.g. an infiltration basin, swales and/or pervious paving) may provide the best solution.

14.7.3 Alternative SuDS options (see CIRIA C753[12] for further details) include:

Pervious Pavements –provide a surface suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate into subsurface storage, with subsequent infiltration

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9 *BRE Special Digest 1 (2005) – Concrete in aggressive ground.*

10 *BS 8500-1&2:2015+A2:2019. Concrete. Complementary British Standard to BS EN 206. Method of specifying and guidance for the specifier (1) & Specification for constituent materials and concrete (2).*

11 *CIRIA Report R113 (1986) - Control of Groundwater for Temporary Works.*

12 *CIRIA C753 (2015) – The SuDS Manual.*

or controlled discharge. Pavement could be porous (water able to infiltrate across entire surface material; e.g. reinforced grass), or permeable (water infiltrates via joints between concrete blocks).

Swales –linear grassed features in which surface water can be stored or conveyed. Where suitable, swales can be designed to allow infiltration.

Basins - a ground depression designed to store surface water that is normally dry, except during and immediately following a rainfall event. There are two types:

- Infiltration –basin designed to store runoff and infiltrate it gradually into the ground.
- Detention –an outlet restricts flows, so that the basin fills and provides attenuation.

Ponds –designed to have permanent pool of water, but with capacity to provide temporary storage-controlled discharge.

14.7.4 Yorkshire Water have published a guide[13] for developers and designers outlining their design requirements for surface water attenuation assets.

14.7.5 With respect to detention basins, which should normally be dry, water table levels should be taken from borehole monitoring wells over 4 consecutive seasons, for at least 3 points in the basin area. The detention basin should be designed to ensure that there is a minimum of 1m of unsaturated soil between the maximum groundwater level and the lowest part of the structure.

14.7.6 It is Lithos' understanding that ground does not have to be free-draining (i.e. sands/gravels), but where clay is present the basin needs to be designed to prevent waterlogging - because this renders maintenance (grass cutting) difficult. It would be prudent to seek confirmation of this from Yorkshire Water and/or the appointed drainage designer.

14.7.7 Appropriate design usually comprises a fall across the short axis (to centre of basin), and then along the long axis (possibly inclusive of a pipe in gravel trench) to the outfall.

14.7.8 The guide also discusses required access to flow control chambers, large diameter (i.e. >900mm) surface water storage pipes, and surface water storage tanks.

14.7.9 Land drains were encountered within the site investigation trial pits. Provision of surface drainage infrastructure will negate the need for field drainage. However, field drainage encountered during construction of the infrastructure works, should where practicable and where the layout allows, be maintained.

14.7.10 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.

14.8 Access road and car parking

14.8.1 An existing house and annex, with external areas of gravel hardstanding/paving, are present in the north of the site where an access road and car park are proposed. Consequently, there was no merit in obtaining CBR values at this stage. However, some made ground (likely a veneer) will be present in this area which will have implications for road/car park construction.

14.8.2 The natural soils present at shallow depth (anticipated formation) are predominantly cohesive. Based on visual inspection of the natural materials and the recorded plasticity indices at the site, published guidance[14] and tables[15] indicate that the Cohesive Drift deposits would be expected to provide a CBR value of at least 2%. This value should be verified prior to or during construction.

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[13] *Design Requirements for Surface Water Attenuation Assets, February 2017.*

[14] *CD225 Design for new pavement foundations Revision 1 (Design Manual for Roads and Bridges)*

[15] *The Structural Design of Bituminous Road, TRRL Laboratory Report 1132 (Table C1, page 36)*

14.8.3 Whilst the CBRs estimated above should be achievable, significant deterioration during/after periods of significant rainfall and/or site trafficking is likely. Consequently, it would be prudent to consider flexibility in the groundworks programme to enable road construction during prolonged dry/warm weather (typically between May and September) when formation will be least vulnerable to deterioration. Alternatively, a minimum 200mm thickness of suitable granular fill (i.e. a "blanket" of 6F2) could be placed along the line of the proposed access road and car park to protect formation during the construction phase.

14.8.4 If made ground is present across the north, its full thickness (up to a maximum of 2m - from existing ground level or proposed road formation, whichever is the lower) should 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

Screened, to allow selection of suitable material, before being replaced in engineered layers (in accordance with Series 600). Unsuitable materials include any soft or wet materials, biodegradables including topsoil, wood, scrap metal, frozen material and oversize.

14.8.5 Some refinement of the above advice might be possible after road/car park design (with consideration of the proposed formation level cf existing ground level), and via inspection (and usually CBR testing) of the proposed formation during site preparatory groundworks.

14.8.6 Any residual made ground materials in the base of the excavation should be inspected and (where necessary) any soft spots removed and replaced with suitable engineered fill.

14.8.7 Where the made ground is re-engineered it is considered that a CBR value of at least 3% should be achievable. However, this should be verified by field trials.

14.8.8 Crushing of demolition/hardstand/foundation arisings will generate aggregate, which (subject to confirmatory testing) should be suitable for use as unbound pavement materials within the access road.

14.9 External works

14.9.1 Due to the relatively level nature of the site, it is considered unlikely there will be any need for retaining walls or underbuild.

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

15 REDEVELOPMENT ISSUES

15.1 General

15.1.1 This report has presented options with respect to foundation solutions, treatment of contamination, re-use of topsoil 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 (Warranty Provider & Local Authority) for their comment/approval.

15.1.2 Even after an appropriate preliminary investigation and ground investigation, with exploratory holes on a closely spaced grid (say trial pits at 30m centres), a geoenvironmental appraisal is typically based on inspection of the ground underlying less than 0.5% of the total site area (and much less at depths in excess of about 3.5m). Consequently, there is always a possibility that unanticipated ground conditions will be encountered during the construction phase.

15.1.3 If unexpected ground is encountered during the construction phase, the Contractor should immediately seek further advice from the Engineer.

15.2 Remediation strategy

15.2.1 Whilst a detailed remediation strategy report is unlikely to be required, preparation of a Remediation Statement would be prudent and should include:

- Demolition of the existing buildings
- Post demolition investigation of the ground beneath the existing buildings, which were inaccessible during the earlier investigations
- General site clearance of surface materials and vegetation
- Topsoil strip & stockpile with visual inspection and hand pick to remove ACMs (cement sheet)
- Break-up of slabs and hardstand
- Provision of 200mm thickness of topsoil in all landscaped areas
- Removal of any old foundations, concrete bases and similar obstructions within 450mm of the finished ground surface in proposed landscaped areas

15.2.2 Whilst this site does not require large-scale remediation works, it is strongly recommended that, in advance of the anticipated infrastructure groundworks, the topsoil is stripped, visually inspected and any ACMs removed prior to stockpiling. Further testing of the topsoil should be undertaken once stockpiled to confirm the absence of any further significant asbestos contamination.

15.2.3 This work should be supervised by a suitably qualified geoenvironmental engineer such as Lithos. Given the site's relatively small size, failure to complete such works before groundworks begin is likely to result in the generation of excessive volumes of material that are unsuitable for retention on site.

15.2.4 Stockpiles of asbestos contaminated material should be located in an area where they will not constrain subsequent works before the material's fate has been determined, agreed and actioned.

15.2.5 Further characterisation of stockpiled materials is likely to be required if off-site disposal is proposed. See also comments in Section 11.7 regarding asbestos.

15.2.6 Immediately prior to demolition of the existing buildings, current legislation (as outlined in HSG 264) requires a pre-demolition (formerly Type 3) asbestos survey to be undertaken. The Contractor should request a copy of the survey report from LNT.

15.2.7 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. 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.

15.2.8 No areas of gross contamination were encountered during the site investigation. However, if any buried drums, "oily", odorous, brightly coloured etc. materials are encountered, further advice should be sought from Lithos. Further advice should also be sought if deep foundations etc associated with the buildings are encountered during the preparatory works; such obstructions might necessitate revised foundation design.

15.3 Control of excavation arisings

15.3.1 Excavations into made ground may yield contaminated arisings. The groundworker should carefully segregate (and stockpile separately) made ground arisings from arisings of "clean" natural soils, in order that an excessive volume of unsuitable material is not generated.

15.3.2 The groundworker should appreciate the need for good materials management. Most notably the importance of not mixing different materials within a given stockpile; i.e. there should be separate stockpiles of: topsoil; grubbed-up concrete hardstand; excess clean, natural soil arisings; general construction waste etc.

15.3.3 Further characterisation of stockpiled materials is likely to be required if off-site disposal is proposed. See also comments in Section 11.7 regarding asbestos.

15.3.4 Made ground arisings could be:

Placed in area deliberately left low on completion of the remediation works in order to accommodate construction arisings

Redistributed beneath concrete oversite, or areas of hardstanding, where they would be satisfactorily isolated from end users;

Exported from site to a suitably licensed landfill facility

15.3.5 Natural ground arisings should be suitable for use as subsoil in the proposed soil cover.

15.4 Good practice guidance

15.4.1 The construction phase groundworker should follow good environmental practice to minimise the risks of spillage, leakage etc with reference, but not limited, to the following documents:

CIRIA C741[16]

EA Pollution Prevention Guidelines[17]:

- PPG6 - Working at construction and demolition sites
- PPG2 - Above ground oil storage tank
- PPG7 –The safe operation of refuelling facilities
- PPG21 –Incident Response Planning

15.4.2 Site preparatory works associated with this project are likely to involve the re-use of both natural and made ground soils on site. Therefore, the Contractor should prepare a Materials Management Plan (MMP) in accordance with the CL:AIRE Code of Practice (v2, March 2011) [18].

15.4.3 The MMP will document how all of the materials to be excavated during the proposed site preparatory and remediation earthworks are to be dealt with.

[16] *CIRIA C741 (2015) - Environmental Good Practice on Site*

[17] *Whilst this has formally been withdrawn it can still be accessed via the EA archives and provides useful information on managing risks.*

[18] *The Definition of Waste: Development Industry Code of Practice. CL:AIRE, 2011.*

15.5 New utilities

15.5.1 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.

15.5.2 It is recommended that trenches for services including site drainage and water supply are cut over size in order to isolate pipe materials from potential contaminants and to enable maintenance to be conducted in "clean" material.

15.5.3 Water Companies have a statutory duty to supply wholesome water, which could be compromised by the selection of an inappropriate pipe material. For example, compounds such as petroleum hydrocarbons and solvents can permeate commonly used plastics pipes, and/or corrosive chemicals can reduce the service life of metallic pipes. Guidance has been developed for the selection of pipes in brownfield sites and is contained in a UKWIR Report[19].

15.5.4 This site is brownfield, and therefore consideration of soil contaminant concentrations is required. Samples taken must be representative of the soil conditions in which the water pipes are proposed to be laid; normally water pipes are laid 0.7m to 1.3m below finished ground level.

15.5.5 At the time of writing, the proposed route(s), and total length, of water supply pipes were unknown. Consequently, to date laboratory testing of soil samples in line with UKWIR guidance has not been undertaken.

15.5.6 However, given the site's history and the relatively consistent ground conditions reported, the use of 'standard' polyethylene water supply pipes should be acceptable, although LNT should consult Affinity Water at the earliest opportunity to confirm this.

15.6 Health & safety issues - construction workers

15.6.1 Access into excavations etc. must be controlled and undertaken in accordance with the CDM Regulations 2015, most notably Regulation 22, to mitigate risk of collapse or asphyxiation.

15.6.2 Before site operations are started, the necessary COSHH statements and Health & Safety Plan should be drafted in accordance with the CDM regulations.

15.6.3 This Topsoil contains asbestos-containing-materials (ACMs). Workers involved in excavations for foundations, drainage, utilities etc are likely to come into direct contact with the made ground.

15.6.4 Although workers will only be exposed to the contaminated soil for a relatively short time, the contaminants represent a risk, and simple precautionary measures are required, i.e. good personal hygiene and basic personal protective equipment. See also comments in Section 11.7 regarding asbestos.

15.6.5 Consequently, during the remediation and construction phases of the site development it will be necessary to protect the health and safety of site personnel. General guidance on these matters is given in the Health and Safety Executive (HSE) document "Protection of Workers and the General Public during the Redevelopment of Contaminated Land".

[19] *UKWIR Report 10/WM/03/21 – 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites'.*

15.7 Potential development constraints

15.7.1 Significant deterioration of the surface is likely to be caused by trafficking, especially after topsoil has been stripped and during/after periods of significant rainfall. Consequently, it would be prudent to consider placement of a minimum 200mm thickness of suitable granular fill (i.e. a "blanket" of 6F2) along the line of the proposed access road/car park and any temporary haul roads to protect formation during the construction phase.

15.7.2 It would be prudent to allow flexibility in the groundworks programme to take advantage of any prolonged dry\warm weather (typically between May and September) to enable footings to be cast and blockwork brought up to DPC level well in advance of the build programme (i.e. so it is never necessary to dig deep footings in winter/early spring, when the groundwater table is likely to be higher).

15.7.3 The existing services (water, electric, telecom, gas) 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.

15.7.4 The current layout suggests the proposed care home building conflicts with an existing pond which may have significant implications for foundation abnormals and the recommendations provided below. It would be considered prudent ascertain the depth of the pond at the earliest opportunity and consider revising the layout to avoid building over the pond.

16 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

16.1 General

16.1.1 The site is located off Clacton Road, approximately 5.7km north of Clacton-on-Sea, and currently comprises a 2 storey domestic dwelling and 1.5 storey annex in the north, with associated gardens and out-buildings in the centre and south. The site was occupied by agricultural land before being developed with the existing house in the early 1920s.

16.1.2 It is understood that consideration is being given to redevelopment of the site with a two storey care home with landscaped areas and car parking.

16.1.3 No significant made ground has been encountered to date although buildings are present in the north and southwest and therefore some made ground is anticipated.

16.1.4 Natural ground comprises Cohesive Drift (firm to stiff sandy Clay) to between 1.0m an d1.9m depth (average 1.5m) underlain by Granular Drift (clayey/silty Sand) to depth. Bedrock has not been encountered during this investigation.

16.1.5 Groundwater is present in the Granular Drift at between 2.2m and 2.5m depth, which was noted to rise by c. 50mm in soakaway test pits after heavy rainfall. This suggests a fairly rapid recharge rate following rainfall events.

16.2 Mining

16.2.1 This site is located beyond the CA's defined coalfields.

16.2.2 There are no known quarries on, or within 50m of the site.

16.3 Hazardous gas

16.3.1 The site is in an area where less than 1% of homes are estimated to be above the radon action level.

16.3.2 There are no known or suspected areas of landfilling within 250m, and the site is not in area considered susceptible to mines gas, nor is it underlain by shallow mineworkings. As such, no special precautions against methane / carbon dioxide gas are required.

16.4 Contamination & remediation

16.4.1 The Topsoil locally contains asbestos-containing-materials (ACMs) which will require visual inspection and hand picking prior to stockpiling for re-use. Further testing of the topsoil should be undertaken once stockpiled to confirm the absence of any further asbestos contamination.

16.4.2 Made Ground Topsoil is chemically suitable for re-use although contains anthropogenic materials (brick, concrete, glass, etc) which are considered unsuitable in garden/landscaped areas. Therefore, this material should be isolated beneath a 450mm thick surface cover of "clean" soil.

16.4.3 Whilst this site does not require large-scale remediation works, it is strongly recommended that, in advance of the anticipated infrastructure groundworks, the topsoil is stripped, visually inspected and any ACMs removed prior to stockpiling. This work should be supervised by a suitably qualified geoenvironmental engineer such as Lithos.

16.4.4 Given the site's relatively small size, failure to complete such works before groundworks begin is likely to result in the generation of excessive volumes of material that are unsuitable for retention on site.

16.5 Foundations

16.5.1 Depending on final loadings and tolerable settlements, the proposed care home could be constructed on widened strip/trench-fill footings at a minimum depth of 0.9m in Cohesive Residual Soil. Foundations will require deepening where necessary due to tree influence.

16.5.2 Foundation excavations should be kept as shallow as possible (where sufficient bearing capacity can be achieved) to minimise issues surrounding constructability associated with groundwater inflows in deeper granular soils.

16.6 Flooding

16.6.1 The site lies in Flood Zone 1, where the risk of flooding from rivers or the sea is classified as low.

16.7 Drainage

16.7.1 Due to very slow infiltration rates and high groundwater levels, soakaways are very unlikely to provide a suitable drainage solution for surface water run-off at the site. Consequently, it will be necessary to consider alternative sustainable drainage systems (SuDS), and there may be a need for surface water balancing.

16.8 Access road and car parking

16.8.1 Based on visual inspection of the shallow natural materials and published guidance, the shallow Cohesive Drift soils should provide a CBR value of at least 2%. This value should be verified prior to or during construction.

16.8.2 However, the existing house/annex is located over the proposed access road and car park area and therefore made ground is likely to be present. This should be excavated and either replaced with suitable aggregate, or screened, to allow selection of suitable material, before being replaced in engineered layers. Where the made ground is re-engineered it is considered that a CBR value of at least 3% should be achievable. However, this should be verified by field trials.

16.9 Further works

16.9.1 Given the constraints discussed in Section 7.2 (existing buildings across the north and southwest) a simple post-demolition trial pit investigation will be required in order to remove residual uncertainties with respect to ground, and provide more definitive recommendations with respect to contamination and foundations.

16.9.2 Depending on final loadings and tolerable settlements, Cone Penetration Testing (CPT) may be required to determine the density of underlying sands to inform foundation design.

Appendix A

General Notes

01 - Environmental setting
Generic notes – geoenvironmental Investigations

General

Third party information obtained from the British Geological Survey (BGS), the Coal Authority, the Local Authori sented in the "Search Responses" 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. Further information is sourced by reference to current and historical OS plans.

In July 2011, the Coal Authority (CA) formalised their requirements in relation to planning applications and introduced some new terminology. The CA, using its extensive records has prepared plans for all coalfield Local Planning Authorities, which effectively refines the defined coalfield areas into High Risk and Low Risk areas. **High Risk** areas are likely to be affected by a range of legacy issues that pose a risk to surface stability, including: mine entries; shallow coal workings; workable coal seam outcrops; mines gas; and previous surface mining sites. **Low Risk** areas comprise the remainder of the defined coalfield, and are areas where no known defined risks have been recorded; although there may still be unrecorded issues. Where a site lies within either a High or Low Risk area, a mining report is obtained from the CA.

Landfills

Reference is made to publicly available Government held digital data via **QGIS** (an Open Source Geographic Information System), data from Landmark or Groundsure, and sometimes the Environment Agency and the Local Authority with respect to known areas of landfilling within 250m of the proposed development site.

Historical OS plans are also 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[1], and the Public Health England website. Advice on the limitation of exposure of the population to radon in buildings was originally published in 1990 by the National Radiological Protection Board (NRPB), which joined the Health Protection Agency (HPA) in 2005; the HPA updated NRPB advice in July 2010[2]. The HPA became part of Public Health England in 2013.

The HPA recommended that the NRPB radon Action Level for homes be retained, and a new Target Level for radon in homes be introduced. The values of the Action Level and Target Level, expressed as the annual average radon concentration in the home, are 200 Bqm^{-3} and 100 Bqm^{-3} respectively. The Target Level was to provide an objective for remedial action in existing homes and preventive action in new homes.

The term 'radon Affected Area' is defined as those parts of the country with >1% of homes estimated to be above the Action Levels. The NRPB first indicated which parts of the country should be regarded as radon Affected Areas in 1990. A more detailed mapping method was developed by the HPA in conjunction with the British Geological Survey in 2007[3]. The level of protection needed is site-specific and can be determined by reference to this mapping on the Public Health England website, which indicates the highest radon potential within each 1km grid square. Each 1km grid square is classified on the basis of the percentage of existing homes within that grid square estimated to have radon concentrations above the Action Level. There are 6 'bands': <1%; 1 to 3%; 3 to 5%; 5 to 10%; 10 to 30%; and >30%.

The NRPB advised that action should be taken to reduce radon concentrations in existing homes if the radon concentration exceeded the Action Level of 200 Bqm^{-3} in room air averaged over a year; ten times the average UK domestic radon concentration. NRPB advice informed changes in the requirements for radon protection in new buildings.

> **Basic** preventive measures are required in new buildings, extensions, conversions and refurbishments if the probability of exceeding the Action Level is **>3%** in England and Wales, and >1% in Scotland and Northern Ireland.
> Provision for further preventive (**Full**) measures is required in new buildings if the probability of exceeding the Action Level is **>10%**.

At present Building Regulations Approved Document C advocates basic measures for the probability banding 3% to 10%, and full measures if >10%. However, Public Health England would like to see all new build include basic measures.

Action & Target Levels should also be applied to non-domestic buildings with public occupancy exceeding 2,000 hrs/yr and to all schools.

Hydrogeology

Reference is made to publicly available Government held digital data via QGIS, and Landmark or Groundsure 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 types 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 superficial 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 superficial deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into three 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 - In most cases, this is because the rock type in question has previously been designated as both a minor and non-aquifer in different locations due to the variable characteristics.

[1] BRE Report BR211, 2015: "Radon: guidance on protective measures for new buildings.

[2] Limitation of Human Exposure to Radon, Documents of the Health Protection Agency - Radiation, Chemical and Environmental Hazards, RCE-15. July 2010.

[3] Miles JCH, Appleton JD, Rees DM, Green BMR, Adlam KAM and Myers AH (2007). Indicative Atlas of Radon in England and Wales. Chilton, HPA-RPD-033.

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

The EA maps only display the principal and secondary aquifers as coloured areas. All uncoloured areas on the 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 superficial deposits are present; to do this, it is necessary to consult the published geological survey maps.

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

If no superficial (drift) aquifers are shown, the bedrock designation is adopted
In areas where the bedrock designation shows unproductive strata (the uncoloured areas) the superficial designation is adopted
In all other areas, the more sensitive of the two designations is used (e.g. If secondary superficial overlies principal bedrock, an overall designation of principal is assumed)

The EA have also designated groundwater 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

Reference is made to publicly available Government held digital data via QGIS, and Landmark or Groundsure 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 6 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 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 (Flood Zone 3) 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 (Flood Zone 2) 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. Where there is no blue shading (Flood Zone 1), there is less than a 0.1% (1 in 1000) chance of flooding occurring each year.

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, 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 who can advise on appropriate mitigating measures; i.e. raising slab levels, provision of storage etc. In accordance with Chapter 10 of the National Planning Policy Framework, a site-specific flood risk assessment is required for: proposals of 1 hectare or greater in Flood Zone 1, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency); and any new development in Flood Zones 2 and 3.

COMAH & explosive sites

Lithos obtain information from Landmark or Groundsure with respect to Control of Major Accident Hazards (COMAH) or explosive sites within 1km of the proposed development site. Lithos' 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 its 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 site model

The site's environmental setting (and proposed end use) is used by Lithos to assess the significance of any (ountered 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 receptors.

Potential pollutant linkages are shown on a preliminary conceptual site model (pCSM). A CSM is essentially a cross-section through a site that reflects both the surface topography and underlying geology, and shows surface features of interest. The most significant sources of contamination are then superimposed onto this cross-section together with potential receptors (human health & controlled waters), and plausible pathways between the two. In addition to environmental issues, the CSM should also highlight geotechnical issues.

A pCSM is prepared after consideration of all available "desk study" data, and before design of the ground investigation. Data reviewed should include historical plans (with superimposition on a current-day plan), previous SI reports, geological maps etc. The pCSM, in conjunction with knowledge of site constraints (buildings, services, slopes etc) is used to design the ground investigation.

The revised CSM takes account of data obtained during the ground investigation, including the distribution of made ground, the nature and distribution of contamination etc.

02 - Ground investigation fieldwork
Generic notes – geoenvironmental investigations

General

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

BS5930:2015 "Code of practice for site investigation"

Eurocode 7: BS EN 1997-1:2004. Geotechnical design - Part 1: General rules

Eurocode 7: BS EN 1997-2:2007. Geotechnical design - Part 2: Ground investigation and testing

BS10175:2013 "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 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: 2015 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. Allows a thorough inspection of the ground; especially the uppermost 1m or so (but able to reach depths of up to c. 4m), with the recovery of representative, disturbed samples. Also used to conduct soakaway testing.

Window or windowless sampling boreholes (**dynamic sampling**). 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).

Cable percussive (Shell & Auger) boreholes, typically using 150mm diameter tools and casing. Enables the recovery of soil samples and data from greater depth than is possible via trial pitting or a mini-percussive drill rig. Also enables the installation of better/deeper monitoring wells (cf use of a mini-percussive drill rig) due to the utilisation of temporary steel casing during drilling.

Rotary percussive open-hole probeholes are typically drilled using a tri-cone rock roller or polycrystalline diamond compact (PDC) bit with air as the flushing medium. Probeholes are generally lined through made ground with temporary steel casing to prevent hole collapse. Often used to penetrate bedrock to investigate abandoned shallow mineworkings

Rotary cored boreholes. A rock core is cut by a bit, passes up into the inner barrel and, at the end of the coring run, the core barrel assembly is lifted to the surface. Core drilling is relatively expensive, but essential if quality data is required to assess issues associated with deep excavation, rock slope stability etc.

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

Relative densities of granular materials given on the trial pit logs are based on visual inspection only, they do not relate to any specific 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 (hand vane readings) 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.

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' 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)
Asbestos identification	1000ml plastic tub
pH & metals	1000ml plastic tub or 250ml glass jars
non-volatile organics	250ml glass jars
Speciated TPH	250ml & 50ml glass jars
VOCs (incl. naphthalene and\or GRO)	50ml glass jar

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 a Lithos investigation are described (logged) in general accordance with BS 5930:2015. 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.

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

03 – Geotechnical laboratory testing
Generic notes – geoenvironmental investigations

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 is routinely carried out on a selection of samples:

- Atterberg limits & moisture contents
- Soluble sulphate & pH

Where soft, cohesive soils are encountered, one-dimensional consolidation tests are scheduled in order to assess settlement characteristics, and unconsolidated undrained triaxial compression tests to assess shear strength.

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

- Grading
- Compaction tests
- Particle density

Test results are presented as received in an Appendix to the 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)

i.e. 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 adopts a conservative approach and recommends 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 (DS 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 ar expressed in terms of SO_4 for direct comparison with BS5328:1997. 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.

Oedometer (Consolidation) tests

Oedometer tests measure a soil's consolidation properties, and are performed by applying different loads to a soil sample and measuring the deformation response. Typically the sample is subject to 5 incremental pressures (4 loading & 1 unloading), and the convention is for each subsequent pressure to be double the previous pressure. BS1377 suggests the initial pressure should be:

a) For stiff soils the effective overburden pressure*
b) For firm soils "somewhat less" than the effective overburden pressure
c) For soft soils "appreciably less" than the effective overburden pressure, usually 25 kPa or less
d) For very soft soils very low, typically 5 kPa or 10 kPa

* Effective overburden pressure (kNm^{-2}) = depth (m) x soil bulk unit weight (kNm^{-3})

Results from these tests are used to predict how a soil in the field will deform in response to a change in effective stress.

Triaxial tests

This test measures the mechanical properties of a soil by placing the sample between two parallel platens which apply stress in one (usually vertical) direction, with fluid used to apply a confining pressure in the perpendicular directions. During the test, the surrounding fluid is pressurized, and then stress on the platens is increased until the material in the cylinder fails.

From triaxial test data, it is possible to extract fundamental material parameters, including its angle of shearing resistance, apparent cohesion, and dilatancy angle. These parameters are then used in computer models to predict how the material will behave in a larger-scale engineering application.

Quick (single stage, Unconsolidated, Undrained tests) are most appropriate for foundation design. This is because load is applied relatively quickly, and shear strength of the clay will be lowest initially; after the applied load causes some consolidation of the ground (after drainage results in dissipation of short-term excess pore water pressure), the in-situ clays will become progressively stronger and hence the factor of safety will increase. Confining pressure is specified as equivalent to overburden pressure (kNm^{-2}).

Foundations on granular soils would use effective shear strength parameters (c' and phi') to assess safe bearing capacity, as the soil would fully drain quickly. These effective shear strength parameters could be determined from Consolidated Undrained (or sometimes the more expensive Consolidated Drained) triaxial tests, but often correlations to the SPT are used.

Unconsolidated Undrained triaxial tests are most appropriate for assessment of the stability of fill slopes on clays. Similar to foundations, the application of load gradually increases the strength of the clays and hence the critical case is the short term undrained condition.

Consolidated Undrained (or sometimes **Consolidated Drained**) triaxial tests are most appropriate for assessment of the stability of cut slopes in clays. This is because unloading of the ground leads to short term reduction in pore pressures that approximately balance the unloading, hence the soil strength is largely unchanged. Over time the reduced pore pressures suck water in, which leads in to the progressive increase in pore pressure and loss of strength. The fully drained state is critical, which must be modelled using effective strength parameters and a reasonable estimate of the long term water table conditions.

Slopes formed in granular soils would use effective shear strength parameters (c' and phi') to assess safe bearing capacity, as the soil would fully drain quickly. These effective shear strength parameters could be determined from Consolidated Undrained (or sometimes the more expensive Consolidated Drained) triaxial tests, but often correlations to the SPT are used.

Determination of analytical suite

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).

Common contaminants

Common **Inorganic** Contaminants include:

- Metals, most notably cadmium, copper, chromium, mercury, lead, nickel, and zinc
- Semi-metals, most notably arsenic, selenium, and (water soluble) boron
- Non-metals, most notably sulphur
- Inorganic anions, most notably cyanides (free & complex), sulphates, sulphides, and nitrates

With respect to the terminology used by most analytical laboratories:

Total cyanide = Free cyanide + Complex cyanide

Total cyanide (CN) is determined by acid extraction; whereas free cyanide is the water soluble fraction. Complex cyanide is "bound" in compounds and is hard to breakdown. Laboratory determination of complex CN involves subjecting the sample to UV digestion for determination of both free and total CN.

Thiocyanate (SCN) is a different species combined with sulphur.

Elemental sulphur (S) and free sulphur are the same. Total sulphur is all forms, including that present in sulphates (SO_4), sulphides etc.

There are 2 forms of chromium (Cr), chromium VI and chromium III. Chromium VI is the more toxic of these. In soils, total chromium is determined by a strong aqua regia acid digestion. Chromium VI is an empirical method based on a water extract test.

Common **Organic** Contaminants include hydrocarbons, phenols, and polychlorinated biphenyls.

Petroleum is a mixture of hydrocarbons produced from the distillation of crude oil, and includes aliphatics (alkanes, alkenes and cycloalkanes), aromatics (benzene and derivatives) and hydrocarbon-like compounds containing minor amounts of oxygen, sulphur or nitrogen. Petroleum hydrocarbons can be grouped based on the carbon number range:

- GRO – Gasoline Range Organics (typically C_6 to C_{10}). Also referred to as PRO – Petroleum Range Organics
- DRO – Diesel Range Organics (typically C_{10} to C_{28})
- LRO - Lubricating Oil Range Organics (typically C_{28} to C_{40})
- MRO – Mineral Oil Range Organics (typically C_{18} to C_{44})

However, it should be borne in mind that the terms "GRO" and "DRO" analysis are purely descriptive terms, the exact definition of which varies. Total Petroleum Hydrocarbons (TPH) is also a poorly defined term; some testing laboratories regard TPH as hydrocarbons ranging from C_5-C_{40}, whereas others define TPH as C_{10}-C_{30}.

The composition of a TPH plume migrating through the ground can vary significantly; this is primarily dictate of the source (e.g. petrol, diesel, engine oil etc). Furthermore, different hydrocarbons are affected differently by weathering processes, and this can result in further variation in the chemical composition of the TPH.

Gasoline contains light aliphatic hydrocarbons (especially within the C_4 to C_5 range) that are volatile. The aromatic hydrocarbons in gasoline are primarily benzene, toluene, ethylbenzene and xylenes, referred to as BTEX. Small amounts of polycyclic aromatic hydrocarbons (PAHs) such as benzo(a)pyrene may also be present. Diesel and light fuel oils have higher molecular weights than gasoline. Consequently, they are less volatile and less water soluble. About 25 to 35% is composed of aromatic hydrocarbons. BTEX concentrations are generally low.

Heavy Fuel Oils are typically dark in colour and considerably more viscous than water. They contain 15 to 40% aromatic hydrocarbons. Polar nitrogen, sulphur and oxygen-containing compounds (NSO) compounds are also present. Lubricating Oils are relatively viscous and insoluble in groundwater. They may contain 10 to 30% aromatics, including the heavier PAHs. NSO compounds are also common.

Polycyclic Aromatic Hydrocarbons (PAHs) have two or more fused benzene rings as a structural characteristic. PAH compounds are present in both petrol and diesel, although in significantly lower concentrations than in coal tars. Certain PAH compounds are carcinogenic (benzo(a)pyrene) and\ or mobile in the environment (naphthalene).

Volatile Organic Compounds (VOCs) are organic chemicals, and most are liquids that readily evaporate on exposure to air. Examples include benzene, toluene, xylene, chloroform etc. Semi-Volatile Organic Compounds (sVOCs) include phenol and benzo(a)pyrene, and have relatively low boiling points. Both groups of chemicals are readily absorbed through skin and some, such as benzene, are believed to be linked to tumour growth.

Phenols are compounds that have a hydroxyl group (-OH) attached to an aromatic ring (ie include a benzene ring and an –OH group). Most are colourless solids. A solution of phenol in water is known as carbolic acid, and is a powerful antiseptic. However, phenol vapour is toxic, and skin contact can result in burns.

Polychlorinated Biphenyls (PCBs) were used in pre-1974 transformers as dielectric fluids. PCB's are of increasing toxicity relative to the degree of chlorination. Acute symptoms of PCB poisoning are irritation of the respiratory tract leading to coughing and shortness of breath. Nausea, vomiting and abdominal pain are caused by ingestion of PCB's.

Dioxins and furans (polychlorinated dibenzodioxins and polychlorinated dibenzofurans) are some of the most toxic chemicals known; in the environment, they tend to bio-accumulate in the food chain. Dioxin is a general term that describes a group of hundreds of chemicals that are highly persistent in the environment. The most toxic compound is 2,3,7,8-tetrachlorodibenzo-p-dioxin or TCDD.

Dioxin is formed by burning chlorine-based chemical compounds with hydrocarbons. The major source of dioxin in the environment comes from waste-burning incinerators and also from backyard burn-barrels. Dioxin pollution is also affiliated with paper mills which use chlorine bleaching in their process and with the production of Polyvinyl Chloride (PVC) plastics and with the production of certain chlorinated chemicals (like many pesticides).

Methods of analysis (organic compounds)

TPH by GC-FID is an analytical technique which only detects hydrocarbons (aliphatic and aromatic) in the range C_{10} to C_{40} (volatiles, heavy tars, humic material and sulphur are not detected). The laboratory can provide a broad, 'banded' breakdown of the TPH results into gasoline range organics (GRO), diesel range organics (DRO) and heavier lubricating oil range organics (LRO), or fully speciated results with the reporting of hydrocarbon concentrations in 14 specific carbon bandings based upon behavioural characteristics, e.g. aliphatic C_6 to C_8, aromatic C_{10} to C_{12} etc.

Speciated VOC (by GC-MS) analysis quantifies the concentrations of 30 USA-EPA priority compounds. These include chlorinated alkanes and alkenes (in the molecular weight range chloroethane to tetrachloroethane); trimethylbenzenes; dichlorobenzenes; and the 4 BTEX compounds (benzene, ethyl-benzene, toluene & xylene).

Speciated sVOC by (GC-MS) analysis quantifies the concentrations of a variety of organic compounds, including the 16 USA-EPA priority PAHs, phenols, 7 USA EPA priority PCB congeners, herbicides & pesticides.

Note: PAHs are hydrocarbons and consequently (where present) will be picked-up when scheduling TPH by GC-FID.

Note: Risk assessment models require physiochemical properties (solubilities, toxicities etc) of compounds in order to model their behaviour in the environment. These physiochemical properties cannot be derived from a single "TPH", "GRO" or "DRO" value. However, the carbon banded fractions can be used in risk assessment models.

Current UK guidance

The UK approach to contaminated land is set out in Land Contamination Risk Management (2020). 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 (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.

Soil screening values used by Lithos

In March 2002 DEFRA and the Environment Agency published a series of technical papers (R&D Publications CLR 7, 8, 9 & 10) outlining the UK approach to the assessment of risk to human health from land contamination. In 2008 CLR 7, 9 & 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 Handbook, Science report: SC050021/SR4
- Compilation of data for priority organic pollutants for derivation of Soil Guideline Values - Science Report: SC050021/SR7

In December 2013 Defra published the results of research project SP1010 – Development of Category 4 Screening Levels (C4SLs) for Assessment of Land Affected by Contamination. The objective of this project was to provide technical guidance in support of Defra's revised Statutory Guidance for Part 2A of the Environmental Protection Act 1990 (Part 2A). The revised Statutory Guidance, published in April 2012, introduced a new four-category system for classifying land under Part 2A, where Category 1 includes land where the level of risk is clearly unacceptable, and Category 4 includes land where the level of risk posed is acceptably low. Project SP1010 aimed to deliver:

- A methodology for deriving C4SLs for four generic land-uses comprising residential, commercial, allotments and public open space; and
- Demonstration of the methodology, via derivation of C4SLs for 6 substances – arsenic, cadmium, chromium IV, lead, benzene & benzo(a)pyrene.

The methodology for deriving both the previous Soil Guideline Values and the Category 4 Screening Levels is based on the Environment Agency's Contaminated Land Exposure Assessment (CLEA) methodology. Development of C4SLs has been achieved by modifying the toxicological and\ or exposure parameters used within CLEA (while maintaining current exposure parameters).

Part 2A Statutory Guidance was developed on the basis that C4SLs could be used under the planning regime. Defra anticipate that, where they exist, C4SLs will be used as generic screening criteria, and Lithos consider C4SLs to be suitable for use as Tier 1 Screening Values. Lithos have discussed this matter with both NHBC and YALPAG (collection of Yorkshire & Lincolnshire local authorities) and received confirmation that they are satisfied with this approach.

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). However, many organic contaminants are more mobile when the SOM is lower, and consequently comparison of soil results with revised, lower screening values may 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 five 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

E – Importation of soil cover

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 & 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 grown in landscaped areas. Where vegetables a to be grown site specific QRA may be required.

Scenario	Land use	Pathways	Justification
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 commerc development consists of offices to provide a conservative assessment.
E	Importation of soil for cover in garden and landscaped areas	Direct ingestion of soil Dermal contact Consumption of vegetables & soil attached to vegetables Inhalation of outdoor vapours and dust	Material used as cover to break existing pathway therefore all direct and indirect pathways releva however cover is **not** placed below plots therefore indoor inhalation is not relevant.

Lithos have assumed the source of contamination is directly below the building foundation; 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.

Lithos have derived Tier 1 values for a number of inorganic and organic determinands in the context of the five Scenarios A to E. The Tier 1 values are not intended to be used when considering potential risks associated with:

- Existing land uses in the context of Part 2A of the Environment Protection Act 1990;
- End uses such as allotments, sports fields, children's playgrounds, care homes, hospitals etc; or
- Groundwater and surface water

Inorganic Tier 1 values for scenarios A to E

Inorganic contaminant	Tier 1 assessment criteria (mg/kg) for Scenarios A to E							Comments/ notes
	SGV*	C4SL*	A	B	C	D	E	
As	32	37	37	Use (A) in SI Report for initial "screen" If >5 x A, then consider increase of cover to 1,000mm	40	640	37	C4SL adopted
Cd	10	26	26		149	410	26	C4SL adopted
Cr			4,000		4,000	28,767	4,000	Assumes Cr is CrIII
Pb	450	200	200		314	2,330	200	C4SL adopted
Ni	130		109		123	892	109	Assessment of health risk only
Se	350		434		596	13,018	434	
Hg	170		199		244	3,603	199	Assumes in an inorganic compound
Vn			584		586	4,994	584	
B			5		5	5	5	Based on phytotoxic risks as plants are the more sensitive receptor (Cu is pH dependant)
Cu			100		100	100	100	
Zn			200		200	200	200	

Organic Tier 1 values for scenarios A to E

Organic contaminant (all sourced via CLEA)	Tier 1 assessment criteria (mg/kg) for Scenarios A to E							Comments/ notes
	SGV*	C4SL*	A	B	C	D	E	
Benzene	0.33	0.87	0.7	<1^	<1^	63	<1	<1 based on professional judgement a lower than calculated value.
Toluene	610		836	2,048	1,912	5,000	<1	Scenario D based on professional judgement and lower than calculated value.
Ethyl Benzene	350		379	592	566	5,000	<10	
Xylenes	240		535	590	585	5,000	<10	Scenario E based on professional judgement and lower than calc value.
Phenol	420		1,434	3,360	2,264	5,000	<10	
PCBs			2	8	2	38	N/A	Based on toxicity of EC7
Benzo(a)pyrene		5	5	25	5	76	5	C4SL adopted. Scenario B 5 times scenario A
Naphthalene			6	6	6	619	<10	Scenario E based on professional judgement and lower than calc value
Gasoline Range Organics			22	23	23	2178	626	See 3-step assessment of TPH below ^Based on professional judgemen lower than calculated value
Diesel Range Organics			215	218	215	^5,000	1,429	
Lubricating Range Org			3,299	5,000	3,829	^5,000	3,299	

* *For a residential end use*

The significance of PAHs can be determined by considering indicator compounds. In most cases benzo(a)pyrene (BaP) is adopted as an indicator due to the amount of toxicological data available and has been used by various authoritative bodies to assess the carcinogenic risk of PAHs in food. A surrogate marker approach can be used to estimate the toxicity of a mixture of PAHs in soil using toxicity data for individual indicator compounds within that mixture. Exposure to the surrogate marker is assumed to represent exposure to all PAHs in that matrix. The surrogate marker approach relies on a number of assumptions:

- Surrogate marker (BaP) must be present in all soil samples
- Profile of the different PAH relative to BaP should be similar in all samples
- PAH profile in the soil samples should be similar to that used in the pivotal toxicity study[1]

To assess the PAH profile in a soil sample, the ratio of the seven genotoxic PAHs (benz[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, chrysene, dibenz[a,h]anthracene and indeno[1,2,3-c,d]pyrene), relative to BaP, should be calculated. The ratio relative to BaP should lie within an order of magnitude above and below the mean ratio to BaP.

[1] SP1010 Appendix E, Provisional C4SIs for benzo(a)pyrene as a surrogate marker for PAHs, CL:AIRE 2013

Naphthalene should also be considered separately against its generic screen. Whilst classed as a PAH, naphthalene is more volatile and mobile in the environment than most other PAHs. As such the significance of naphthalene cannot be considered within the surrogate marker approach.

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 representative constituent fractions or "EC Bandings". The TPHCWG have derived a series of physiochemical and toxicological parameters for each of the bandings.

The significance of speciated TPH results can be assessed by following the 3 steps outlined in the tables below.

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

The equation used to assess cumulative effects in step 3 is shown below.

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

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

Statistical Assessment

Current UK guidance is provided by CL:AIRE[2], and uses two-way confidence intervals and graphical summaries, to assist assessors when determining whether or not a dataset is adequate to answer the question posed; e.g. "is existing site topsoil suitable for retention & re-use?". To answer such a question, it is necessary to recover and test a large number of samples (a minimum of 10; ideally 20+) in order to undertake meaningful statistical analysis.

However, in the context of site investigation to assess the significance of contamination on brownfield sites which are typically underlain by **heterogenous made ground**, some remediation is almost always required (placement of soil cover, excavation of gross contamination etc). Consequently, in such circumstances, it is not necessary to demonstrate that made ground soils are "clean" and therefore there is no need to test large numbers of samples and undertake statistical analysis. Sample results can simply be compared directly with appropriate screening values (e.g. Lithos Tier 1 values).

The CL:AIRE (2020) guidance replaces the withdrawn "Guidance on Comparing Soil Contamination Data with a Critical Concentration" (2008).

The old approach to statistical analysis was based on a definitive yes/no answer which required limited consideration of the dataset and Conceptual Site Model. It was widely accepted that this did not allow sites or risk to be adequately assessed. The updated approach requires a comprehensive understanding of the datasets within the context of the Conceptual Site Model.

Current guidance requires that:

- A robust CSM is in place which identifies source areas, averaging areas and averaging zones
- Sampling locations are relatively evenly spread across the site and were selected using simple or stratified random sampling with no targeting being undertaken
- The field data and CSM do not suggest the presence of a hotspot of contamination which should be treated as a separate zone
- The samples are all taken from a similar same depth and within the same material type across the zone being assessed
- A minimum of 10 samples have been taken. It should be appreciated that confidence in a dataset increases as the number of samples obtained and tested from a zone increases.

The statistical analysis assumes a homogenous distribution of strata and contamination and therefore the dataset will be normally distributed (symmetric, log symmetric or fat tailed).

A normally distributed dataset is assessed using a number of statistical tools to generate a Dot and Box Plot which includes summary statistics and confidence intervals. The review of statistical data enables the assessor to make a decision, with an associated level of confidence, where the true mean of the sample population lies in relation to the critical concentration.

It is essential when using statistics to assess sample data that all decisions relate back to the conceptual site model. Statistics cannot indicate if contamination on a site is likely to present a risk to the end user, this is the role of the 'competent person' i.e. Lithos.

However, broadly speaking the following applies:

- Mean and UCL below the critical concentration – no further assessment required.
- Mean below the critical concentration, but UCL above – consider the CSM and likely sources.
- Mean and UCL above the critical concentration – further assessment required, remediation likely depending on the CSM.
- LCL, Mean & UCL above the critical concentration – further assessment required, remediation likely.

[2] *CL:AIRE, 2020.Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration.*

Other screening values used by Lithos

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 (2007) – Assessing risks posed by hazardous ground gases to buildings

BS 8485:2015 – 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 Sewage Sludge in Agriculture: Code of Practice 2018 for copper and zinc (at pH 5.5 to 6.0). The CLEA derived Tier 1 value 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".*

Tier 1 **groundwater risk assessments** are always site specific and compare leachate or groundwater concentrations with the appropriate water quality standard based on the CSM and consideration of relevant water quality impacts and assessments.

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**. 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 redevelopment 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 (e.g. 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 (e.g. WAC) is required.

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).

1. Undertake further statistical analysis following the approach set out in Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration, 2020 (see above) 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).
2. Carry out a more detailed quantitative risk assessment in order to determine whether contamination risks actually exist.
3. 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. Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration, 2020 provides some guidance on averaging areas noting that they are the area within which a receptor may be exposed to contamination but leaving the site assessor to determine the appropriate averaging area for their site.

Lithos consider 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; i.e. 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, i.e. contamination would normally be more pervasive and significant in granular soils than cohesive soils

06 - Soakaways
Generic notes – geoenvironmental investigations

Background

Soakaways have been the traditional way to dispose of stormwater from buildings and paved areas remote from a public watercourse. In recent years, soakaways have been used within urban, fully-sewered areas to limit the impact on discharge of new upstream building works, and to avoid costs of sewer up-grading outside a development.

Soakaways are increasingly seen as a more widely applicable option alongside other means of stormwater control and disposal. Soakaways must store the immediate stormwater run-off and allow for its efficient infiltration into the adjacent soil. They must discharge their stored water sufficiently quickly to provide the necessary capacity to receive run-off from a subsequent storm. The time taken for discharge depends upon the soakaway shape and size, and the surrounding soil's infiltration characteristics. Soakaways can be constructed in many different forms and from a range of materials.

BRE Digest 365, DG365: 1991 describes design and construction procedures, explains how to calculate rainfall design values and soil infiltration rates, and gives design examples. Further advice is provided in NHBC Standards Chapter 5.3 (Section 9 & Appendix F), Building Regulations Section 3 of Approved Document H (Drainage & Waste Disposal), and Chapter 13 of CIRIA's SUDS Manual (C753:2015).

Soakaways should generally be built on land lower than or sloping away from buildings and be sited at least 5m from the foundations of a building.

BRE365 states that 'Groundwater should not rise to the level of the base of the soakaway during annual variations in the water table' this is further reinforced in Chapter 13 of CIRIA C753:2015 which states that: "*A minimum distance of 1m between the base of the infiltration system and the maximum likely groundwater level should always be adopted. This is to minimise the risk of groundwater rising into the infiltration component and reducing the available storage volume, to protect the functionality of the infiltration process by ensuring a sufficient depth of unsaturated material and to protect the groundwater from any contamination in the run-off*". There may be a requirement to groundwater monitoring wells at a site in order to monitor seasonal variations in groundwater level at least over a wet winter period.

Soakaways should not be sited on sloping sites, an assessment should also be made to ensure that infiltrating water will not cause a rise in groundwater levels, waterlogging of downhill areas or springs, and that slopes are not made unstable.

Made ground (and ground within 5m of deep fill) is not generally regarded as suitable for soakaways, due to the potential for inundat settlement and the leaching of contaminants.

Chalk: CIRIA C574:2002 notes that concentrated ingress of water into the chalk can initiate dissolution, particularly in low-density chalk. For this reason, soakaways should be sited well away from foundations for structures, roads or railways:-

- in areas where dissolution features are known to be prevalent, soakaways should be avoided but, if unavoidable, should be sited at least 20m away from foundations etc
- where the chalk is of low density (weak), or where density is not known, soakaways should be sited at least 10m away from foundations
- where the chalk is of medium density, or higher (moderately weak), soakaways should be sited at least 5m away from foundations

Test methodology

Lithos undertake soakaway tests in general accordance with BRE Digest 365 "Soakaway Design". The BRE Digest recommends that each soakaway pit is filled and allowed to drain three times to near empty; the three fillings to be on the same or consecutive days. However, each test can take over 2 hours to complete. Consequently, at site investigation / feasibility stage, testing is usually undertaken in a 'broad sweep', relatively widely spaced; often only 1 or 2 fills. The drainage designer reviews SI data and if soakaways look feasible, commences design with the incorporation of soakaways. Prior to finalising design, the Drainage Engineer will usually recommend further soakaway testing: (a) within 25m of proposed chamber locations; and (b) to include 3 fills.

Whilst in theory 3 fills is fine, in practice it is often not straightforward. Where drainage rates are quick (draining < 1 hour), allowing 3 fills per pit within a day, even larger water bowsers (say 2,300 gallon/10,000 litre) will run out of water after testing in two pits. Re-filling can take 2 to 3 hours depending on available water supplies etc. So, it is typically only possible to do fully compliant BRE 365 testing in 4 pits a day.

Where infiltration is moderate (a fill drains in say 2 to 4 hours), soakaways may be considered feasible, but it will not usually be possible to complete 3 fills in a day. Therefore, it becomes necessary to leave pits open overnight (usually with a consequent need for herras fencing, site security etc, or the use of stone backfill).

Infiltration rates

Infiltration rates for each soakaway test are calculated (where possible) in accordance with BRE Digest 365. This design takes into account the time of emptying the soakaway pit between 25% and 75% of its effective depth. The effective depth is calculated from the starting water level to the soakaway pit base. Where the water level did not fall to 25% effective depth, the data was interpolated in order to obtain a representative infiltration rate.

Soakaway design

Soakaway design should be carried out by a suitably qualified and experienced Drainage Engineer, in accordance with BRE Digest 365 using the infiltration rates calculated from soakaway testing during a ground investigation.

It is generally assumed that soakaways become impracticable on residential developments when:

- A chamber type design requires a square pit with side length in excess of 1.8m, or an effective depth greater than 1.5m.
- A trench type design requires a length greater than about 10m, or an effective depth greater than 1.5m.

Increasing the soakaway effective depth might offer a solution, but consideration should be given to:

- Standing groundwater level
- Depth to base of permeable strata
- Cost of excavation

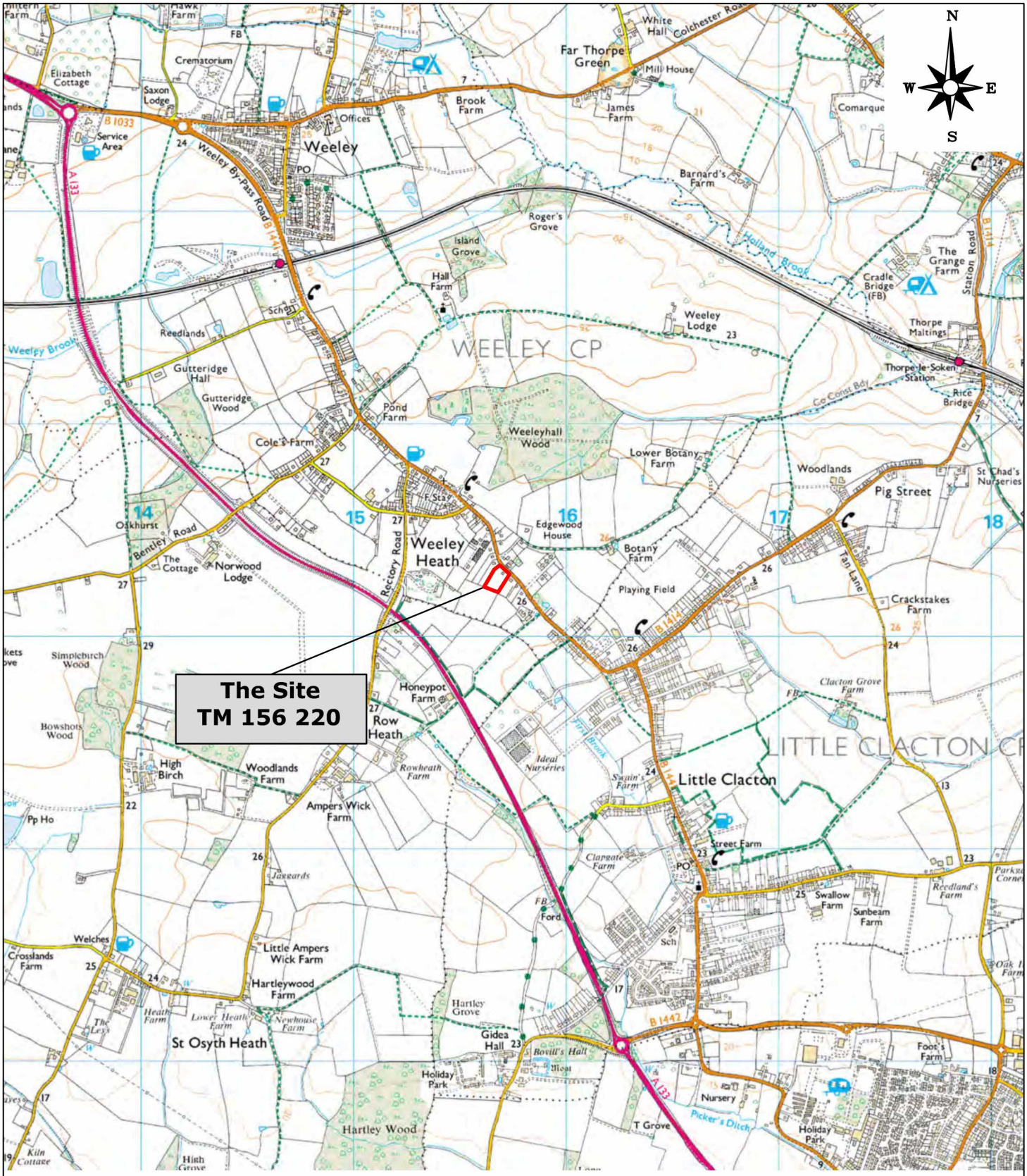
Soakaway percolation in some rock types is predominately via the vertical joints within the rock mass. The relatively small-scale soakaway test pits may not intercept such joints and this can result in variable test results. However, it is likely that the larger surface area of a completed soakaway within the development will intercept such joints.

The drainage designer submits designs for approval to:

- The Lead Local Flood Authority (LLFA), usually part of the Local Authority (e.g. NYCC). The LLFA are a consultee to the planning authority. They review the full technical design to ensure that proposals (both plots & highways) are satisfactory. The LLFA may also set standards for soakaway design (NYCC have, and these now require 3 fills and soakaway testing within 25m of proposed chamber locations).
- Local Authority Highways Dept. The Highways Authority adopt highways drainage, so review drainage design (via approval of a Section 38 submission). They also visit site to inspect construction.
- Building warranty provider (e.g. NHBC, Premier etc), if soakaways are proposed for roof & driveway waters.

Appendix B

Drawings



LITHOS CONSULTING

[redacted]

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DRAWING TITLE	SITE LOCATION PLAN
DRAWN	LEW
DATE	13 06 23
CHECKED	ASw
DATE	13 06 23
STATUS	FOR COMMENT ☐ DRAFT ☐ FOR APPROVAL ☐ FINAL ☑
SCALE	1:25,000
SHEET	A4
DRAWING NO.	4762/1
REVISION	

NOTES

APPROXIMATE SITE BOUNDARY

REPRODUCED FROM LNT CONSTRUCTION DRAWING REFERENCE C016 9EP - F.01, DATED 30 03 2023

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

[redacted]

CLIENT

LNT CARE DEVELOPMENTS LTD

JOB TITLE

CLACTON ROAD, WEELEY HEATH

DRAWING TITLE

PROPOSED SITE LAYOUT

DRAWN	DATE	STATUS
LEW	13 06 23	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
ASw	13 06 23	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:500	A3	4762/2	

NOTES

- GRASSED AREAS
- OVERGROWN AREAS
- TREES
- POND
- BUILDINGS
- GRAVEL SURFACING
- PAVING
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

CLIENT

LNT CARE DEVELOPMENTS LTD

JOB TITLE

CLACTON ROAD, WEELEY HEATH

DRAWING TITLE

SITE FEATURES

DRAWN	DATE	STATUS
LEW	13 06 23	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
ASw	13 06 23	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
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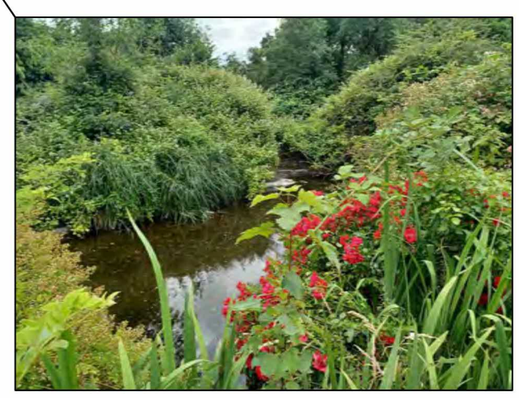

N
W E
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NOTES

- GRASSED AREAS
- OVERGROWN AREAS
- TREES
- POND
- BUILDINGS
- GRAVEL SURFACING
- PAVING
- APPROXIMATE SITE BOUNDARY
- LOCATION & ORIENTATION OF PHOTOGRAPH

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

[redacted]

CLIENT

LNT CARE DEVELOPMENTS LTD

JOB TITLE

CLACTON ROAD, WEELEY HEATH

DRAWING TITLE

SITE PHOTOGRAPHS

DRAWN	DATE	STATUS
LEW	07 07 23	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
ASw	07 07 23	DRAFT ☐
		FINAL ☑

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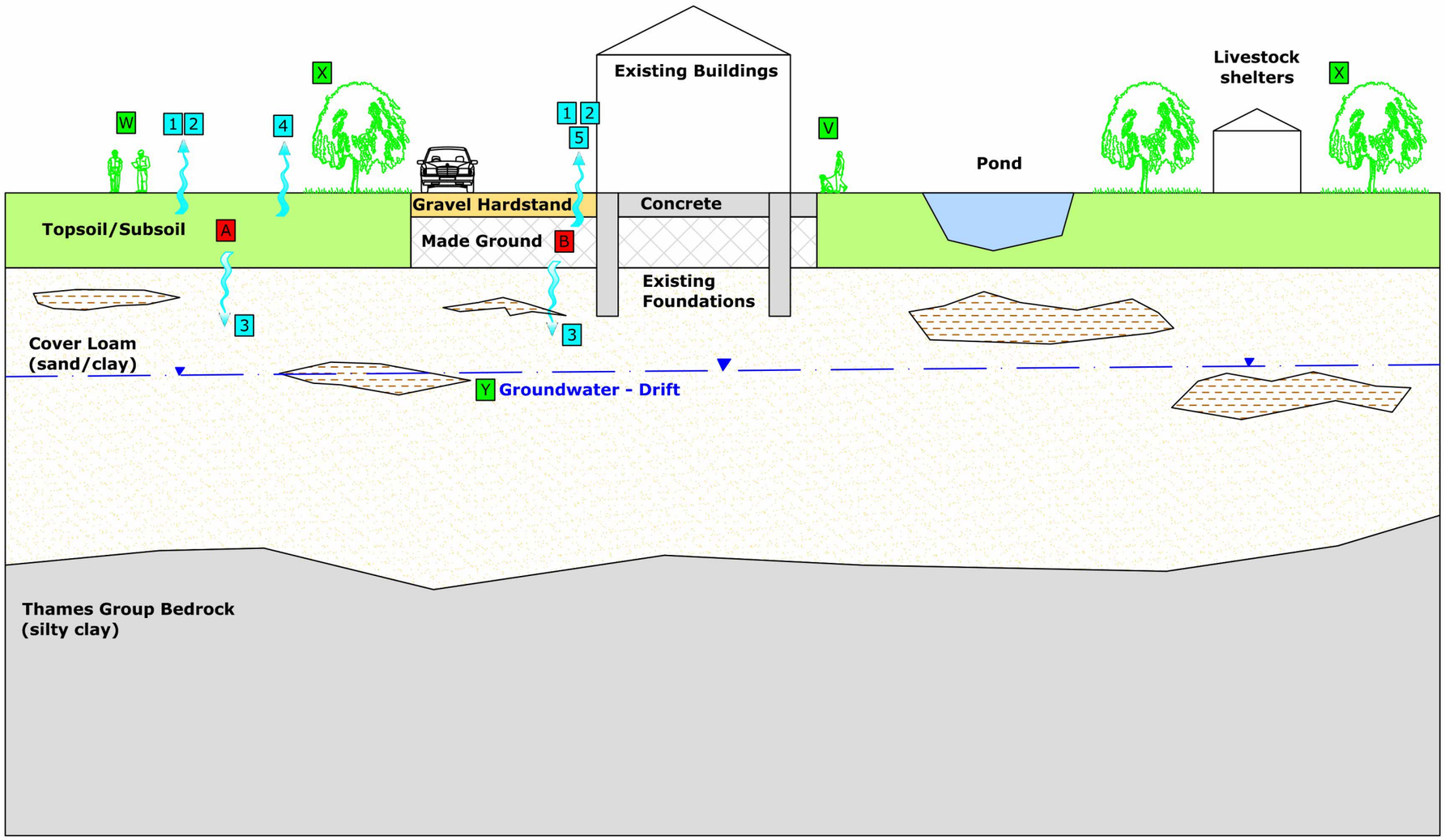

SOURCES	PATHWAYS	RECEPTORS
A TOPSOIL (INORGANICS & ORGANICS)	1 DERMAL CONTACT	V END USERS (RESIDENTS)
B MADE GROUND (INORGANICS & ORGANICS)	2 INGESTION/INHALATION	W SITE WORKERS
	3 LEACHING OF CONTAMINANTS	X VEGETATION
	4 UPTAKE BY PLANTS	Y GROUNDWATER
	5 VOLATILISATION	

NOTES

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

CLIENT

LNT CARE DEVELOPMENTS LTD

JOB TITLE

CLACTON ROAD, WEELEY HEATH

DRAWING TITLE

PRELIMINARY CONCEPTUAL SITE MODEL

DRAWN	DATE	STATUS
LEW	02 07 23	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
ASw	02 07 23	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
Not to scale	A3	4762/5	

NOTES

- TRIAL PIT LOCATION
- SOAKAWAY TEST LOCATION
- TOPSOIL SAMPLE LOCATION
- APPROXIMATE SITE BOUNDARY

EXPLORATORY HOLE LOCATIONS BASED ON DATA FROM A HAND-HELD GPS (+/- 3M ACCURACY)

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

CLIENT

LNT CARE DEVELOPMENTS LTD

JOB TITLE

CLACTON ROAD, WEELEY HEATH

DRAWING TITLE

EXPLORATORY HOLE LOCATIONS

DRAWN	DATE	STATUS
LEW	06 07 23	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
ASw	06 07 23	DRAFT ☐
		FINAL ☑

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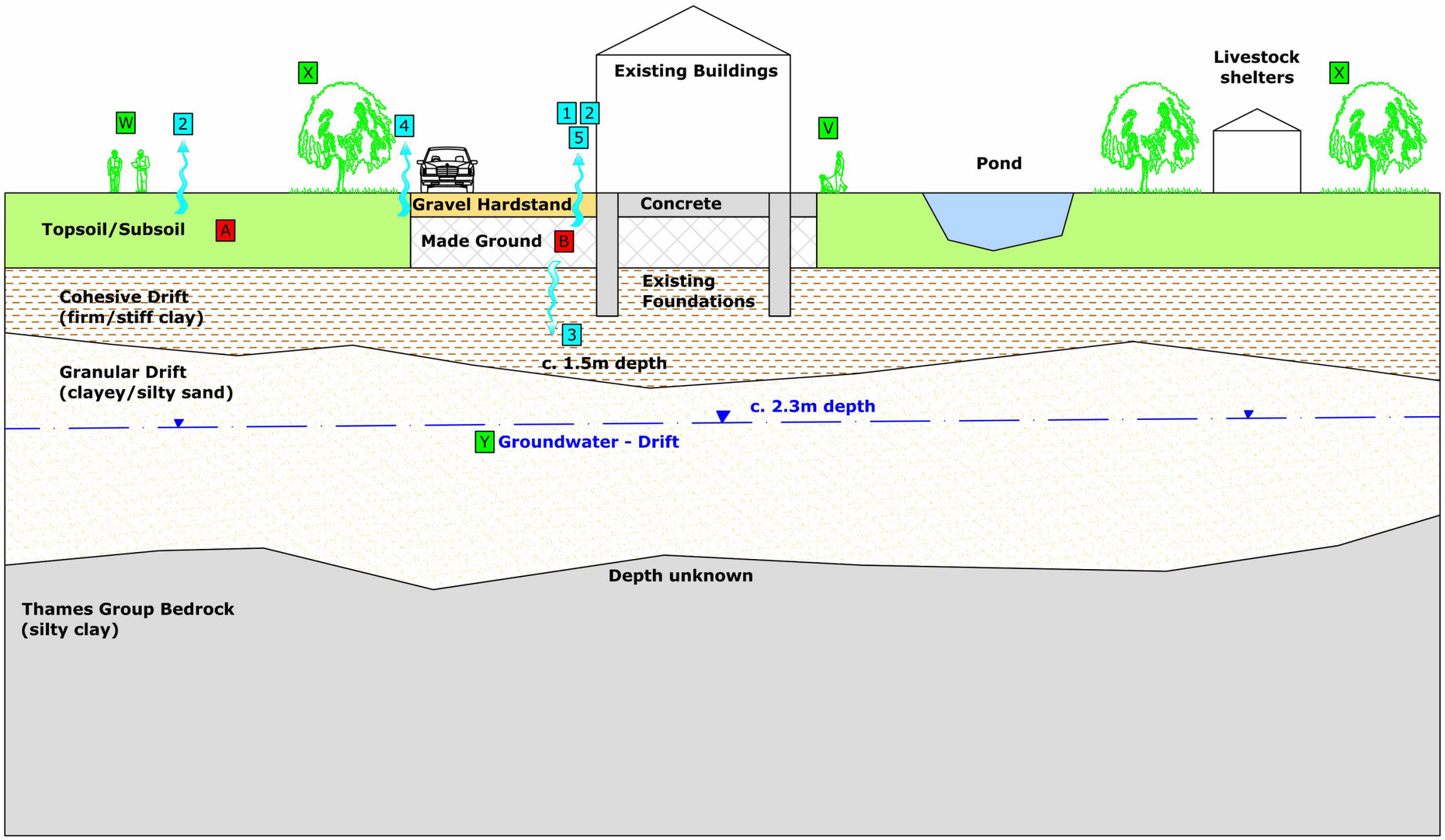


SOURCES	PATHWAYS	RECEPTORS
A TOPSOIL (ASBESTOS)	1 DERMAL CONTACT	V END USERS (RESIDENTS)
B MADE GROUND (INORGANICS & ORGANICS)	2 INGESTION/INHALATION	W SITE WORKERS
	3 LEACHING OF CONTAMINANTS	X VEGETATION
	4 UPTAKE BY PLANTS	Y GROUNDWATER
	5 VOLATILISATION	

NOTES

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

CLIENT

LNT CARE DEVELOPMENTS LTD

JOB TITLE

CLACTON ROAD, WEELEY HEATH

DRAWING TITLE

REVISED CONCEPTUAL SITE MODEL

DRAWN	DATE	STATUS
LEW	02 08 23	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
ASw	02 08 23	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
Not to scale	A3	4762/7	

Appendix C

Commission

002/4762/ASw

6th June 2023

LITHOS CONSULTING

Registered in England 07068066

Parkhill
Wetherby
West Yorkshire
LS22 5DZ

[redacted]

Ms S Rose
LNT Care Developments Ltd
Helios 47
Isabella Road
Garforth
LS25 2DY

Dear Sam

Clacton Road, Weeley Heath

Further to your recent invitation, please find attached our proposal for undertaking a site investigation on the above land. We understand that proposed development will include a 3 storey care home with parking and landscaped areas; a sketch layout has been provided.

Review of the information supplied suggests that the site consists of a single parcel of land of c. 0.8 ha. Review of Google Maps suggests the site is currently occupied by a residential dwelling and associated gardens.

Brief review of internet data suggests the site:

- Appears to have been occupied by the existing house since the 1930s;
- Is not located within 250m of a known landfill site;
- Is not within a groundwater source protection zone;
- Is in an area where the risk of encountering UXO is considered low; and
- Is located beyond the Coal Authority's defined coalfields.

Brief examination of the relevant geological map suggests the site is underlain by Coversands (fine grained aeolian sands with beds of clay and silt) with Thames Group bedrock (mainly silty clays and clays) estimated from around 6m depth.

The scope of works outlined in this letter should enable us to assess abnormal development issues, associated with the ground. However, the nature of site investigation is such that it is not always possible to foresee all the potential issues. Consequently, it is sometimes necessary to recommend additional work, but where this occurs we will inform you immediately, provide costs, and seek your further instruction. We have visited site and reviewed available internet data and our geological maps in order to minimise the likelihood of further work.

Ground investigation is generally best undertaken once the site is vacated and preferably post-demolition; access constraints associated with existing buildings and underground service runs, can prevent thorough inspection of the ground via extensive trial pitting/trenching. Consequently, some uncertainties may remain and a supplementary, post-demolition ground investigation may be required by the relevant regulatory authorities.

Nonetheless, useful data can be obtained at this time and we will certainly aim to resolve as much uncertainty relating to ground as possible, in order to enable you to make an unconditional offer for the site.

We will need a Promap or topo survey in CAD format, to provide a base plan for technical drawings etc. If you do not have one, we could obtain at cost plus £**.

Our site investigation will be undertaken in accordance with UK good practice (as outlined in BS5930, BS10175, LCRM etc). Our Report may not be fully compliant with Eurocode 7 (EC7) and will not purport to be a Ground Investigation Report, nor a Geotechnical Design Report as defined by EC7. Our ground appraisal is intended to assist others as they proceed with design of the proposed development.

This proposal allows for the following works:

Desk study: Environmental search data and historical maps (obtained from Landmark), will be reviewed in order to determine whether past land uses have had any effect on the proposed development. In addition, published geological plans of the area will be examined.

We will also visit site to undertake a walkover survey. However, given travel time to Weeley Heath, the walkover will be done the day before fieldwork commences (usually we would do a walkover a week or two in advance of fieldwork).

Fieldwork: We have allowed for a day's trial pitting (with soakaway testing) supervised and logged by an experienced geoenvironmental engineer.

This proposal has been put together without a recent site visit and it has been assumed that access will be available for a wheeled JCB 3CX-type excavator. If this is not the case, it may be necessary to hire additional resources (bog mats, tracked mini excavators, stone etc) in order for works to continue. We will discuss the requirement for any such items and associated costs with you prior to ordering.

Trial pitting will enable us to determine the:

- Nature of any made ground
- Nature, distribution and thickness of shallow soils
- Suitability of the ground for soakaways
- Suitability of the ground for founding structures and highways

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 trial 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 up to 400mm proud at each trial pit location.

We will minimise the amount of trafficking around the site where possible to minimise the damage to existing paths, grassed areas etc.

However, at this stage, no allowance has been made for any further reinstatement such as removal of excess arisings, replacement of turf, reinstatement of wheel marks etc. Please ensure that this would be acceptable to the property owner prior to commencement of works as full reinstatement and disposal of excess arisings off site would add significant costs to the proposal.

If the pitting encounters significant thicknesses of made ground or very soft/loose deposits (the latter is considered possible), boreholes may be required to obtain geotechnical data from greater depth. We will advise you of any need for boreholes within 2 days of completion of the pitting.

Soakaway testing will also be carried out in 3 pits in order to assess the suitability of the ground for plot and highway surface water drainage.

In line with BRE Digest 365 "Soakaway Design", you have requested that each soakaway pit is filled and allowed to drain three times to near empty (where possible).

Given the anticipated need for 3 fills (and therefore testing over 2 or 3 days), we have allowed for the provision of heras fencing to prevent unauthorised access and ensure pits can be safely left open overnight.

If infiltration rates are good, we should be able to complete 3 tests within each pit in a day. Conversely, if infiltration rates are very poor, it might be concluded that further testing is not worthwhile. If infiltration rates are modest, we will likely require a further day (or two) of testing.

Given the potential for excavation instability, we have allowed for the import limestone chippings (75mm, single size) to site a day or so before the soakaway testing (10 tonnes temporarily at a location to be agreed with the property owner (subject to vehicle access). We will then use the JCB to dig holes and cart stone to fill the soakaway pits (in order to prevent collapse during test). We will leave stone at least 500mm below ground level, so that the pits can be reinstated with topsoil. However, we will have to 'lose' the surplus subsoil arisings somewhere on site; probably close to a boundary hedge. It would be worth discussing this with the landowner.

Our fee for undertaking the Soakaway testing (Item D of the attached breakdown) is £**** plus VAT (Day 1); and then £****/day thereafter (inclusive of plant hire and supervision).

This investigation should yield sufficient data to enable a foundation zoning plan, and possibly a detailed Foundation Schedule. However, if ground conditions are found to be more variable than anticipated, a 'tighter' grid of pits will be necessary prior to preparation of a detailed Foundation Schedule. This proposal does not allow for the preparation of a detailed Foundation Schedule, but we will provide a quote on completion of the site investigation if requested.

At this stage, we have assumed that overnight security will not be required, but this will be reviewed following a site visit. If required, security would be an E/O of £*** per night.

Exploratory holes will be positioned a hand-held GPS (typically +/- 3m accuracy); if required we could arrange for a surveyor to pick-up exploratory holes (and provide co-ordinates/ground levels) for an E\O cost of £***.

This site is brownfield and therefore likely to be underlain by made ground. However, the rate of gas generation within most made ground tends to be low, resulting in small concentrations and flows. Consequently, at this stage, we have not allowed for undertaking a hazardous gas risk assessment but we will review the need for this in light of desk study data and the ground conditions actually encountered.

Testing : This will comprise routine geotechnical soils analysis, including 10 moisture content & Atterberg limits, 10 pH & water-soluble sulphate and 5 gradings.

Current and former use of the site (residential) are considered unlikely to have resulted in significant contamination of the ground. Consequently, we have only allowed for contaminant testing of up to 6 made ground samples, plus a further 10 samples of topsoil to confirm its suitability for re-use. The test suite will include heavy metals, speciated PAH, and banded TPH (with supplementary speciation as/where appropriate).

If more significant made ground is encountered, we will inform you immediately and provide costs for the recommended chemical testing.

We have also allowed for 3 waste acceptance criteria (WAC) tests on made ground, with a further 3 tests on samples of natural ground. WAC testing is required for any material deposited within a landfill and will identify which landfill type can accept the waste, i.e. inert, non-hazardous etc. WAC analysis is different to the 'routine' laboratory testing undertaken in order to determine hazardous properties; hazardous properties of a waste cannot be determined by WAC testing.

Within in our proposal we have allowed for the screening (ID) of 16 samples for asbestos. In the event that positive IDs are reported, it is likely that we will need to schedule further analysis (asbestos quantification), in order to determine the significance of the results.

Asbestos quantification is currently a relatively expensive test and consequently we have not allowed for it at this stage. We will inform you immediately after receipt of results if we consider asbestos quantification is required.

Visible contaminants, sharps and the clay/sand/silt content of 3 topsoil samples will be determined to check compliance with BS3882 requirements.

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 3 days of fieldwork completion.

On completion of the desk study, fieldwork and laboratory testing a comprehensive, factual and interpretative report will be issued. This will contain exploratory hole logs, 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 include consideration of foundation types.

At the time of writing, fieldwork could be commenced within 3 weeks of receipt of your written instruction to proceed. Our comprehensive geoenvironmental appraisal report will be issued within 4 weeks of fieldwork completion.

Given previous usage of this land, a **Remediation Statement** may be required by the Local Authority to support discharge of planning Conditions. If required, we will provide a separate Remediation Statement for an E\O fee of c. £***.

A copy of the final report 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. Revision of the costings provided may be required if works are not instructed within **3 months** of the date this proposal was issued.

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 invoices for this project on completion of each Item(s) instructed.

Please note if following instruction of the works outlined in this proposal, it is necessary to subsequently **postpone or cancel**, this should be done at least 3 working days before Lithos are due to commence intrusive investigation on site. We reserve the right to charge a cancellation fee in the event of later notification to cover plant / drill rig costs and abortive consultancy time. The cancellation fee will not exceed £**** plus VAT.

Health, safety & welfare: The works outlined above will be carried out in accordance with Lithos' task- and site- specific Risk Assessments and Method Statements.

Details of welfare will be included within the Method Statements. However, this investigation is expected to last for up to 3 working days in the gardens of a residential property and therefore this proposal includes for provision of a chemical toilet.

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).

However, Lithos cannot accept liability for damage to any underground services that are not accurately marked on plans made available to us prior to commencement of our field investigation, or have not been accurately marked on the ground by a responsible third party (e.g. utility company, site owner).

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. However, if you do not have the necessary plans, Lithos will obtain them direct from each of the utility companies.

It is highly likely that the site is underlain by many "private" services and drains etc which will not be shown on statutory utility plans. Consequently, it would be appreciated if copies of plans showing these services could be made available to our field engineer, and\or someone with site knowledge could advise us with respect to safe locations for our exploratory holes.

Under the **CDM** Regulations 2015, Lithos must be provided with pre-construction information already in your possession, or information that can reasonably be obtained through sensible enquiry. This information must be relevant to the project, have an appropriate level of detail, and be proportionate to the nature of the risks.

If no other designers or contractors have been appointed, Lithos could perform the role of Principal Contractor but only for the duration of the site investigation outlined in this proposal. If you require us to perform the role of Principal Contractor, please make this clear in your instruction. It should be noted that we are not suitably qualified to perform this role where other designers or contractors are also appointed.

It is anticipated that the site investigation outlined in this proposal will be undertaken several months before any construction is commenced on site. Consequently, our works can be considered in isolation and, given the anticipated number of person days on site, this site investigation is not notifiable to the HSE.

Further work: In addition to the investigation outlined above, the following further works may ultimately be required:

- **Cable percussion boreholes**, in order to carry out SPTs at approximate 1m intervals to allow assessment of the in-situ density of granular soils and confirm either that they are strong enough to support shallow footings or provide data for Vibro contractors. The ability to use temporary steel casing to line the borehole during drilling, enables the recovery of more reliable geotechnical data.
- Further pitting and testing within the footprint of the existing house following demolition.
- Preparation of a **Remediation Statement**.

Terms & conditions: LNT and Lithos have an agreed and signed Appointment document, a copy of which is enclosed, and this work will be undertaken in accordance with that.

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

Yours sincerely

[redacted]

Alan Swales
Associate Director
for and on behalf of
LITHOS CONSULTING LIMITED

1 DEFINITIONS AND INTERPRETATION

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

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

"Documents" means 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 us, and whether in paper form or stored electronically or on disk, or otherwise;

"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;

"Project" means the project described in the Proposal and any enquiry from you on which we have based our Proposal;

"Proposal" means the offer document prepared by us 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 us pursuant to the Agreement and as set out in the Proposal and includes any additions or amendments thereto made in accordance with these Terms;

"Terms" means these terms entitled "Lithos Consulting Terms of Appointment" as amended from time to time.

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 You agree to engage us and we agree to provide the Services in accordance with the provisions of this Agreement.

3 OUR OBLIGATIONS

3.1 We shall perform the Services using the reasonable standard of skill and care normally exercised by qualified members of our profession, performing similar services under similar conditions.

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

4 YOUR OBLIGATIONS

4.1 Throughout the period of this Agreement you shall afford to us, or procure for our benefit, access to any site where access is required for the performance of the Services.

4.2 You accept responsibility for ensuring that we are 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, which you shall clearly mark on the ground or identify on accurate location plans supplied to us prior to the commencement of the Services. You shall also inform us 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. You shall indemnify us against all costs, losses, 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 you discover any conflict, defect or other fault in the information or designs provided by us pursuant to the Agreement, you will advise us in writing of such defect, conflict or other fault and we 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 COPYRIGHT

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

5.2 You shall have a non-exclusive licence to copy and use such Intellectual Property for purposes directly related to the Project. Such licence shall enable you to copy and use the Intellectual Property but solely for your 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 us.

5.3 Should you 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, you must obtain our prior written consent. The giving of such consent shall be at our absolute discretion and shall be upon such terms as we may require. We shall not be liable to you 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 our behalf.

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

5.5 In the event of you being in default of payment of any fees or other amounts due, we may suspend further use of the licence on giving no less than 2 calendar days' notice of the intention to do so. Use of the licence may be resumed on receipt of the outstanding amounts.

6 CONFIDENTIALITY

6.1 Neither you nor we shall at any time disclose to any person any confidential information concerning the business, affairs, customers, clients or suppliers of the other party or of any member of the group of companies to which the other party belongs, except as permitted by clauses 6.2 and 6.4.

6.2 Each party may disclose the other party's confidential information:

(a) to its employees, officers, representatives, contractors, sub-contractors or advisers who need to know such information for the purposes of exercising the party's rights or carrying out its obligations under or in connection with this Agreement. Each party shall ensure that its employees, officers, representatives, contractors, sub-contractors or advisers to whom it discloses the other party's confidential information comply with this paragraph 6; and

(b) as may be required by law, to a court of competent jurisdiction or any governmental or regulatory authority.

6.3 Neither you nor we shall use any other party's confidential information for any purpose other than to exercise our rights or perform our respective obligations under or in connection with this Agreement.

6.4 Subject to the above and our privacy policy which can be found on www.lithos.co.uk, we shall be permitted to use information related to the Services we provide in connection with the Project for the purposes of marketing its services and in proposals for work of a similar type.

7 ASSIGNMENT

7.1 You may assign the benefit of this Agreement on two occasions with our prior written consent (not to be unreasonably withheld) and any additional assignments shall be with our prior consent.

7.2 We may at any time assign, mortgage, charge, subcontract, delegate, declare a trust over or deal in any other manner with any or all of our rights and obligations under this Agreement.

8 INSURANCE

8.1 We shall maintain a professional indemnity insurance policy covering our liabilities for negligence under this Agreement, with a limit of indemnity of £5,000,000 (FIVE MILLION POUNDS) any one claim, save for pollution and contamination claims and asbestos claims both of which carry £2,000,000 (TWO MILLION POUNDS) in the aggregate cover. This policy is annually renewable and whilst renewal is not automatic, We shall maintain such insurance at all times until six years from the date of the completion (or termination) of the Services under this Agreement, provided such insurance is available at commercially reasonable rates and terms.

8.2 If for any period such insurance is not available at commercially reasonable rates and terms, we shall inform you 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 us to obtain.

9 PAYMENT

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

9.2 You shall pay you any VAT properly chargeable on the Services and any amount expressed as payable to us under this Agreement is exclusive of VAT unless stated otherwise.

9.3 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.

9.4 If you dispute the amount included for payment in an invoice then you must serve a written notice on us no later than 14 calendar days before the final date for payment. If no notice is given within the required timeframe the amount due shall be the amount stated in the invoice.

9.5 If you fail to pay any monies in accordance with the foregoing payment provisions, we shall be entitled to charge interest on any monies owed to us, such interest to be at a rate of 4% 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. The parties acknowledge that our liability under this clause 10.5 is a substantial remedy for the purposes of section 9(1) of the Late Payment of Commercial Debts (Interest) Act 1998.

10 LIMITATIONS ON LIABILITY

10.1 Unless otherwise agreed in writing, our total liability under or in connection with this 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 the level of insurance cover referred to within clause 8.1 above, or 20 times the total value of invoices issued to you for the Services.

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 us after the expiry of a period of six years from the date of the completion (or termination) of the Services under this Agreement.

10.3 Whilst we usually scan for potential exploratory locations with a Cable Avoidance Tool, we 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 We shall not be liable for the cost of rectifying any defect, conflict or other fault in the information or designs provided by us 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 we have been advised in writing of the same by you and have 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 DELAY

We shall comply with any timescale agreed for completion of the Services unless delayed or prevented by circumstances beyond our reasonable control and in the event of any such circumstances arising we undertake to complete the Services within a reasonable period, but will not be liable to you for any delay as a result.

12 TERMINATION

12.1 The Agreement may be terminated by either of us 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 termination must be given to the party which is insolvent by the other party.

12.2 If for any reason our Services are suspended for a period in excess of three calendar months then we shall be entitled to terminate our appointment under this Agreement in respect of the Services by no less than seven days written notice to you.

12.3 If you fail to pay in full any sum due under the terms of this Agreement by the final date for payment for that sum and no effective pay less notice is issued, we may serve written notice to you demanding payment within 14 days of such notice. If you fail to comply with such notice, we shall be entitled to terminate our employment under this Agreement forthwith.

12.4 Any termination of our appointment howsoever caused shall be without prejudice to our rights to require payment for all Services performed up to the date of such termination 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.

13 THIRD PARTY RIGHTS

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.

14 COLLATERAL WARRANTIES & LETTERS OF RELIANCE

We shall consider and may consent to a request from you for us to enter into a collateral warranty or letter of reliance with a third party with regard to the Servicesprovided under this Agreement. The giving of such consent shall be at our absolute discretion and providing we agree to our standard form of collateral warranty or letter of reliance (subject to any reasonable changes to be approved by us at our absolute discretion) and in return for payment of a fee (to be notified at the time of the request).

15 NOTICES

15.1 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 pre-paid 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 our respective registered office addresses.

15.2 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 pre-paid first class post.

16 ENTIRE AGREEMENT

16.1 The Agreement constitutes the complete and entire agreement between us 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 us in respect of the Services can only be made in contract under the provisions of this Agreement and not otherwise under the law or tort or otherwise.

16.2 No amendments, modifications or variation of this Agreement shall be valid unless made in writing and agreed to by us; such agreement must be recorded in writing by at least one of us.

16.3 We shall not be bound by any standard or printed terms or conditions furnished by you in any of your documents unless we specifically state in writing separately from such documents that we intend such terms and conditions to apply.

17 DISPUTES, JURISDICTION AND GOVERNING LAW

17.1 This Agreement shall be governed by and construed in accordance with English law and we irrevocably and unconditionally submit to the jurisdiction of the English Courts.

17.2 Where the Housing Grants, Construction and Regeneration Act 1996 applies, any dispute between us 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.

Dan Platford

Subject: 4762: Clacton Road, Weeley Heath

From: Sam Rose <[redacted]
Sent: Thursday, June 8, 2023 8:43 AM
To: Alan Swales [redacted]
Subject: RE: 4762: Clacton Road, Weeley Heath, CO16 9EP (SI Quote)

Thanks Alan, please find attached PO confirming instruction. Please confirm a date for the works and provide a copy of your RAMS. We have discussed reinstatement with the seller and they're aware of what's involved, but if you can make it clear within the RAMS so I can ask them to approve before works commence.

We've instructed Murphys to complete a utility mapping survey and I'm just awaiting a date for this, but can provide the results once available.

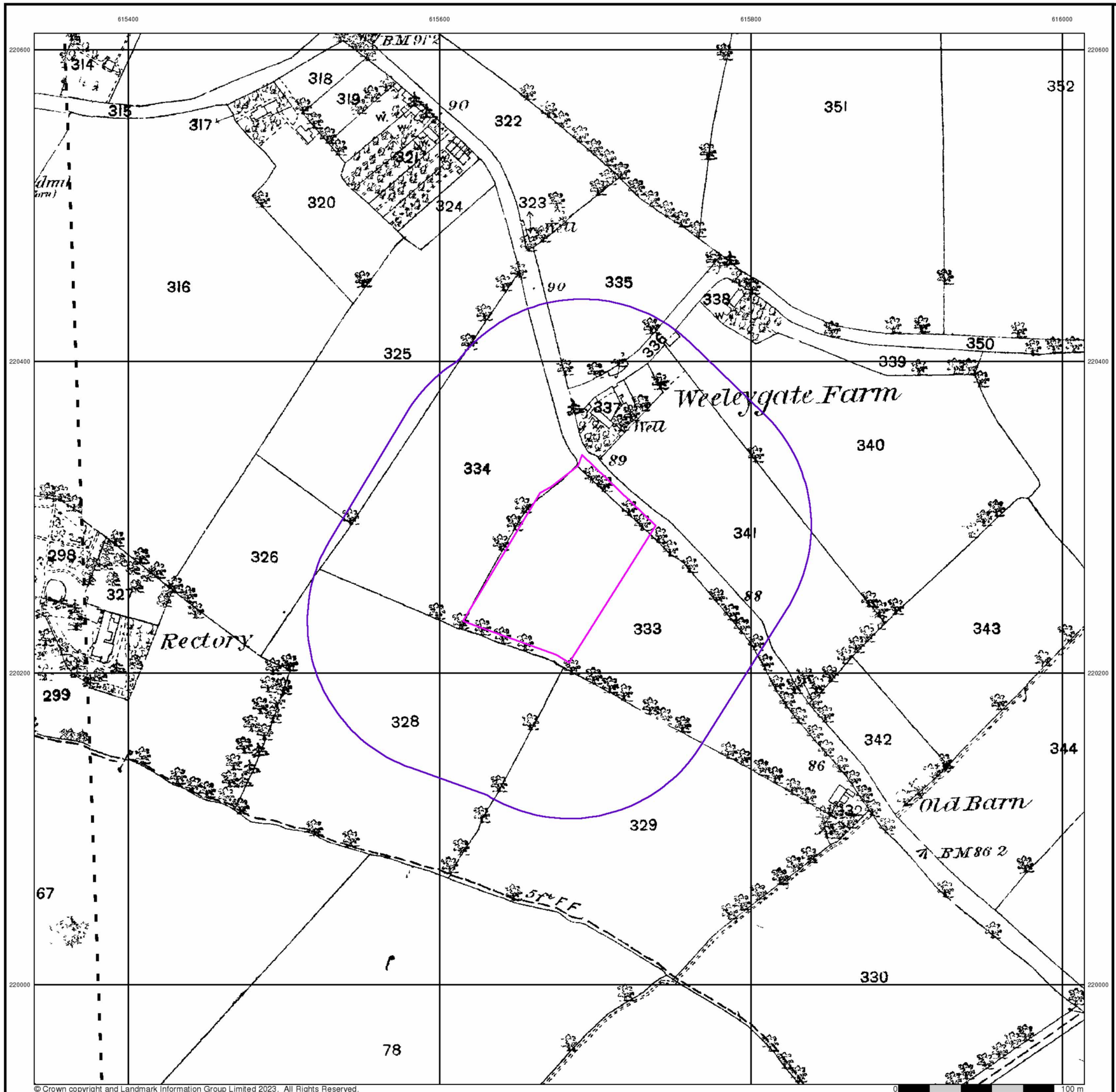
We do have another project coming up in Bristol which will probably take priority over this one, but I'll let you have the details shortly.

Kind regards

Sam

Appendix D

Historical OS Plans



0 100 m

LITHOS CONSULTING

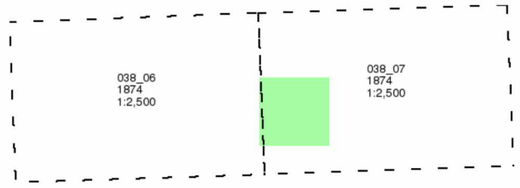
Essex

Published 1874

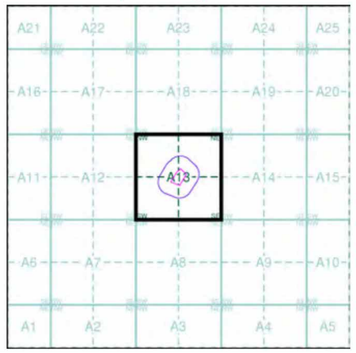
Source map scale - 1:2,500

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

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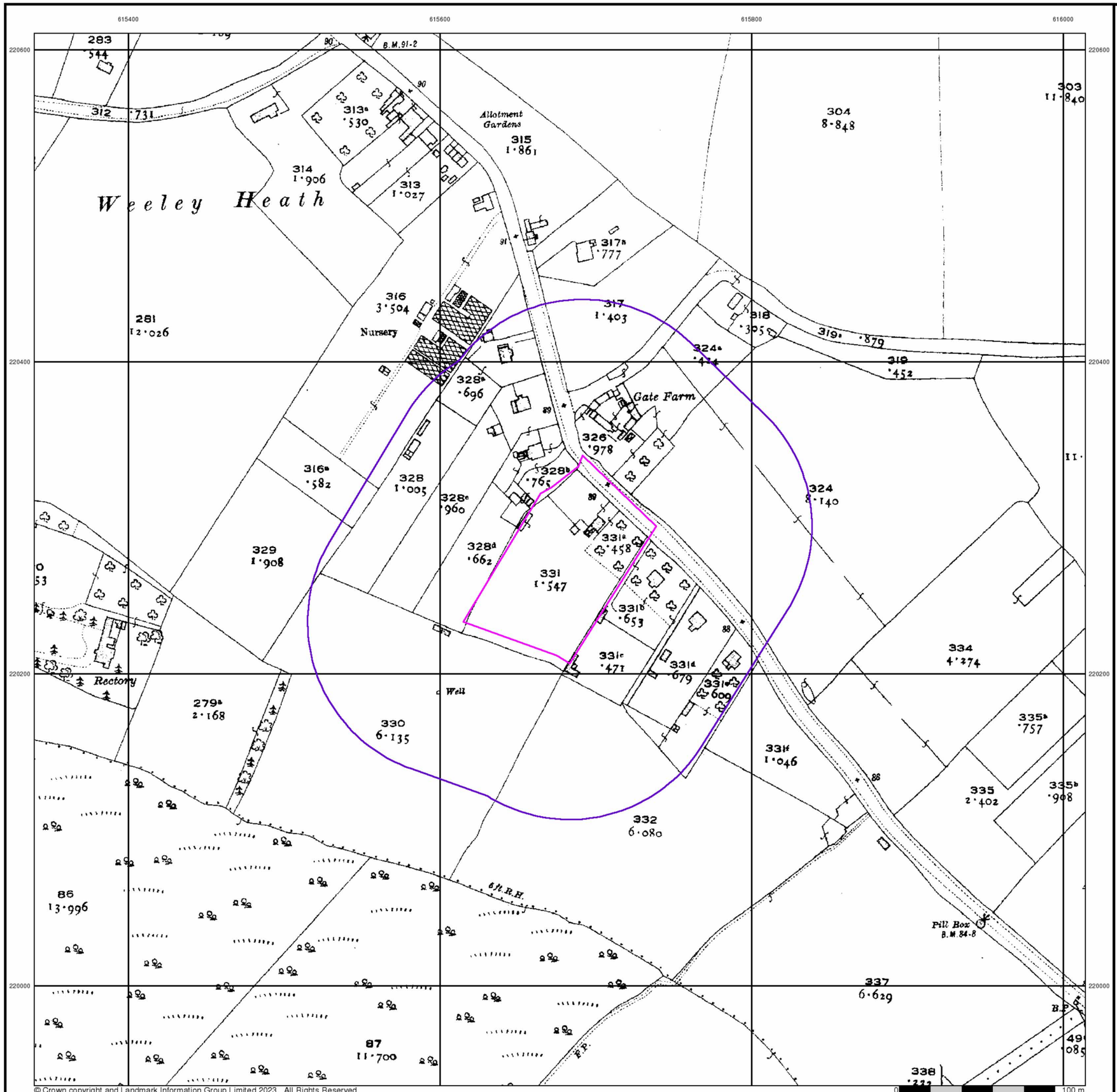
Customer Ref:	PO20801/CH/4762
National Grid Reference:	615680, 220270
Slice:	A
Site Area (Ha):	0.84
Search Buffer (m):	100

Site Details

Clacton Road, Weeley Heath, CO16 9EF

Landmark INFORMATION GROUP



LITHOS CONSULTING

Essex

Published 1923

Source map scale - 1:2,500

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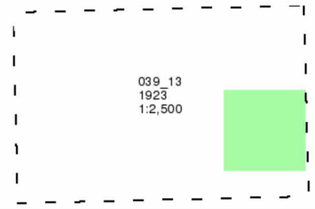
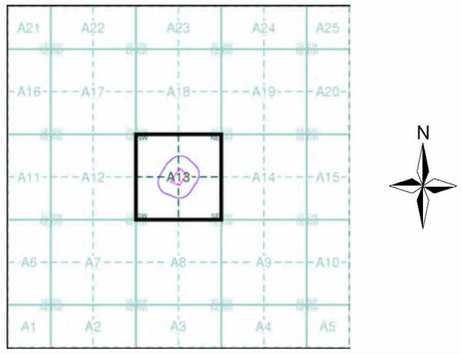
Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

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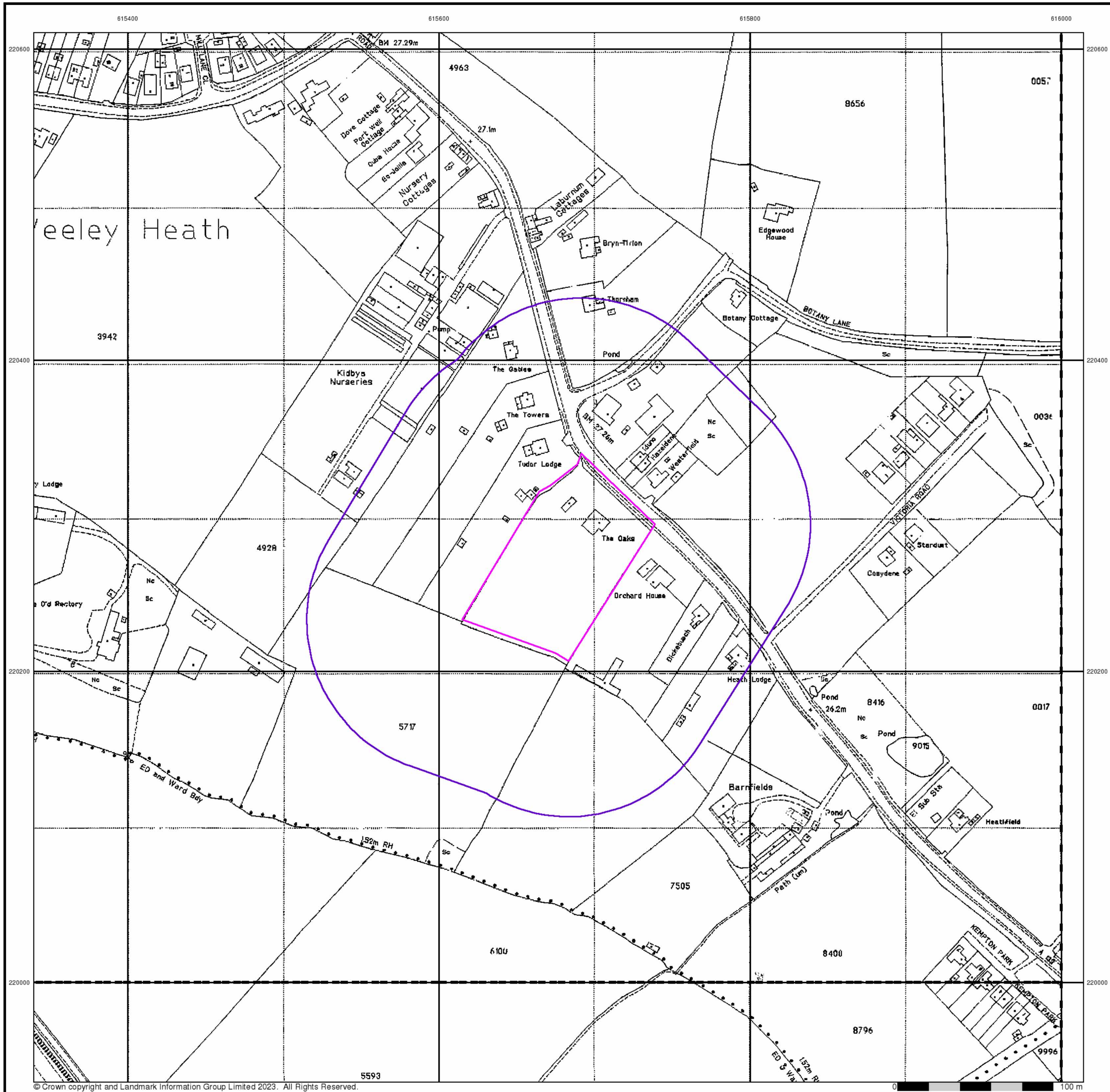
Customer Ref:	PO20801/CH/4762
National Grid Reference:	615680, 220270
Slice:	A
Site Area (Ha):	0.84
Search Buffer (m):	100

Site Details

Clacton Road, Weeley Heath, CO16 9EF

Landmark INFORMATION GROUP



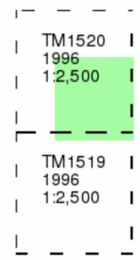
Large-Scale National Grid Data

Published 1996

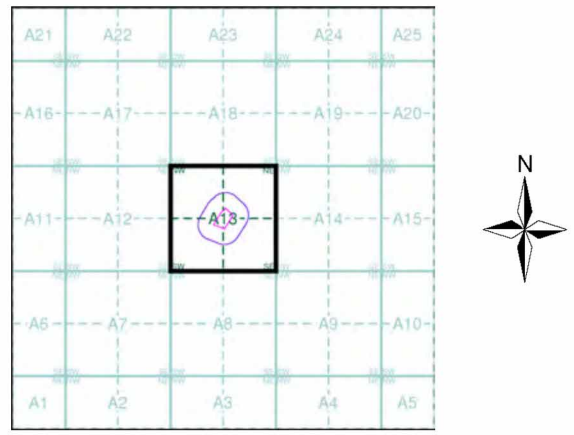
Source map scale - 1:2,500

'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: 312601118_1_1
Customer Ref: PO20801/CH/4762
National Grid Reference: 615680, 220270
Slice: A
Site Area (Ha): 0.84
Search Buffer (m): 100

Site Details

Clacton Road, Weeley Heath, CO16 9EF

[redacted]

Appendix E

Search Responses & other Correspondence

Envirocheck® Report:

Datasheet

Order Details:

Order Number:
312601118_1_1

Customer Reference:
PO20801/CH/4762

National Grid Reference:
615680, 220270

Slice:
A

Site Area (Ha):
0.84

Search Buffer (m):
1000

Site Details:

Clacton Road
Weeley Heath
CO16 9EF

Client Details:

Mr M Perrin
Lithos Consulting Ltd
Parkhill
Walton Road
Wetherby
LS22 5DZ

Contents

Introduction

The Environment Act 1995 has made site sensitivity a key issue, as the legislation pays as much attention to the pathways by which contamination could spread, and to the vulnerable targets of contamination, as it does the potential sources of contamination.
For this reason, Landmark's Site Sensitivity maps and Datasheet(s) place great emphasis on statutory data provided by the Environment Agency/Natural Resources Wales and the Scottish Environment Protection Agency; it also incorporates data from Natural England (and the Scottish and Welsh equivalents) and Local Authorities; and highlights hydrogeological features required by environmental and geotechnical consultants. It does not include any information concerning past uses of land. The datasheet is produced by querying the Landmark database to a distance defined by the client from a site boundary provided by the client.
In this datasheet the National Grid References (NGRs) are rounded to the nearest 10m in accordance with Landmark's agreements with a number of Data Suppliers.

Report Version v53.0

LITHOS CONSULTING

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Agency & Hydrological					
BGS Groundwater Flooding Susceptibility	pg 1			Yes	n/a
Contaminated Land Register Entries and Notices					
Discharge Consents	pg 1		5	1	8
Prosecutions Relating to Controlled Waters			n/a	n/a	n/a
Enforcement and Prohibition Notices					
Integrated Pollution Controls					
Integrated Pollution Prevention And Control					
Local Authority Integrated Pollution Prevention And Control					
Local Authority Pollution Prevention and Controls	pg 4				1
Local Authority Pollution Prevention and Control Enforcements					
Nearest Surface Water Feature	pg 4		Yes		
Pollution Incidents to Controlled Waters	pg 4			1	1
Prosecutions Relating to Authorised Processes					
Registered Radioactive Substances					
River Quality					
River Quality Biology Sampling Points					
River Quality Chemistry Sampling Points					
Substantiated Pollution Incident Register					
Water Abstractions	pg 5		1	4	9 (*9)
Water Industry Act Referrals					
Groundwater Vulnerability Map	pg 10	Yes	n/a	n/a	n/a
Groundwater Vulnerability - Soluble Rock Risk			n/a	n/a	n/a
Groundwater Vulnerability - Local Information			n/a	n/a	n/a
Bedrock Aquifer Designations	pg 11	Yes	n/a	n/a	n/a
Superficial Aquifer Designations	pg 11	Yes	n/a	n/a	n/a
Source Protection Zones					
Extreme Flooding from Rivers or Sea without Defences				n/a	n/a
Flooding from Rivers or Sea without Defences				n/a	n/a
Areas Benefiting from Flood Defences				n/a	n/a
Flood Water Storage Areas				n/a	n/a
Flood Defences				n/a	n/a
OS Water Network Lines	pg 11			3	17

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Waste					
BGS Recorded Landfill Sites					
Historical Landfill Sites					
Integrated Pollution Control Registered Waste Sites					
Licensed Waste Management Facilities (Landfill Boundaries)					
Licensed Waste Management Facilities (Locations)	pg 14				1
Local Authority Landfill Coverage	pg 14	2	n/a	n/a	n/a
Local Authority Recorded Landfill Sites					
Potentially Infilled Land (Non-Water)					
Potentially Infilled Land (Water)	pg 14				2
Registered Landfill Sites					
Registered Waste Transfer Sites					
Registered Waste Treatment or Disposal Sites	pg 14				1
Hazardous Substances					
Control of Major Accident Hazards Sites (COMAH)					
Explosive Sites					
Notification of Installations Handling Hazardous Substances (NIHHS)					
Planning Hazardous Substance Consents					
Planning Hazardous Substance Enforcements					

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Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Geological					
BGS 1:625,000 Solid Geology	pg 15	Yes	n/a	n/a	n/a
BGS Estimated Soil Chemistry	pg 15	Yes			Yes
BGS Recorded Mineral Sites					
BGS Urban Soil Chemistry					
BGS Urban Soil Chemistry Averages					
CBSCB Compensation District			n/a	n/a	n/a
Coal Mining Affected Areas			n/a	n/a	n/a
Mining Instability			n/a	n/a	n/a
Man-Made Mining Cavities					
Natural Cavities					
Non Coal Mining Areas of Great Britain				n/a	n/a
Potential for Collapsible Ground Stability Hazards	pg 15	Yes	Yes	n/a	n/a
Potential for Compressible Ground Stability Hazards				n/a	n/a
Potential for Ground Dissolution Stability Hazards				n/a	n/a
Potential for Landslide Ground Stability Hazards	pg 16	Yes	Yes	n/a	n/a
Potential for Running Sand Ground Stability Hazards	pg 16	Yes	Yes	n/a	n/a
Potential for Shrinking or Swelling Clay Ground Stability Hazards	pg 16	Yes	Yes	n/a	n/a
Radon Potential - Radon Affected Areas			n/a	n/a	n/a
Radon Potential - Radon Protection Measures			n/a	n/a	n/a
Industrial Land Use					
Contemporary Trade Directory Entries	pg 17		2	2	13
Fuel Station Entries	pg 18			2	
Points of Interest - Commercial Services	pg 18	2	1	3	6
Points of Interest - Education and Health					
Points of Interest - Manufacturing and Production	pg 19				6
Points of Interest - Public Infrastructure	pg 20			1	2
Points of Interest - Recreational and Environmental					
Gas Pipelines					
Underground Electrical Cables					

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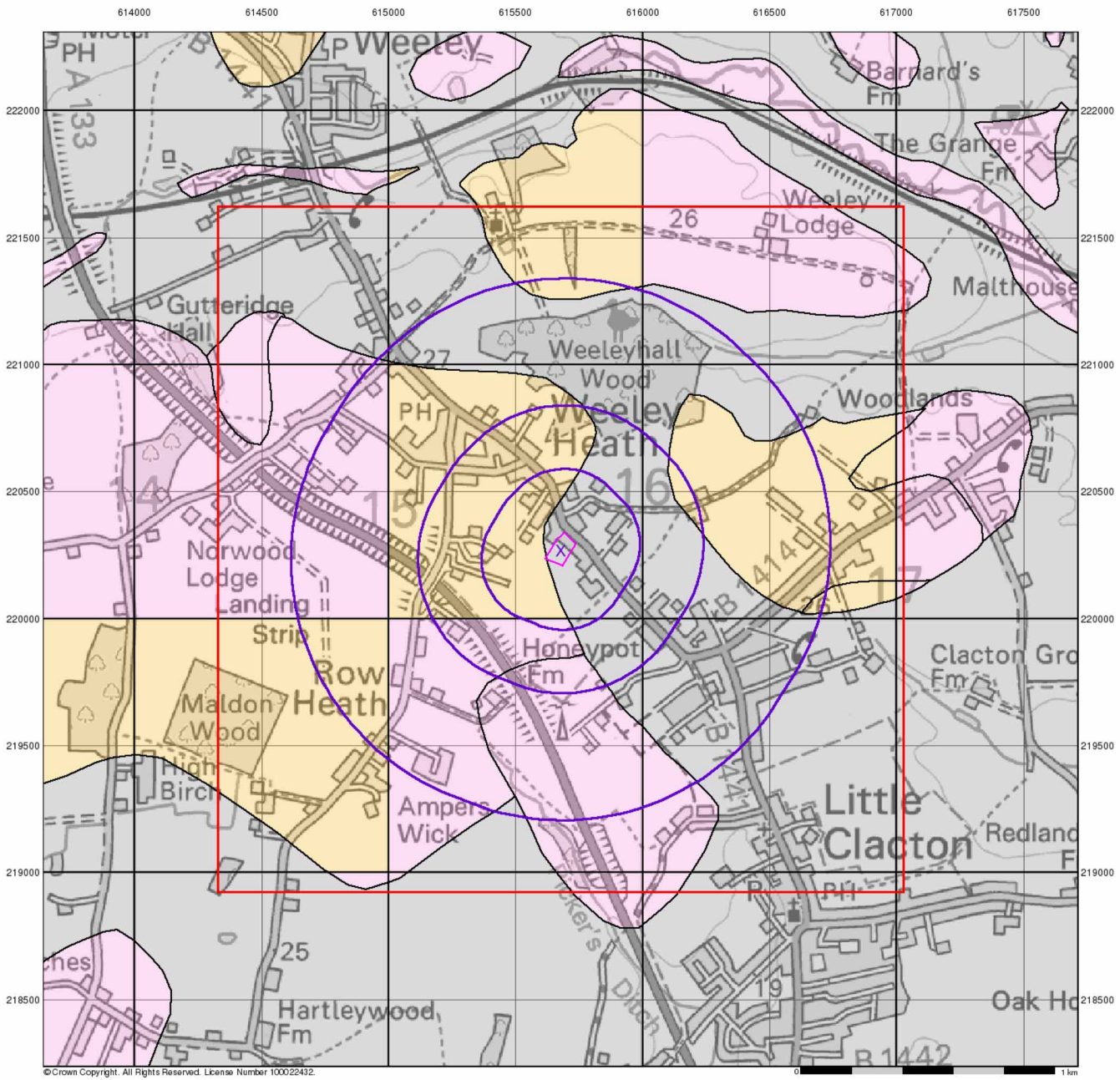
Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Sensitive Land Use					
Ancient Woodland	pg 21			1	1
Areas of Adopted Green Belt					
Areas of Unadopted Green Belt					
Areas of Outstanding Natural Beauty					
Environmentally Sensitive Areas					
Forest Parks					
Local Nature Reserves					
Marine Nature Reserves					
National Nature Reserves					
National Parks					
Nitrate Sensitive Areas					
Nitrate Vulnerable Zones	pg 21	2			
Ramsar Sites					
Sites of Special Scientific Interest	pg 21			1	
Special Areas of Conservation					
Special Protection Areas					
World Heritage Sites					



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Groundwater Vulnerability

General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

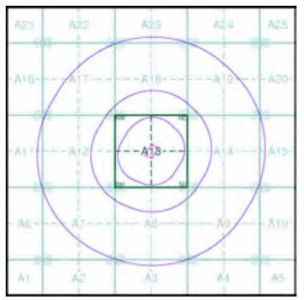
Agency and Hydrological

Bedrock Aquifers	Superficial Aquifers
High Vulnerability, Principal Aquifer	High Vulnerability, Principal Aquifer
High Vulnerability, Secondary Aquifer	High Vulnerability, Secondary Aquifer
Medium Vulnerability, Principal Aquifer	Medium Vulnerability, Principal Aquifer
Medium Vulnerability, Secondary Aquifer	Medium Vulnerability, Secondary Aquifer
Low Vulnerability, Principal Aquifer	Low Vulnerability, Principal Aquifer
Low Vulnerability, Secondary Aquifer	Low Vulnerability, Secondary Aquifer

Unproductive Aquifer

Soluble Rock

Site Sensitivity Context Map - Slice A



Order Details

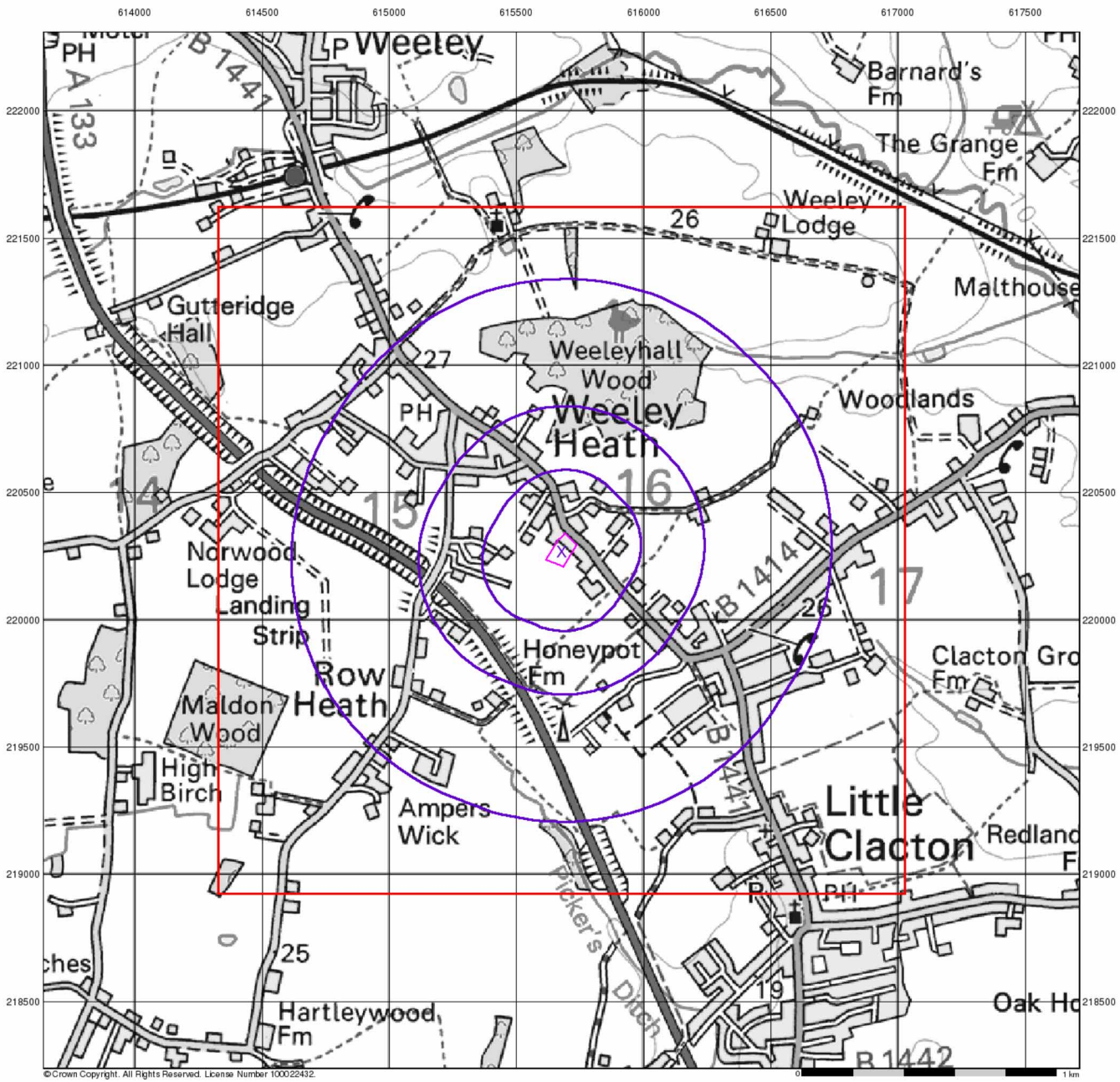
Order Number:	312601118_1_1
Customer Ref:	PO20801/CH/4762
National Grid Reference:	615680, 220270
Slice:	A
Site Area (Ha):	0.84
Search Buffer (m):	1000

Site Details

Clacton Road, Weeley Heath, CO16 9EF

Landmark INFORMATION GROUP

[redacted]



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Source Protection Zones

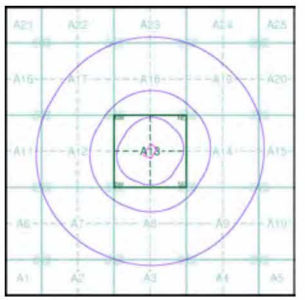
General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Agency and Hydrological

- Inner zone (Zone 1)
- Inner zone - subsurface activity only (Zone 1c)
- Outer zone (Zone 2)
- Outer zone - subsurface activity only (Zone 2c)
- Total catchment (Zone 3)
- Total catchment - subsurface activity only (Zone 3c)
- Special interest (Zone 4)

Site Sensitivity Context Map - Slice A



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Landmark INFORMATION GROUP

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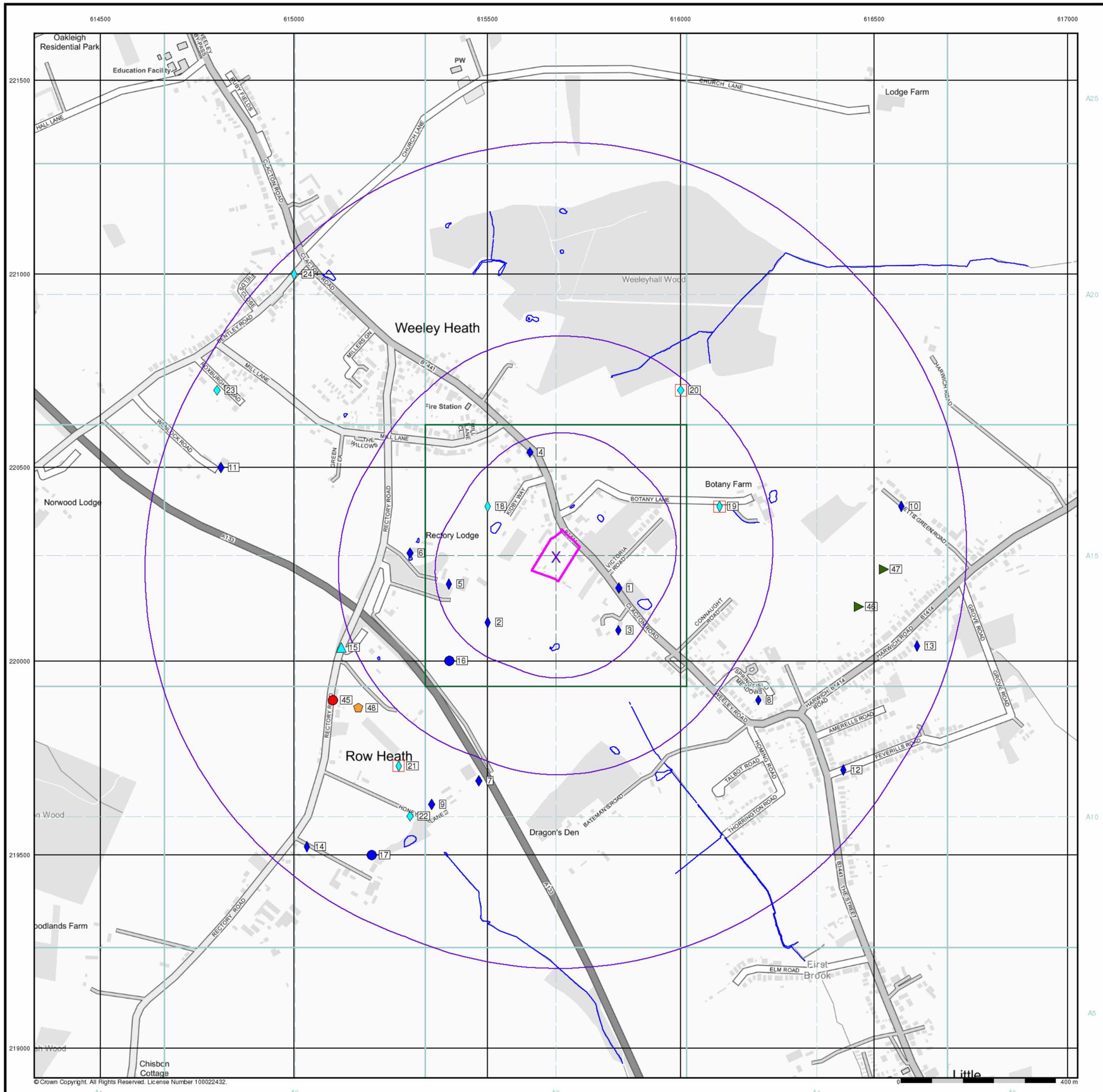


LITHOS CONSULTING

General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Map ID

Several of Type at Location

Agency and Hydrological

- Contaminated Land Register Entry or Notice (Location)
- Contaminated Land Register Entry or Notice
- Discharge Consent
- Enforcement or Prohibition Notice
- Integrated Pollution Control
- Integrated Pollution Prevention Control
- Local Authority Integrated Pollution Prevention and Control
- Local Authority Pollution Prevention and Control
- Local Authority Pollution Prevention and Control Enforcement
- Pollution Incident to Controlled Waters
- Prosecution Relating to Authorised Processes
- Prosecution Relating to Controlled Waters
- Registered Radioactive Substance
- River Network or Water Feature
- River Quality Sampling Point
- Substantiated Pollution Incident Register
- Water Abstraction
- Water Industry Act Referral

Hazardous Substances

COMAH Site | Explosive Site | NIHHS Site

- Planning Hazardous Substance Consent
- Planning Hazardous Substance Enforcement

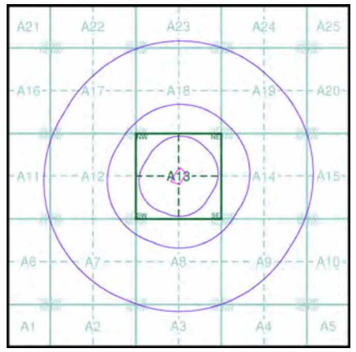
Geological

- BGS Recorded Mineral Site

Waste

- BGS Recorded Landfill Site (Location)
- BGS Recorded Landfill Site
- EA Historic Landfill (Buffered Point)
- EA Historic Landfill (Polygon)
- Integrated Pollution Control Registered Waste Site
- Licensed Waste Management Facility (Landfill Boundary)
- Licensed Waste Management Facility (Location)
- Local Authority Recorded Landfill Site (Location)
- Local Authority Recorded Landfill Site
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Registered Landfill Site
- Registered Landfill Site (Location)
- Registered Landfill Site (Point Buffered to 100m)
- Registered Landfill Site (Point Buffered to 250m)
- Registered Waste Transfer Site (Location)
- Registered Waste Transfer Site
- Registered Waste Treatment or Disposal Site (Location)
- Registered Waste Treatment or Disposal Site

Site Sensitivity Map - Slice A



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Search Buffer (m):	1000

Site Details

Clacton Road, Weeley Heath, CO16 9EF

Landmark INFORMATION GROUP

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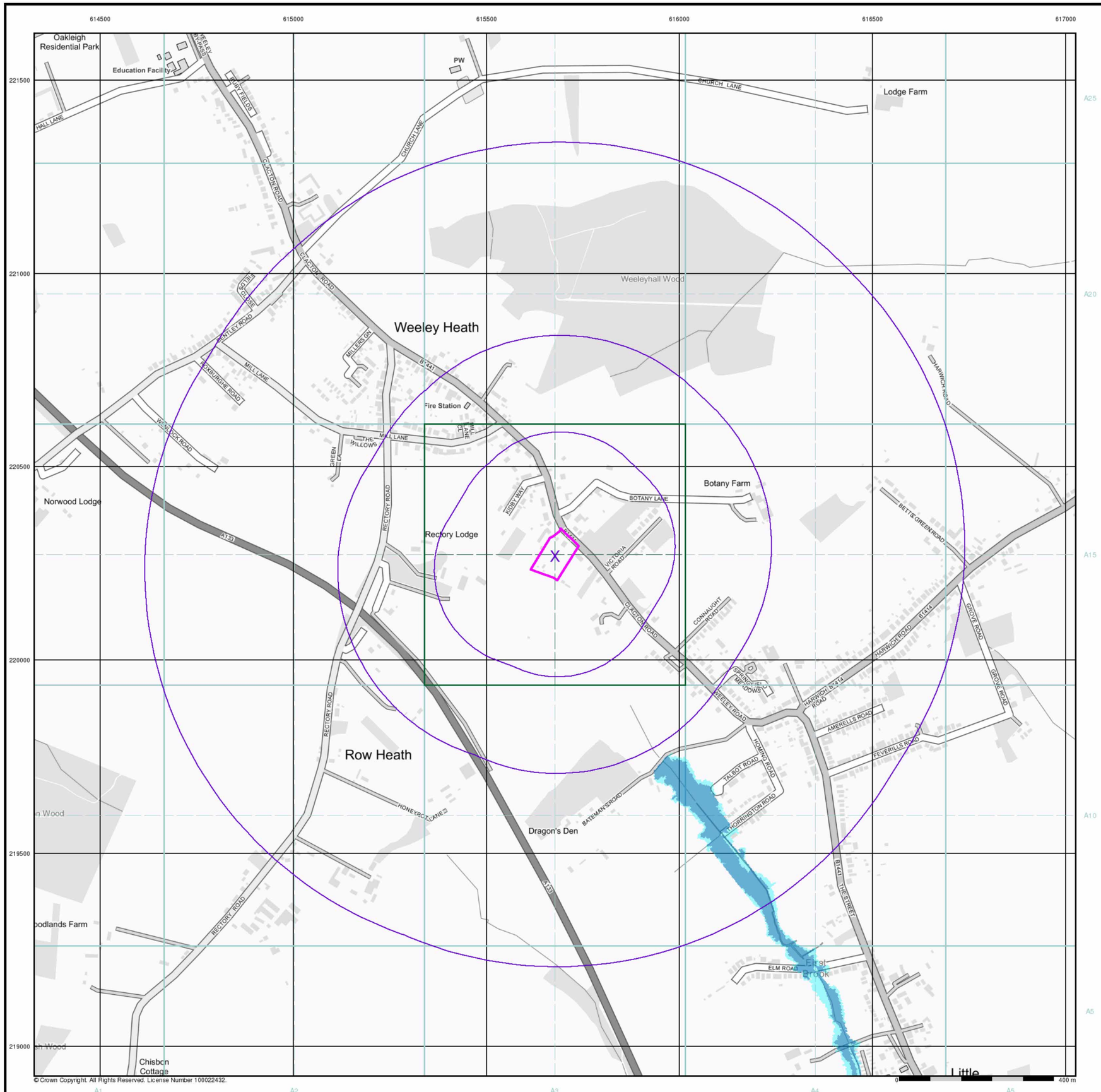

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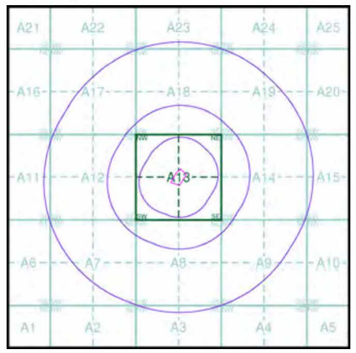
General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

Agency and Hydrological (Flood)

- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
- Flooding from Rivers or Sea without Defences (Zone 3)
- Area Benefiting from Flood Defence
- Flood Water Storage Areas
- Flood Defence

Flood Map - Slice A



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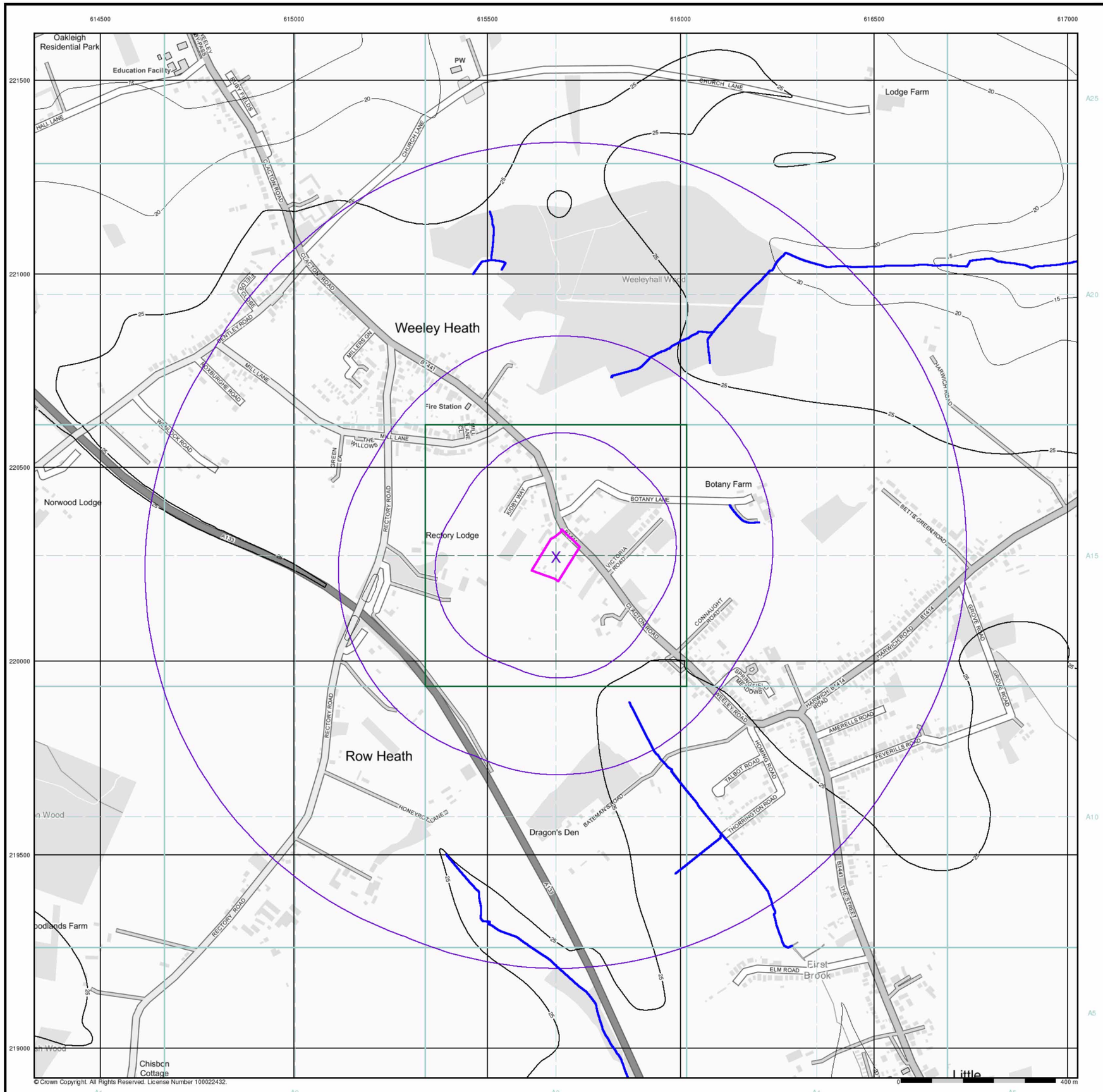
Site Area (Ha):	0.84
Search Buffer (m):	1000

Site Details

Clacton Road, Weeley Heath, CO16 9EF

Landmark INFORMATION GROUP



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General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

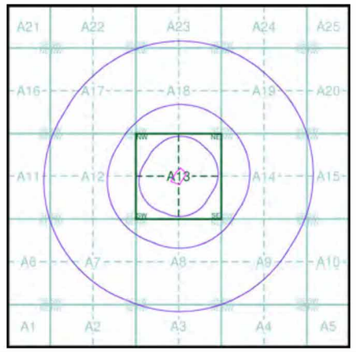
OS Water Network Data

- Canal
- Reservoir
- Foreshore
- Marsh
- Tidal River
- Inland River
- Drain
- Other
- Lake
- Transfer
- Lock Or Flight Of Locks
- Sea

Contours (height in meters)

- Standard Contour (105, 100, 95)
- Master Contour
- Spot Height 167.3
- MLW Mean Low Water
- MHW Mean High Water

OS Water Network Map - Slice A



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Customer Ref:	PO20801/CH/4762
National Grid Reference:	615680, 220270
Slice:	A
Site Area (Ha):	0.84
Search Buffer (m):	1000

Site Details

Clacton Road, Weeley Heath, CO16 9EF

Landmark INFORMATION GROUP

Envirocheck® Report:

Mining and Ground Stability Datasheet

Order Details:

Order Number:
312601118_1_1

Customer Reference:
PO20801/CH/4762

National Grid Reference:
615680, 220270

Slice:
A

Site Area (Ha):
0.84

Search Buffer (m):
1000

Site Details:

Clacton Road
Weeley Heath
CO16 9EF

Client Details:

Mr M Perrin
Lithos Consulting Ltd
Parkhill
Walton Road
Wetherby
LS22 5DZ

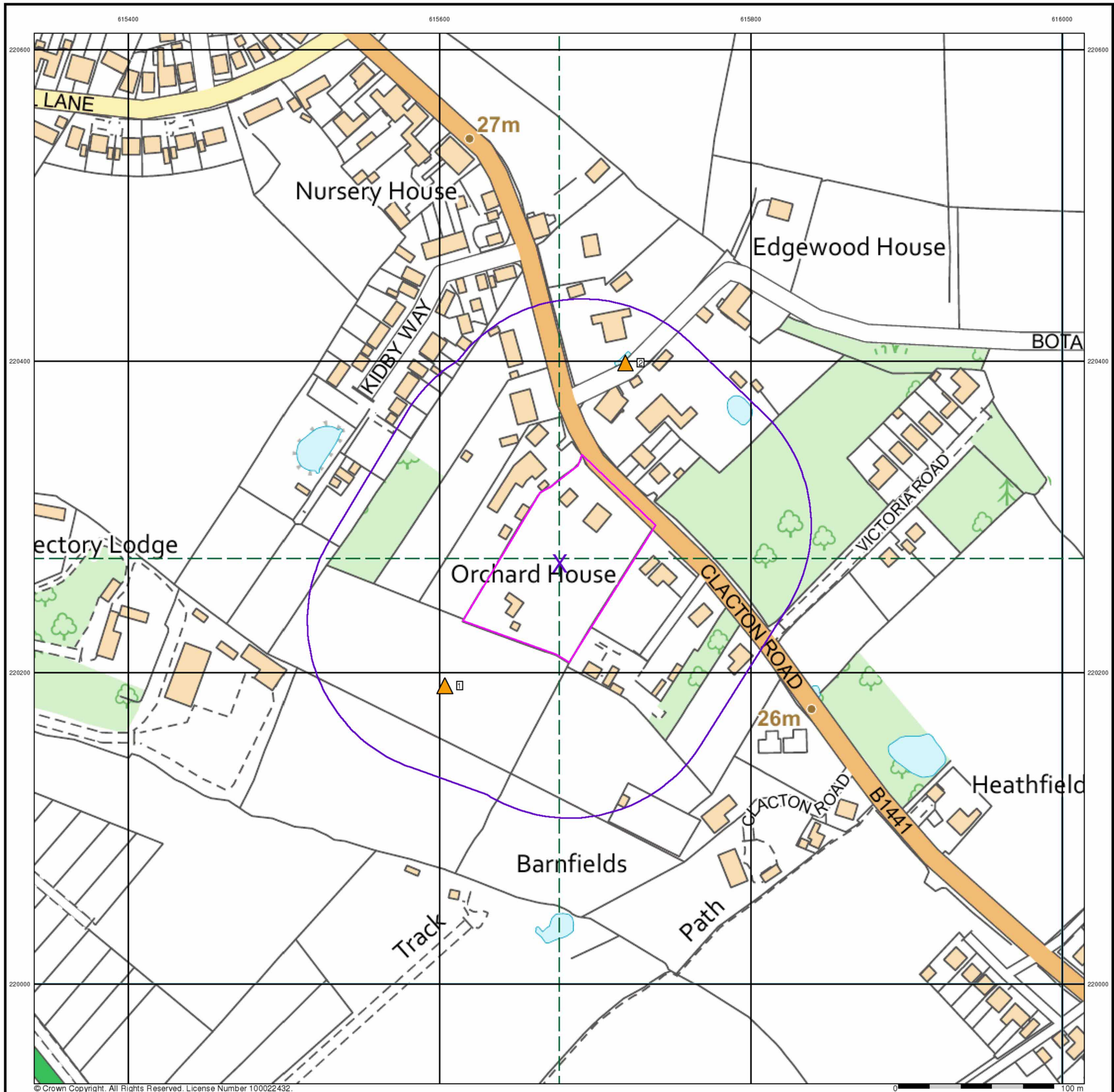
Contents

Report Version v53.0

LITHOS CONSULTING

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m
Mining and Natural Cavities Data					
BGS Recorded Mineral Sites					
Coal Mining Affected Areas			n/a	n/a	n/a
Man Made Mining Cavities					
Mining Instability			n/a	n/a	n/a
Natural Cavities					
Non Coal Mining Areas of Great Britain				n/a	n/a
Potential Mining Areas					
Historical Land Use Information (1:2,500)					
Extractive Industries or Potential Excavations from 1855-1909 (100m)				n/a	n/a
Extractive Industries or Potential Excavations from 1893-1915 (100m)				n/a	n/a
Extractive Industries or Potential Excavations from 1906-1937 (100m)				n/a	n/a
Extractive Industries or Potential Excavations from 1924-1949 (100m)				n/a	n/a
Extractive Industries or Potential Excavations from 1950-1980 (100m)	pg 1		2	n/a	n/a
Subterranean Features (100m)				n/a	n/a
Historical Land Use Information (1:10,000)					
Air Shafts					
Disturbed Ground					
General Quarrying					
Heap, unknown constituents					
Mineral Railway					
Mining & quarrying general					
Mining of coal & lignite					
Quarrying of sand & clay, operation of sand & gravel pits					
Former Marshes					
Potentially Infilled Land (Non-Water)					
Potentially Infilled Land (Water)	pg 2				2
Ground Stability Data (1:50,000)					
CBSCB Compensation District			n/a	n/a	n/a
Brine Pumping Related Features					
Brine Subsidence Solution Area					
Potential for Collapsible Ground Stability Hazards	pg 3	Yes	Yes	n/a	n/a
Potential for Compressible Ground Stability Hazards	pg 3	Yes	Yes	n/a	n/a
Potential for Ground Dissolution Stability Hazards	pg 3	Yes	Yes	n/a	n/a
Potential for Landslide Ground Stability Hazards	pg 3	Yes	Yes	n/a	n/a
Potential for Running Sand Ground Stability Hazards	pg 3	Yes	Yes	n/a	n/a
Potential for Shrinking or Swelling Clay Ground Stability Hazards	pg 3	Yes	Yes	n/a	n/a
Salt Mining Related Features					



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Historical Land Use Information (1:2,500)

General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Map ID | Several of Type at Location

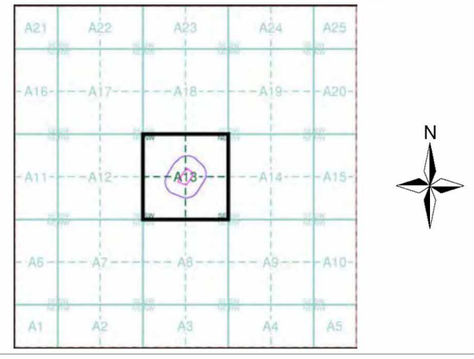
Potentially Contaminative Industrial Uses (Extractive Industries Activity)

	Point	Line	Polygon
Extractive Industries Activity from 1855 - 1909	▲	—	▭
Extractive Industries Activity from 1893 - 1915	▲	—	▨
Extractive Industries Activity from 1906 - 1937	▲	—	▭
Extractive Industries Activity from 1924 - 1949	▲	—	▨
Extractive Industries Activity from 1950 - 1980	▲	—	▥

Subterranean Features

	Point	Line	Polygon
Subterranean Features	▼	- - -	▭

Mining and Ground Stability - Segment A13



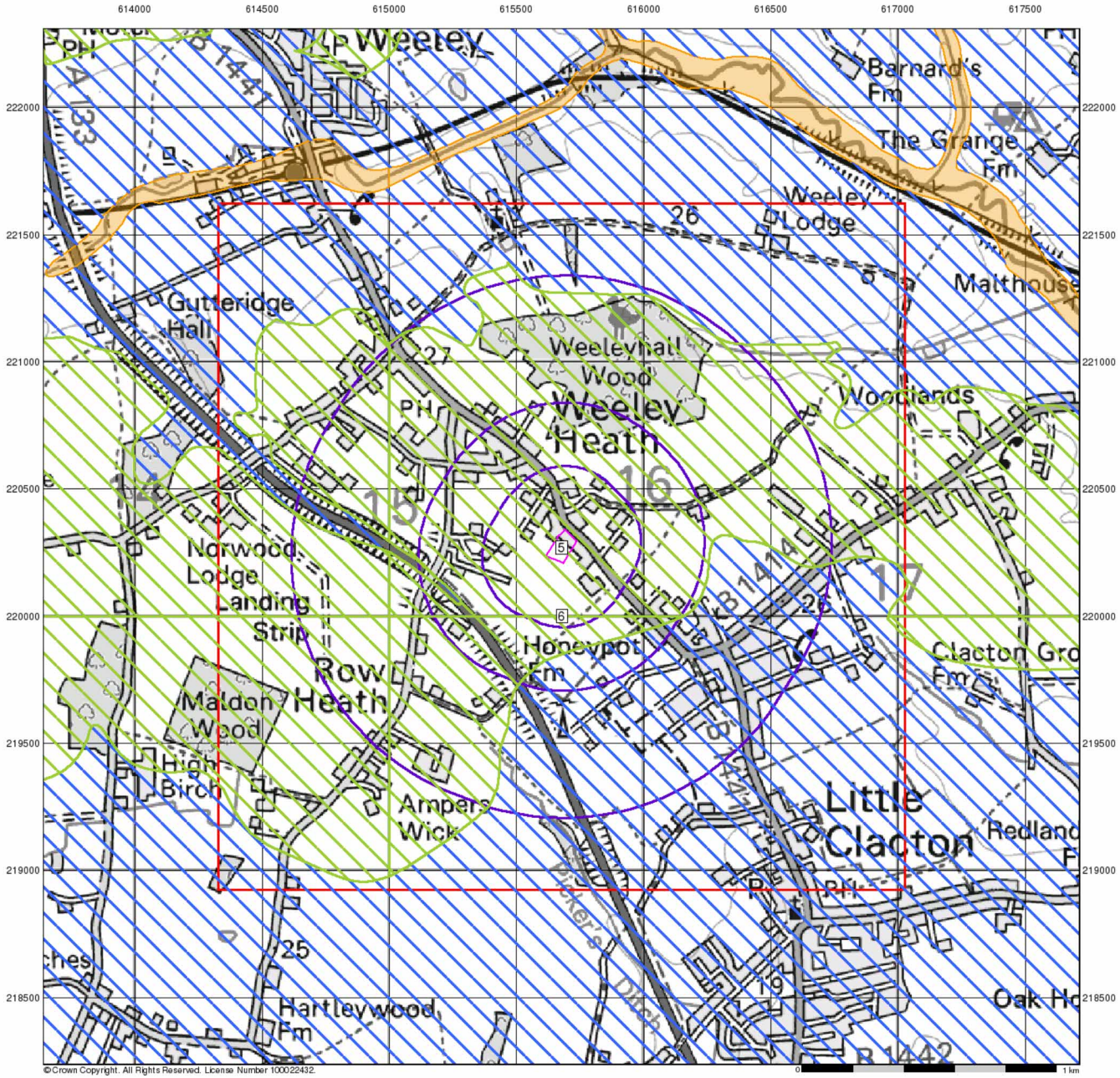
Order Details

Order Number: 312601118_1_1
Customer Ref: PO20801/CH/4762
National Grid Reference: 615680, 220270
Slice: A
Site Area (Ha): 0.84
Plot Buffer (m): 100

Site Details

Clacton Road, Weeley Heath, CO16 9EF

[redacted]



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Ground Stability Data (1:50,000)

General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Potential for Compressible Ground Stability Hazards

High | Low | Moderate | Very Low

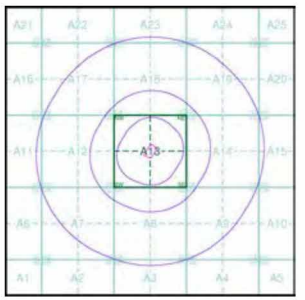
Potential for Collapsible Ground Stability Hazards

High | Low | Moderate | Very Low

Brine Pumping and Salt Mining

	Point	Polygon
Brine Pumping Related Feature	▲	▨
Salt Mining Related Feature	▲	▨

Mining and Ground Stability - Slice A



Order Details

Order Number:	312601118_1_1
Customer Ref:	PO20801/CH/4762
National Grid Reference:	615680, 220270
Slice:	A
Site Area (Ha):	0.84
Search Buffer (m):	1000

Site Details

Clacton Road, Weeley Heath, CO16 9EF

Landmark INFORMATION GROUP

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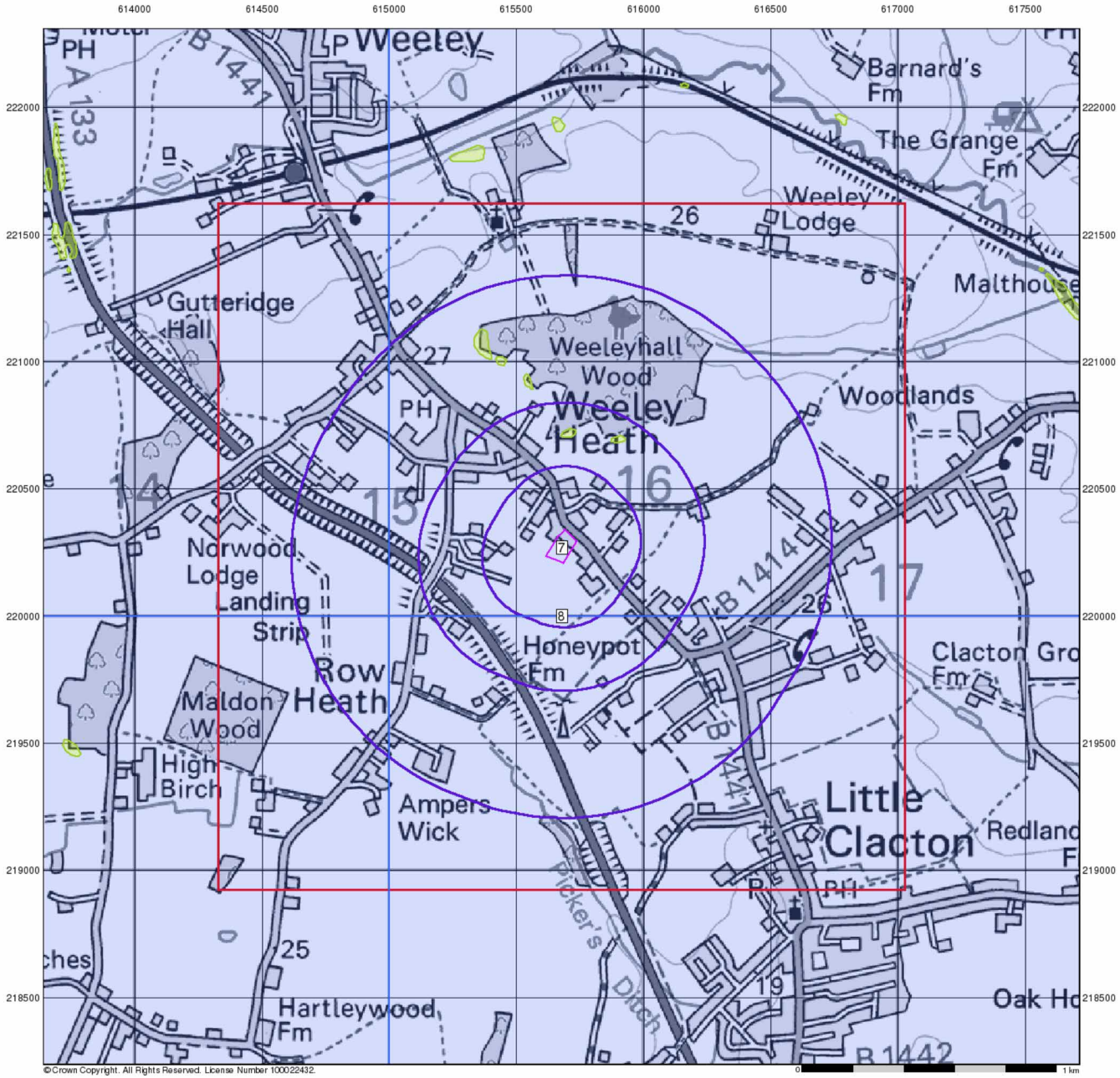


LITHOS CONSULTING

Ground Stability Data (1:50,000)

General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

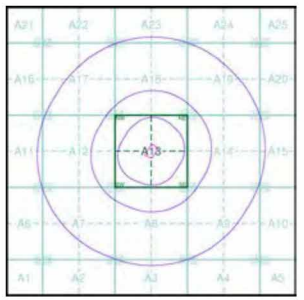
Potential for Landslide Ground Stability Hazards

High | Low | Moderate | Very Low

Potential for Ground Dissolution Stability Hazards

High | Low | Moderate | Very Low

Mining and Ground Stability - Slice A



Order Details

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National Grid Reference:	615680, 220270
Slice:	A
Site Area (Ha):	0.84
Search Buffer (m):	1000

Site Details

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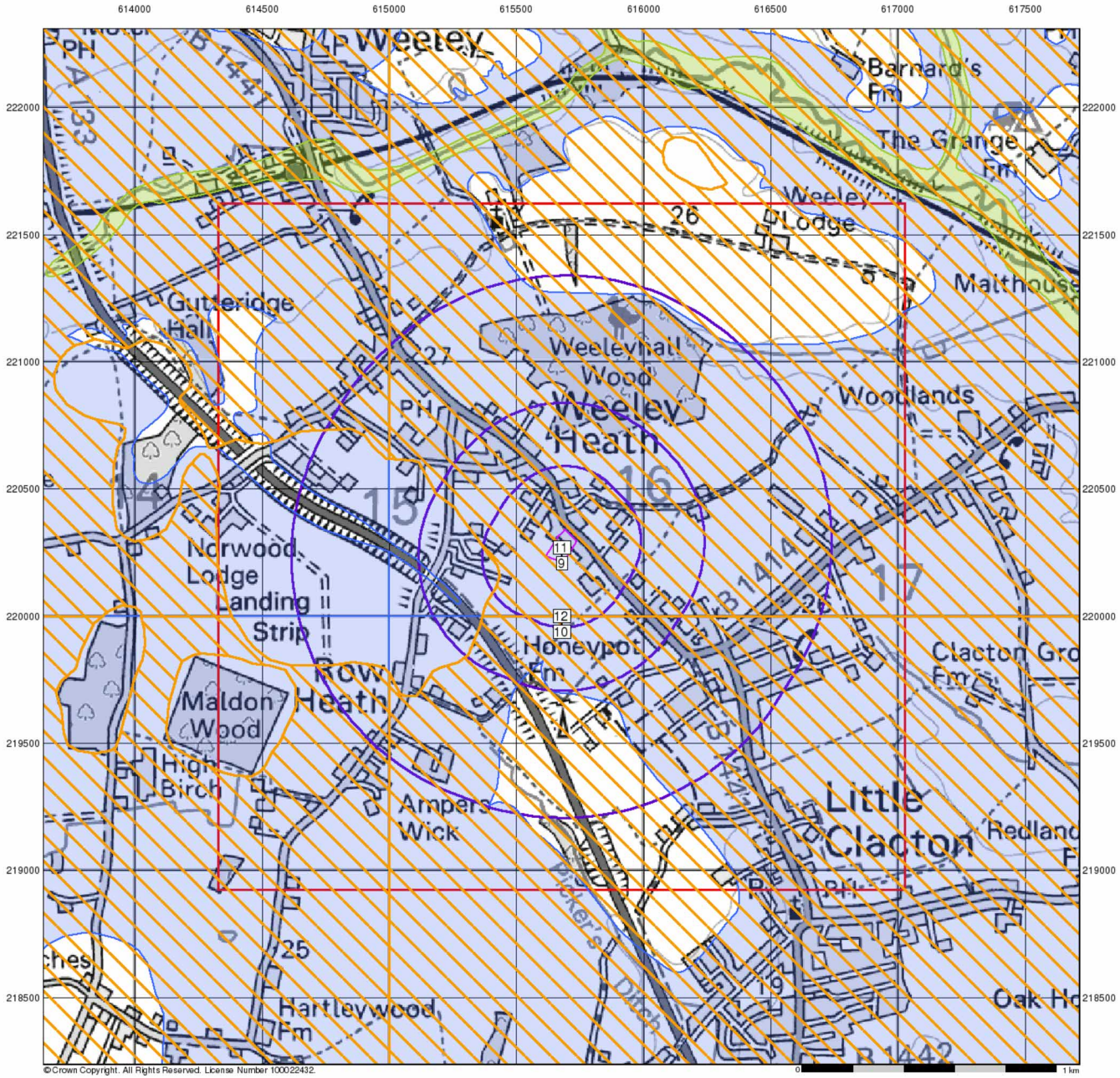
Landmark INFORMATION GROUP

[redacted]



LITHOS CONSULTING

Ground Stability Data (1:50,000)

General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

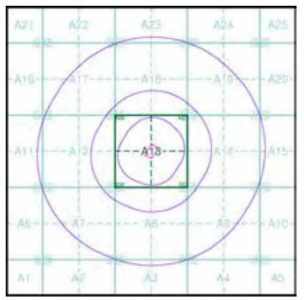
Potential for Running Sand Ground Stability Hazards

High | Low | Moderate | Very Low

Potential for Shrinking or Swelling Clay Ground Stability Hazards

High | Low | Moderate | Very Low

Mining and Ground Stability - Slice A



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Slice:	A
Site Area (Ha):	0.84
Search Buffer (m):	1000

Site Details

Clacton Road, Weeley Heath, CO16 9EF

Landmark INFORMATION GROUP

[redacted]

Norwest Holst Soil Engineering Ltd.

Trial Pit No. **21**

TRIAL PIT LOG

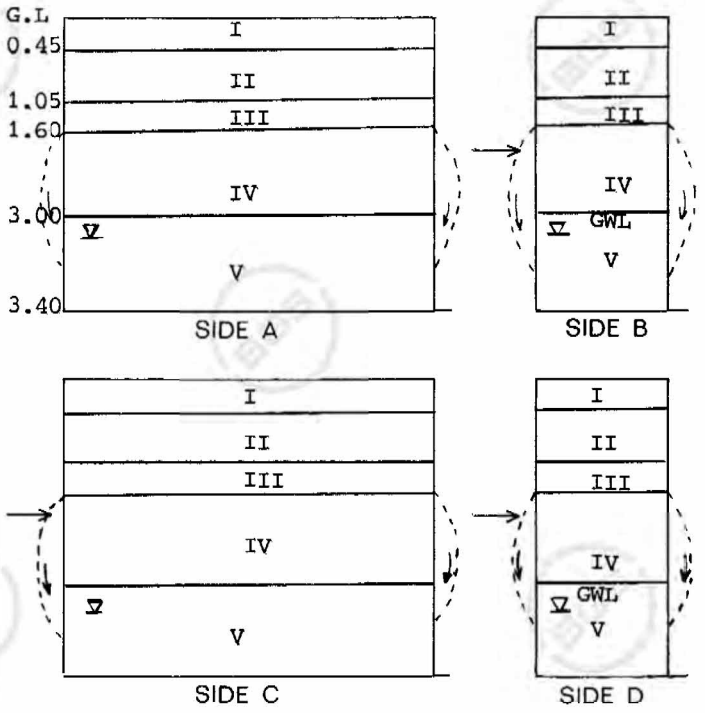
Tm12SE 16

Contract No. F8490
Location A133 Little Clacton Bypass
Client Essex County Council
Excavation Plant Ford 655
Dimensions (l x b x h) 2.70 x 1.10 x 3.40

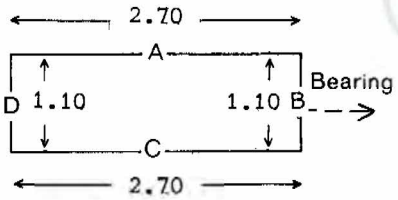
15189
20237

Co-ords E5197, N10236
Ground Level 27.15 m.A.O.D.
Date 13.7.89

ELEVATIONS:—



PLAN (Not to scale)



SAMPLES

No. & Type	Depth m.
BULK	0.50
BULK	1.10
BULK	2.00
BULK	2.80
BULK	3.15
BULK	3.40

No.	Depth m.	STRATA DESCRIPTION	Cv/Cp kN/m²
I	G.L 0.45	TOPSOIL	
II	0.45– 1.05	Hard friable grey, orange-brown and cream very silty sandy CLAY. Some fine to medium gravel, rootlets and organic material. (Head Deposits)	
III	1.05– 1.60	Firm mottled light grey and orange brown very silty CLAY. ...Occasional fine to medium gravel and occasional pockets of orange brown fine sand. (Glacial Deposits)	
IV	1.60– 3.00	Medium dense to dense orange brown very silty fine to medium SAND with pockets of red brown and grey brown slightly clayey fine sand. Occasional fine to medium flint gravel. (Glacial Deposits) Grades to :	
V	3.00– 3.40	Light grey brown silty fine to medium SAND with occasional fine to medium gravel and fine white shell fragments. (Running sand) (Glacial Deposits)	

NOTES Cv/Cp Approximate value of undrained shear strength from hand vane/penetrometer
Groundwater: Slight seepage at 2.80m, running sand at 3.20m
Pumping:
Supports/Stability: Running sand at 3.20m, sides undercut and collapsed.

Norwest Holst Soil Engineering Ltd.

Borehole No. 511

BOREHOLE LOG

TM 12 SE 20

Contract No. F8490
Location. A133 Little Clacton. By Pass
Client. Essex County Council
Method of Boring. Cable Percussion
Diameter of Borehole. 150mm

15170
20155

Sheet 1 of 2
Co-ords E5178 N10154
Ground Level 26.91 m.A.O.D.
Date 14-17/7/89

Description of Strata	Legend	Depth Below G.L. (m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"N"/ R.Q.D.%	Daily Progress
TOPSOIL		0.30	26.61				14/7
Medium dense light grey-brown and orange brown clayey fine to medium occasional coarse SAND with occasional fine to medium gravel and rootlets. (Glacial Deposits)		1.40	25.51		1.00 (50)		
Medium dense orange-brown slightly clayey silty medium SAND with occasional clayey pockets. (Glacial Deposits) Less clayey below 3.00m Becoming gravelly below 4.00m					2.00 s 3.00 s 4.00 s 5.00 s	"16" "12" "30" "20"	
		6.00	20.91	150mm CASED TO 6.00			14/7
Firm to stiff dark grey fissured very silty CLAY with silty partings and black organic material. (London Clay) ...becoming indistinctly laminated below 10.00m ...becoming very stiff below 10.00m H.P. = 100 - 140					6.00 s 7.00 c 8.00 (55) 9.50 s	"16" "12" "25"	17/7

Type of Sample

Is	S.P.T.	▮	Undisturbed
Ic	C.P.T.	x	Vane
0	Jar	△	Water
●	Bulk	▮	Piezometer

Remarks (Observations of Ground Water etc.) () - U100 blows

Water struck at 3.00m, level rose after 20 mins to 2.50m.

Water levels are subject to seasonal or tidal variations and should not be taken as constant

Norwest Holst Soil Engineering Ltd.

Borehole No. 511

BOREHOLE LOG

Contract No. F8490
Location A133 Little Clacton By Pass
Client Essex County Council
Method of Boring Cable Percussion
Diameter of Borehole 150mm

Tm 12 SE/20

Sheet 2 of 2
Co-ords E5178 N10154
Ground Level 26.91 m.A.O.D.
Date 14-17/7/89

Description of Strata	Legend	Depth Below G.L.(m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"N"/ R.Q.D.%	Daily Progress
Stiff to very dark grey indistinctly laminated fissured very silty CLAY. (London Clay)					11.60 (60)		
Borehole complete at 12.00m		12.00	14.91				17/7

Type of Sample

Is S.P.T. ■ Undisturbed
Ic C.P.T. x Vane
0 Jar △ Water
● Bulk ▮ Piezometer

Remarks (Observations of Ground Water etc.)

Water levels are subject to seasonal or tidal variations and should not be taken as constant

Appendix F

Exploratory Hole Logs

Trial Pit Log

Trialpit No **TP01** Sheet 1 of 1

Project Name:	Clacton Road, Weeley Heath	Project No. 4762	Co-ords: 615685.00 - 220292.00 Level:	Date 03/07/2023
Location:	Essex		Dimensions (m): Depth 2.10	Scale 1:20
Client:	LNT Care Developments Ltd			Logged LEW

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend
	Depth	Type	Results			
				0.20		
				0.50		
				1.00		
				2.10		

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with 40mm clean gravel to 0.6m depth for soakaway testing and to ground level with arisings upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

Trial Pit Log

Trialpit No **TP02**

Sheet 1 of 1

Project Name:	Clacton Road, Weeley Heath	Project No. 4762	Co-ords: 615693.00 - 220280.00 Level:	Date 03/07/2023
Location:	Essex		Dimensions (m): Depth 2.20	Scale 1:20
Client:	LNT Care Developments Ltd			Logged LEW

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend
	Depth	Type	Results			
				0.20		
				0.60		
				1.80		
▼				2.20		

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 2.2m during excavation. 3. Backfilled with 40mm clean gravel to 0.5m depth for soakaway testing and to ground level with arisings upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

Trial Pit Log

Trialpit No **TP03**

Sheet 1 of 1

Project Name:	Clacton Road, Weeley Heath	Project No. 4762	Co-ords: 615678.00 - 220224.00 Level:	Date 03/07/2023
Location:	Essex		Dimensions (m): Depth 2.40	Scale 1:20
Client:	LNT Care Developments Ltd			Logged LEW

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend
	Depth	Type	Results			
				0.20		
				0.60		
				1.90		
▼				2.40		

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 2.3m during excavation. 3. Backfilled with 40mm clean gravel to 0.7m depth for soakaway testing and to ground level with arisings upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

Trial Pit Log

Trialpit No **TP04**

Sheet 1 of 1

Project Name:	Clacton Road, Weeley Heath	Project No. 4762	Co-ords: 615671.00 - 220247.00 Level:	Date 03/07/2023
Location:	Essex		Dimensions (m): Depth 2.50	Scale 1:20
Client:	LNT Care Developments Ltd			Logged LEW

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend
	Depth	Type	Results			
				0.20		
				0.50		
				1.20		
				2.10		
				2.50		

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit collapsed between 1.2m and 2.5m depth at 2.5m.

Trial Pit Log

Trialpit No **TP05**

Sheet 1 of 1

Project Name:	Clacton Road, Weeley Heath	Project No. 4762	Co-ords: 615663.00 - 220276.00 Level:	Date 03/07/2023
Location:	Essex		Dimensions (m): Depth 2.60	Scale 1:20
Client:	LNT Care Developments Ltd			Logged LEW

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend
	Depth	Type	Results			
				0.20		
				0.50		
				1.60		
▼				2.60		

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 2.5m during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

Trial Pit Log

Trialpit No **TP06**

Sheet 1 of 1

Project Name:	Clacton Road, Weeley Heath	Project No. 4762	Co-ords: 615685.00 - 220263.00 Level:	Date 05/07/2023
Location:	Essex		Dimensions (m): Depth 2.80	Scale 1:20
Client:	LNT Care Developments Ltd			Logged LEW

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend
	Depth	Type	Results			
				0.20		
				0.60		
				1.40		
▼						
				2.40		
▼						
				2.80		

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 2.2m and 2.6m during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit collapsed between 1.7m and 2.8m depth at 2.8m.

Appendix G

Soakaway Calculation Sheets

SOIL INFILTRATION RATE IN ACCORDANCE WITH BRE DIGEST 365: 1991

Client:	LNT Care Developments Ltd
Engineer	L Whiteley
Job Name:	Clacton Road, Weeley Heath
Job No.:	4762

Date:	**03/07/2023**
Trial Pit No.	**TP01**
Test No.	**1**

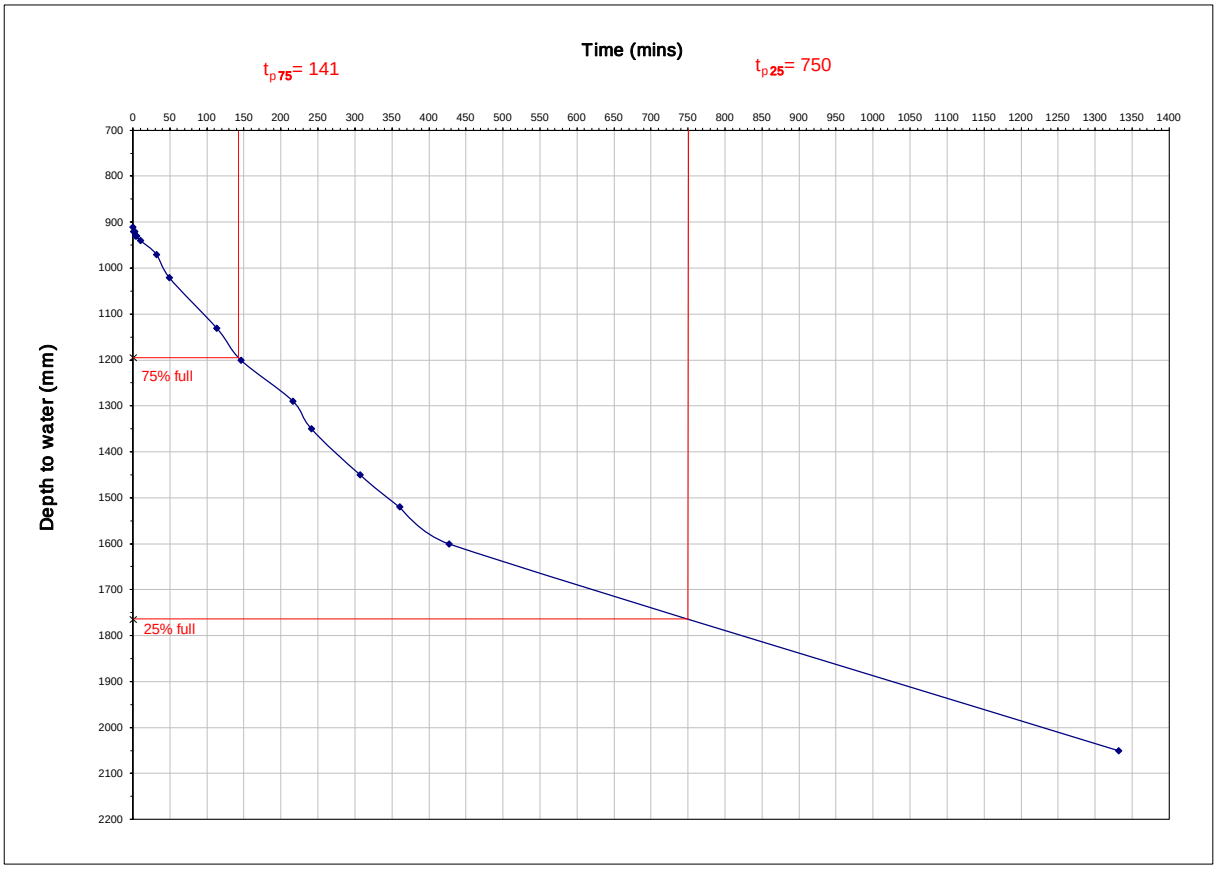
Time	Elapsed Time	Depth to water from ground level	
	(min)	(m)	(mm)
09:29 (3/7/23)	0	0.91	910
09:30	1	0.92	920
09:31	2	0.92	920
09:32	3	0.93	930
09:34	5	0.93	930
09:39	10	0.94	940
10:01	32	0.97	970
10:18	49	1.02	1020
11:22	113	1.13	1130
11:55	146	1.20	1200
13:05	216	1.29	1290
13:30	241	1.35	1350
14:36	307	1.45	1450
15:29	360	1.52	1520
16:36	427	1.60	1600
07:41 (4/7/23)	1332	2.05	2050

SOAKAWAY TRIAL PIT			
Dimensions		**(m)**	**(mm)**
Length	=	1.80	1800
Width	=	0.50	500
Depth	=	2.05	2050

Effective Depth (% full)		**(mm)**	**(m)**
0.25	=	1765	1.77
0.50	=	1480	1.48
0.75	=	1195	1.20

Depth at start of test (mm)	=	910
Depth at end of test (mm)	=	2050
Base area of pit	=	0.9
a_{p50} - 50% internal surface area inc. base	=	3.522
V_{p75-25} - Volume 75 - 25%	=	0.513

Read from the graph:		
$t_{p\,75}$ (min)	=	141
$t_{p\,25}$ (min)	=	750



Soil infiltration rate (pit filled with stone), f, (m/s) = 1.20E-06

SOIL INFILTRATION RATE IN ACCORDANCE WITH BRE DIGEST 365: 1991

Client:	LNT Care Developments Ltd
Engineer	L Whiteley
Job Name:	Clacton Road, Weeley Heath
Job No.:	4762

Date:	**04/07/2023**
Trial Pit No.	**TP01**
Test No.	**2**

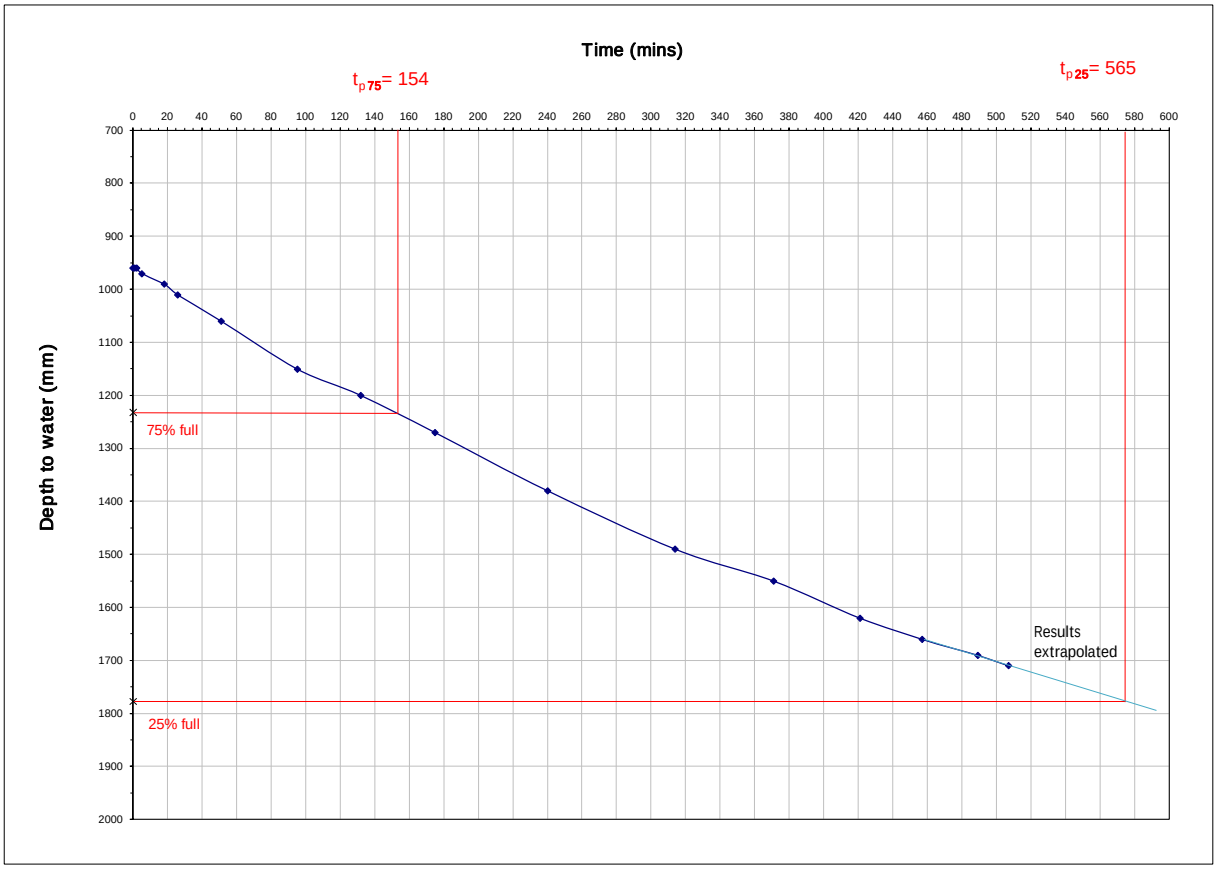
Time	Elapsed Time	Depth to water from ground level	
	(min)	(m)	(mm)
08:33	0	0.96	960
08:34	1	0.96	960
08:35	2	0.96	960
08:38	5	0.97	970
08:51	18	0.99	990
08:59	26	1.01	1010
09:24	51	1.06	1060
10:08	95	1.15	1150
10:45	132	1.20	1200
11:28	175	1.27	1270
12:33	240	1.38	1380
13:47	314	1.49	1490
14:44	371	1.55	1550
15:34	421	1.62	1620
16:10	457	1.66	1660
16:42	489	1.69	1690
17:00	507	1.71	1710

SOAKAWAY TRIAL PIT			
Dimensions		**(m)**	**(mm)**
Length	=	1.80	1800
Width	=	0.50	500
Depth	=	2.05	2050

Effective Depth (% full)		**(mm)**	**(m)**
0.25	=	1777.5	1.78
0.50	=	1505	1.51
0.75	=	1232.5	1.23

Depth at start of test (mm)	=	960
Depth at end of test (mm)	=	1710
Base area of pit	=	0.9
a_{p50} - 50% internal surface area inc. base	=	3.407
V_{p75-25} - Volume 75 - 25%	=	0.4905

Read from the graph:		
$t_{p\,75}$ (min)	=	154
$t_{p\,25}$ (min)	=	565



Soil infiltration rate (pit filled with stone), f, (m/s) = 1.75E-06

SOIL INFILTRATION RATE IN ACCORDANCE WITH BRE DIGEST 365: 1991

Client:	LNT Care Developments Ltd
Engineer	L Whiteley
Job Name:	Clacton Road, Weeley Heath
Job No.:	4762

Date:	**05/07/2023**
Trial Pit No.	**TP01**
Test No.	**3**

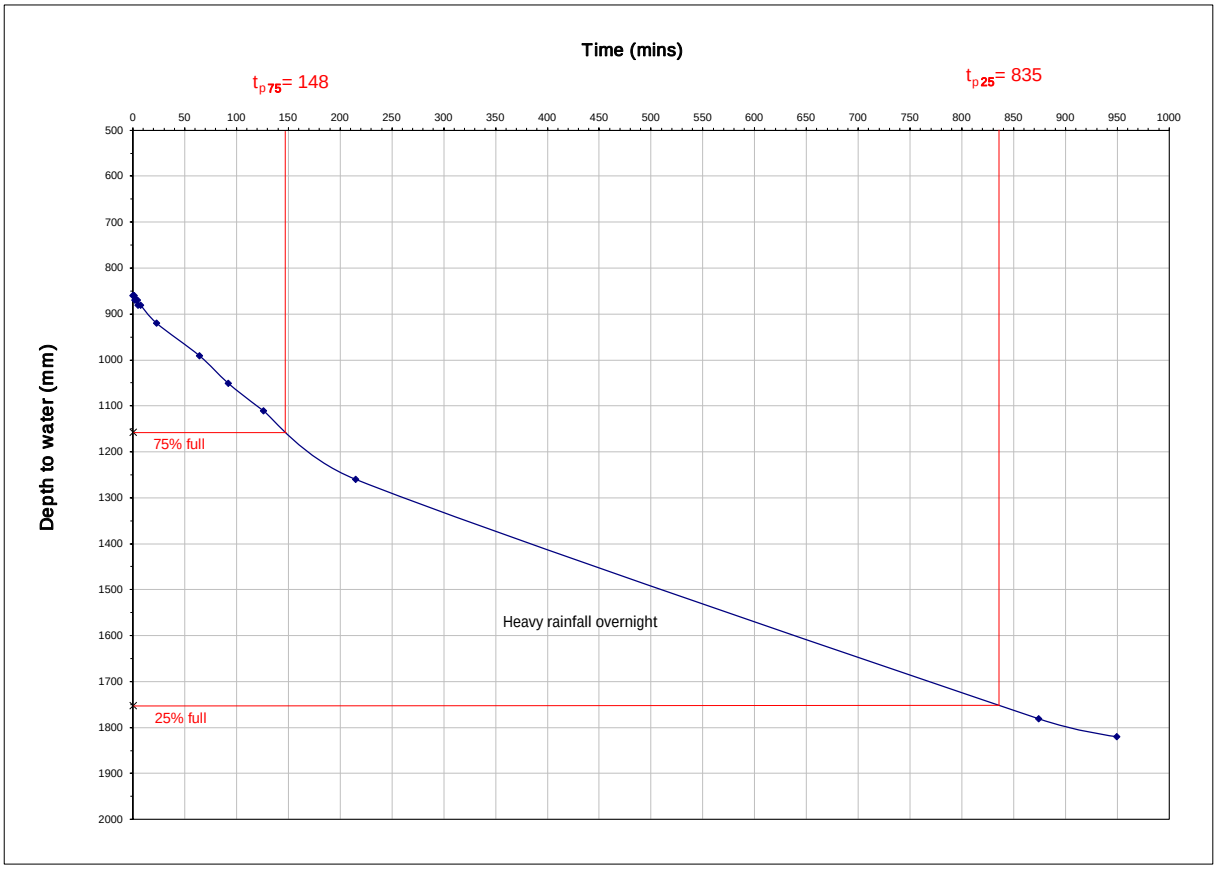
Time	Elapsed Time	Depth to water from ground level	
	(min)	(m)	(mm)
17:02	0	0.86	860
17:03	1	0.86	860
17:04	2	0.87	870
17:05	3	0.87	870
17:06	4	0.87	870
17:07	5	0.88	880
17:09	7	0.88	880
17:25	23	0.92	920
18:06	64	0.99	990
18:34	92	1.05	1050
19:08	126	1.11	1110
20:37	215	1.26	1260
07:36 (5/7/23)	874	1.78	1780
08:51	949	1.82	1820

SOAKAWAY TRIAL PIT			
Dimensions		**(m)**	**(mm)**
Length	=	1.80	1800
Width	=	0.50	500
Depth	=	2.05	2050

Effective Depth (% full)		**(mm)**	**(m)**
0.25	=	1752.5	1.75
0.50	=	1455	1.46
0.75	=	1157.5	1.16

Depth at start of test (mm)	=	860
Depth at end of test (mm)	=	1820
Base area of pit	=	0.9
a_{p50} - 50% internal surface area inc. base	=	3.637
V_{p75-25} - Volume 75 - 25%	=	0.5355

Read from the graph:		
$t_{p\,75}$ (min)	=	148
$t_{p\,25}$ (min)	=	835



Soil infiltration rate (pit filled with stone), f, (m/s) = 1.07E-06

SOIL INFILTRATION RATE IN ACCORDANCE WITH BRE DIGEST 365: 1991

Client:	LNT Care Developments Ltd
Engineer	L Whiteley
Job Name:	Clacton Road, Weeley Heath
Job No.:	4762

Date:	**03/07/2023**
Trial Pit No.	**TP02**
Test No.	**1**

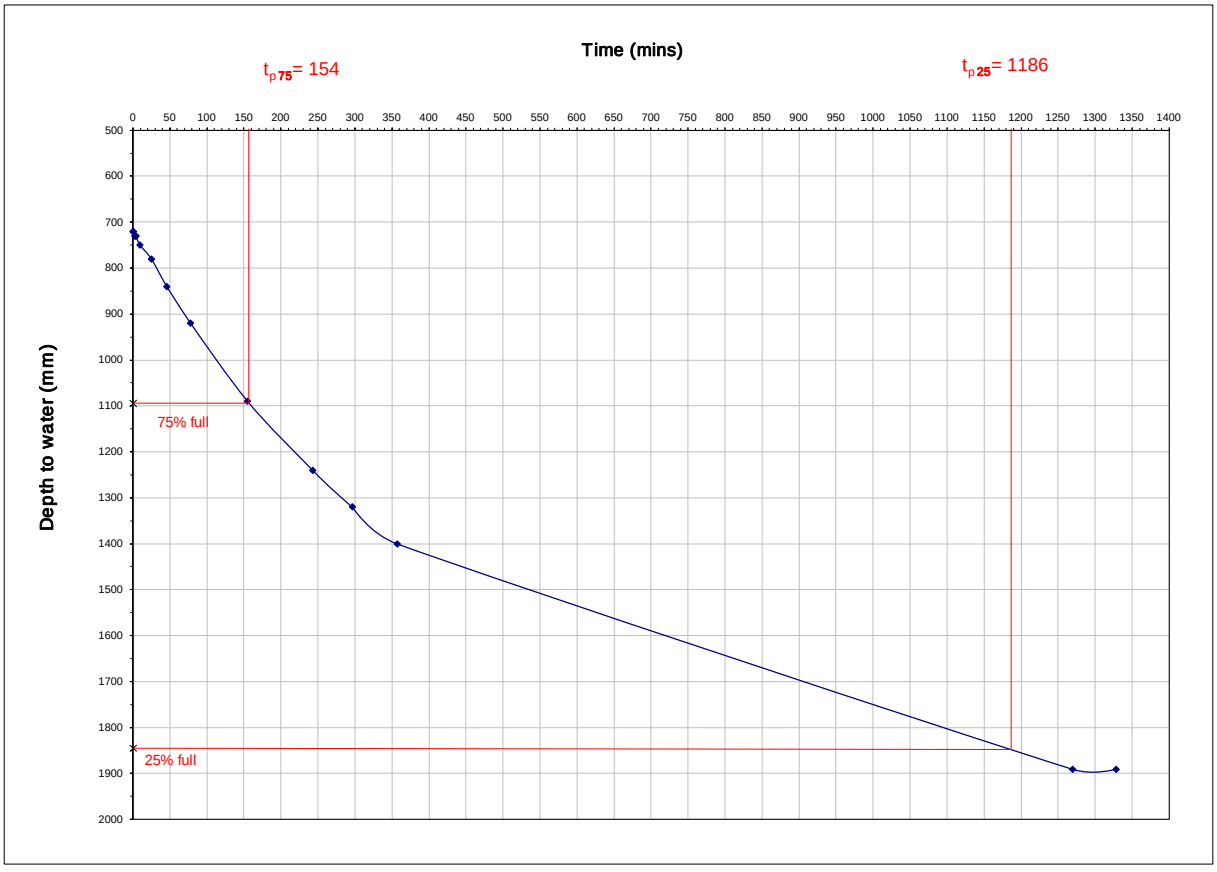
Time	Elapsed Time	Depth to water from ground level	
	(min)	(m)	(mm)
10:35 (3/7/23)	0	0.72	720
10:36	1	0.72	720
10:37	2	0.73	730
10:38	3	0.73	730
10:39	4	0.73	730
10:44	9	0.75	750
11:00	25	0.78	780
11:21	46	0.84	840
11:53	78	0.92	920
13:10	155	1.09	1090
14:38	243	1.24	1240
15:31	296	1.32	1320
16:32	357	1.40	1400
07:44 (4/7/23)	1269	1.89	1890
08:43	1328	1.89	1890

SOAKAWAY TRIAL PIT			
Dimensions		**(m)**	**(mm)**
Length	=	1.90	1900
Width	=	0.50	500
Depth	=	2.22	2220

Effective Depth (% full)		**(mm)**	**(m)**
0.25	=	1845	1.85
0.50	=	1470	1.47
0.75	=	1095	1.10

Depth at start of test (mm)	=	720
Depth at end of test (mm)	=	1890
Base area of pit	=	0.95
a_{p50} - 50% internal surface area inc. base	=	4.55
V_{p75-25} - Volume 75 - 25%	=	0.7125

Read from the graph:		
$t_{p\,75}$ (min)	=	154
$t_{p\,25}$ (min)	=	1186



Soil infiltration rate (pit filled with stone), f, (m/s) = 7.59E-07

SOIL INFILTRATION RATE IN ACCORDANCE WITH BRE DIGEST 365: 1991

Client:	LNT Care Developments Ltd
Engineer	L Whiteley
Job Name:	Clacton Road, Weeley Heath
Job No.:	4762

Date:	**04/07/2023**
Trial Pit No.	**TP02**
Test No.	**2**

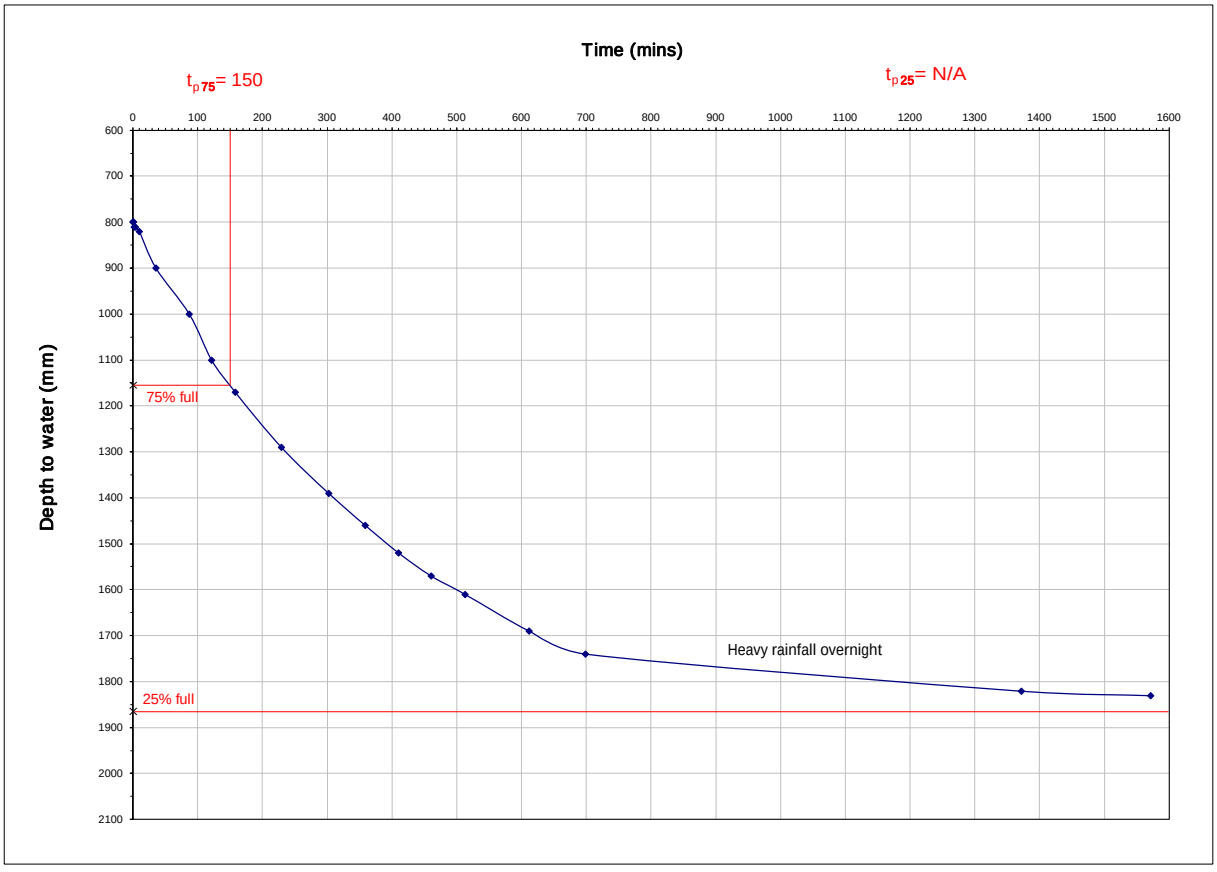
Time	Elapsed Time	Depth to water from ground level	
	(min)	(m)	(mm)
08:46	0	0.80	800
08:47	1	0.80	800
08:48	2	0.81	810
08:50	4	0.81	810
08:56	10	0.82	820
09:21	35	0.90	900
10:13	87	1.00	1000
10:47	121	1.10	1100
11:24	158	1.17	1170
12:35	229	1.29	1290
13:48	302	1.39	1390
14:45	359	1.46	1460
15:36	410	1.52	1520
16:26	460	1.57	1570
17:19	513	1.61	1610
18:58	612	1.69	1690
20:25	699	1.74	1740
07:38 (5/7/23)	1372	1.82	1820
10:57	1571	1.83	1830

SOAKAWAY TRIAL PIT			
Dimensions		**(m)**	**(mm)**
Length	=	1.90	1900
Width	=	0.50	500
Depth	=	2.22	2220

Effective Depth (% full)		**(mm)**	**(m)**
0.25	=	1865	1.87
0.50	=	1510	1.51
0.75	=	1155	1.16

Depth at start of test (mm)	=	800
Depth at end of test (mm)	=	1830
Base area of pit	=	0.95
a_{p50} - 50% internal surface area inc. base	=	4.358
V_{p75-25} - Volume 75 - 25%	=	0.6745

Read from the graph:		
$t_{p\,75}$ (min)	=	150
$t_{p\,25}$ (min)	=	N/A



Test did not attain 25% Effective depth. Unable to calculate soil infiltration rate

SOIL INFILTRATION RATE IN ACCORDANCE WITH BRE DIGEST 365: 1991

Client:	LNT Care Developments Ltd
Engineer	L Whiteley
Job Name:	Clacton Road, Weeley Heath
Job No.:	4762

Date:	**03/07/2023**
Trial Pit No.	**TP03**
Test No.	**1**

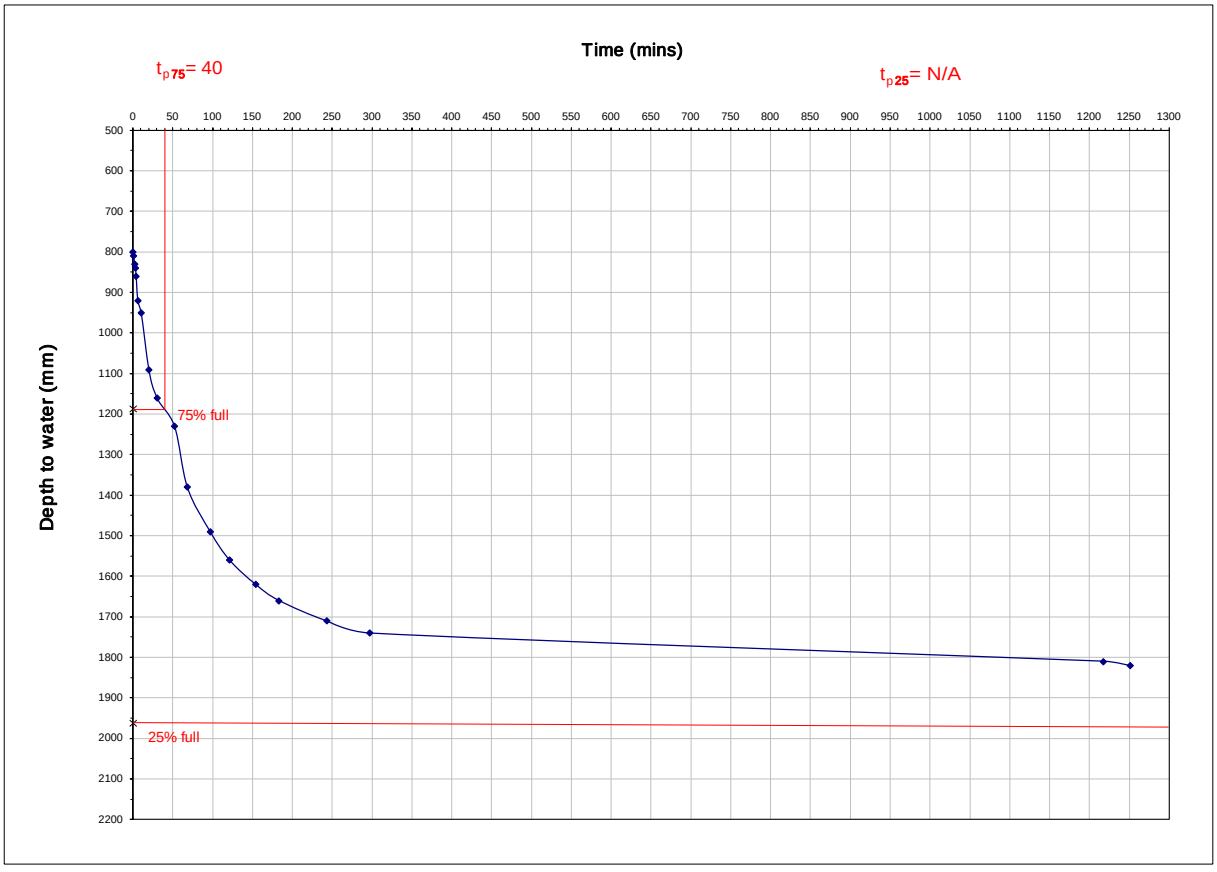
Time	Elapsed Time	Depth to water from ground level	
	(min)	(m)	(mm)
11:31 (3/7/23)	0	0.80	800
11:32	1	0.81	810
11:33	2	0.83	830
11:34	3	0.84	840
11:35	4	0.86	860
11:37	6	0.92	920
11:41	10	0.95	950
11:51	20	1.09	1090
12:01	30	1.16	1160
12:23	52	1.23	1230
12:39	68	1.38	1380
13:08	97	1.49	1490
13:32	121	1.56	1560
14:05	154	1.62	1620
14:34	183	1.66	1660
15:34	243	1.71	1710
16:28	297	1.74	1740
07:48 (4/7/23)	1217	1.81	1810
08:22	1251	1.82	1820

SOAKAWAY TRIAL PIT			
Dimensions		**(m)**	**(mm)**
Length	=	2.10	2100
Width	=	0.50	500
Depth	=	2.35	2350

Effective Depth (% full)		**(mm)**	**(m)**
0.25	=	1962.5	1.96
0.50	=	1575	1.58
0.75	=	1187.5	1.19

Depth at start of test (mm)	=	800
Depth at end of test (mm)	=	1820
Base area of pit	=	1.05
a_{p50} - 50% internal surface area inc. base	=	5.08
V_{p75-25} - Volume 75 - 25%	=	0.81375

Read from the graph:		
$t_{p\,75}$ (min)	=	40
$t_{p\,25}$ (min)	=	N/A



Test did not attain 25% Effective depth. Unable to calculate soil infiltration rate

SOIL INFILTRATION RATE IN ACCORDANCE WITH BRE DIGEST 365: 1991

Client:	LNT Care Developments Ltd
Engineer	L Whiteley
Job Name:	Clacton Road, Weeley Heath
Job No.:	4762

Date:	**04/07/2023**
Trial Pit No.	**TP03**
Test No.	**2**

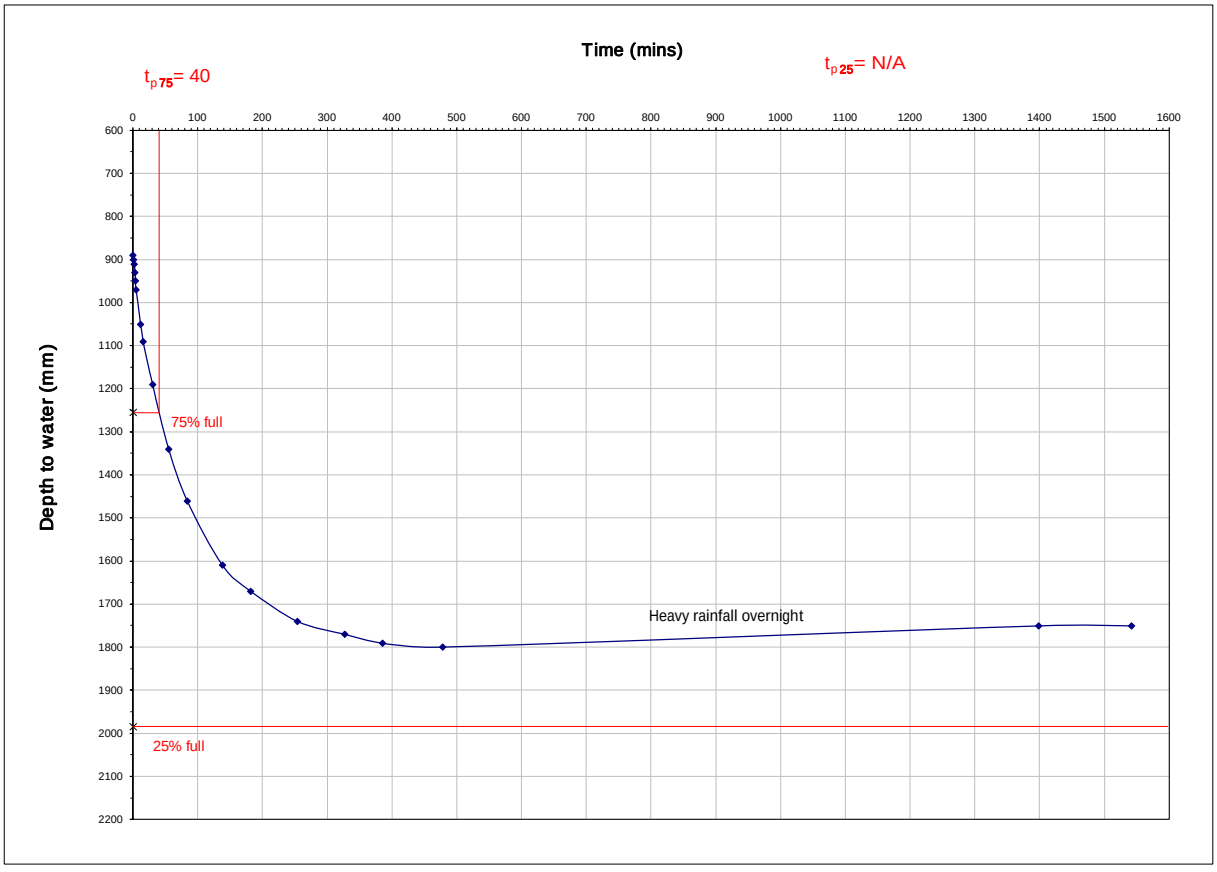
Time	Elapsed Time	Depth to water from ground level	
	(min)	(m)	(mm)
08:24	0	0.89	890
08:25	1	0.90	900
08:26	2	0.91	910
08:27	3	0.93	930
08:28	4	0.95	950
08:29	5	0.97	970
08:36	12	1.05	1050
08:40	16	1.09	1090
08:54	30	1.19	1190
09:19	55	1.34	1340
09:48	84	1.46	1460
10:42	138	1.61	1610
11:26	182	1.67	1670
12:38	254	1.74	1740
13:51	327	1.77	1770
14:49	385	1.79	1790
16:22	478	1.80	1800
07:42 (5/7/23)	1398	1.75	1750
10:06	1542	1.75	1750

SOAKAWAY TRIAL PIT			
Dimensions		**(m)**	**(mm)**
Length	=	2.10	2100
Width	=	0.50	500
Depth	=	2.35	2350

Effective Depth (% full)		**(mm)**	**(m)**
0.25	=	1985	1.99
0.50	=	1620	1.62
0.75	=	1255	1.26

Depth at start of test (mm)	=	890
Depth at end of test (mm)	=	1800
Base area of pit	=	1.05
a_{p50} - 50% internal surface area inc. base	=	4.846
V_{p75-25} - Volume 75 - 25%	=	0.7665

Read from the graph:		
$t_{p\,75}$ (min)	=	40
$t_{p\,25}$ (min)	=	N/A



Test did not attain 25% Effective depth. Unable to calculate soil infiltration rate

Appendix H

Chemical Test Results

Certificate of Analysis

Certificate Number	23-16366	*Issued:*	21-Jul-23

Client Lithos Consulting Ltd
Parkhill
Walton Rd
Wetherby
LS22 5DZ

Our Reference	23-16366
Client Reference	4762
Order No	PO20925
Contract Title	Clacton Road, Weeley Heath
Description	15 Soil samples, 3 Leachate samples.
Date Received	10-Jul-23
Date Started	10-Jul-23
Date Completed	21-Jul-23
Test Procedures	Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By [redacted]

Kirk Bridgewood
General Manager

2139

Summary of Chemical Analysis
Soil Samples

Our Ref 23-16366
Client Ref 4762
Contract Title Clacton Road, Weeley Heath

Test	Method	LOD	Units	Lab No	2199927	2199928	2199929	2199930	2199931	2199932
				.Sample ID	TP01	TP01	TP02	TP03	TP04	TP05
				Depth	0.10	0.15	0.10	0.10	0.10	0.10
				Other ID	1	2	1	1	1	1
				Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Sampling Date	03/07/2023	03/07/2023	03/07/2023	03/07/2023	03/07/2023	03/07/2023
				Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Preparation										
Stones >10mm	DETSC 1003*	1	% m/m		3.0	3.0	4.0	2.0	5.0	2.0
Moisture Content	DETSC 1004	0.1	%		7.6	8.1	8.7	9.7	8.7	9.0
Metals										
Arsenic	DETSC 2301#	0.2	mg/kg		12	11	9.1	8.3	7.7	8.1
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg		1.3	1.3	0.6	1.0	1.1	0.7
Cadmium	DETSC 2301#	0.1	mg/kg		0.9	0.9	0.4	0.2	0.2	0.2
Chromium	DETSC 2301#	0.15	mg/kg		15	17	17	17	16	17
Chromium III	DETSC 2301*	0.15	mg/kg		15	17	17	17	16	17
Chromium, Hexavalent	DETSC 2204*	1	mg/kg		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg		28	28	21	12	18	17
Lead	DETSC 2301#	0.3	mg/kg		110	120	84	36	47	49
Mercury	DETSC 2325#	0.05	mg/kg		0.11	0.13	0.09	0.11	0.08	0.17
Nickel	DETSC 2301#	1	mg/kg		15	15	11	10	9.7	10
Selenium	DETSC 2301#	0.5	mg/kg		< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg		32	32	33	34	31	32
Zinc	DETSC 2301#	1	mg/kg		460	490	190	76	66	110
Inorganics										
pH	DETSC 2008#		pH		7.0	7.1	6.0	5.6	5.7	5.8
Total Organic Carbon	DETSC 2084#	0.5	%		4.1	2.9	2.5	2.4	2.7	2.3
Petroleum Hydrocarbons										
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg							
EPH (C10-C12)	DETSC 3311	10	mg/kg							
EPH (C12-C16)	DETSC 3311	10	mg/kg							
EPH (C16-C21)	DETSC 3311	10	mg/kg							
EPH (C21-C35)	DETSC 3311	10	mg/kg							
EPH (C35-C40)	DETSC 3311	10	mg/kg							
EPH (C10-C40)	DETSC 3311#	10	mg/kg							
PAHs										
Naphthalene	DETSC 3303#	0.03	mg/kg		0.05	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg		0.15	< 0.03	0.10	< 0.03	< 0.03	0.04
Acenaphthene	DETSC 3303#	0.03	mg/kg		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg		0.07	< 0.03	0.04	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg		1.7	0.06	1.2	0.05	0.07	0.26
Anthracene	DETSC 3303	0.03	mg/kg		0.20	< 0.03	0.13	< 0.03	< 0.03	0.05
Fluoranthene	DETSC 3303#	0.03	mg/kg		3.5	0.14	2.5	0.11	0.18	0.82
Pyrene	DETSC 3303#	0.03	mg/kg		3.0	0.12	2.1	0.09	0.16	0.75
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg		1.1	0.06	0.69	0.04	0.07	0.31
Chrysene	DETSC 3303	0.03	mg/kg		1.6	0.08	1.1	0.06	0.10	0.41
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg		1.8	0.08	1.2	0.06	0.11	0.42
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg		0.71	0.03	0.49	< 0.03	0.04	0.17
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg		1.3	0.05	0.76	0.04	0.07	0.33

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Summary of Chemical Analysis
Soil Samples

Our Ref 23-16366
Client Ref 4762
Contract Title Clacton Road, Weeley Heath

			Lab No	2199927	2199928	2199929	2199930	2199931	2199932
			.Sample ID	TP01	TP01	TP02	TP03	TP04	TP05
			Depth	0.10	0.15	0.10	0.10	0.10	0.10
			Other ID	1	2	1	1	1	1
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date	03/07/2023	03/07/2023	03/07/2023	03/07/2023	03/07/2023	03/07/2023
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	Method	LOD	Units						
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.71	0.04	0.40	0.03	0.05	0.19
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	0.15	< 0.03	0.09	< 0.03	< 0.03	0.05
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.94	0.04	0.58	< 0.03	0.05	0.20
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	17	0.70	11	0.45	0.89	4.0

Summary of Chemical Analysis
Soil Samples

Our Ref 23-16366
Client Ref 4762
Contract Title Clacton Road, Weeley Heath

			Lab No	2199933	2199934	2199935	2199936	2199937	2199938
			.Sample ID	TP06	HP01	HP02	HP03	HP04	HP05
			Depth	0.10	0.10	0.10	0.10	0.10	0.10
			Other ID	1	1	1	1	1	1
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date	03/07/2023	03/07/2023	03/07/2023	03/07/2023	03/07/2023	03/07/2023
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	Method	LOD	Units						
Preparation									
Stones >10mm	DETSC 1003*	1	% m/m	1.0	6.0	4.0	2.0	4.0	8.0
Moisture Content	DETSC 1004	0.1	%	16	11	11	8.9	15	11
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg	7.1	7.5	7.4	7.3	6.8	6.5
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg	0.4	0.5	0.6	0.6	2.0	1.1
Cadmium	DETSC 2301#	0.1	mg/kg	0.2	0.4	0.2	0.2	0.9	0.1
Chromium	DETSC 2301#	0.15	mg/kg	16	18	16	14	16	14
Chromium III	DETSC 2301*	0.15	mg/kg	16	18	16	14	16	14
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	14	20	18	18	38	14
Lead	DETSC 2301#	0.3	mg/kg	62	43	54	74	130	38
Mercury	DETSC 2325#	0.05	mg/kg	0.47	0.08	0.11	0.06	0.08	0.12
Nickel	DETSC 2301#	1	mg/kg	10	12	9.7	10	11	8.1
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	32	32	33	28	29	29
Zinc	DETSC 2301#	1	mg/kg	82	180	69	83	170	52
Inorganics									
pH	DETSC 2008#		pH	5.8	5.7	5.8	6.5	6.9	5.2
Total Organic Carbon	DETSC 2084#	0.5	%	2.1	3.1	2.6	2.6	6.2	6.1
Petroleum Hydrocarbons									
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg						
EPH (C10-C12)	DETSC 3311	10	mg/kg						
EPH (C12-C16)	DETSC 3311	10	mg/kg						
EPH (C16-C21)	DETSC 3311	10	mg/kg						
EPH (C21-C35)	DETSC 3311	10	mg/kg						
EPH (C35-C40)	DETSC 3311	10	mg/kg						
EPH (C10-C40)	DETSC 3311#	10	mg/kg						
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.04	0.04	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.05	0.14	0.23	0.19	0.04	0.06
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	0.04	0.04	< 0.03	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.17	0.37	0.87	0.79	0.13	0.18
Pyrene	DETSC 3303#	0.03	mg/kg	0.15	0.32	0.75	0.71	0.12	0.16
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.06	0.14	0.34	0.33	0.06	0.07
Chrysene	DETSC 3303	0.03	mg/kg	0.09	0.20	0.44	0.44	0.10	0.12
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.09	0.22	0.47	0.50	0.11	0.14
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.07	0.18	0.19	0.04	0.06
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.05	0.15	0.37	0.39	0.07	0.10

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Summary of Chemical Analysis
Soil Samples

Our Ref 23-16366
Client Ref 4762
Contract Title Clacton Road, Weeley Heath

			Lab No	2199933	2199934	2199935	2199936	2199937	2199938
			.Sample ID	TP06	HP01	HP02	HP03	HP04	HP05
			Depth	0.10	0.10	0.10	0.10	0.10	0.10
			Other ID	1	1	1	1	1	1
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date	03/07/2023	03/07/2023	03/07/2023	03/07/2023	03/07/2023	03/07/2023
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	Method	LOD	Units						
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.04	0.09	0.24	0.27	0.05	0.07
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	0.03	0.06	0.07	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.04	0.10	0.22	0.25	0.06	0.06
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	0.73	1.8	4.2	4.2	0.76	1.0

Summary of Chemical Analysis
Soil Samples

Our Ref 23-16366
Client Ref 4762
Contract Title Clacton Road, Weeley Heath

Test	Method	LOD	Units	Lab No	2199939	2199940	2199941
				.Sample ID	TP02	TP06	TP05
				Depth	0.50	0.80	1.60
				Other ID	3	3	6
				Sample Type	SOIL	SOIL	SOIL
				Sampling Date	03/07/2023	03/07/2023	03/07/2023
				Sampling Time	n/s	n/s	n/s
Preparation							
Stones >10mm	DETSC 1003*	1	% m/m		3.0	5.0	2.0
Moisture Content	DETSC 1004	0.1	%		10	13	8.3
Metals							
Arsenic	DETSC 2301#	0.2	mg/kg		9.7	12	7.8
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg		0.6	0.4	< 0.2
Cadmium	DETSC 2301#	0.1	mg/kg		< 0.1	0.1	< 0.1
Chromium	DETSC 2301#	0.15	mg/kg		24	29	14
Chromium III	DETSC 2301*	0.15	mg/kg		24	29	14
Chromium, Hexavalent	DETSC 2204*	1	mg/kg		< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg		14	23	7.2
Lead	DETSC 2301#	0.3	mg/kg		22	15	5.1
Mercury	DETSC 2325#	0.05	mg/kg		< 0.05	< 0.05	< 0.05
Nickel	DETSC 2301#	1	mg/kg		13	32	13
Selenium	DETSC 2301#	0.5	mg/kg		< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg		43	59	29
Zinc	DETSC 2301#	1	mg/kg		53	45	18
Inorganics							
pH	DETSC 2008#		pH		6.6	7.5	6.3
Total Organic Carbon	DETSC 2084#	0.5	%		0.7	< 0.5	< 0.5
Petroleum Hydrocarbons							
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg		< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg		< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg		< 10	< 10	< 10
EPH (C16-C21)	DETSC 3311	10	mg/kg		< 10	< 10	< 10
EPH (C21-C35)	DETSC 3311	10	mg/kg		< 10	< 10	< 10
EPH (C35-C40)	DETSC 3311	10	mg/kg		< 10	< 10	< 10
EPH (C10-C40)	DETSC 3311#	10	mg/kg		< 10	< 10	< 10
PAHs							
Naphthalene	DETSC 3303#	0.03	mg/kg		< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg		< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg		< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg		< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg		< 0.03	< 0.03	< 0.03
Anthracene	DETSC 3303	0.03	mg/kg		< 0.03	< 0.03	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg		0.05	< 0.03	< 0.03
Pyrene	DETSC 3303#	0.03	mg/kg		0.04	< 0.03	< 0.03
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg		< 0.03	< 0.03	< 0.03
Chrysene	DETSC 3303	0.03	mg/kg		< 0.03	< 0.03	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg		0.03	< 0.03	< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg		< 0.03	< 0.03	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg		< 0.03	< 0.03	< 0.03

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Summary of Chemical Analysis
Soil Samples

Our Ref 23-16366
Client Ref 4762
Contract Title Clacton Road, Weeley Heath

			Lab No	2199939	2199940	2199941
			.Sample ID	TP02	TP06	TP05
			Depth	0.50	0.80	1.60
			Other ID	3	3	6
			Sample Type	SOIL	SOIL	SOIL
			Sampling Date	03/07/2023	03/07/2023	03/07/2023
			Sampling Time	n/s	n/s	n/s
Test	Method	LOD	Units			
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	0.12	< 0.10	< 0.10

WASTE ACCEPTANCE CRITERIA TESTING ANALYTICAL REPORT

Our Ref 23-16366
Client Ref 4762
Contract Title Clacton Road, Weeley Heath
Sample Id TP02 3 0.50

Sample Numbers 2199939 2199942
Date Analysed 21/07/2023

Test Results On Waste

Determinand and Method Reference	Units	Result	WAC Limit Values: Inert Waste	SNRHW	Hazardous Waste
DETSC 2084# Total Organic Carbon	%	0.7	3	5	6
DETSC 2003# Loss On Ignition	%	4.2	n/a	n/a	10
DETSC 3321# BTEX	mg/kg	< 0.04	6	n/a	n/a
DETSC 3401# PCBs (7 congeners)	mg/kg	< 0.01	1	n/a	n/a
DETSC 3311# TPH (C10 - C40)	mg/kg	< 10	500	n/a	n/a
DETSC 3301 PAHs	mg/kg	< 1.6	100	n/a	n/a
DETSC 2008# pH	pH Units	6.6	n/a	>6	n/a
DETSC 2073* Acid Neutralisation Capacity (pH4)	mol/kg	< 1.0	n/a	TBE	TBE
DETSC 2073* Acid Neutralisation Capacity (pH7)	mol/kg	< 1.0	n/a	TBE	TBE

Test Results On Leachate

Determinand and Method Reference	Conc in Eluate ug/l 10:1	Amount Leached* mg/kg LS10	WAC Limit Values (Limit values for LS10 Leachate): Inert Waste	SNRHW	Hazardous Waste
DETSC 2306 Arsenic as As	4	0.04	0.5	2	25
DETSC 2306 Barium as Ba	6	< 0.1	20	100	300
DETSC 2306 Cadmium as Cd	< 0.030	< 0.02	0.04	1	5
DETSC 2306 Chromium as Cr	4.3	< 0.1	0.5	10	70
DETSC 2306 Copper as Cu	3.7	0.037	2	50	100
DETSC 2306 Mercury as Hg	< 0.010	< 0.002	0.01	0.2	2
DETSC 2306 Molybdenum as Mo	< 1.1	< 0.1	0.5	10	30
DETSC 2306 Nickel as Ni	1.9	< 0.1	0.4	10	40
DETSC 2306 Lead as Pb	1.8	< 0.05	0.5	10	50
DETSC 2306 Antimony as Sb	0.44	< 0.05	0.06	0.7	5
DETSC 2306 Selenium as Se	0.44	< 0.03	0.1	0.5	7
DETSC 2306 Zinc as Zn	23	0.23	4	50	200
DETSC 2055 Chloride as Cl	1000	< 100	800	15,000	25,000
DETSC 2055* Fluoride as F	110	1.1	10	150	500
DETSC 2055 Sulphate as SO4	2400	< 100	1000	20,000	50,000
DETSC 2009* Total Dissolved Solids	11000	110	4000	60,000	100,000
DETSC 2130 Phenol Index	< 100	< 1	1	n/a	n/a
DETSC 2085 Dissolved Organic Carbon	4000	< 50	500	800	1000

TBE - To Be Evaluated
SNRHW - Stable Non-Reactive Hazardous Waste

Additional Information

DETSC 2008 pH	7.4
DETSC 2009 Conductivity uS/cm	15.7
* Temperature*	19.0

Mass of Sample Kg*	0.110
Mass of dry Sample Kg*	0.099

Stage 1

Volume of Leachant L2*	0.974
Volume of Eluate VE1*	0.92

Disclaimer: The WAC limit values are provided for guidance only. DETS does not accept responsibility for errors or omissions. Values are correct at time of issue.

V.2.06 * DETS are accredited for the testing of leachates and not the leachate preparation stage which is unaccredited.

WASTE ACCEPTANCE CRITERIA TESTING ANALYTICAL REPORT

Our Ref 23-16366
Client Ref 4762
Contract Title Clacton Road, Weeley Heath
Sample Id TP06 3 0.80

Sample Numbers 2199940 2199943
Date Analysed 21/07/2023

Test Results On Waste

Determinand and Method Reference	Units	Result	WAC Limit Values Inert Waste	SNRHW	Hazardous Waste
DETSC 2084# Total Organic Carbon	%	< 0.5	3	5	6
DETSC 2003# Loss On Ignition	%	3.8	n/a	n/a	10
DETSC 3321# BTEX	mg/kg	< 0.04	6	n/a	n/a
DETSC 3401# PCBs (7 congeners)	mg/kg	< 0.01	1	n/a	n/a
DETSC 3311# TPH (C10 - C40)	mg/kg	< 10	500	n/a	n/a
DETSC 3301 PAHs	mg/kg	< 1.6	100	n/a	n/a
DETSC 2008# pH	pH Units	7.5	n/a	>6	n/a
DETSC 2073* Acid Neutralisation Capacity (pH4)	mol/kg	< 1.0	n/a	TBE	TBE
DETSC 2073* Acid Neutralisation Capacity (pH7)	mol/kg	< 1.0	n/a	TBE	TBE

Test Results On Leachate

Determinand and Method Reference	Conc in Eluate ug/l 10:1	Amount Leached* mg/kg LS10	WAC Limit Values Limit values for LS10 Leachate Inert Waste	SNRHW	Hazardous Waste
DETSC 2306 Arsenic as As	0.56	< 0.01	0.5	2	25
DETSC 2306 Barium as Ba	3.2	< 0.1	20	100	300
DETSC 2306 Cadmium as Cd	< 0.030	< 0.02	0.04	1	5
DETSC 2306 Chromium as Cr	0.52	< 0.1	0.5	10	70
DETSC 2306 Copper as Cu	0.54	< 0.02	2	50	100
DETSC 2306 Mercury as Hg	< 0.010	< 0.002	0.01	0.2	2
DETSC 2306 Molybdenum as Mo	< 1.1	< 0.1	0.5	10	30
DETSC 2306 Nickel as Ni	< 0.50	< 0.1	0.4	10	40
DETSC 2306 Lead as Pb	0.28	< 0.05	0.5	10	50
DETSC 2306 Antimony as Sb	< 0.17	< 0.05	0.06	0.7	5
DETSC 2306 Selenium as Se	< 0.25	< 0.03	0.1	0.5	7
DETSC 2306 Zinc as Zn	3.6	0.036	4	50	200
DETSC 2055 Chloride as Cl	770	< 100	800	15,000	25,000
DETSC 2055* Fluoride as F	170	1.7	10	150	500
DETSC 2055 Sulphate as SO4	1900	< 100	1000	20,000	50,000
DETSC 2009* Total Dissolved Solids	9500	95	4000	60,000	100,000
DETSC 2130 Phenol Index	< 100	< 1	1	n/a	n/a
DETSC 2085 Dissolved Organic Carbon	< 2000	< 50	500	800	1000

TBE - To Be Evaluated
SNRHW - Stable Non-Reactive Hazardous Waste

Additional Information

DETSC 2008 pH	7.2
DETSC 2009 Conductivity uS/cm	13.5
* Temperature*	19.0

Mass of Sample Kg*	0.110
Mass of dry Sample Kg*	0.096

Stage 1

Volume of Leachant L2*	0.942
Volume of Eluate VE1*	0.89

Disclaimer: The WAC limit values are provided for guidance only. DETS does not accept responsibility for errors or omissions. Values are correct at time of issue.

V.2.06 * DETS are accredited for the testing of leachates and not the leachate preparation stage which is unaccredited.

WASTE ACCEPTANCE CRITERIA TESTING ANALYTICAL REPORT

Our Ref 23-16366
Client Ref 4762
Contract Title Clacton Road, Weeley Heath
Sample Id TP05 6 1.60

Sample Numbers 2199941 2199944
Date Analysed 21/07/2023

Test Results On Waste

Determinand and Method Reference	Units	Result	WAC Limit Values: Inert Waste	SNRHW	Hazardous Waste
DETSC 2084# Total Organic Carbon	%	< 0.5	3	5	6
DETSC 2003# Loss On Ignition	%	2.2	n/a	n/a	10
DETSC 3321# BTEX	mg/kg	< 0.04	6	n/a	n/a
DETSC 3401# PCBs (7 congeners)	mg/kg	< 0.01	1	n/a	n/a
DETSC 3311# TPH (C10 - C40)	mg/kg	< 10	500	n/a	n/a
DETSC 3301 PAHs	mg/kg	< 1.6	100	n/a	n/a
DETSC 2008# pH	pH Units	6.3	n/a	>6	n/a
DETSC 2073* Acid Neutralisation Capacity (pH4)	mol/kg	< 1.0	n/a	TBE	TBE
DETSC 2073* Acid Neutralisation Capacity (pH7)	mol/kg	< 1.0	n/a	TBE	TBE

Test Results On Leachate

Determinand and Method Reference	Conc in Eluate ug/l 10:1	Amount Leached* mg/kg LS10	WAC Limit Values (Limit values for LS10 Leachate): Inert Waste	SNRHW	Hazardous Waste
DETSC 2306 Arsenic as As	0.2	< 0.01	0.5	2	25
DETSC 2306 Barium as Ba	6	< 0.1	20	100	300
DETSC 2306 Cadmium as Cd	< 0.030	< 0.02	0.04	1	5
DETSC 2306 Chromium as Cr	< 0.25	< 0.1	0.5	10	70
DETSC 2306 Copper as Cu	< 0.40	< 0.02	2	50	100
DETSC 2306 Mercury as Hg	< 0.010	< 0.002	0.01	0.2	2
DETSC 2306 Molybdenum as Mo	< 1.1	< 0.1	0.5	10	30
DETSC 2306 Nickel as Ni	< 0.50	< 0.1	0.4	10	40
DETSC 2306 Lead as Pb	< 0.090	< 0.05	0.5	10	50
DETSC 2306 Antimony as Sb	< 0.17	< 0.05	0.06	0.7	5
DETSC 2306 Selenium as Se	< 0.25	< 0.03	0.1	0.5	7
DETSC 2306 Zinc as Zn	28	0.28	4	50	200
DETSC 2055 Chloride as Cl	8200	< 100	800	15,000	25,000
DETSC 2055* Fluoride as F	< 100	< 0.1	10	150	500
DETSC 2055 Sulphate as SO4	17000	170	1000	20,000	50,000
DETSC 2009* Total Dissolved Solids	54000	540	4000	60,000	100,000
DETSC 2130 Phenol Index	< 100	< 1	1	n/a	n/a
DETSC 2085 Dissolved Organic Carbon	< 2000	< 50	500	800	1000

TBE - To Be Evaluated
SNRHW - Stable Non-Reactive Hazardous Waste

Additional Information

DETSC 2008 pH	7.3
DETSC 2009 Conductivity uS/cm	77.4
* Temperature*	19.0

Mass of Sample Kg*	0.110
Mass of dry Sample Kg*	0.101

Stage 1

Volume of Leachant L2*	1
Volume of Eluate VE1*	0.94

Disclaimer: The WAC limit values are provided for guidance only. DETS does not accept responsibility for errors or omissions. Values are correct at time of issue.

V.2.06 * DETS are accredited for the testing of leachates and not the leachate preparation stage which is unaccredited.

Summary of Asbestos Analysis
Soil Samples

Our Ref 23-16366
Client Ref 4762
Contract Title Clacton Road, Weeley Heath

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
2199927	TP01 1 0.10	SOIL	NAD	none	Robertas Ciparis
2199928	TP01 2 0.15	SOIL	NAD	none	Robertas Ciparis
2199929	TP02 1 0.10	SOIL	NAD	none	Robertas Ciparis
2199930	TP03 1 0.10	SOIL	NAD	none	Robertas Ciparis
2199931	TP04 1 0.10	SOIL	NAD	none	Robertas Ciparis
2199932	TP05 1 0.10	SOIL	Chrysotile	Chrysotile present as fibre bundles and in visible cement fragment	Robertas Ciparis
2199933	TP06 1 0.10	SOIL	NAD	none	Robertas Ciparis
2199934	HP01 1 0.10	SOIL	NAD	none	Robertas Ciparis
2199935	HP02 1 0.10	SOIL	NAD	none	Robertas Ciparis
2199936	HP03 1 0.10	SOIL	NAD	none	Robertas Ciparis
2199937	HP04 1 0.10	SOIL	NAD	none	Robertas Ciparis
2199938	HP05 1 0.10	SOIL	NAD	none	Robertas Ciparis
2199939	TP02 3 0.50	SOIL	NAD	none	Robertas Ciparis
2199940	TP06 3 0.80	SOIL	NAD	none	Robertas Ciparis
2199941	TP05 6 1.60	SOIL	NAD	none	Robertas Ciparis

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * -not included in laboratory scope of accreditation.

Information in Support of the Analytical Results

Our Ref 23-16366
Client Ref 4762
Contract Clacton Road, Weeley Heath

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
2199927	TP01 0.10 SOIL	03/07/23	GJ 250ml, PT 1L		
2199928	TP01 0.15 SOIL	03/07/23	GJ 250ml, PT 1L		
2199929	TP02 0.10 SOIL	03/07/23	GJ 250ml, PT 1L		
2199930	TP03 0.10 SOIL	03/07/23	GJ 250ml, PT 1L		
2199931	TP04 0.10 SOIL	03/07/23	GJ 250ml, PT 1L		
2199932	TP05 0.10 SOIL	03/07/23	GJ 250ml, PT 1L		
2199933	TP06 0.10 SOIL	03/07/23	GJ 250ml, PT 1L		
2199934	HP01 0.10 SOIL	03/07/23	GJ 250ml, PT 1L		
2199935	HP02 0.10 SOIL	03/07/23	GJ 250ml, PT 1L		
2199936	HP03 0.10 SOIL	03/07/23	GJ 250ml, PT 1L		
2199937	HP04 0.10 SOIL	03/07/23	GJ 250ml, PT 1L		
2199938	HP05 0.10 SOIL	03/07/23	GJ 250ml, PT 1L		
2199939	TP02 0.50 SOIL	03/07/23	GJ 250ml x2, GJ 60ml, PT 1L x2		
2199940	TP06 0.80 SOIL	03/07/23	GJ 250ml, GJ 60ml, PT 1L		
2199941	TP05 1.60 SOIL	03/07/23	GJ 250ml, GJ 60ml, PT 1L		
2199942	TP02 0.50 LEACHATE	03/07/23	GJ 250ml x2, GJ 60ml, PT 1L x2		
2199943	TP06 0.80 LEACHATE	03/07/23	GJ 250ml, GJ 60ml, PT 1L		
2199944	TP05 1.60 LEACHATE	03/07/23	GJ 250ml, GJ 60ml, PT 1L		

Key: G-Glass P-Plastic J-Jar T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

End of Report

Certificate of Analysis

Certificate Number	23-17902	*Issued:*	31-Jul-23

Client Lithos Consulting Ltd
Parkhill
Walton Rd
Wetherby
LS22 5DZ

Our Reference	23-17902
Client Reference	4762
Order No	PO20925
Contract Title	Clacton Road, Weeley Heath
Description	One Soil sample.
Date Received	10-Jul-23
Date Started	27-Jul-23
Date Completed	31-Jul-23
Test Procedures	Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By [redacted]
Kirk Bridgewood
General Manager

2139

Summary of Asbestos Analysis
Samples

Our Ref 23-17902
Client Ref 4762
Contract Title Clacton Road, Weeley Heath

Lab No	Sample ID	Sample Location	Material Type	Result	Comment*	Analyst

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * -not included in laboratory scope of accreditation.

Summary of Asbestos Quantification Analysis
Soil Samples

Our Ref 23-17902
Client Ref 4762
Contract Title Clacton Road, Weeley Heath

		Lab No	2209286
		.Sample ID	TP05
		Depth	0.10
		Other ID	1
		Sample Type	
		Sampling Date	03/07/2023
		Sampling Time	
Test	Method	Units	
Total Mass% Asbestos (a+b+c)	DETSC 1102	Mass %	**0.201**
Gravimetric Quantification (a)	DETSC 1102	Mass %	0.200
Detailed Gravimetric Quantification (b)	DETSC 1102	Mass %	<0.001
Quantification by PCOM (c)	DETSC 1102	Mass %	na
Potentially Respirable Fibres (d)	DETSC 1102	Fibres/g	na
Breakdown of Gravimetric Analysis (a)			
Mass of Sample		g	984.90
ACMs present*		type	Cement
Mass of ACM in sample		g	13.12
% ACM by mass		%	1.33
% asbestos in ACM		%	15
% asbestos in sample		%	0.200
Breakdown of Detailed Gravimetric Analysis (b)			
% Amphibole bundles in sample		Mass %	na
% Chrysotile bundles in sample		Mass %	<0.001
Breakdown of PCOM Analysis (c)			
% Amphibole fibres in sample		Mass %	na
% Chrysotile fibres in sample		Mass %	na
Breakdown of Potentially Respirable Fibre Analysis (d)			
Amphibole fibres		Fibres/g	na
Chrysotile fibres		Fibres/g	na

* Denotes test or material description outside of UKAS accreditation.
% asbestos in Asbestos Containing Materials (ACMs) is determined by
by reference to HSG 264.
Recommended sample size for quantification is approximately 1kg
# denotes deviating sample

Information in Support of the Analytical Results

Our Ref 23-17902
Client Ref 4762
Contract Clacton Road, Weeley Heath

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
2209286	TP05 0.10 SOIL	03/07/23	GJ 250ml, PT 1L		

Key: G-Glass P-Plastic J-Jar T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-
Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

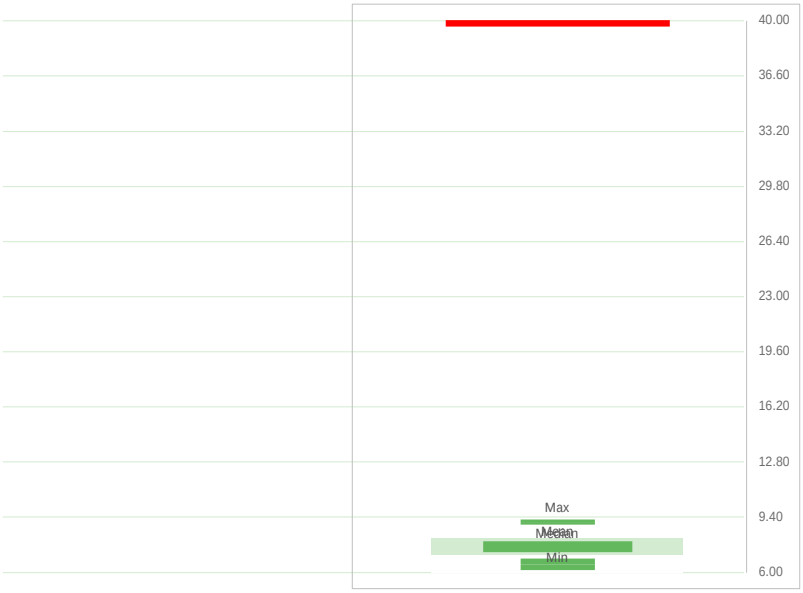
End of Report

Clacton Road, Weeley Heath

Job No: 4762
Engineer: LBW
Date: 27 July 2023

Topsoil: Dataset for As - Dot & Box Plots and Summary Statistics

Determinant	As
Critical concentration	40.00
No. samples	10.00
Max	9.10
Mean	7.58
Min	6.50
Median	7.45
Standard Deviation	0.76
Standard Error	0.24
T value	2.26
Upper Confidence Level (95%)	8.13
Upper Confidence Level (80%)	7.91
Lower Confidence Level (5%)	7.11
Transform data	Normal
Upper Confidence Level for chart	95%



Spatial distribution can show sampling clusters based on ground type it does not identify areas of contamintion

Clacton Road, Weeley Heath

Job No: 4762
Engineer: LBW
Date: 27 July 2023

Topsoil: Dataset for Pb - Dot & Box Plots and Summary Statistics

Determinant	Pb
Critical concentration	314.00
No. samples	10.00
Max	130.00
Mean	57.07
Min	36.00
Median	51.50
Standard Deviation	28.52
Standard Error	9.02
T value	2.26
Upper Confidence Level (95%)	77.47
Upper Confidence Level (80%)	69.54
Lower Confidence Level (5%)	39.39
Transform data	Normal

Upper Confidence Level for chart	95%

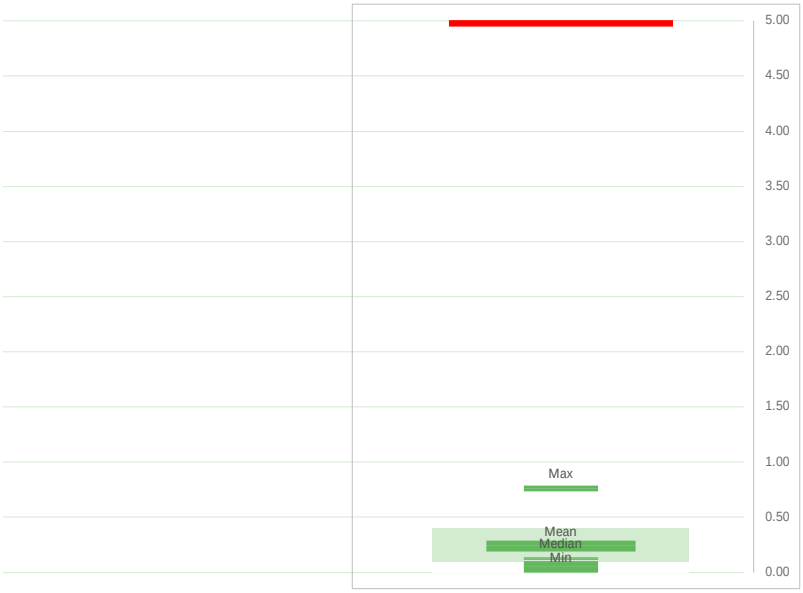
Spatial distribution can show sampling clusters based on ground type it does not identify areas of contamintion

Clacton Road, Weeley Heath

Job No: 4762
Engineer: LBW
Date: 27 July 2023

Topsoil: Dataset for B(a)P - Dot & Box Plots and Summary Statistics

Determinant	B(a)P
Critical concentration	5.00
No. samples	10.00
Max	0.76
Mean	0.24
Min	0.05
Median	0.13
Standard Deviation	0.23
Standard Error	0.07
T value	2.26
Upper Confidence Level (95%)	0.40
Upper Confidence Level (80%)	0.34
Lower Confidence Level (5%)	0.10
Transform data	Normal
Upper Confidence Level for chart	95%



Spatial distribution can show sampling clusters based on ground type it does not identify areas of contamintion

Appendix I

Geotechnical Test Results

LABORATORY REPORT

Contract Number: PSL23/5525

Report Date: 02 August 2023

Client's Reference: 4762

Client Name: Lithos Consulting
Parkhill
Walton Road
Wetherby
North Yorkshire
LS22 5DZ

For the attention of: Lewis Whiteley

Project Name: Clacton Road, Weeley Heath

Date Received: 12/7/2023
Date Commenced: 12/7/2023
Date Completed: 02/08/2023

Notes: Opinions and Interpretations are outside the UKAS Accreditation

Checked and Approved Signatories:

A Watkins (Director)	R Berriman (Quality Manager)	S Royle (Laboratory Manager)
L Knight (Assistant Laboratory Manager)	S Eyre (Senior Technician)	[redacted] (Senior Technician)

5 – 7 Hexthorpe Road,
Hexthorpe,
Doncaster,
DN4 0AR
[redacted]

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
TP02	2	B	0.20		Brown TOPSOIL.
TP03	2	B	0.20		Brown TOPSOIL.
TP05	2	B	0.20		Brown TOPSOIL.
TP01	3	D	0.70		Brown mottled grey sandy CLAY.
TP03	3	D	0.80		Brown mottled grey sandy CLAY.
TP05	4	D	0.80		Brown mottled grey sandy CLAY.
TP02	4	D	0.90		Brown mottled grey sandy CLAY.
TP06	4	D	0.90		Brown slightly gravelly sandy CLAY.
TP04	3	D&B	0.90		Brown mottled grey very sandy CLAY.
TP03	4	D	1.10		Brown mottled grey slightly gravelly sandy CLAY.
TP05	5	D&B	1.20		Brown slightly gravelly very sandy CLAY.
TP02	5	D	1.30		Brown slightly gravelly sandy CLAY.
TP04	5	D	2.20		Brown slightly gravelly sandy CLAY.
TP01	4	D&B	1.20		Brown clayey silty SAND.
TP06	5	D&B	1.50		Brown slightly gravelly clayey silty SAND.

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m^3 Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
TP01	3	D	0.70		17			41	19	22	100	Intermediate Plasticity CI
TP03	3	D	0.80		12			36	18	18	100	Intermediate Plasticity CI
TP05	4	D	0.80		17			43	15	28	100	Intermediate Plasticity CI
TP02	4	D	0.90		13			41	20	21	100	Intermediate Plasticity CI
TP06	4	D	0.90		13			38	19	19	98	Intermediate Plasticity CI
TP04	3	D&B	0.90		13			31	15	16	100	Low Plasticity CL
TP03	4	D	1.10		17			39	19	20	98	Intermediate Plasticity CI
TP05	5	D&B	1.20		10			26	14	12	98	Low Plasticity CL
TP02	5	D	1.30		15			38	18	20	98	Intermediate Plasticity CI
TP04	5	D	2.20		21			44	22	22	99	Intermediate Plasticity CI
TP01	4	D&B	1.20		39				NP			
TP06	5	D&B	1.50		10				NP			

SYMBOLS : **NP : Non Plastic** *** : Liquid Limit and Plastic Limit Wet Sieved.**

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Clacton Road, Weeley Heath

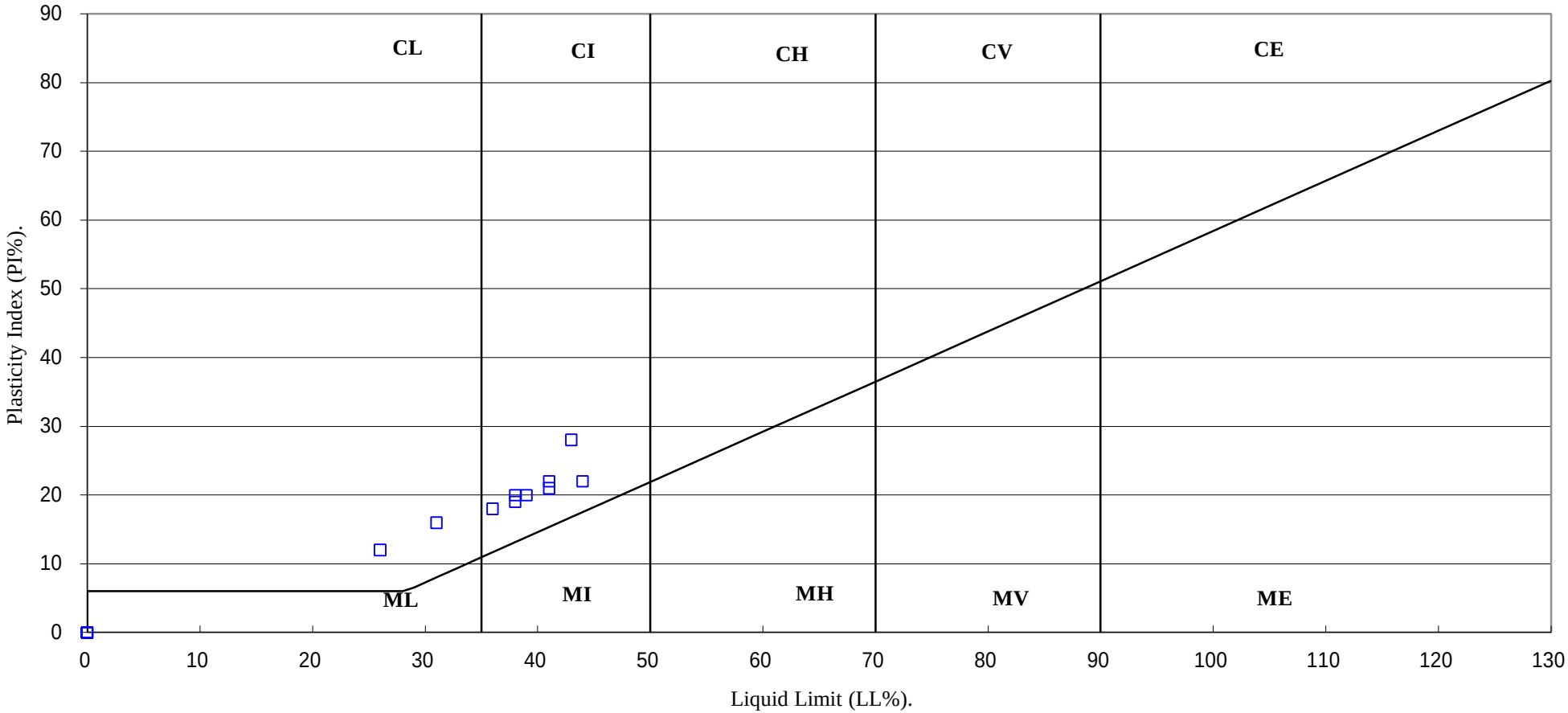
Contract No:

PSL23/5525

Client Ref:

4762

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



UKAS TESTING 4043	PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY	**Clacton Road, Weeley Heath**

Contract No:
PSL23/5525
Client Ref:
4762

PARTICLE SIZE DISTRIBUTION TEST

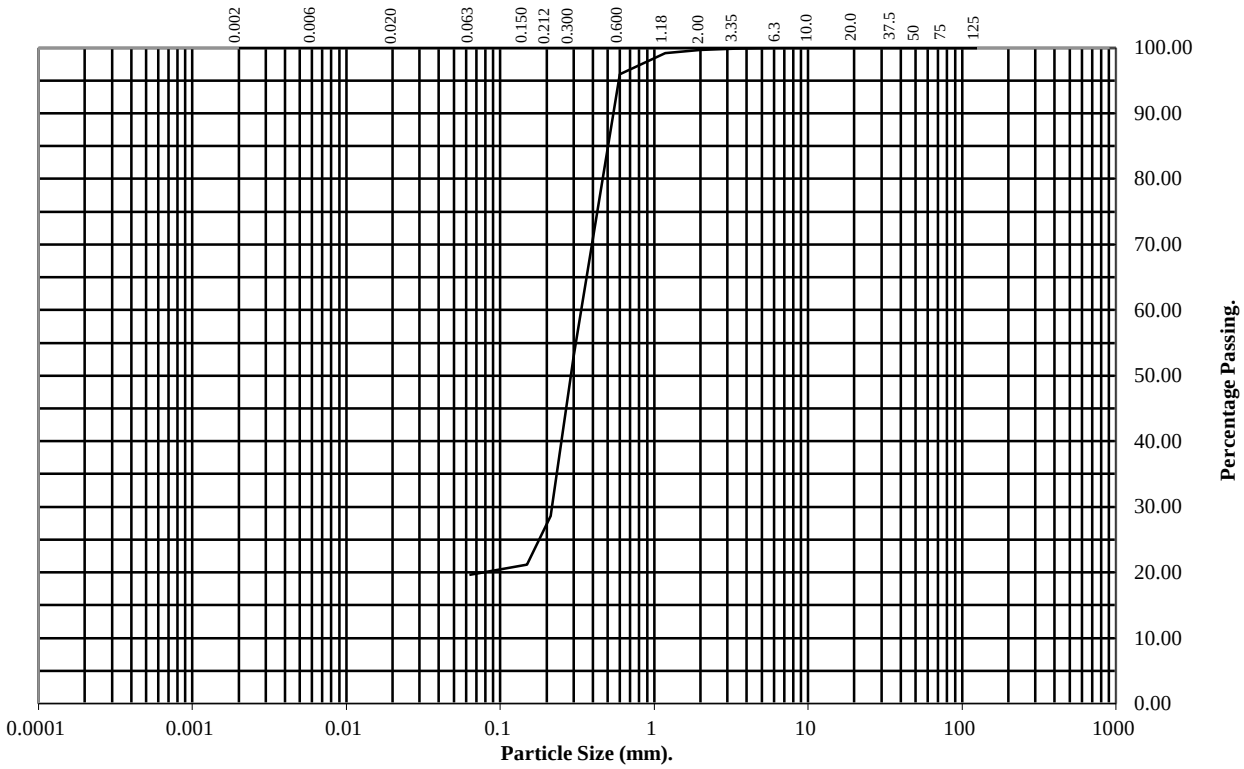
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TP01** **Top Depth (m):** **1.20**

Sample Number: **4** **Base Depth(m):**

Sample Type: **D&B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
50	100
37.5	100
20	100
10	100
6.3	100
3.35	100
2	100
1.18	99
0.6	96
0.3	53
0.212	29
0.15	21
0.063	20

Soil Fraction	Total Percentage
Cobbles	0
Gravel	0
Sand	80
Silt/Clay	20

Remarks:

See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Clacton Road, Weeley Heath

Contract No: **PSL23/5525**

Client Ref: **4762**

PARTICLE SIZE DISTRIBUTION TEST

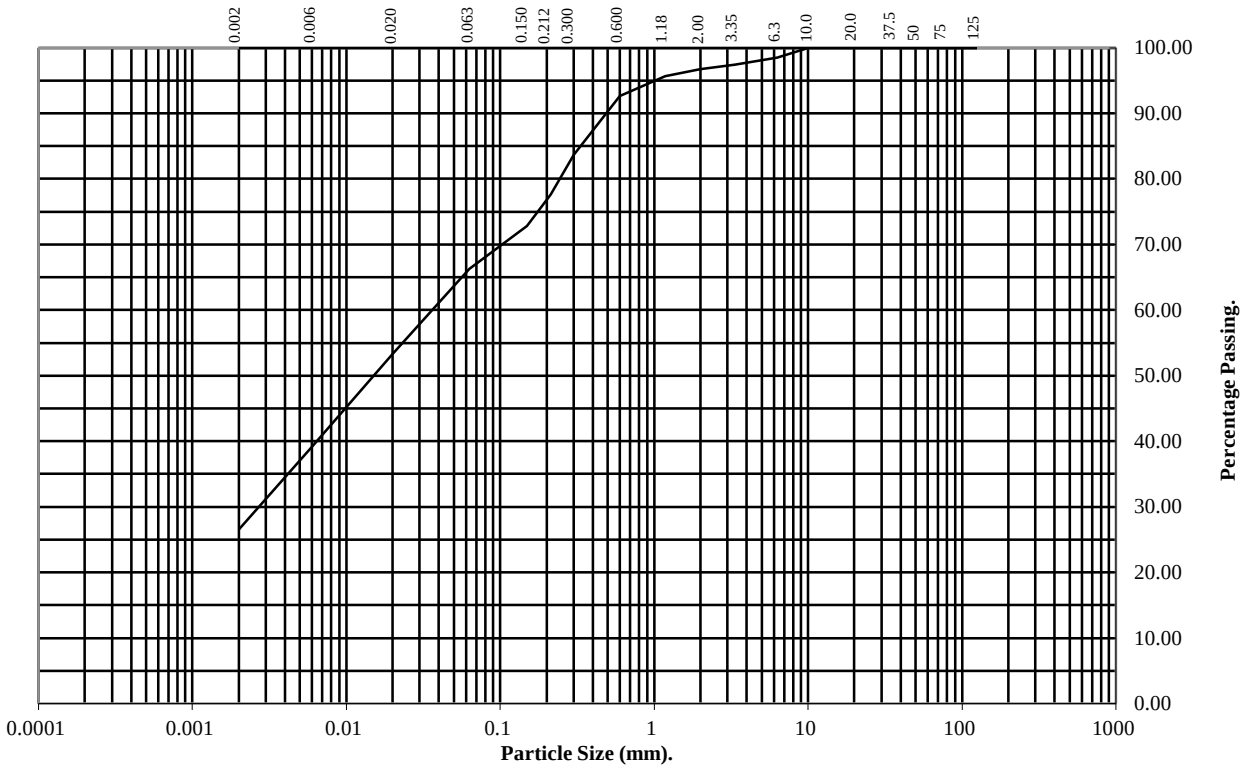
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: **TP02** **Top Depth (m):** **0.20**

Sample Number: **2** **Base Depth(m):**

Sample Type: **B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
50	100
37.5	100
20	100
10	100
6.3	99
3.35	97
2	97
1.18	96
0.6	93
0.3	84
0.212	78
0.15	73
0.063	66

Particle Diameter	Percentage Passing
0.02	53
0.006	39
0.002	27

Soil Fraction	Total Percentage
Cobbles	0
Gravel	3
Sand	31
Silt	39
Clay	27

Remarks:
See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Clacton Road, Weeley Heath

Contract No:
PSL23/5525
Client Ref:
4762

PARTICLE SIZE DISTRIBUTION TEST

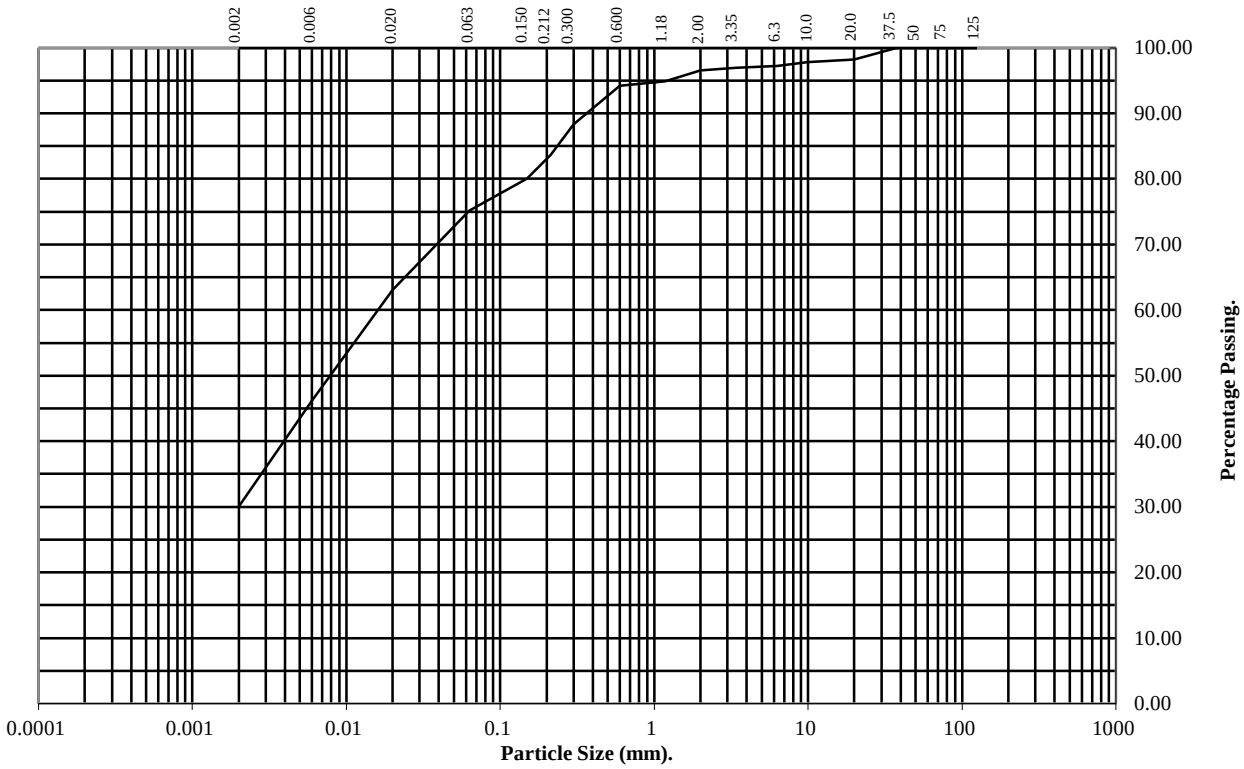
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: **TP03** **Top Depth (m):** **0.20**

Sample Number: **2** **Base Depth(m):**

Sample Type: **B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
50	100
37.5	100
20	98
10	98
6.3	97
3.35	97
2	96
1.18	95
0.6	94
0.3	88
0.212	84
0.15	80
0.063	75

Particle Diameter	Percentage Passing
0.02	63
0.006	46
0.002	30

Soil Fraction	Total Percentage
Cobbles	0
Gravel	4
Sand	21
Silt	45
Clay	30

Remarks:
See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Clacton Road, Weeley Heath

Contract No:
PSL23/5525
Client Ref:
4762

PARTICLE SIZE DISTRIBUTION TEST

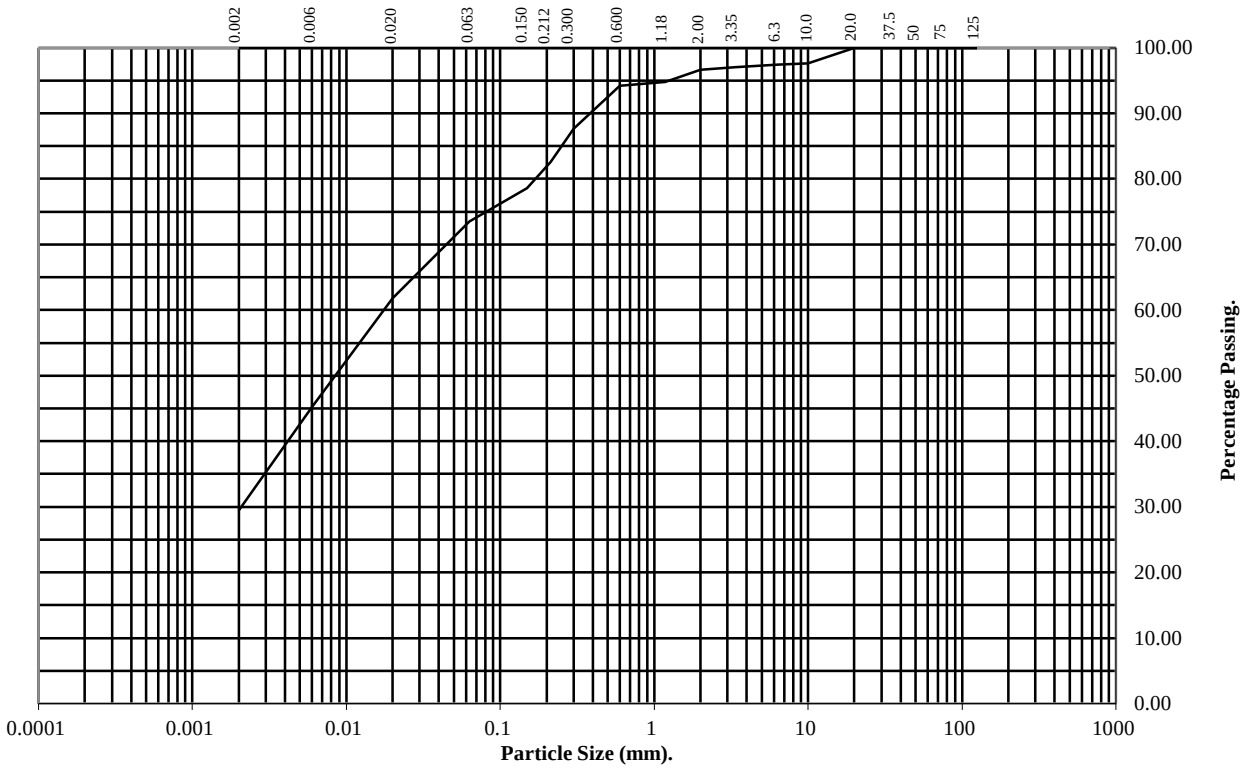
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: **TP05** **Top Depth (m):** **0.20**

Sample Number: **2** **Base Depth(m):**

Sample Type: **B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
50	100
37.5	100
20	100
10	98
6.3	97
3.35	97
2	97
1.18	95
0.6	94
0.3	88
0.212	83
0.15	79
0.063	74

Particle Diameter	Percentage Passing
0.02	62
0.006	45
0.002	29

Soil Fraction	Total Percentage
Cobbles	0
Gravel	3
Sand	23
Silt	45
Clay	29

Remarks:
See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Clacton Road, Weeley Heath

Contract No:
PSL23/5525
Client Ref:
4762

PARTICLE SIZE DISTRIBUTION TEST

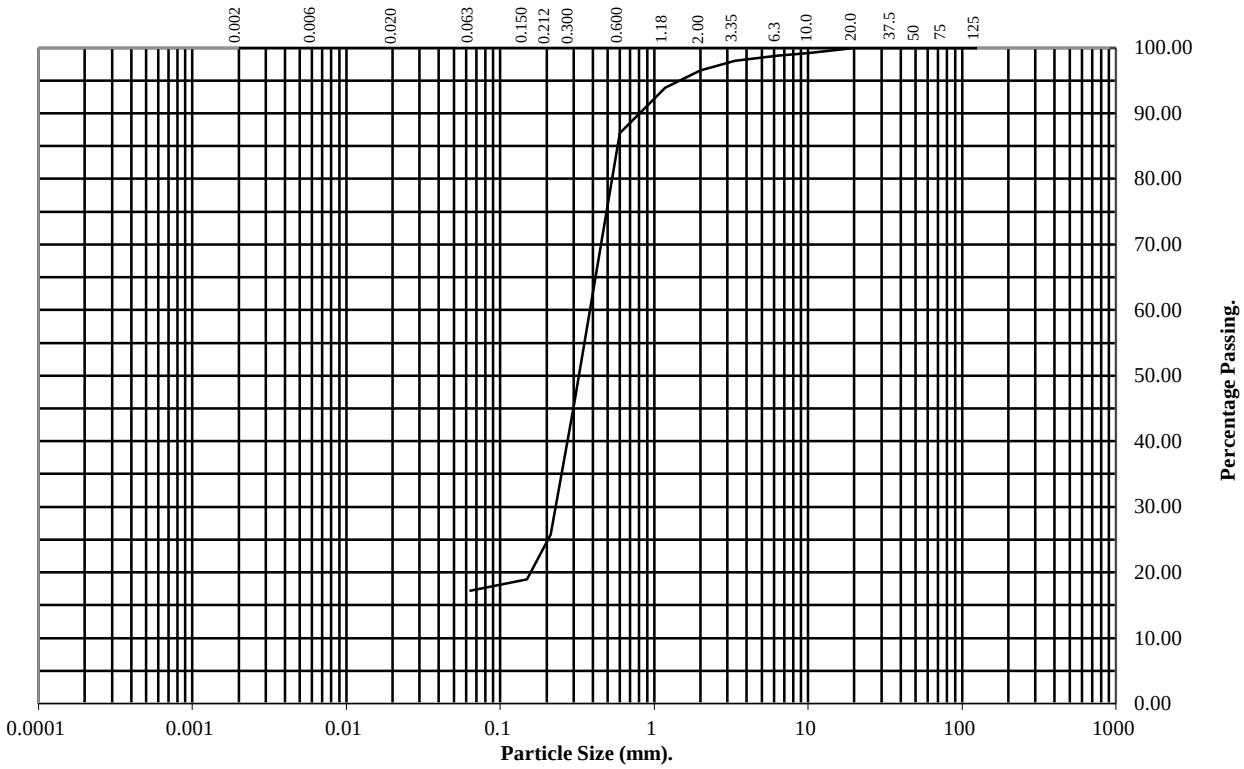
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **TP06** **Top Depth (m):** **1.50**

Sample Number: **5** **Base Depth(m):**

Sample Type: **D&B**



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
50	100
37.5	100
20	100
10	99
6.3	99
3.35	98
2	96
1.18	94
0.6	87
0.3	45
0.212	26
0.15	19
0.063	17

Soil Fraction	Total Percentage
Cobbles	0
Gravel	4
Sand	79
Silt/Clay	17

Remarks:

See Summary of Soil Descriptions

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY A PHENNA GROUP COMPANY

Clacton Road, Weeley Heath

Contract No: **PSL23/5525**

Client Ref: **4762**

7 - 11 Harding Street
Leicester
LE1 4DH

Professional Soils Laboratory
5/7 Hexthorpe Road
Hexthorpe
Doncaster
DN4 0AR

Analytical Test Report: L23/03647/PSL - 23-35577

Your Project Reference:	**PSL23/5525 Clacton Road, Weeley Heath**		
Your Order Number:	PSL23/5525	Samples Received / Instructed:	19/07/2023 / 19/07/2023
Report Issue Number:	1	Sample Tested:	19/07 to 26/07/2023
Samples Analysed:	13 soil samples	Report issued:	26/07/2023

Signed

[redacted]

James Gane
Analytical Services Manager
CTS Group

Notes:

General

Please refer to Methodologies page for details pertaining to the analytical methods undertaken.

Samples will be retained for 14 days after issue of this report unless otherwise requested.

Moisture Content was determined in accordance with CTS method statement MS - CL - Sample Prep, oven dried at <30˚C.

Moisture Content is reported as a percentage of the dry mass of soil, this calculation is in accordance with BS1377, Part 2, 1990, Clause 3.2

Where specification limits are included these are for guidance only. Where a measured value has been highlighted this is not implying acceptance or failure and certainty of measurement values have not been taken into account.

Uncertainty of measurement values are available on request.

Samples were supplied by customer, results apply to the samples as received.

Deviating Samples

On receipt samples are compared against our sample holding and handling protocols, where any deviations have been noted these are reported on our deviating sample page (if present)

Accreditation Key

UKAS = UKAS Accreditation, MCERTS = MCERTS Accreditation, u = Unaccredited

MCERTS Accreditation only covers the SAND, CLAY and LOAM matrices

Date of Issue: 06.07.23

Issued by: J. Gane

Issue No: 4

Rev No: 1

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L23/03647/PSL - 23-35577

Project Reference - PSL23/5525 Clacton Road, Weeley Heath

Analytical Test Results - Soil

Lab Reference			305284	305285	305286	305287	305288	305289	305290
Client Sample ID			-	-	-	-	-	-	-
Client Sample Location			TP03	TP05	TP02	TP06	TP04	TP05	TP02
Client Sample Type			D	D	D	D	DB	DB	D
Client Sample Number			3	4	4	4	3	5	5
Depth - Top (m)			0.80	0.80	0.90	0.90	0.90	1.20	1.30
Depth - Bottom (m)			0.80	0.80	0.90	0.90	0.90	1.20	1.30
Date of Sampling			05/07/2023	05/07/2023	05/07/2023	05/07/2023	05/07/2023	05/07/2023	05/07/2023
Time of Sampling			-	-	-	-	-	-	-
Sample Matrix			Sand	Clay	Clay	Clay	Clay	Clay	Clay
Determinant	Units	Accreditation							
pH	pH Units	MCERTS	8.4	7.7	8.0	7.9	8.5	6.0	7.6
Sulphate (Water soluble as SO_4)	(mg/l)	u	26	54	17	16	23	120	21

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L23/03647/PSL - 23-35577

Project Reference - PSL23/5525 Clacton Road, Weeley Heath

Analytical Test Results - Soil

Lab Reference			305291	305292	305293	305294	305295	305296
Client Sample ID			-	-	-	-	-	-
Client Sample Location			TP04	TP01	TP04	TP06	TP01	TP03
Client Sample Type			D	DB	D	DB	D	D
Client Sample Number			5	4	4	5	5	6
Depth - Top (m)			2.20	1.20	1.40	1.50	1.90	2.20
Depth - Bottom (m)			2.20	1.20	1.40	1.50	1.90	2.20
Date of Sampling			05/07/2023	05/07/2023	05/07/2023	05/07/2023	05/07/2023	05/07/2023
Time of Sampling			-	-	-	-	-	-
Sample Matrix			Clay	Sand	Sand	Sand	Sand	Sand
Determinant	Units	Accreditation						
pH	pH Units	MCERTS	7.5	7.8	8.4	8.1	7.8	7.7
Sulphate (Water soluble as SO_4)	(mg/l)	u	91	12	52	< 10	11	88

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L23/03647/PSL - 23-35577

Project Reference - PSL23/5525 Clacton Road, Weeley Heath

Sample Descriptions

Lab Reference	Client Sample ID	Client Sample Location	Client Sample Type	Client Sample Number	Description	Moisture Content (%)	Stone Content (%)	Passing 2mm test sieve (%)
305284	-	TP03	D	3	Reddish brown silty sand	-	-	100
305285	-	TP05	D	4	Reddish brown slightly sandy silty clay	-	-	100
305286	-	TP02	D	4	Reddish brown slightly sandy silty clay	-	-	95
305287	-	TP06	D	4	Reddish brown silty clay	-	-	98
305288	-	TP04	DB	3	Reddish brown slightly sandy silty clay	-	-	100
305289	-	TP05	DB	5	Reddish brown slightly gravelly slightly sandy silty clay	-	-	59
305290	-	TP02	D	5	Reddish brown slightly gravelly silty clay	-	-	86
305291	-	TP04	D	5	Reddish brown silty clay	-	-	100
305292	-	TP01	DB	4	Reddish brown silty sand	-	-	100
305293	-	TP04	D	4	Reddish brown silty sand	-	-	98
305294	-	TP06	DB	5	Reddish brown silty sand	-	-	99
305295	-	TP01	D	5	Reddish brown silty sand	-	-	100
305296	-	TP03	D	6	Reddish brown silty sand	-	-	78

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L23/03647/PSL - 23-35577

Project Reference - PSL23/5525 Clacton Road, Weeley Heath

Sample Comments

Lab Reference	Client Sample ID	Client Sample Location	Client Sample Type	Client Sample Number	Comments
305284	-	TP03	D	3	
305285	-	TP05	D	4	
305286	-	TP02	D	4	
305287	-	TP06	D	4	
305288	-	TP04	DB	3	
305289	-	TP05	DB	5	
305290	-	TP02	D	5	
305291	-	TP04	D	5	
305292	-	TP01	DB	4	
305293	-	TP04	D	4	
305294	-	TP06	DB	5	
305295	-	TP01	D	5	
305296	-	TP03	D	6	

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Project Reference - PSL23/5525 Clacton Road, Weeley Heath

Analysis Methodologies

Test Code	Test Name / Reference	Sample condition for analysis	Sample Preperation	Test Details
ANIONSS	MS - CL - Anions by Aquakem (2:1Extract)	Oven dried	Passing 2mm test sieve	Determination of Anions (inc Sulphate, chloride etc.) in soils by Aquakem. Analysis is based on a 2:1 water to soil extraction ratio
PHS	MS - CL - pH in Soils	As received	Passing 10mm test sieve	Determination of pH in soils using a pH probe (using a 1:3 soil to water extraction)
SAMPLEPREP	MS - CL - Sample Preparation	-	-	Preparation of samples (including determination of moisture content) to allow for subsequent analysis

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L23/03647/PSL - 23-35577

Project Reference - PSL23/5525 Clacton Road, Weeley Heath

Sample Deviations

Deviations are listed below against each sample and associated test method, where deviation(s) are noted it means data may not be representative of the sample at the time of sampling and it is possible that results provided may be compromised.
Observations on receipt
A - No date of sampling provided
C - Received in inappropriate container
H - Contains headspace
T - Temperature on receipt exceeds storage temperature
R - Date of sampling to receipt insufficient to allow analysis to be completed without deviation, Please note this is only a deviation if 'X' is also recorded against the sample
Observations whist in laboratory
X - Exceeds sampling to extraction or analysis timescales

Lab Reference	Client Sample ID	Client Sample Location	Client Sample Type	Client Sample Number	Test	Deviations
305284	-	TP03	D	3	MS - CL - pH in Soils	RX
305285	-	TP05	D	4	MS - CL - pH in Soils	RX
305286	-	TP02	D	4	MS - CL - pH in Soils	RX
305287	-	TP06	D	4	MS - CL - pH in Soils	RX
305288	-	TP04	DB	3	MS - CL - pH in Soils	RX
305289	-	TP05	DB	5	MS - CL - pH in Soils	RX
305290	-	TP02	D	5	MS - CL - pH in Soils	RX
305291	-	TP04	D	5	MS - CL - pH in Soils	RX
305292	-	TP01	DB	4	MS - CL - pH in Soils	RX
305293	-	TP04	D	4	MS - CL - pH in Soils	RX
305294	-	TP06	DB	5	MS - CL - pH in Soils	RX
305295	-	TP01	D	5	MS - CL - pH in Soils	RX
305296	-	TP03	D	6	MS - CL - pH in Soils	RX