Appendix B

The Coal Authority Report (Ref No. 51000516935003, dated 25th April 2014)

The Coal Authority

Issued by:
The Coal Authority, Property Search Services, 200 Lichfield Lane, Berry Hill, Mansfield, Nottinghamshire, NG18 4RG
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SOWTON INDUSTRIAL ESTATE
ABBEY COURT
UNIT 5/7 EAGLE WAY
EXETER
DEVON
EX2 7HY

Our reference:	**51000516936003**
Your reference:	**55645951_2|**
Date of your enquiry:	**25 April 2014**
Date we received your enquiry:	**25 April 2014**
Date of issue:	**25 April 2014**

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

Non-Residential Coal Authority Mining Report

SITE AT 304460, 670950, DECHMONT, WEST LOTHIAN,

This report is based on and limited to the records held by the Coal Authority, at the time we answer the search.

Coal mining	See comments below

Information from the Coal Authority

Underground coal mining

Past

According to the records in our possession, the property is not within the zone of likely physical influence on the surface from past underground workings.
However the property is in an area where the Coal Authority believe there is coal at or close to the surface. This coal may have been worked at some time in the past.

Present

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

Future

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

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

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

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

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

Mine entries

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

Records may be incomplete. Consequently, there may exist in the local area mine entries of which the Coal Authority has no knowledge.

Coal mining geology

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

Opencast coal mining

Past

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

Present

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

Future

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

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

Coal mining subsidence

The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres, since 31st October 1994.

There is no current Stop Notice delaying the start of remedial works or repairs to the property.

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

Mine gas

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

Hazards related to coal mining

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

Withdrawal of support

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

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

Working facilities orders

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

Payments to owners of former copyhold land

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

Comments on Coal Authority information

In view of the mining circumstances a prudent developer would seek appropriate technical advice before any works are undertaken.

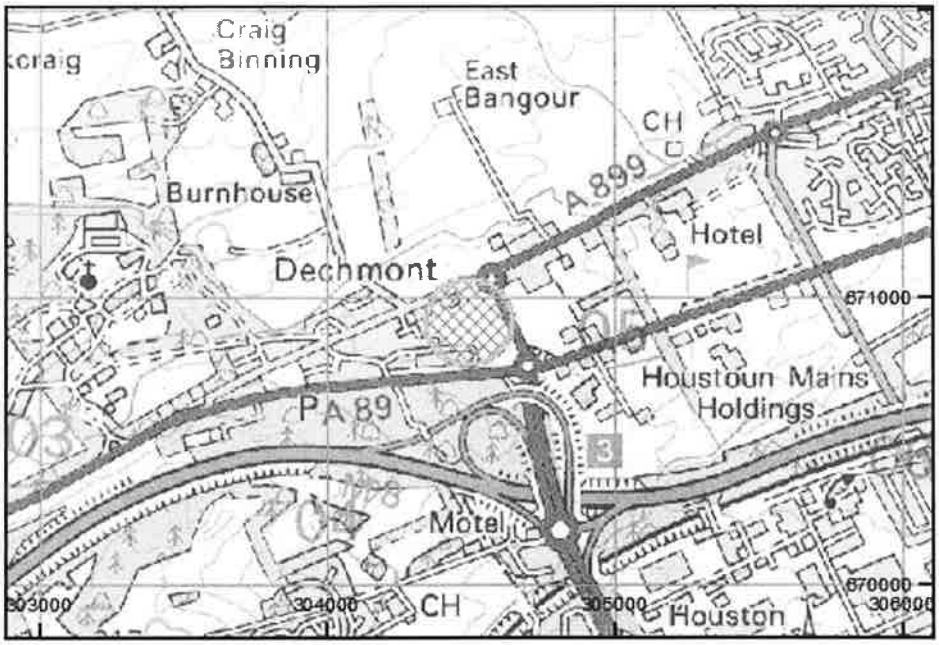
Therefore if development proposals are being considered, technical advice relating to both the investigation of coal and former coal mines and their treatment should be obtained before beginning work on site. All proposals should apply good engineering practice developed for mining areas. No development should be undertaken that intersects, disturbs or interferes with any coal or mines of coal without the permission of the Coal Authority. Developers should be aware that the investigation of coal seams/former mines of coal may have the potential to generate and/or displace underground gases and these risks both under and adjacent to the development should be fully considered in developing any proposals. The need for effective measures to prevent gases entering into public properties either during investigation or after development also needs to be assessed and properly addressed. This is necessary due to the public safety implications of any development in these circumstances.

Additional Remarks

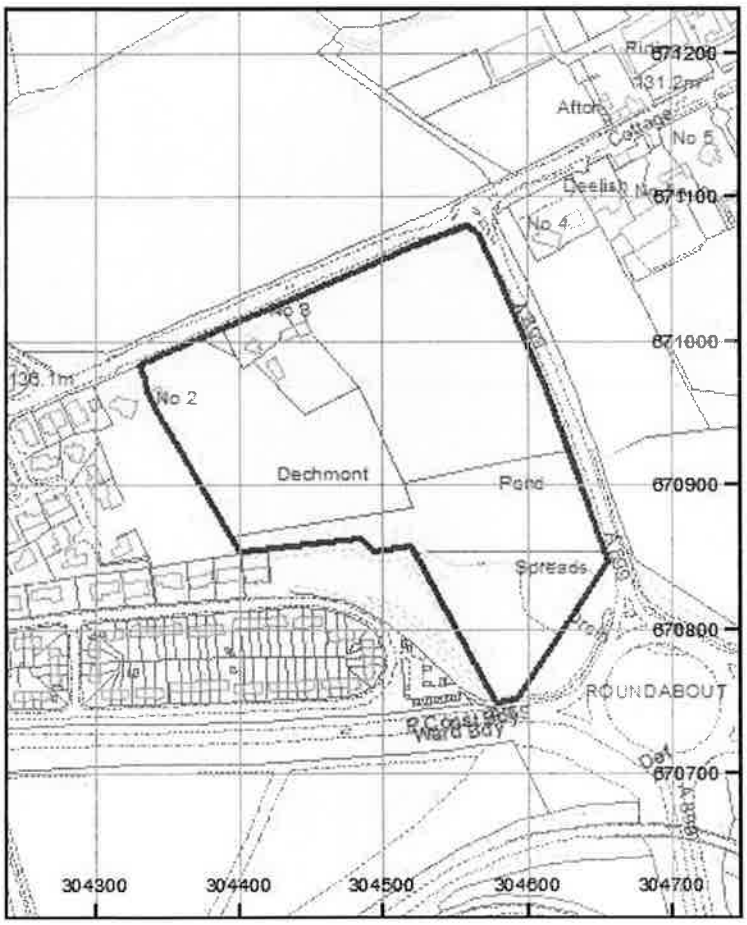
This report is prepared in accordance with the Law Society's Guidance Notes 2006, the User Guide 2006 and the Coal Authority Terms and Conditions 2006.

Location map

Approximate position of property



Enquiry boundary



Key

Approximate position of enquiry boundary shown

Mapping sourced from Ordnance Survey

Appendix C

BGS Georeport (Report ID: GR_208664/1, dated 28 April 2014)

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

GeoReports

Craig MacNeil
Mason Evans Partnership
The Piazza
95 Morrison Street
Glasgow
G5 8BE

Geological Assessment:

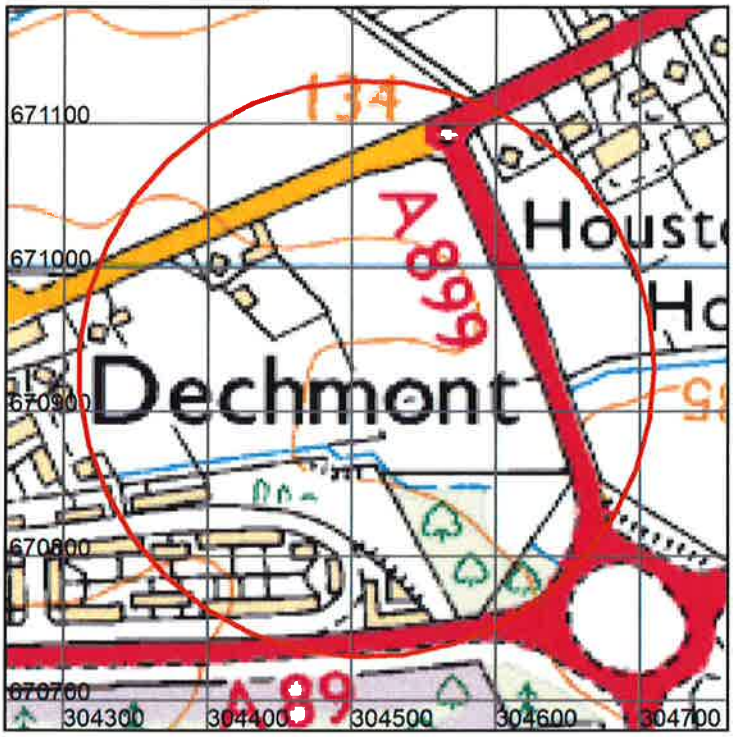
This report contains a geological description of the specified site or area. It is based on currently available 1:10 000 scale geological maps, unless otherwise stated, together with other relevant local information such as borehole records. The report includes extracts from digitised 1:50 000 scale geological maps (DigMapGB-50).

The report contains the following modules:
Geological Map Extracts
Geological Assessment (area)
Natural Ground Stability
Geoscience Data List

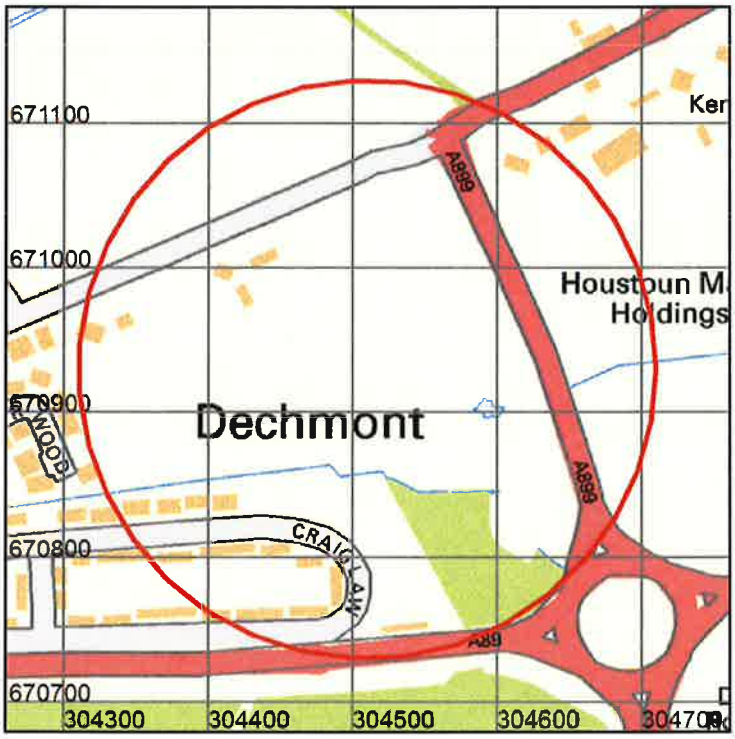
Report Id: ***GR_208664/1***

Client reference: G2014/166

Search location



Scale: 1:5 000 (1cm = 50 m)



OS Street View: Scale: 1:5 000 (1cm = 50 m)

This report describes a site located at National Grid Reference 304510, 670930. Note that for sites of irregular shape, this point may lie outside the site boundary. Where the client has submitted a site plan the assessment will be based on the area given.

Search location indicated in red

Geological Map Extracts

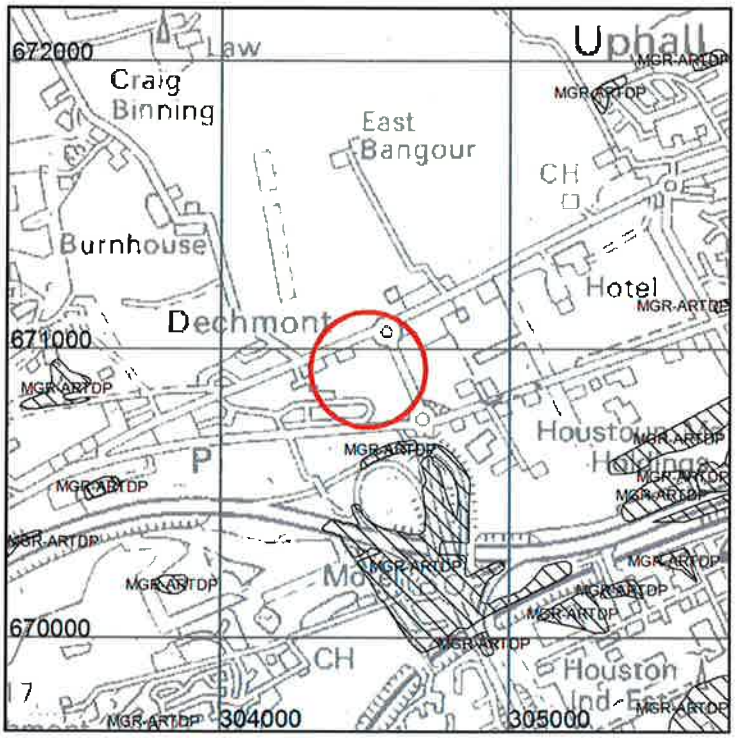
This part of the report contains extracts of geological maps taken from the 1:50 000 scale BGS Digital Geological Map of Great Britain (DiGMapGB-50). The geological information in DiGMapGB is separated into four themes: artificial ground, landslide deposits, superficial deposits and bedrock, shown here in separate maps. The fifth 'combined geology' map superimposes all four of these themes, to show the geological formations that occur at the surface, just beneath the soil.

More information about DiGMapGB-50 and how the various geological units are classified can be found on the BGS website (www.bgs.ac.uk). The maps are labelled with two-part computer codes that indicate the name of the geological unit and its composition. Descriptions of the units listed in the map keys may be available in the BGS Lexicon of Named Rock Units, which is also on the BGS website (http://www.bgs.ac.uk/lexicon/). If available, these descriptions can be found by searching against the first part of the computer code used on the maps. Please treat this labelling with caution in areas of complex geology, where some of the labels may overlap occurrences of several geological formations. If in doubt, please contact BGS Enquiries for clarification.

In the map keys the geological units are listed in order of their age, as defined in the BGS Lexicon, with the youngest first. However, where units are of the same defined age they are listed alphabetically and this may differ from the actual geological sequence.

Artificial ground

This is ground at or near the surface that has been modified by man. It includes ground that has been deposited (Made Ground) or excavated (Worked Ground), or some combination of these: Landscaped Ground or Disturbed Ground.



Scale: 1:25 000 (1cm = 250 m)

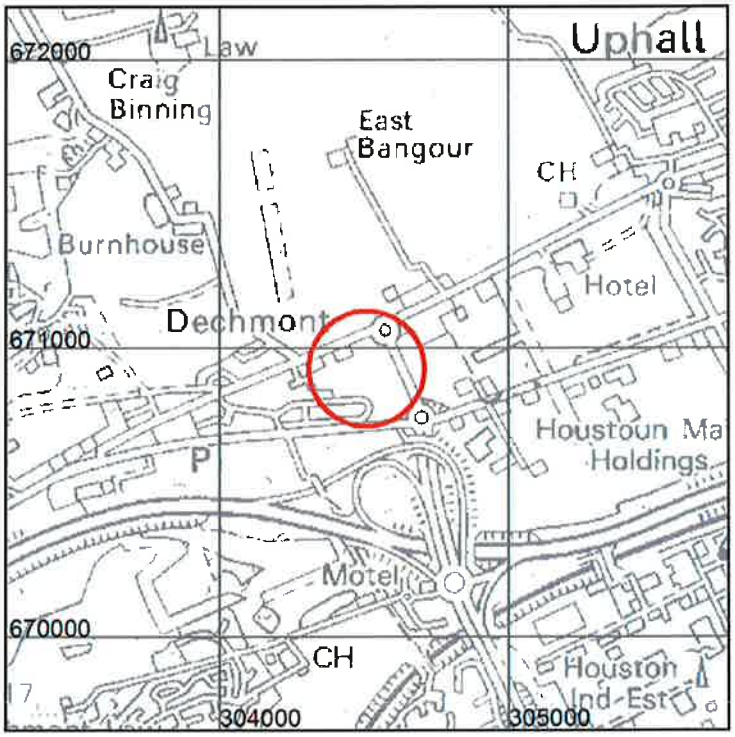
Search area indicated in red

Key to Artificial ground:

Map colour	Computer Code	Name of geological unit	Composition
	MGR-ARTDP	MADE GROUND (UNDIVIDED)	ARTIFICIAL DEPOSIT

Landslide deposits

These are deposits formed by localised mass-movement of soils and rocks on slopes under the action of gravity. Landslides may occur within the bedrock, superficial deposits or artificial ground; and the landslide deposits may themselves be artificially modified.



Scale: 1:25 000 (1cm = 250 m)

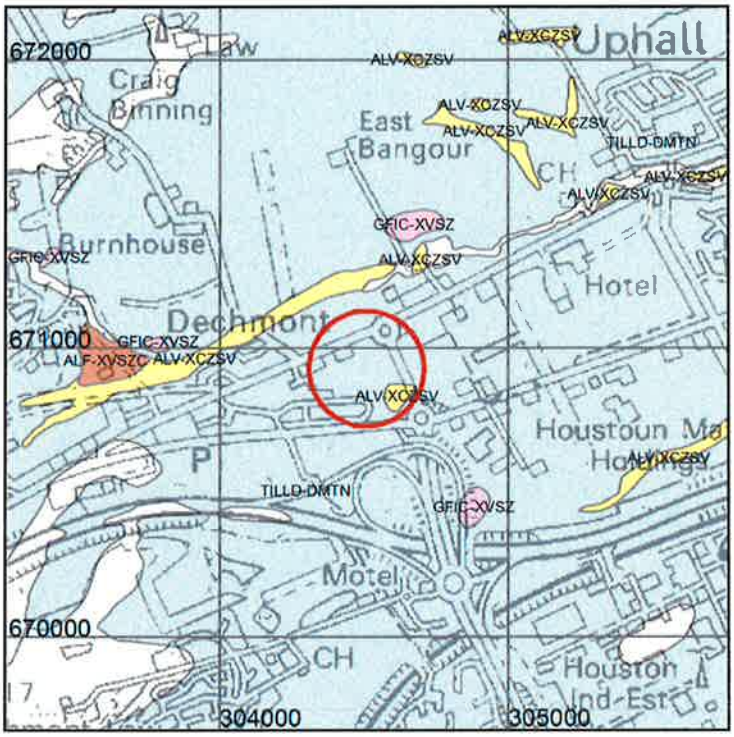
Search area indicated in red

Key to Landslide deposits:

No deposits found in the search area

Superficial deposits

These are relatively young geological deposits, formerly known as 'Drift', which lie on the bedrock in many areas. They include deposits such as unconsolidated sands and gravels formed by rivers, and clayey tills formed by glacial action. They may be overlain by landslide deposits or by artificial deposits, or both.



Scale: 1:25 000 (1cm = 250 m)

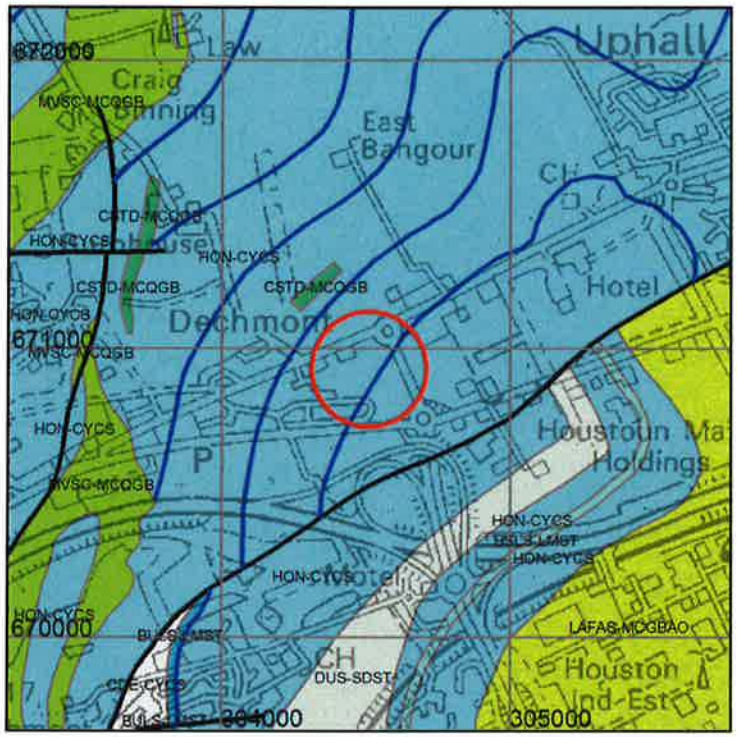
Search area indicated in red

Key to Superficial deposits:

Map colour	Computer Code	Name of geological unit	Composition
	ALV-XCZSV	ALLUVIUM	CLAY, SILT, SAND AND GRAVEL [UNLITHIFIED DEPOSITS CODING SCHEME]
	TILLD-DMTN	TILL, DEVENSIAN	DIAMICTON
	ALF-XVSZC	ALLUVIAL FAN DEPOSITS	GRAVEL, SAND, SILT AND CLAY [UNLITHIFIED DEPOSITS CODING SCHEME]
	GFIC-XVSZ	GLACIOFLUVIAL ICE CONTACT DEPOSITS	GRAVEL, SAND AND SILT [UNLITHIFIED DEPOSITS CODING SCHEME]

Bedrock

Bedrock forms the ground underlying the whole of an area, commonly overlain by superficial deposits, landslide deposits or artificial deposits, in any combination. The bedrock formations were formerly known as the 'Solid Geology'.



Search area indicated in red

Fault

Coal, ironstone or mineral vein

Note: Faults are shown for illustration and to aid interpretation of the map. Because these maps are generalised from more detailed versions not all such features are shown and their absence on the map face does not necessarily mean that none are present. Coals, ironstone beds and mineral veins occur only in certain rock types and regions of the UK; if present here, they will be described under 'bedrock' below.

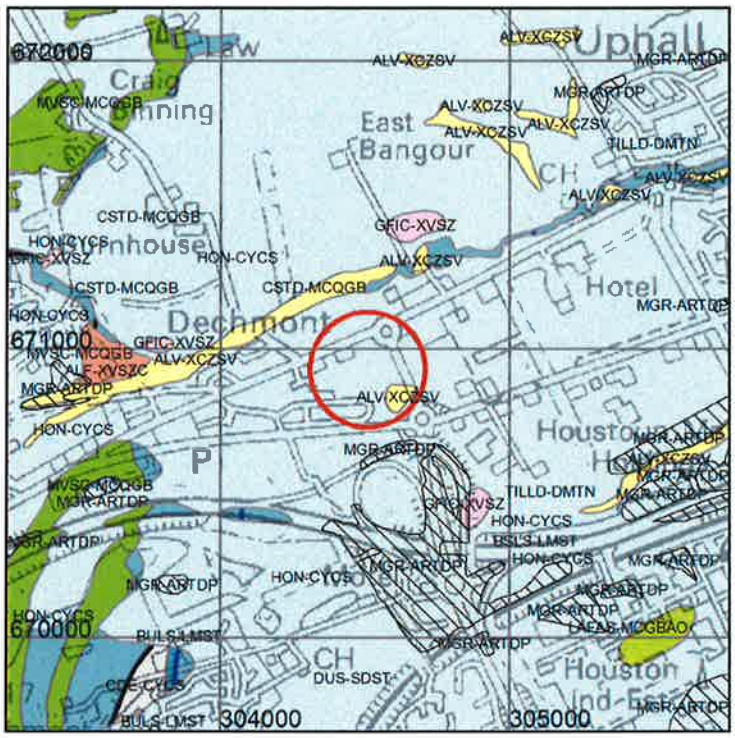
Scale: 1:25 000 (1cm = 250 m)

Key to Bedrock geology:

Map colour	Computer Code	Name of geological unit	Rock type
	CSTD-MCQGB	CENTRAL SCOTLAND LATE CARBONIFEROUS THOLEIITIC DYKE SWARM	QUARTZ-MICROGABBRO
	MVSC-MCQGB	MIDLAND VALLEY SILL-COMPLEX	QUARTZ-MICROGABBRO
	CDE-CYCS	CALDERS MEMBER	SEDIMENTARY ROCK CYCLES, STRATHCLYDE GROUP TYPE
	DUS-SDST	DUNNET SANDSTONE	SANDSTONE
	HON-CYCS	HOPETOUN MEMBER	SEDIMENTARY ROCK CYCLES, STRATHCLYDE GROUP TYPE
	BSLS-LMST	BARRACKS LIMESTONE	LIMESTONE
	BULS-LMST	BURDIEHOUSE LIMESTONE	LIMESTONE
	LAFAS-MCGBAO	DINANTIAN TO WESTPHALIAN SILLS OF LOTHIANS AND FIFE	ANALCIME-MICROGABBRO, OLIVINE

Combined 'Surface Geology' Map

This map shows all the geological themes from the previous four maps overlaid in order of age.



Scale: 1:25 000 (1cm = 250 m)

Search area indicated in red

Please see the Keys to the Artificial, Landslide, Superficial and Bedrock geology maps.

Geological Assessment

This module contains a geological description of the site or area specified by the customer. It is based on currently available 1:10 000 scale geological maps unless otherwise stated, together with other relevant local information such as borehole records.

Setting:
The site (the area within the plan provided) is located on open ground between the eastern side of Dechmont and the A899 Road, in West Lothian. The ground surface at the site lies at an elevation of approximately 135 m above Ordnance Datum. Natural surface drainage at the site is likely to follow the very gentle eastward slope of the ground surface.

The Ordnance Survey Master Map data shows a drainage ditch flowing eastward through the southern part of the site. The drainage is shown to spread over marshy ground at the south-eastern corner of the site. The Master Map data also shows a pond near the eastern central margin of the site.

Artificial ground:
Published geological maps show no thick or extensive areas of artificial ground within the site boundary. However, the 1922 and 1949 Ordnance Survey maps show that a curling pond (now filled) was located in the southern part of the site; the area is shown on modern maps as marshy ground. The former Bangour Railway ran close to the south-western edge of the site, and may have been associated with some artificially modified ground. There is a related embankment shown on the 1:10,000 scale Ordnance Survey map at the position of the former railway. Artificial ground of limited thickness and extent, associated with development of the A899 road and Dechmont Main Street, may be present along the northern and eastern margins of the site. The 1:10,000 scale geological map shows landscaped ground at the site of Dechmont Roundabout.

Superficial deposits:
The natural superficial (drift) deposits underlying the site have been mapped predominantly as glacial till. These deposits are expected to consist of a firm to stiff, silty or sandy clay containing rock clasts of gravel to boulder size. The top one to two metres of the till may be weathered, siltier or sandier, and somewhat softer than the remainder. Records from boreholes that were drilled near the site suggest that, in places, the till may exceed15 m thickness. In general, the till is expected to rest on bedrock.

Alluvium, comprising clay, silt, sand and gravel, has been mapped in the south-eastern part of the site.

Rockhead depth:
The depth to rockhead (bedrock) under the site is not known with any certainty. However, records from boreholes within the search radius, and from adjacent areas, suggest that rockhead may be encountered at 10-20 m depth below the ground surface. The BGS Geology for Land Use Planning map for the Livingston area suggests a rockhead depth of 10-15 m at the site.

Bedrock:
The bedrock immediately underlying the site belongs to the Hopetoun Member of the West Lothian Oil Shale Formation, of Carboniferous age. These rocks consist of cyclic successions of mudstone, sandstone, seatrock and siltstone, with bands of ironstone and limestone, and seams of coal. Geological maps show the Houston Coal (which may be up to 2 m thick and is known to have been mined locally in the past) at rockhead, trending from south-west to north-east, under the central part of the site. The Houston Coal is present at increasing depth under the south-eastern part of the site.

The general dip of the strata in the vicinity of the site is towards the south-east at an angle of approximately 20 degrees. The presence and location of any faults at rockhead under the site is not known with any certainty, due to the cover of superficial deposits. Geological maps do not indicate that any major faults have been inferred under the site. The nearest known fault is located approximately 200 m to the south of the site, and trends to the east-north-east. The presence of any localised faulting at rockhead under the site would be represented by a zone, or zones, of broken or damaged rock.

Additional considerations:
The Houston Coal has been worked in the vicinity of the site. The mine site plan SP 975 (listed on p. 30) indicates that the site is within an area of former mining. Geological maps show an abandoned pit shaft approximately 40 m beyond the eastern margin of the site, at approximate NGR [304680 670900]. A second pit is marked a further 150 m to the east, at approximate NGR [304810 670995]. Old maps show that a borehole, located approximately 130 m beyond the north-eastern corner of the site, encountered Houston Coal 'waste' at approximately 25 m depth (about 5 m below rockhead), implying the presence of shallow workings in the coal. The BGS Geology for Land Use Planning map indicates that 'old workings' were also encountered at an excavation approximately 100 m to the south-west of the site.

In light of these findings it would be prudent to contact the Coal Authority for any information they may be able to provide regarding any workings in coal and associated minerals, of which they are aware, in the vicinity of the site. Microfiche copies of any mine abandonment plans for workings in coal and associated minerals, and any non-coal mineral plans are available for inspection at this office by

arrangement with the BGS Records Section (tel. 0131 650 0282).

The automatically generated natural geological hazards maps on p. 15 highlight a probable compressible ground hazard, and possible running sand hazard, for the southern part of the site. This hazard is in association with the deposits that have been mapped as alluvium, which are probably related to infilling of the former curling pond.

Natural Ground Stability

This module provides an indication of potential significant NATURAL ground instability generated automatically from BGS's GeoSure dataset, which is based on 1:50 000 scale digital data.

This is not a site-specific assessment and only indicates the potential for a geohazard to occur within the site boundary and a surrounding 50 m buffer zone.

Contents of the report:

- **Definitions and limitations:** an explanation of what this report provides.
- **Search Results:** answers a series of questions about the natural geological hazards that could occur in the area, and their significance.
- **Maps:** shows areas where the natural geological hazards indicated may occur, and their significance in terms of a range of indicative implications.
- **General explanations of the hazards:** a brief description of each hazard considered by this report.

Definitions to help you understand this report:

- **Natural Geological Hazards** are shrink-swell, landslides (slope instability), soluble rocks (dissolution), compressible ground, collapsible deposits and running sand. This does not include mining related subsidence. Note that these geological hazards may occur in either natural or man-made deposits.
- **Natural Ground Instability** refers to the propensity for upward, lateral or downward movement of the ground that can be caused by a number of natural geological hazards. Some movements associated with particular hazards may be gradual and of millimetre or centimetre scale, whilst others may be sudden and of metre or tens of metres scale.
- **Significant** natural ground instability has the potential to cause damage to some weaker buildings and structures. It should be noted, however, that many buildings, particularly more modern ones, are built to such a standard that they can remain unaffected in areas of significant ground movement.
- Where significant natural ground instability is indicated, its relative **level** of significance is expressed on a scale of C to E ('low' to 'high'), relating to its potential to cause subsidence damage in low-rise buildings.

Limitations:

- The maps in this module provide an indication of potential near-surface ground instability related to particular natural geological hazards. These are shrink-swell clay, landslides, soluble rocks (ground dissolution), compressible ground, collapsible deposits, and running sand. They do not give an indication of potential hazards at depth as might be encountered in a borehole, for example.
- The search does not cover any man-made hazards, such as contaminated land or mining. Searches of coal mining should be carried out via The Coal Authority Mine Reports Service: www.coalminingreports.co.uk.
- The results in this module are generated automatically from BGS's GeoSure dataset, based on 1:50 000 digital geological maps and the interpretation of other records in the possession of BGS at the time. Their scope and accuracy is limited by the methods used to create the dataset and they may differ from a geologist's interpretation of a wider array of geological information. The answer given should therefore only be treated as indicative for the search area.
- Other more specific and detailed information may be held by BGS for the site, and an assessment of this could result in a modified assessment of ground stability potential. This more detailed assessment is available via other BGS **GeoReports**.
- The information is intended for use by suitably-qualified professionals involved in conveyancing or development of low-rise domestic properties. If in doubt users should consult a suitably-qualified professional about the search results in this report before making any major decisions based upon it.
- An indication of natural ground instability does not necessarily mean that a building will be affected by subsidence. Such an assessment can be made only by inspection of the building itself by a suitably-qualified professional. This will take into account a variety of other contributing factors, such as building type and build quality, and nearby vegetation (in particular, the proximity and type of trees).

Search Results:
The following table provides answers to a series of questions about any potential natural ground instability found in the search area and assesses how significant they are.

Question 1	Answer
Which natural geological hazards could be contributing to ground instability in the area? **NOTE: The hazard levels are described as A (least) to E (greatest), or as 'No Hazard'. Levels A and B are not considered significant and are not shown on the maps.**	Clays that can swell when wet and shrink when dry, causing the ground to rise and fall ('Shrink-Swell') (LEVEL B) Weak or unstable rocks that could slip downhill on steep slopes (greater than about 5 degrees) or into excavations ('Landslides (slope instability)') (LEVEL B) Rocks that can dissolve and develop underground cavities that may lead to surface collapses and hollows ('Soluble Rocks (dissolution)') (LEVEL No hazard) Very soft ground that might compress and progressively sink under the weight of a building ('Compressible Ground') (LEVEL D) Material that collapses when a load is placed on it or when it becomes saturated ('Collapsible Deposits') (LEVEL B) Sand that can wash away or flow into holes or fissures due to presence of water ('Running Sand') (LEVEL C)

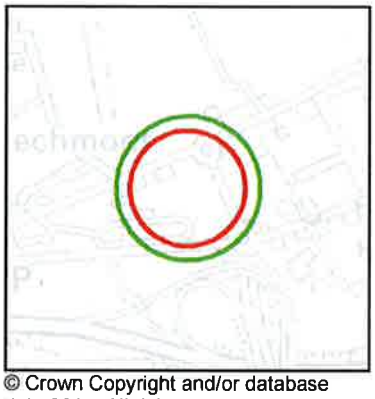
Question 2	Answer
What action should be taken?	If natural geological hazards at level C, D or E have been indicated this means there is potential ground instability in your area that may cause some properties to suffer subsidence damage. However, it does not necessarily mean that your property will be affected, and in order to find out if this is the case or not, you should obtain further advice from a qualified expert, such as a building surveyor. Show them this report and ask them to evaluate the property and its surroundings for any signs of existing subsidence damage and for advice on the likelihood for subsidence to occur in the future. The notes at the end of this report module may be useful in this regard. Note that the type of building and its surroundings (e.g. the presence of trees) are also very important when considering subsidence risk. Many types of properties, particularly newer ones, are well constructed and unlikely to be affected by subsidence, even in areas of significant ground movements.

Question 3	Answer
Where could the natural geological hazards occur in the area?	See the maps that follow

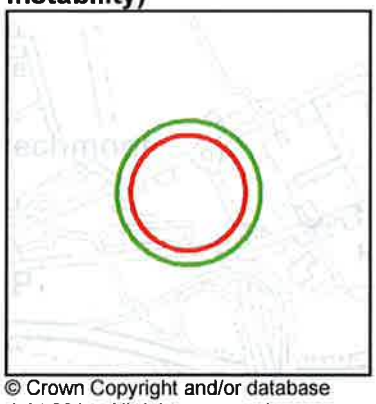
Automatically generated maps of near-surface natural geological hazards

The following maps show where significant natural ground instability at or near the surface could occur in relation to each of six geological hazards: shrink-swell, landslide (slope instability), soluble rocks (dissolution), compressible ground, collapsible deposits and running sand. The relative level of potential is indicated in colour and described in the key. Please note that a hazard is reported as significant for the property if it occurs within the specified site or the surrounding buffer zone.

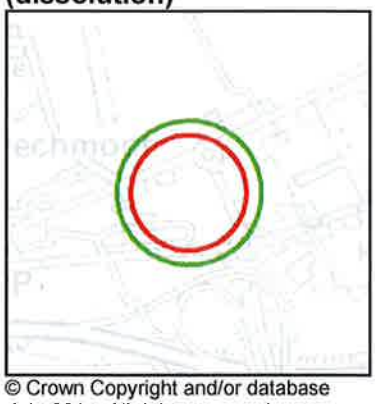
Shrink-Swell



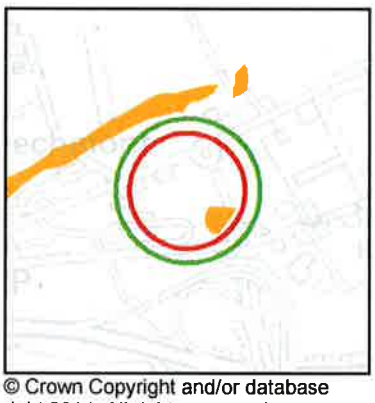
Landslides (slope instability)



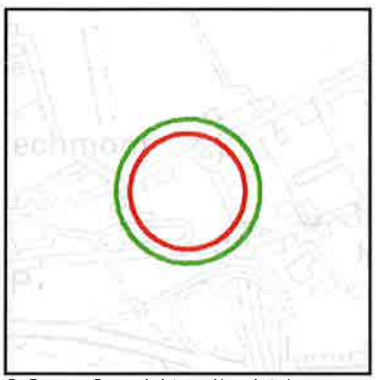
Soluble Rocks (dissolution)



Compressible Ground



Collapsible Deposits



Running Sand

Search area indicated in red

50 m buffer indicated in green

For the key to relative level of potential for natural geological hazards see over the page

The unshaded (white) areas on the map (levels A, B or 'No hazard') represent areas where the conditions that cause natural ground movements due to the six natural geological hazards are considered to be absent or unlikely to be significant.

Key to Shrink-Swell Hazard:

Level	Hazard description	Advice for public	Advice for specialist
C	Ground conditions predominantly medium plasticity.	Do not plant trees with high soil moisture demands near to buildings. Avoid increased infiltration and seek specialist advice before disposing of large amounts of water to the ground through soakaways.	**New build** – Test for plasticity index is recommended. Possible increase in construction cost to remove potential shrink-swell problems. **Existing property** – Possible increase in insurance risk in droughts or where high moisture demand vegetation is present due to shrink-swell clay problems if foundations are not suitable.
D	Ground conditions predominantly high plasticity.	Do not plant or remove trees or shrubs near to buildings without expert advice about their effect and management. Seek specialist advice before disposing of large amounts of water to the ground through soak-aways	**New build** – Test for plasticity index is necessary. Probable increase in construction cost to remove potential shrink-swell problems. **Existing property** – Probable increase in insurance risk in droughts or where high moisture demand vegetation is present due to shrink-swell clay problems if foundations are not suitable.
E	Ground conditions predominantly very high plasticity.	Do not plant or remove trees or shrubs near to buildings without expert advice about their effect and management. Seek specialist advice before disposing of large amounts of water to the ground through soak-aways	**New build** – Test for plasticity index is essential. Definite increase in construction cost to remove potential shrink-swell problems. **Existing property** – Significant increase in insurance risk in droughts or where high moisture demand vegetation is present due to shrink swell clay problems if foundations are not suitable.

Key to Landslides (slope instability) Hazard:

Level	Hazard description	Advice for public	Advice for specialist
C	Slope instability problems may be present or anticipated. Site investigation should consider specifically the slope stability of the site.	Ask about implication for stability if large changes to drainage or excavations take place near to buildings. Seek specialist advice if major changes in ground conditions are likely and before disposing of large amounts of water to the ground through soak-aways	**New build** – Consider possibility of trench side or slope movement during excavations, or consequence of changes to drainage. Possible increase in construction cost to remove potential slope stability problems. **Existing property** – No significant increase in insurance risk due to natural slope instability problems.
D	Slope instability problems are probably present or have occurred in the past. Land use should consider specifically the stability of the site.	Avoid large amounts of water entering the ground through pipe leakage or soakaways without specialist advice. Do not undercut or place large amounts of material on slopes without technical advice.	**New build** – Assess slope stability of site and consequences of excavation, loading and water content changes during and after construction. **Existing property** – Probable increase in insurance risk due to natural slope instability after changes to ground conditions such as a very long, excessively wet winter.
E	Slope instability problems almost certainly present and may be active. Significant constraint on land use.	Seek expert advice about stability of the ground and its management to maintain and increase its stability.	**New build** – Slope stability assessment necessary, special design may be necessary, construction may not be possible. **Existing property** – Significant increase in insurance risk in some cases. Site-specific consideration is necessary to separate cases where landslides are stabilised or ancient and stable from those that may be active or may fail.

Key to Soluble Rocks (dissolution) Hazard:

Level	Hazard description	Advice for public	Advice for specialist
C	Soluble rocks are present within the ground. Some dissolution features may be present. Potential for difficult ground conditions are at a level where they may be considered; localised subsidence need not be considered except in exceptional circumstances.	Consider implications for stability when changes to surface drainage or new construction are planned. Seek specialist advice before disposing of surface drainage to the adjacent ground.	**New build** – Site investigation should consider potential for dissolution problems on the site and its surroundings. Care should be taken with local drainage into the adjacent bedrock. **Existing property** – Possible increase in insurance risk due to soluble rocks. Some possibility of potential liability due to groundwater pollution may be present.
D	Soluble rocks are present within the ground. Many dissolution features may be present. Potential for difficult ground conditions are at a level where they should be considered. Potential for subsidence is at a level where it may need to be considered.	Consider obtaining specialist advice before loading the land or undertaking building work. Seek specialist advice before disposing of surface drainage to the adjacent ground. Maintain drainage infrastructure.	**New build** – Specialist site investigation and stability assessment may be necessary before construction. Construction work may cause subsidence. Isolate surface drainage from the karst system and groundwater. Increased construction costs are possible. **Existing property** – Possible increase in insurance risk due to soluble rocks. Some possibility of potential liability due to groundwater pollution may be present.
E	Soluble rocks are present within the ground. Numerous dissolution features may be present. Potential for difficult ground conditions should be investigated. Potential for localised subsidence is at a level where it should be considered.	Obtain specialist advice on need for stabilisation work and/or land management plan to maintain stability. Do not dispose of surface drainage into the adjacent ground. Maintain drainage infrastructure.	**New build** – Specialist land stability assessment necessary. Investigation, remediation and/or mitigation works may be necessary to stabilise the area. Construction work may cause subsidence. Isolate surface drainage from the karst system and groundwater. Increased construction costs. **Existing property** – Probable increase in insurance risk due to soluble rocks. Probable potential liability due to groundwater pollution.

Key to Compressible Ground Hazard:

Level	Hazard description	Advice for public	Advice for specialist
C	Compressibility and uneven settlement potential may be present. Land use should consider specifically the compressibility and variability of the site.	Take technical advice regarding settlement when planning extensions to existing property or when retrofitting soakaways.	**New build** – Consider possibility of settlement during construction due to compressible deposits. Unlikely to be increase in construction costs due to potential compressibility problems. **Existing property** – No significant increase in insurance risk due to compressibility problems.
D	Compressibility and uneven settlement hazards are probably present. Land use should consider the compressibility and variability of the site.	Avoid large differential loadings of ground. Do not drain or dewater ground near the property without specialist advice.	**New build** – Assess the variability and bearing capacity of the ground. May need special foundations to avoid excessive settlement during and after construction. Consider effects of changes to drainage regime and groundwater level. Extra construction costs are likely. **Existing property** – Possible increase in insurance risk from compressibility if groundwater levels drop due to drought or dewatering.
E	Highly compressible strata present. Significant constraint on land use depending on thickness.	Avoid large differential loadings of ground. Do not drain or dewater ground near the property without specialist advice.	**New build** – Assess the variability and bearing capacity of the ground. Probably needs special foundations to avoid excessive settlement during and after construction. Consider effects of changes to drainage regime and groundwater level. Construction may not be possible at economic cost. **Existing property** – Probable increase in insurance risk from compressibility due to drought or dewatering unless appropriate foundations are present.

Key to Collapsible Deposits Hazard:

Level	Hazard description	Advice for public	Advice for specialist
C	Deposits with potential to collapse when loaded and saturated are possibly present in places.	Avoid large amounts of water entering the ground through pipe leakage or soakaways without specialist advice. Do not increase loading on existing foundations without technical advice.	Contact local authorities for information on local occurrence of damage due to collapsible ground. **New build** – Assess the possibility of collapsible (loessic) deposits by ground investigation. If present do not exceed safe bearing capacity during or after construction and maintain site drainage, or carry out ground stabilisation. **Existing property** – Possible increase in insurance risk if collapsible deposits are present and if the load on the ground is increased or ground saturated by leakage or localised flooding.
D	Deposits with potential to collapse when loaded and saturated are probably present in places.	Avoid large amounts of water entering the ground through pipe leakage or soakaways without specialist advice. Do not increase loading on existing foundations without technical advice.	Contact local authorities for information on local occurrence of damage due to collapsible deposits. **New build** – Assess the possibility of collapsible deposits by ground investigation. If present do not exceed safe bearing capacity during or after construction and maintain site drainage, or carry out ground stabilisation. **Existing property** – Possible increase in insurance risk if collapsible deposits are present and if the load on the ground is increased or ground saturated by leakage or localised flooding.
E	Deposits with potential to collapse when loaded and saturated have been identified.	Avoid large amounts of water entering the ground through pipe leakage or soak-aways. Do not increase loading on existing foundations without technical advice.	Contact local authorities for information on local occurrence of damage due to collapsible ground. **New build** – Assess the possibility of collapsible deposits by ground investigation. If present do not exceed safe bearing capacity during or after construction and maintain site drainage, or carry out ground stabilisation. **Existing property** – Possible increase in insurance risk if collapsible deposits are present and if the load on the ground is increased or ground saturated by leakage or localised flooding.

Key to Running Sand Hazard:

Level	Hazard description	Advice for public	Advice for specialist
C	Running sand conditions may be present. Constraints may apply to land uses involving excavation or the addition or removal of water.	Normal maintenance to avoid leakage of water-bearing services or water bodies (ponds, swimming pools) should avoid any problems due to running sands. Seek specialist advice before disposing of large amounts of water to the ground through soak-aways	**New build** – Consider possibility of running sands into trenches or excavations if water table is high. Avoid concentrated water inputs to site. Unlikely to be increase in construction costs due to potential for running sand problems. **Existing property** – No significant increase in insurance risk due to running sand problems.
D	Running sand conditions are probably present. Constraints may apply to land uses involving excavation or the addition or removal of water.	Avoid large amounts of water entering the ground through pipe leakage or soak-aways without specialist advice. Do not dig (deep) holes into saturated ground near the property without technical advice.	**New build** – Assess the need for close-boarded sides to excavations and the consequences of soil and groundwater conditions during and after construction. **Existing property** – Possible increase in insurance risk from running conditions due to service leakage, high rainfall events or localised flooding.
E	Running sand conditions are almost certainly present. Constraints will apply to land uses involving excavation or the addition or removal of water.	Avoid large amounts of water entering the ground through pipe leakage or soak-aways without specialist advice. Do not dig (deep) holes into saturated ground without technical advice.	**New build** – Assess the need for close-boarded sides to excavations and the consequences of soil and groundwater conditions during and after construction. Possible extra cost during construction and requirement for basements to be water proofed. **Existing property** – Possible increase in insurance risk from running conditions due to service leakage, high rainfall events or localised flooding.

General explanation of geological hazards

This is a general description of the hazards that might be described in the Geohazard Potential module.

Shrink-Swell
A shrinking and swelling clay changes volume significantly according to how much water it contains. All clay deposits change volume as their water content varies, typically swelling in winter and shrinking in summer, but some do so to a greater extent than others. Most foundations are designed and built to withstand seasonal changes. However, in some circumstances, buildings constructed on clay that is particularly prone to swelling and shrinking behaviour may experience problems. Contributory circumstances could include drought, tree roots drying-out the ground, leaking service pipes, or changes to local drainage such as the creation of soakaways. Shrinkage may remove support from the foundations of a building, whereas clay expansion may lead to uplift (heave) or lateral stress on part or all of a structure; any such movements may cause cracking and distortion.

Landslides (slope instability)
A landslide is a relatively rapid outward and downward movement of a mass of rock or soil on a slope, due to the force of gravity. A slope is under stress from gravity but will not move if its strength is greater than this stress. If the balance is altered so that the stress exceeds the strength, then movement will occur. The stability of a slope can be reduced by removing ground at the base of the slope, increasing the water content of the materials forming the slope or by placing material on the slope, especially at the top. Property damage by landslide can occur through the removal of supporting ground from under the property or by the movement of material onto the property.

The assessment of landslide hazard refers to the stability of the present land surface. It does not encompass a consideration of the stability of excavations.

Soluble Rocks (dissolution)
Some rocks are soluble in water and can be progressively removed by the flow of water through the ground. This process tends to create cavities, potentially leading to the collapse of overlying materials and possibly subsidence at the surface. The collapse of the materials above a cavity can be aggravated by natural or induced ingress of surface of subsurface water into the ground. Collapse can also be aggravated by groundwater abstraction.

Compressible Ground
Many ground materials, including artificial deposits, can be compressed when a load, such as a building, is placed upon them. If ground is extremely compressible the building may sink. If the ground is not uniformly compressible, different parts of the building may sink by different amounts, possibly causing tilting, cracking or distortion.

Collapsible Deposits

Collapsible deposits consist of certain fine-grained loessic (wind-blown) materials that have relatively large spaces between the solid particles. Such deposits are prone to collapse (they may undergo rapid subsidence) when they are loaded and then saturated with water. If the material below a building collapses it may cause the building to sink. If the collapsible ground is variable in thickness or distribution, different parts of the building may sink by different amounts, possibly causing tilting, cracking or distortion. This hazard is most likely to be encountered in parts of southern England.

Running Sand

Running sand conditions occur when loosely-packed sand, saturated with water, flows into an excavation, borehole or other type of void. The pressure of the water filling the spaces between the sand grains reduces the contact between the grains and they are carried along by the flow. This can lead to subsidence of the surrounding ground.

If sand below a building runs it may remove support and the building may sink. Different parts of the building may sink by different amounts, possibly causing tilting, cracking or distortion.

Geoscience Data List

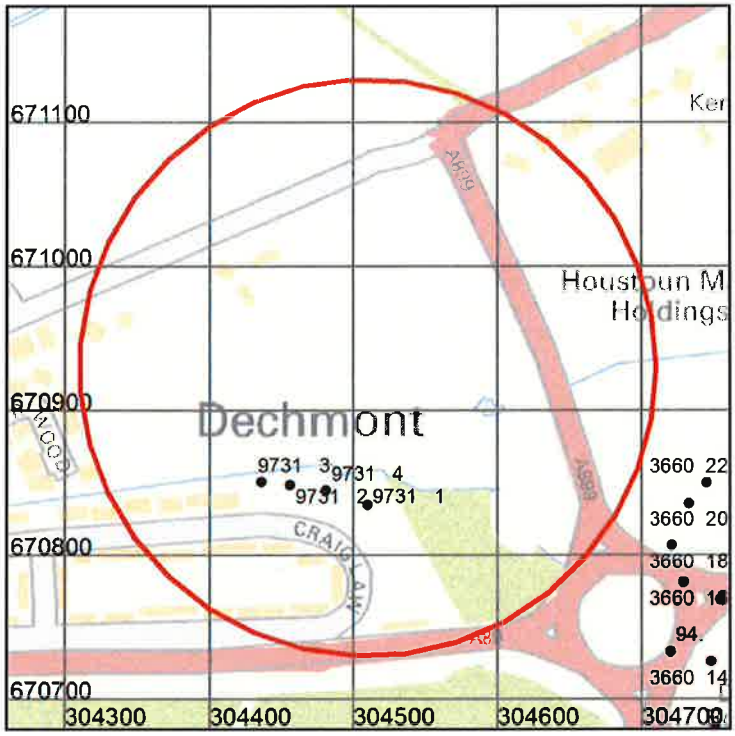
List of available geological data

This section lists the principal data sets held in the National Geoscience Records Centre that are relevant to your enquiry and explains how to obtain copies of the records. Users with access to computing facilities can make their own index searches using the BGS Internet (go to 'Online shops' at www.bgs.ac.uk). This will give access to the BGS Bookshop, Publications catalogue, GeoRecords (borehole browser) and GeoReports.

For current pricing see these internet pages or contact us using the list found at the back of this report.

Note that this report contains selective datasets and is not a definitive listing of all data held in BGS.

Borehole location map



Scale: 1:5 000 (1cm = 50 m)

Borehole records

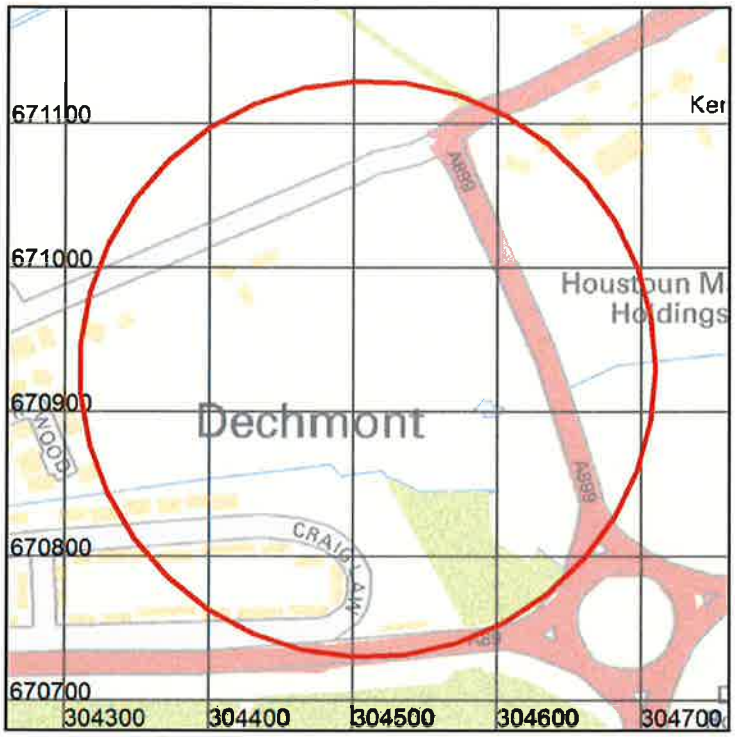
Number of records in map area: 11

In the following table a blank Length field indicates that the borehole is confidential or that no depth has been recorded digitally.
Enquiry staff may be able to provide you with contact details for the originator if you wish to seek release of confidential information.

Borehole registered no	Grid reference	Borehole name	Length (m)
NT07SW3660/14	NT 04748 70726	LIVINGSTON 0470 2A BH14	3
NT07SW3660/15	NT 04755 70769	LIVINGSTON 0470 2A BH15	3
NT07SW3660/16	NT 04729 70781	LIVINGSTON 0470 2A BH16	3
NT07SW3660/18	NT 04721 70807	LIVINGSTON 0470 2A BH18+18A	3
NT07SW3660/20	NT 04733 70836	LIVINGSTON 0470 2A BH20	3
NT07SW3660/22	NT 04745 70850	LIVINGSTON 0470 2A BH22	3
NT07SW94	NT 04720 70733	HOUSTON NO.9 BORE	35
NT07SW9731/1	NT 04510 70835	DECHMONT 1	33

Borehole registered no	Grid reference	Borehole name	Length (m)
NT07SW9731/2	NT 04456 70849	DECHMONT 2	33
NT07SW9731/3	NT 04436 70851	DECHMONT 3	33
NT07SW9731/4	NT 04481 70845	DECHMONT 4	35

Water Well location map



Scale: 1:5 000 (1cm = 50 m)

Water Well records

Number of records in map area: 0

All of these records are registered in the main Borehole Records collections (see Borehole Records Table and map above), but please note that some may be duplicate or part duplicate copies. This map shows records of water wells and boreholes in the National Well Record Archive held at Wallingford (WL) or Murchison House (MH). Each record has a Well Registration number which should be quoted when applying for copies.

Additional index information may be held for the Water Well Records as shown below, indicating the information that can be found on the well record itself. If fields are blank, then the well record has not been examined and its contents are unknown. A 'Yes' or a 'No' indicates that the well record has been examined and the information indicated is, or is not, present. This information should help you when requesting copies of records.

Water Well records

BGS holds no water well records for the selected area

KEY:
Aquifer = The principal aquifer recorded in the borehole
G = Geological Information present on the log
C = Borehole construction information present on the log
W = Water level or yield information present on the log
Ch = Water chemistry information present on the log

Boreholes with water level readings

Number of records in map area: 0

BGS holds no boreholes with water level readings for the selected area

Locations with aquifer properties

Number of records in map area: 0

BGS holds no locations with aquifer properties for the selected area

Site investigation reports
Number of records in search area: 6

Additional laboratory and test data may be available in these reports, subject to any copyright and confidentiality conditions. The grid references used are based on an un-refined rectangle and therefore may not be applicable to a specific site. Borehole records in these reports will be individually referenced within the borehole records collection, described above.

Number	Site investigation title
11	M8 DECHMONT - NEWBRIDGE
3660	LIVINGSTON 0470 2A
9731	DECHMONT
13086	LIVINGSTON:DEER PARK DEVELOPMENT
17209	BATHGATE LIVINGSTON BROXBURN - RD REPORT
31157	M8 Newbridge - Dechmont Section & Blackburn Relief Road

National Grid geological maps (1:10 000 and 1:10 560 scale)
Number of records in search area: 3

Map	Type	Survey
NT07SW	C	1869
NT07SW	D	1991
NT07SW	S	1991

County Series geological maps (1:10 560 scale)
Number of records in search area: 6

Map	Type	Published
Linlithgowshire10NW	CD	1921
Linlithgowshire10NW	C	1921
Linlithgowshire10NW	CS	1921
Linlithgowshire6SW	CD	1908
Linlithgowshire6SW	CS	1908
Linlithgowshire6SW	C	1908

New Series medium scale geological maps (1:50 000 and 1:63 360 scale)
Number of records in search area: 1

Sheet number	Sheet name	Type	Published
32	Edinburgh	C	1967

Old Series one inch geological maps (1:63 360 scale)
Number of records in search area: 0
BGS holds no old series one inch geological maps for the selected area

Hydrogeological maps (various scales)
Number of records in search area: 0
BGS holds no hydrogeological maps for the selected area

Geological Memoirs
Number of records in search area: 1

Geological memoir	Date
Neighbourhood of Edinburgh	1962

Technical reports
Technical reports may be available for this area. Please email sales@bgs.ac.uk for further information.

Waste sites
Number of records in search area: 0

Listing of some 3500 waste sites for England and Wales identified by BGS as part of a survey carried out on behalf of the Department of the Environment in 1973. Later information may be available from the Local authority.
BGS holds no records of waste sites for the selected area

Mining plans
Number of records in search area: 4

This listing includes plans of various types, principally relating to mining activity including abandonment plans. The coverage is not comprehensive; however that for Scotland is most complete.

Record Type	Plan No.	Title
SP	537	
SP	541	
SP	569	
SP	975	

Contact Details

Keyworth (KW) Office
British Geological Survey
Environmental Science Centre
Nicker Hill
Keyworth
Nottingham
NG12 5GG
Tel: 0115 9363143
Fax: 0115 9363276
Email: enquiries@bgs.ac.uk

Wallingford (WL) Office
British Geological Survey
Maclean Building
Wallingford
Oxford
OX10 8BB
Tel: 01491 838800
Fax: 01491 692345
Email: hydroenq@bgs.ac.uk

Murchison House (MH) Office
British Geological Survey
Murchison House
West Mains Road
Edinburgh
EH9 3LA
Tel: 0131 650 0207
Fax: 0131 650 0252
Email: enquiry@bgs.ac.uk

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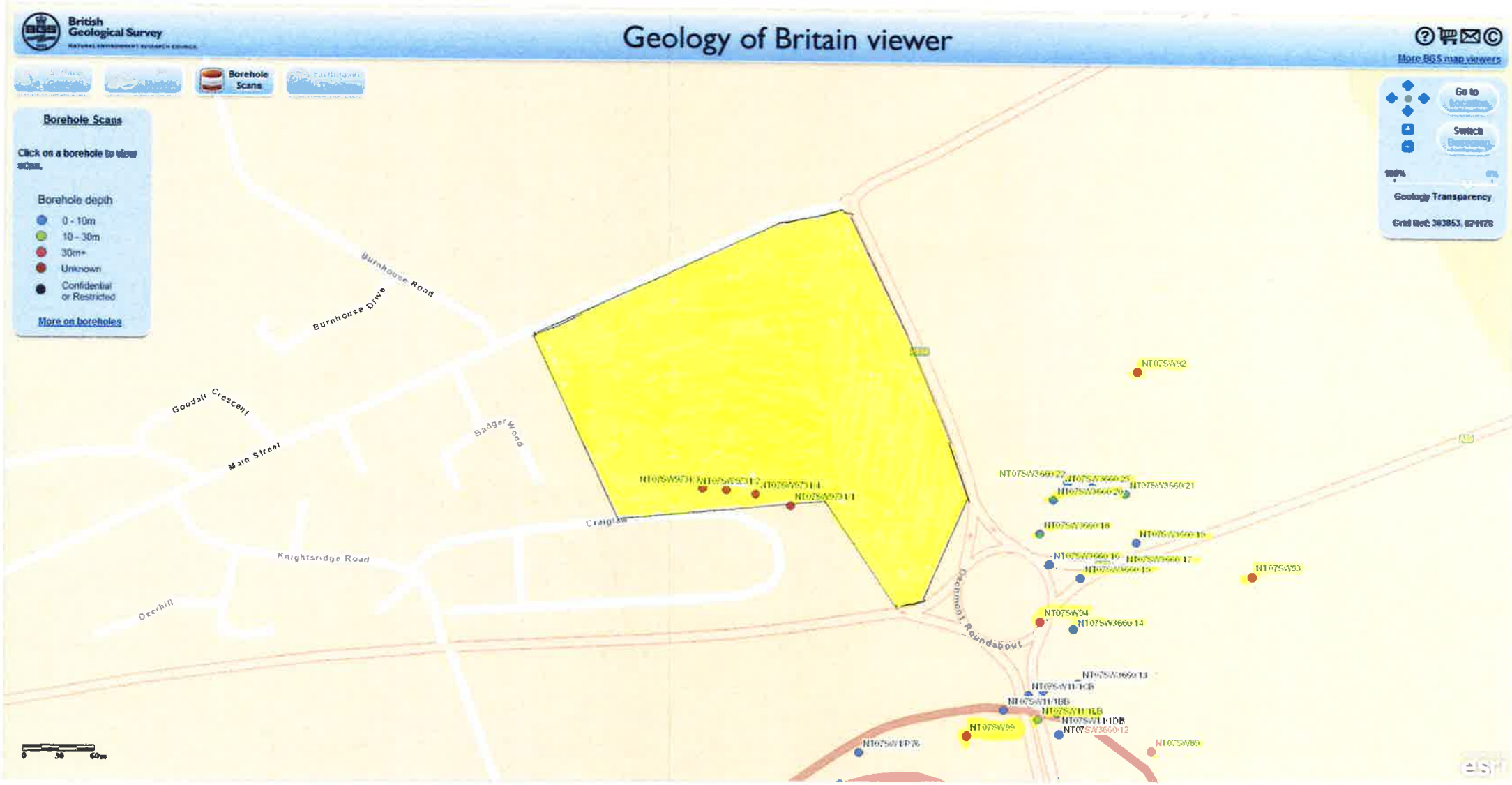
- The data, information and related records supplied in this Report by BGS can only be indicative and should not be taken as a substitute for specialist interpretations, professional advice and/or detailed site investigations. You must seek professional advice before making technical interpretations on the basis of the materials provided.
- Geological observations and interpretations are made according to the prevailing understanding of the subject at the time. The quality of such observations and interpretations may be affected by the availability of new data, by subsequent advances in knowledge, improved methods of interpretation, and better access to sampling locations.
- Raw data may have been transcribed from analogue to digital format, or may have been acquired by means of automated measuring techniques. Although such processes are subjected to quality control to ensure reliability where possible, some raw data may have been processed without human intervention and may in consequence contain undetected errors.
- Detail, which is clearly defined and accurately depicted on large-scale maps, may be lost when small-scale maps are derived from them.
- Although samples and records are maintained with all reasonable care, there may be some deterioration in the long term.
- The most appropriate techniques for copying original records are used, but there may be some loss of detail and dimensional distortion when such records are copied.
- Data may be compiled from the disparate sources of information at BGS's disposal, including material donated to BGS by third parties, and may not originally have been subject to any verification or other quality control process.
- Data, information and related records, which have been donated to BGS, have been produced for a specific purpose, and that may affect the type and completeness of the data recorded and any interpretation. The nature and purpose of data collection, and the age of the resultant material may render it unsuitable for certain applications/uses. You must verify the suitability of the material for your intended usage.
- If a report or other output is produced for you on the basis of data you have provided to BGS, or your own data input into a BGS system, please do not rely on it as a source of information about other areas or geological features, as the report may omit important details.
- The topography shown on any map extracts is based on the latest OS mapping and is not necessarily the same as that used in the original compilation of the BGS geological map, and to which the geological linework available at that time was fitted.
- Note that for some sites, the latest available records may be quite historical in nature, and while every effort is made to place the analysis in a modern geological context, it is possible in some cases that the detailed geology at a site may differ from that described.

Report issued by
BGS Enquiry Service

Appendix D

Historical Borehole Records obtained from the British Geological Survey


British Geological Survey
Geology of Britain viewer
More BGS map viewers
Borehole Scans
Borehole Scans
Click on a borehole to view scans.
Borehole depth
0 - 10m
10 - 30m
30m+
Unknown
Confidential or Restricted
More on boreholes
Go to location
Switch Basemap
100%
0%
Geology Transparency
Grid Ref: 303853, 674978
Burnhouse Road
Burnhouse Drive
Goodall Crescent
Main Street
Badger Wood
Craiglea
Knightsridge Road
Deerhill
Deerhorn Roundabout
NT07SW92
NT07SW93
NT07SW94
NT07SW99
NT07SW89
NT07SW3660-12
NT07SW3660-13
NT07SW3660-14
NT07SW3660-15
NT07SW3660-16
NT07SW3660-17
NT07SW3660-18
NT07SW3660-21
NT07SW3660-22
NT07SW3660-25
NT07SW3660-26
0
30
60m

HYDRACRAT LTD.

SITE INVESTIGATION DEPARTMENT

REEMA ROAD :: BELLSHILL

DRILL LOG

No. of Borehole.....1..... Location of Borehole.....Dechmont.....

Customer..... Date.....15.6.87.....

Depth Below Ground Level				Details of Strata	
From	To	Thickness	Core Recovery	Description	Dip°
GL	0.20	0.20		Soil	
0.20	1.30	1.10		Sandy Clay	
1.30	17.90	16.60		Boulder Clay	
17.90	24.00	6.10		Marl	
24.00	33.00	9.00		Mudstone	
				Borehole Complete.	

NT07SW9731/2

HYDRACRAT LTD.

SITE INVESTIGATION DEPARTMENT

REEMA ROAD :: BELLSHILL

DRILL LOG

No. of Borehole.....2..... Location of Borehole.....Deshmont.....

Customer..... Date.....15.6.87.

Depth Below Ground Level				Details of Strata	
From	To	Thickness	Core Recovery	Description	Dip°
GL	0.25	0.25		Soil	
0.25	1.50	1.25		Sandy Clay	
1.50	17.80	16.30		Boulder Clay	
17.80	20.60	2.80		Mudstone	
20.60	20.90	0.30		Ironstone	
20.90	24.50	4.60		Mudstone	
24.50	25.10	0.60		Sandstone	
25.10	29.50	4.40		Mudstone	
29.50	31.00	1.50		Sandstone	
31.00	33.00	2.00		Mudstone	
				6.00 Casing	
				Borehole Complete.	

NT07SW9731/3

HYDRACRAT LTD.

SITE INVESTIGATION DEPARTMENT

REEMA ROAD :: BELLSHILL

DRILL LOG

No. of Borehole.....3..... Location of Borehole.....Dechmont.....

Customer..... Date.....15.6.87.

Depth Below Ground Level				Details of Strata	
From	To	Thickness	Core Recovery	Description	Dip°
GL	0.20	0.20		Soil	
0.20	2.00	1.80		Sandy Clay	
2.00	10.00	8.00		Sand & Gravel	
10.00	20.50	10.50		Boulder Clay	
20.50	24.30	3.80		Mudstone	
24.30	25.50	1.20		Sandstone	
25.50	26.70	1.20		Mudstone	
26.70	30.00	3.30		Sandstone	
30.00	30.50	0.50		Mudstone	
30.50	33.50	3.00		Sandstone	
				10.50 Casing	
				Borehole Complete.	

NT07SW9731/4

HYDRACRAT LTD.

SITE INVESTIGATION DEPARTMENT

REEMA ROAD :: BELLSHILL

DRILL LOG

No. of Borehole.....4..... Location of Borehole.....Dechmont.....

Customer..... Date.....15.6.87.....

Depth Below Ground Level				Details of Strata	
From	To	Thickness	Core Recovery	Description	Dip°
GL	0.20	0.20		Soil	
0.20	1.80	0.60		Sandy Clay	
1.80	20.80	19.00		Boulder Clay	
20.80	22.00	1.20		Sandstone	
22.00	22.60	0.60		Mudstone	
22.60	24.00	1.40		Sandstone	
24.00	32.50	8.50		Mudstone	
32.50	33.30	0.80		Sandstone	
33.30	35.00	1.70		Mudstone	
				12.00 Casing	
				Borehole Complete.	

NT07SW93+94.

(68/2713) Wt. 12760/47 5000 12/36 M. & St., Ltd. G 68. NT07SW 93-94

SECTION OF Houston No 8 - 9.

SITE FIXED

Surface Level

Communicated 1940 by Scottish Oils Ltd (Broxburn Oil Co bore books)

Date of boring or sinking 1866. Borer

One-inch Map Six-inch Map (County and Half-Quarter Sheet) Lin 10NW.

NT07SW/93

		Thickness. Fathoms.	feet.	ins.	Depth from Su Fathoms.	fe
No 8. bore. 184 yds. from	Clay & boulders.	10	.	.	10	(
No 1.	marl.	1	3	.	11	
	Blaw marly		3	.	12	(
	marl green.	1	3	.	13	
	Blaw marly.	1	5	6.	15	
	marl green.	7	.	.	22	
	" hd.			9.	22	
	Blw blaw.	2	3	4.	25	(
	FKS. & blaw.		1	1	25	
	Blaw & shale nbs		2	8.	25	
	" ak.		2	.	26	(
	" black.	1	3	9.	27	
	" hd.			8	27	
COAL.				10	28	(
	Coaly blaw.			9.	28	(
	marly			3.	28	
	marl green.	5	.	.	33	
COAL.			3		34	(
	Dk. blaw.		1	4.	34	
COAL.			1		34	
	Fcl white		2	6	34	

NT07SW/94

SITE FIXED

	Thickness. Fathoms.	feet.	ins.	Depth from Surface. Fathoms.	feet.	ins.
Dk. grks.		2		12	2	9
Blaw black.		3		12	5	9
" hd		2	4.	13	2	4
" black.		5		14	1	4
Iron st coarse.			6.	14	1	10
Blaw black.		1		14	2	10
" & balls.		1	6.	14	4	4
Mast.	4	4	6.	19	2	10.

No 10.

NT07SW 92

SECTION OF Houston No. 13

Surface Level

Communicated 1940 by Scottish Oils Ltd. (Broxburn Oil Co. Boring)

Date of boring or sinking 1867 Borer

One-inch Map 32 Six-inch Map Lin 10N.W.

No. 13 112 yds N. from No. 8 bore on N. side of hedge.

	Thickness Ft.	In.	From Ft.
Surface	31	0	31
Marly green	11	-	42
" red	19	-	61
" soft	2	6	63
" green	48	6	112
— marly blaes	2		114
marl green	6		120

NT07SW 98-103

Skeleton information concerning bores for which journals have not been obtained but for which sites are known.

			Thickness Ft.	Thickness In.	Depth from Surface Ft.	Depth from Surface In.
Lin 10 NW 10	NT07SW 98	No. 1 Bore, S.W. corner of Haggistwood chiefly sdst. & flas. (no living Bribs)	451	9		
11	99	No. 8 Bore Houston, centre of boundary of Haggis			Surface 4.2.9 Blaes 2.1.6 Sdst & flas 13.6.1 Marls 19.1.0 Basal Sdst 2.10	
15	100	Marls	108	0		
16	101	No. 7 Bore Houston. Sdst. flakes & fireclay	163	10		
20	102	Blaes, sandstone & flakes.	120	—		
24	103	No. 6a Bore, sdst 7'7"				

NT 07 SW

British National Grid (27700) : 304716,670650

Report an issue with this borehole

NT07SW11/1LB

BOREHOLE RECORD SHEET

LOCATION M8 NEWBRIDGE - DECHMONT

WATER LEVELS DRY INITIAL DRY FINAL

JOB No. 8.22 BOREHOLE No. 1L 14

DATE COMMENCED 28th July, 1967

SURFACE LEVEL 442.6 O.D. DIAMETER 6" See Note

DATE COMPLETED 4th November, 1967

DESCRIPTION	Leg.	Depth	Thickness	Level	Samples	n (blows)	w (%)	δ (lb./cu.ft.)	c (lb.sq./ft.)	o (deg.)	L.L. (%)	P.L. (%)	P.I. (%)
FILLING : Very Dense red blaes		6'0"	6'0"										
					U4 7'0"		13.3	136	4465	4			
Very stiff intact dark grey/brown sandy BOULDER CLAY.					B 9'0"								
					D 9'10"								
					U4 13'0"								
					B 15'2"								
					D 16'6"								
					U4 19'0"								
					B+D 22'0"								
Continued Overleaf /					U4 25'0"								

REMARKS:

Note : Diamond Coring commenced at a depth of 27'0" Diameter being 76 m.m.

SYMBOLS: n — No. of blows per foot in standard penetration test w — Natural moisture content δ — Natural bulk density c — Apparent cohesion o — Angle of internal friction
L.L. — Liquid Limit P.L. — Plastic Limit P.I. — Plasticity Index U.4 — 4 ins. Dia. Undisturbed Sample U.1¼ — 1¼ ins. Dia. Undisturbed Sample D — Disturbed Sample B — Bulk Sample

British National Grid (27700) : 304716,670650

Report an issue with this borehole

NT07SW 11/1LB.

BOREHOLE RECORD SHEET

LOCATION M8 NEWBRIDGE - DECHMONT

WATER LEVELS ____ INITIAL ____ FINAL

JOB No. ____ BOREHOLE No. 1 L (Contd.)

DATE COMMENCED ____

SURFACE LEVEL ____ DIAMETER ____

DATE COMPLETED ____

DESCRIPTION	Leg.	Depth	Thickness	Level	Samples	n (blows)	w (%)	γ (lb./cu.ft.)	c (lb.sq./ft.)	φ (deg.)	L.L. (%)	P.L. (%)	P.I. (%)
Very stiff intact dark grey/brown sandy BOULDER CLAY.		6'0"											
		26'6"	20'6"										
COBBLE		27'0"	0'6"										
Weathered and broken black SHALE.		37'0"	10'0"										
Broken black SHALE		50'0"	13'0"										

REMARKS:

SYMBOLS: n — No. of blows per foot in standard penetration test w — Natural moisture content γ — Natural bulk density c — Apparent cohesion φ — Angle of internal friction
L.L. — Liquid Limit P.L. — Plastic Limit P.I. — Plasticity Index U.4 — 4 ins. Dia. Undisturbed Sample U.1¾ — 1¾ ins. Dia. Undisturbed Sample D — Disturbed Sample B — Bulk Sample

NT07SW89.

(68/2713) Wt. 12760/47 5000 12/36 M. & St., Ltd. G 68.

NT 07 SW 89

SECTION OF Houston No 10 bore. 165 yds SE. of No 9 and 75 yds. N of No 6 bore.

D

SITE FIXED

Surface Level

Communicated 1946 by Scottish Oils. Ltd (Broxburn oil cos bore

Date of boring or sinking 1861 Borer

One-inch Map 32 Six-inch Map (County and Half-Quarter Sheet) Lin. 10 N.W.

	Thickness. Fathoms.	feet.	ins.	Depth from Su Fathoms.	fe
Clay & boulders.	4	.	.	4	(
Gravel.	1	.	.	5	(
Clay & boulders.	4	.	.	9	(
Sdst green.		2		9	
Yel. fky.		2	6.	9	6
Sdst green.		3	.	10	
Fcl.	2	1	4.	12	
Sdst hd.			6	12	
Fcl. fky.		5	9.	13	
Fkd & fcl.	2	4	. 6.	16	
Blaes & ribs		1	8.	16	
Fky fcl.		3	2.	17	
Blaes light	1	.	8.	18	
" & fcl.	1	3	.	19	
Shale soft.		1	4	19	
" harder.			3.	20	(
Blaes & fcl.		4		20	
Soft shale & fcl.	1	.	6.	21	
Fky fcl.		3		22	
Hd. ironst. lings			4.	22	
Fcl. fky.	2	1	3.	24	
" " & grey fkd.		4	1.	25	
" Hr.		5	9		

NT07SW89.

	Thickness.			Depth from Surface.		
	Fathoms.	feet.	ins.	Fathoms.	feet.	ins.
Fkd & fcl.		4	4	28	1	8
Soft blaes & fcl.		4	2	28	5	10
Fky fcl.		4		29	3	10
Soft blaes & fcl.		1	3	29	5	1
" shaley "		1	4	30	0	8
Blaes & fireclay		3	9	30	4	5
Grey fkd.		2	9	32	1	2
Blaes & shale nbs		2	9	32	3	11
" dk.	1	1	6	33	5	5
"		3	9	34	3	2
" & grey fkd		1		34	4	2
Fky. fcl. & balls.		5		35	3	2
Grey fkd & balls.	1	1		36	4	2
Hd. fky. sdst.		1	3	36	5	5
Grey fkd.		1	9	37	1	2
Blaes & fkd.	1		2	38	1	4
Sdst.			9	38	2	1

GEORGE WIMPEY & CO. (MINERAL DEPOSITS) LTD

BOREHOLE RECORD SHEET

LOCATION: Phase 2 - Contract No. 8.2. WATER LEVELS: 7'0" INITIAL: 8'6" FINAL:
JOB NO.: 856 BOREHOLE NO.: [illegible] DATE COMMENCED: 24-1-66
SURFACE LEVEL: DIAMETER: 3" DATE COMPLETED: 24-1-66
MAP REF. E 152704 N 254955

DESCRIPTION	Leg.	Group Symbol	Depth	Thickness	Level	Samples	n (blows)	w (%)	γ (lb./cu. ft.)	q_u (lb./sq. ft.)	c (lb./sq. ft.)	φ (deg.)	L.L. (%)	P.L. (%)	P.I. (%)	INDICATED/RECOMMENDED ALLOWABLE BEARING CAPACITY (Tons/sq. ft.) Strip.	Sq.
Topsoil.			0 6	0 6		B 1'0"											
Soft Intact Mottled Brown Sandy Clay containing Gravel with Patches of Stiff Sandy Clay.			7 0	6 6		U4 2'0"		27.6	124								
Stiff Intact Dark Greyish [illegible] Sandy Clay containing Gravel.			10 0	3 0		B 4'0" D 6'0"											

REMARKS: C.B.R. test at 2'0" : 0.9% at moisture content of 23.0% and density of 130 lbs/ft3.

SYMBOLS: n - No. of blows per foot in standard penetration test w - Natural moisture content γ - Natural bulk density q_u - Unconfined compressive strength c - Apparent cohesion φ - Angle of internal friction. P.L. - Plastic Limit P.I. - Plasticity Index U.S. - 3 in. dia. Undisturbed Sample. U.3 - 11 in. dia. Undisturbed Sample. D - Disturbed Sample. B - Bulk Sample.

GEORGE N[illegible]SON & CO. (MINERAL BORERS) LTD

BOREHOLE RECORD SHEET

ATION : Phase 2 - Contract No. 2. WATER LEVELS: 6'0" INITIAL: 2'6" FINAL:

NO. : 856 BOREHOLE NO. C470-12 DATE COMMENCED: 25-1-66

FACE LEVEL: DIAMETER: 3" DATE COMPLETED: 25-1-66

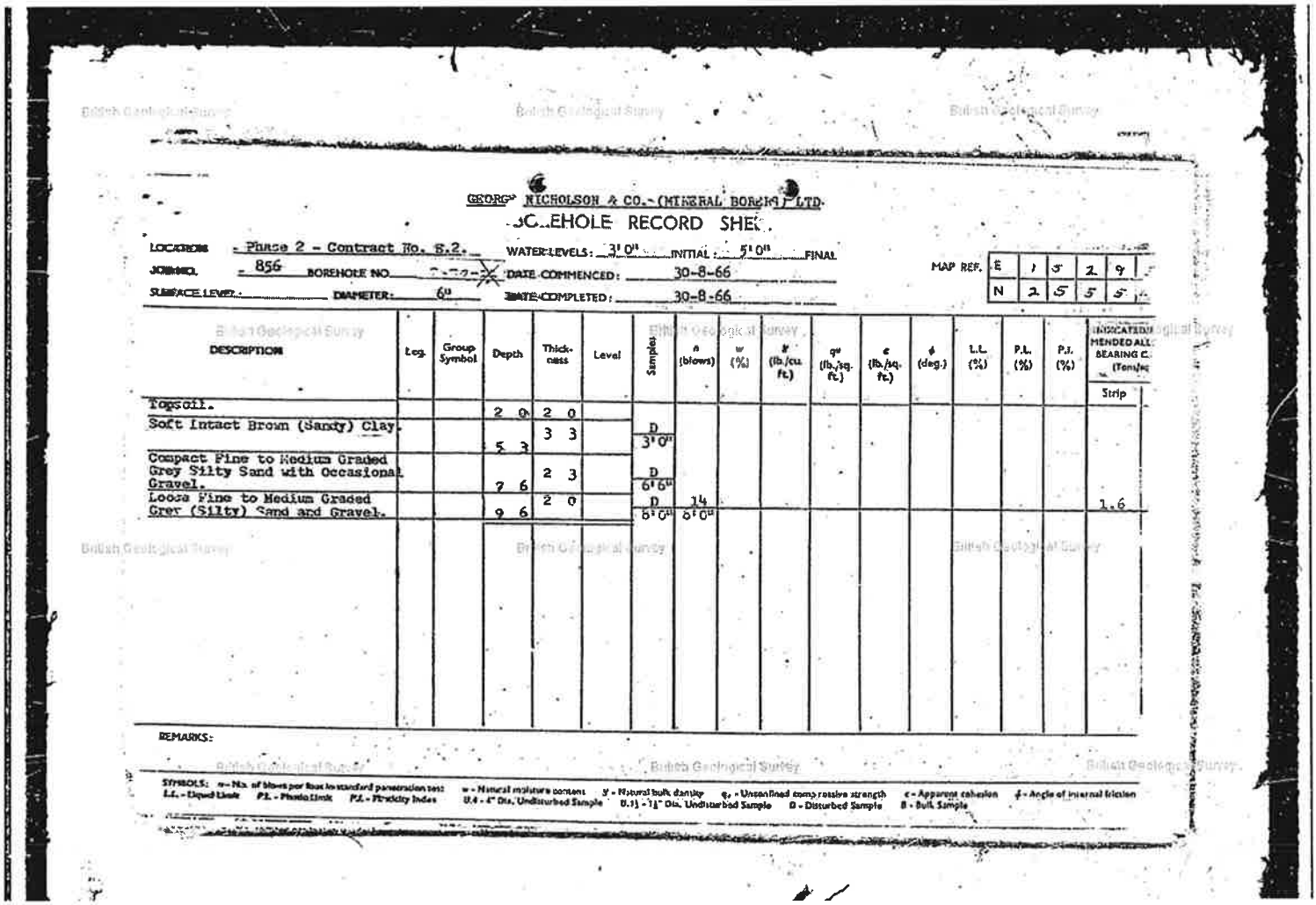
MAP REF. E 1 5 2 9 5

N 2 5 5 5 0

DESCRIPTION	Leg.	Group Symbol	Depth	Thickness	Level	Samples	n (blows)	w (%)	γ (lb./cu. ft.)	q_u (lb./sq. ft.)	c (lb./sq. ft.)	φ (deg.)	L.L. (%)	P.L. (%)	P.I. (%)	INDICATED/RECOMMENDED ALLOWABLE BEARING CAPACITY (Tons/sq. ft.) Strip	Spre
Topsoil.			2	2		U4											
Soft to Firm Intact Mottled Brown Sandy Clay containing Gravel.			6 3	4 0		2'3" B 4'0" D		51.7	104								
Soft Intact Greyish Silty Sandy Clay.			8 0	1 9		6'6"											
Loose Fine to Medium Graded Brown (Clayey) Sand and Gravel.			9 0	1 0													
Stiff Intact Dark Greyish Sandy Clay containing Gravel			10 0	1 0		D 9'6"											

REMARKS: C.B.R. test at 2'3" : 1.0% at moisture content of 50.4% and density of 107 lbs/ft3.

SYMBOLS: n = No. of blows per foot in standard penetration test w = Natural moisture content γ = Natural bulk density q_u = Unconfined compressive strength c = Apparent cohesion φ = Angle of internal friction
L.L. = Liquid Limit P.L. = Plastic Limit P.I. = Plasticity Index U.4 = 4 in. dia. Undisturbed Sample. U.3 = 3 in. dia. Undisturbed Sample. D = Disturbed Sample. B = Bulk Sample.



GEORGE NICHOLSON & CO. (MINERAL BORING) LTD.

BOREHOLE RECORD SHEET

LOCATION: - Phase 2 - Contract No. 8.2. WATER LEVELS: 3' 0" INITIAL 5' 0" FINAL

JOB NO. - 856 BOREHOLE NO. [illegible] DATE COMMENCED: 30-8-66

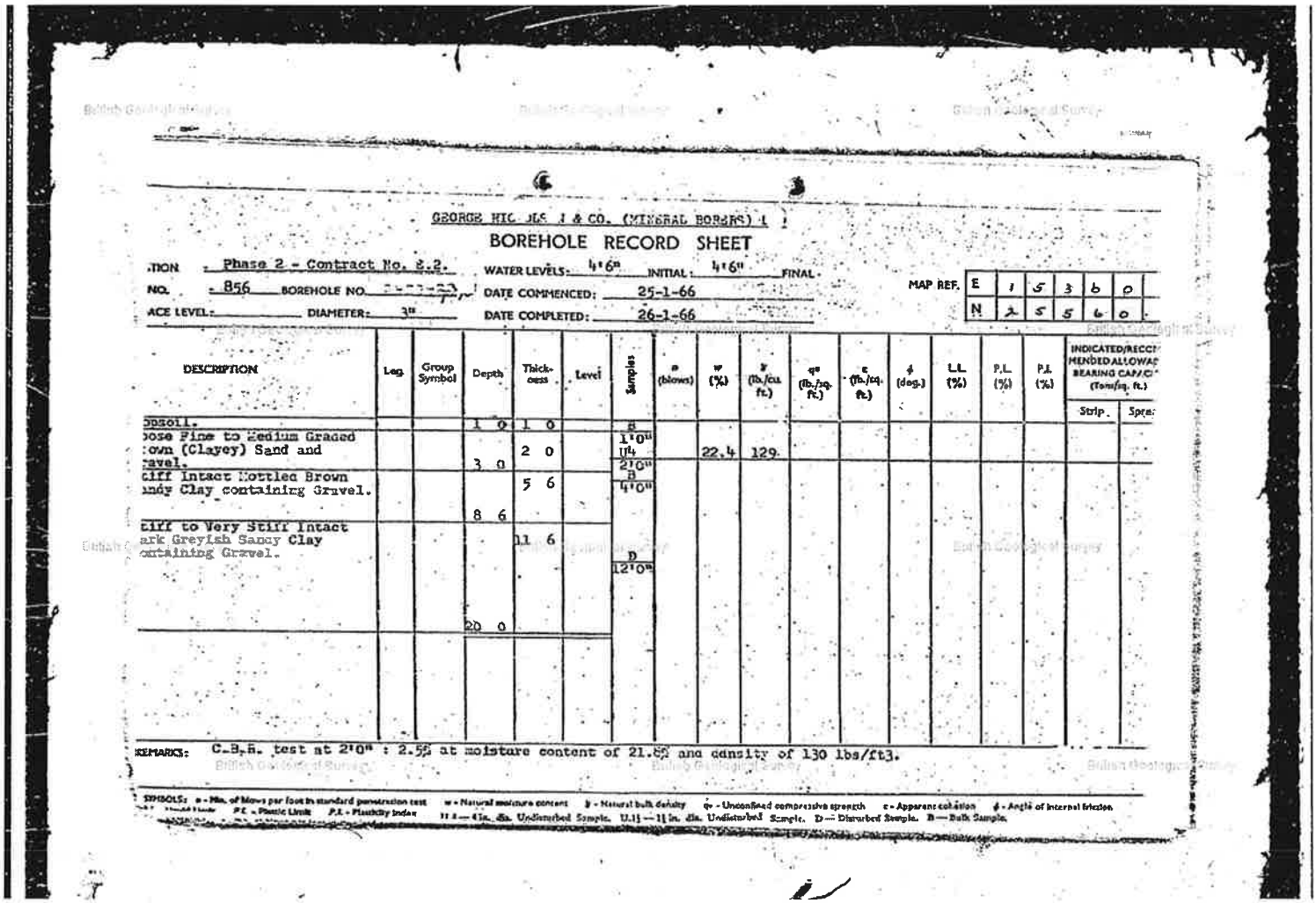
SURFACE LEVEL: DIAMETER: 6" DATE COMPLETED: 30-8-66

MAP REF. E 1 3 2 9 N 2 5 5 5

DESCRIPTION	Leg.	Group Symbol	Depth	Thickness	Level	Samples	n (blows)	w (%)	γ (lb./cu. ft.)	q_u (lb./sq. ft.)	c (lb./sq. ft.)	φ (deg.)	L.L. (%)	P.L. (%)	P.I. (%)	INDICATED/RECOMMENDED ALLOWABLE BEARING C. (Tons/sq. ft.)
Topsoil.			2 0	2 0												Strip
Soft Intact Brown (Sandy) Clay.			5 3	3 3		D 3' 0"										
Compact Fine to Medium Graded Grey Silty Sand with Occasional Gravel.			7 6	2 3		D 6' 6"										
Loose Fine to Medium Graded Grey (Silty) Sand and Gravel.			9 6	2 0		D 8' 0"	14 8' 0"									1.6

REMARKS:

SYMBOLS: n - No. of blows per foot in standard penetration test; w - Natural moisture content; γ - Natural bulk density; q_u - Unconfined compressive strength; c - Apparent cohesion; φ - Angle of internal friction; L.L. - Liquid Limit; P.L. - Plastic Limit; P.I. - Plasticity Index; U.4 - 4" Dia. Undisturbed Sample; U.1½ - 1½" Dia. Undisturbed Sample; D - Disturbed Sample; B - Bulk Sample



GEORGE HIC JLS J & CO. (MINERAL BORERS) L

BOREHOLE RECORD SHEET

TION Phase 2 - Contract No. S.2. WATER LEVELS: 4'6" INITIAL: 4'6" FINAL:

NO. 856 BOREHOLE NO. DATE COMMENCED: 25-1-66

ACE LEVEL: DIAMETER: 3" DATE COMPLETED: 26-1-66

MAP REF. E 153600

N 255600

DESCRIPTION	Leg.	Group Symbol	Depth	Thick-ness	Level	Samples	n (blows)	w (%)	γ (lb./cu. ft.)	q_u (lb./sq. ft.)	c (lb./sq. ft.)	φ (deg.)	L.L. (%)	P.L. (%)	P.I. (%)	INDICATED/RECOMMENDED ALLOWABLE BEARING CAP. (Tons/sq. ft.) Strip	Spre
opsoil.			1 0	1 0		B											
ose Fine to Medium Graded own (Clayey) Sand and ravel.			3 0	2 0		1'0" 1ft4 2'0" B		22.4	129								
tiff Intact Mottled Brown ndy Clay containing Gravel.			8 6	5 6		4'0"											
tiff to Very Stiff Intact ark Greyish Sandy Clay ontaining Gravel.			20 0	11 6		D 12'0"											

REMARKS: C.B.R. test at 2'0" : 2.5% at moisture content of 21.6% and density of 130 lbs/ft3.

SYMBOLS: n - No. of blows per foot in standard penetration test w - Natural moisture content γ - Natural bulk density q_u - Unconfined compressive strength c - Apparent cohesion φ - Angle of internal friction
P.L. - Plastic Limit P.I. - Plasticity Index U.4 — 4 in. dia. Undisturbed Sample. U.1½ — 1½ in. dia. Undisturbed Sample. D — Disturbed Sample. B — Bulk Sample.

British National Grid (27700) : 304794,670840

Report an issue with this borehole

NT07SW3660/21.

GEORGE NICHOLSON & CO. (MINERAL BORERS) LTD

BOREHOLE RECORD SHEET

CATION : Phase 2 - Contract No. E.2.
NO. : 856 BOREHOLE NO. 2-47C/21
FACE LEVEL: DIAMETER: 3" to 2'10" 6"/6" to 6'6"
WATER LEVELS: 8'0" INITIAL: 5'3" FINAL:
DATE COMMENCED: 26-1-66
DATE COMPLETED: 26-1-66
MAP REF. E 1 5 4 6 0 N 2 5 5 7 0

DESCRIPTION	Leg.	Group Symbol	Depth	Thickness	Level	Samples	n (blows)	w (%)	γ (lb./cu. ft.)	q_u (lb./sq. ft.)	c (lb./sq. ft.)	φ (deg.)	L.L. (%)	P.L. (%)	P.I. (%)	INDICATED/RECOMMENDED ALLOW. BEARING CAPAC (Tons/sq. ft.) Strip	Sp
Topsoil.			1 6	1 6													
Firm to Stiff Intact Mottled Brown Sandy Clay containing Gravel.			8 6	7 0		U4 0'0" B 0'5"		16.8	129								
Compact Fine to Medium Graded Brown Clayey Sand and Gravel with Patches of Clay.			11 0	2 6		D 13'0"											
Stiff to Very Stiff Intact Dark Greyish Sandy Clay containing Gravel.			20 0	9 0													

REMARKS: C.B.R. test at 8'6" : 5.0% at moisture content of 16.1% and density of 134 lbs/ft3.

SYMBOLS: n - No. of blows per foot in standard penetration test w - Natural moisture content γ - Natural bulk density q_u - Unconfined compressive strength c - Apparent cohesion φ - Angle of internal friction U — Undisturbed Sample, B — Bulk Sample.

GEORGE [illegible] ION & CO. (MINERAL BORERS) LTD

BOREHOLE RECORD SHEET

ATION : Phase 2 - Contract No. 6.2.
NO. : 856 BOREHOLE NO. [illegible]
FACE LEVEL: DIAMETER: 3"
WATER LEVELS: 2'0" INITIAL : 3'0" FINAL
DATE COMMENCED: 20-1-66
DATE COMPLETED: 21-1-66
MAP REF. E 15 42 55
N 25 51 85

DESCRIPTION	Leg.	Group Symbol	Depth	Thick-ness	Level	Samples	n (blows)	w (%)	γ (lb./cu. ft.)	qu (lb./sq. ft.)	c (lb./sq. ft.)	φ (deg.)	L.L. (%)	P.I. (%)	P.I. (%)	INDICATED/RECOMMENDED ALLOWABLE BEARING CAPACITY (Tons/sq. ft.) Strip	Spread
opsoil.			0 0	0 6		B 1'0"											
oft to Firm Mottled Lark rown Sandy Clay containing ravel.				6 6		U4 2'6"		21.9	130								
			7 0			B 4'6"											
tiff Intact Dark Greyish [illegible] andy Clay containing Gravel.			10 0	3 0		B 8'0"											

REMARKS: C.B.R. test at 2'6" : 1.0% at moisture content of 27.5% and density of 131 lbs/ft3.

SYMBOLS: n - No. of blows per foot in standard penetration test w - Natural moisture content γ - Natural bulk density qu - Unconfined compressive strength c - Apparent cohesion φ - Angle of internal friction.
SYMBOLS: N - No. of blows/... P.I. - Plasticity Index ... U.I. — 11 in. dia. Undisturbed Sample. D — Disturbed Sample. B — Bulk Sample.

GEORGE WIMPEY & CO. (MINERAL BORERS) LTD

BOREHOLE RECORD SHEET

LOCATION: Phase 2 - Contract No. 8.2. WATER LEVELS: 2'6" INITIAL: 2'3" FINAL:
JOB NO. 856 BOREHOLE NO. 1470-15 DATE COMMENCED: 21-1-66
SURFACE LEVEL: DIAMETER: 3" DATE COMPLETED: 21-1-66
MAP REF. E 15410 N 23300

DESCRIPTION	Leg.	Group Symbol	Depth	Thickness	Level	Samples	n (blows)	w (%)	γ (lb./cu ft.)	q_u (lb./sq. ft.)	c (lb./sq. ft.)	φ (deg.)	L.L. (%)	P.L. (%)	P.I. (%)	INDICATED/RECOMMENDED ALLOWABLE BEARING CAP. (Tons/sq. ft.) Strip	S
Peaty Topsoil.			0 0	0 6		B 1'0"											
Soft Intact Mottled Brown Sandy Clay containing Gravel with Traces of Peat.				7 0		U4 2'6"		25.7	100								
			7 6			B 8'0"											
Stiff Intact Dark Greyish Sandy Clay containing Gravel.			10 0	2 6													

REMARKS: C.B.R. test at 2'6" : 0.6% at moisture content of 30.8% and density of 115 lbs/ft3.

SYMBOLS: n - No. of blows per foot in standard penetration test. w - Natural moisture content. γ - Natural bulk density. q_u - Unconfined compressive strength. c - Apparent cohesion. φ - Angle of internal friction. U4 - 4 in. dia. Undisturbed Sample. U3 - 3 in. dia. Undisturbed Sample. D - Disturbed Sample. B - Bulk Sample.

British National Grid (27700) : 304790,670777

Report an issue with this borehole

NT07SW3660/17.

GEORGE M[illegible]SON & CO. (MINERAL BORERS) LTD

BOREHOLE RECORD SHEET

SECTION Phase 2 - Contract No. 8.2. WATER LEVELS: 2'6" INITIAL: 2'0" FINAL:
BOREHOLE NO. 856 BOREHOLE NO. [illegible] DATE COMMENCED: 21-1-66
SURFACE LEVEL: DIAMETER: 3" DATE COMPLETED: 24-1-66
MAP REF. E 1 5 5 1 0 N 2 5 3 6 0

DESCRIPTION	Leg.	Group Symbol	Depth	Thickness	Level	Samples	n (blows)	w (%)	γ (lb./cu. ft.)	qu (lb./sq. ft.)	c (lb./sq. ft.)	φ (deg.)	L.L. (%)	P.I. (%)	P.I. (%)	INDICATED/RECOMMENDED ALLOWABLE BEARING CAPACITY (Tons/sq. ft.) Strip	Spre
Topsoil.			0 9	0 9		B.											
Firm to Stiff Intact Dark Brown Sandy Clay containing Gravel.			3 6	2 9		1'0" U4		22.8	132								
						2'6" D											
Compact Fine to Medium Graded Brown (Clayey) Sand and Gravel.			5 3	1 9		4'6" D											
Stiff to Very Stiff Intact Dark Greyish Sandy Clay containing Gravel.			10 0	4 9		7'0"											

REMARKS: C.B.R. test at 2'6" : 2.6% at moisture content of 19.7% and density of 133 lbs/ft3.

SYMBOLS: n = No. of blows per foot to standard penetration test w = Natural moisture content γ = Natural bulk density qu = Unconfined compressive strength c = Apparent cohesion φ = Angle of internal friction
L.L. = Liquid Limit P.L. = Plastic Limit P.I. = Plasticity Index U.4 — 4 in. dia. Undisturbed Sample. U.1½ — 1½ in. dia. Undisturbed Sample. D — Disturbed Sample. B — Bulk Sample.

GEORGE [illegible] & CO. (MINERAL BORERS) LTD

BOREHOLE RECORD SHEET

CATION : Phase 2 - Contract No. E.2. WATER LEVELS: 2'9" INITIAL : 3'0" FINAL :

MAP REF. E 1 5 3 1 0
N 2 5 3 1 5

G NO. 856 BOREHOLE NO. [illegible] DATE COMMENCED: 21-1-66

FACE LEVEL DIAMETER: 3" DATE COMPLETED: 21-1-66

DESCRIPTION	Leg.	Group Symbol	Depth	Thickness	Level	Samples	n (blows)	w (%)	γ (lb./cu. ft.)	q_u (lb./sq. ft.)	c (lb./sq. ft.)	φ (deg.)	L.L. (%)	P.I. (%)	P.I. (%)	INDICATED/RECOMMENDED ALLOWABLE BEARING CAPACITY (Tons/sq. ft.) Strip.	Sp
Peaty Topsoil.			0 9	0 9		B 1'0"											
Firm Intact Brown Very Sandy Clay containing Gravel.			3 6	2 9		U4 2'0"		21.0	131								
Loose Fine to Medium Graded Brown (Clayey) Sand and Gravel.			5 6	2 0		B 4'6"											
Stiff Intact Dark Greyish Sandy Clay containing Gravel.			10 0	4 6		B 6'0"											

REMARKS: C.B.R. test at 2'6" : 1.5% at moisture content of 19.0% and density of 131 lbs/ft3.

SYMBOLS: n - No. of blows per foot in standard penetration test w - Natural moisture content γ - Natural bulk density q_u - Unconfined compressive strength c - Apparent cohesion φ - Angle of internal friction
L.L. - Liquid Limit P.L. - Plastic Limit P.I. - Plasticity Index U.3 — 3in. dia. Undisturbed Sample. U.1½ — 1½ in. dia. Undisturbed Sample. D — Disturbed Sample. B — Bulk Sample.

GEORGE H. DOWN & CO. (MINERAL BORING) LTD

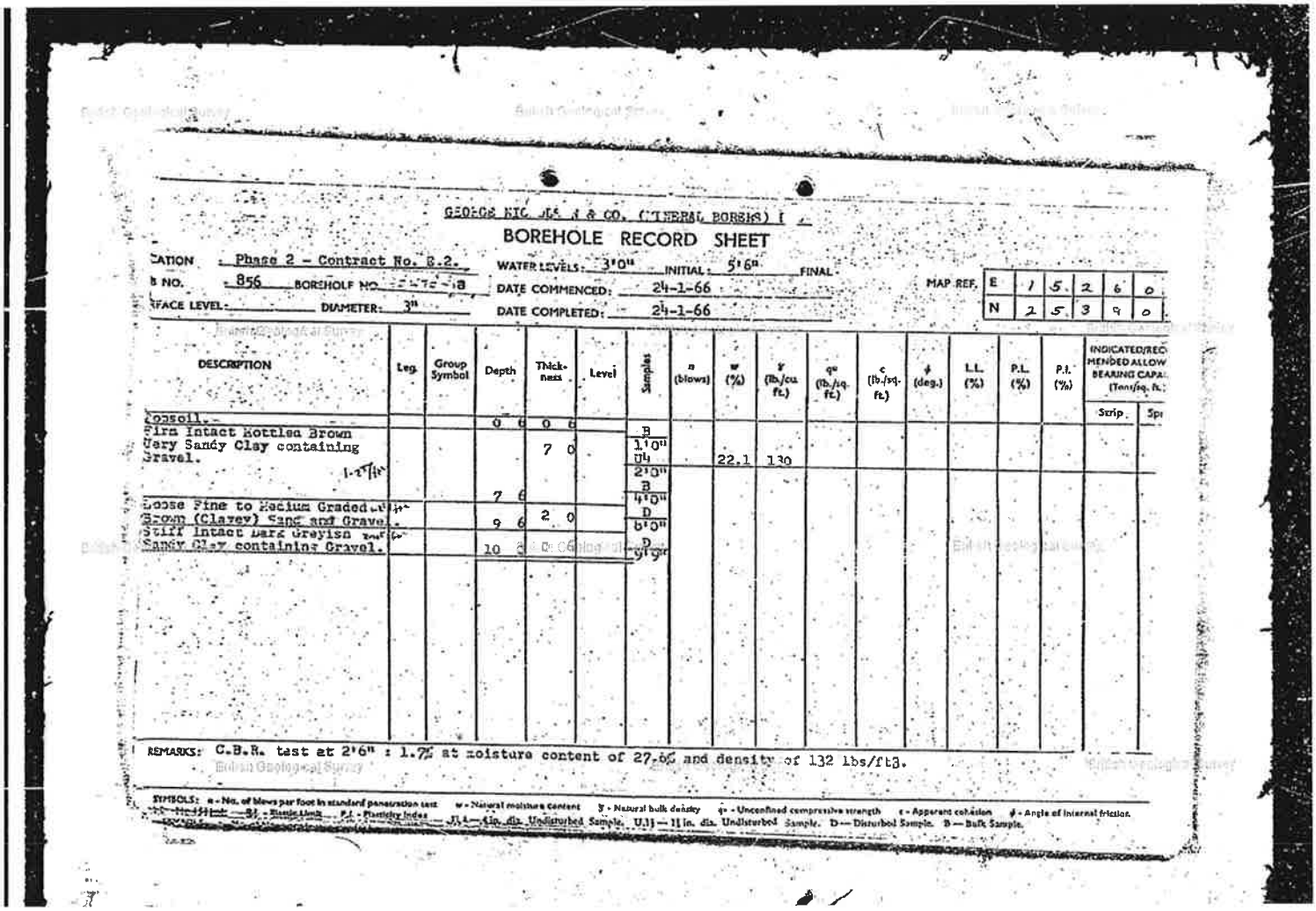
BOREHOLE RECORD SHEET

CATION : Phase 2 - Contract No. E.2.
S NO. : 856 BOREHOLE NO. 3470-19
RFACE LEVEL: DIAMETER: 3"
WATER LEVELS: Dry INITIAL: Dry FINAL:
DATE COMMENCED: 24-1-66
DATE COMPLETED: 24-1-66
MAP REF. E 15533 N 24544

DESCRIPTION	Leg.	Group Symbol	Depth	Thickness	Level	Samples	N (blows)	w (%)	γ (lb./cu. ft.)	qu (lb./sq. ft.)	c (lb./sq. ft.)	φ (deg.)	L.L. (%)	P.I. (%)	P.I. (%)	INDICATED/RECOMMENDED ALLOWABLE BEARING CAPA. (Tons/sq. ft.) Strip	Sp
Topsoil.			0 9	0 9		D											
Firm Intact Brown Very Sandy Clay containing Gravel with Patches of Sand.				9 3		1'0" U4		32.7	119								
			10 0			2'0" D 4'0"											

REMARKS: C.B.R. test at 2'0" : 1.% at moisture content of 32.0% and density of 118 lbs/ft3.

SYMBOLS: N = No. of blows per foot in standard penetration test. w = Natural moisture content. γ = Natural bulk density. qu = Unconfined compressive strength. c = Apparent cohesion. φ = Angle of internal friction.
L.L. = Liquid Limit. P.L. = Plastic Limit. P.I. = Plasticity Index. U.3 — 3 in. dia. Undisturbed Sample. U.1½ — 1½ in. dia. Undisturbed Sample. D — Disturbed Sample. B — Bulk Sample.



GEORGE KIG J&J & CO. (TERRAL BORERS) L

BOREHOLE RECORD SHEET

CATION: Phase 2 – Contract No. E.2. WATER LEVELS: 3'0" INITIAL: 5'6" FINAL:
B NO. 856 BOREHOLE NO. NT07SW18 DATE COMMENCED: 24-1-66
RFACE LEVEL: DIAMETER: 3" DATE COMPLETED: 24-1-66
MAP REF. E 1526 0
N 2539 0

DESCRIPTION	Leg.	Group Symbol	Depth	Thickness	Level	Samples	n (blows)	w (%)	γ (lb./cu. ft.)	q_u (lb./sq. ft.)	c (lb./sq. ft.)	φ (deg.)	L.L. (%)	P.L. (%)	P.I. (%)	INDICATED/RECOMMENDED ALLOWABLE BEARING CAPACITY (Tons/sq. ft.): Strip	Spr
Topsoil.			0 6	0 6		B											
Firm Intact Mottled Brown Very Sandy Clay containing Gravel.				7 0		1'0" U4		22.1	130								
			7 6			2'0" B											
Loose Fine to Medium Graded Brown (Clayey) Sand and Grave.			9 6	2 0		4'0" D											
Stiff Intact Dark Greyish Sandy Clay containing Gravel.			10 [illegible]			6'0" D											
						9'0" D											

REMARKS: C.B.R. test at 2'6" : 1.7% at moisture content of 27.6% and density of 132 lbs/ft3.

SYMBOLS: n - No. of blows per foot in standard penetration test w - Natural moisture content γ - Natural bulk density q_u - Unconfined compressive strength c - Apparent cohesion φ - Angle of internal friction. ~~W.L. - Water Limit~~ P.L. - Plasticity Index U3 - 3in. dia. Undisturbed Sample. U3½ - 3½in. dia. Undisturbed Sample. U4 - 4in. dia. Undisturbed Sample. U11 - 11in. dia. Undisturbed Sample. D - Disturbed Sample. B - Bulk Sample.

GEORGE NICHOLSON & CO. (MINERAL BORERS) LTD

BOREHOLE RECORD SHEET

LOCATION Phase 2 - Contract No. 8.2. WATER LEVELS: 4' 0" INITIAL 5' 3" FINAL
JOB NO. 856 BOREHOLE NO. C470 - 18/1 DATE COMMENCED: 30-8-66
SURFACE LEVEL: DIAMETER: 6" DATE COMPLETED: 30-8-66
MAP REF. E 1 5. 2 6 0 N 2 6 3 7 0

DESCRIPTION	Leg.	Group Symbol	Depth	Thickness	Level	Samples	n (blows)	w (%)	γ (lb./cu. Ft.)	q_u (lb./sq. ft.)	c (lb./sq. ft.)	φ (deg.)	L.L. (%)	P.L. (%)	P.I. (%)	INDICATED, AMENDED ALL BEARING C. (Tons/sq. Strip
Topsoil.			4 0	4 0		D 3' 0"										
Loose Fine to Medium Graded Brown Clayey Sand and Fine to Medium Gravel.			7 3	3 3		D 5' 0"										
Very Soft to Soft Intact Grey Silty Clay.			7 9	0 6		D 7' 6"										
Boulders.			9 6	1 9												

REMARKS:

DENSITY: ... γ = Natural bulk density ... q_u = Unconfined compressive strength c = Apparent cohesion φ = Angle of internal friction

Appendix E

Page Extracts from Relevant Mining Memoirs

MEMOIRS OF THE GEOLOGICAL SURVEY OF SCOTLAND - THE OIL SHALES OF THE LOTHIANS (1912)

Binny Sandstone.—The Dunnet and Broxburn Oil-shales are separated by an important zone of sandstones, of variable thickness, with some blaes and marls both above and below, which are known locally as the "Binny," "Hermand," "Humbie" or "Dalmeny" Sandstones. As this rock was first and most extensively wrought at Binny, this name has been selected to identify this horizon. The material obtained from Hermand quarry is a first-class building stone, contains nearly 95 per cent. of silica, is very compact and not liable to be affected by the weather. It is grey in tint, and its architectural qualities can be studied from the following buildings in Edinburgh, all of which have been exposed to the weather for more than 20 years, namely, the new part of the Calton Jail; St. Andrew's Free Church, Drumsheugh Gardens; the western section of the Royal Scottish Museum, Chambers Street; and the Bank of Scotland, George Street. At Binny, the quarries which supplied the freestone for many of the finest buildings in Edinburgh during the first half of the nineteenth century, such as the Scott Monument, are now totally abandoned and full of water. The rock, which lies in thick beds separated by bands of blaes, is grey in hue and very strong and durable. It is hard and well adapted for lasting monumental work; but its hardness, like that of the celebrated Craigleith freestone, makes it costly to hew, and the quantity of unproductive blaes between the beds, together with the increasing thickness of overlying material, have rendered the quarrying of it too expensive to be longer payable at Binny. When the quarries were in operation, blocks were obtained weighing as much as 17 tons. There were 26 feet of good building stone of a fine white colour below, and grey above, overlaid by 3 feet of hard sandstone, covered by 31 feet of blaes.

At Dalmeny this sandstone was extensively worked in the past, and the material was said to be superior in quality to that of Binny. Among the Edinburgh buildings erected with Dalmeny stone are the Palace Hotel; Union Bank, George Street; the east side of Palmerston Place, and nearly all the east side of Coates Gardens. The sandstone is in thick massive beds with partings of blaes, and the upper part of the section shows much grey bituminous shale full of entomostraca, thus resembling the sequence at Binny. The Binny Sandstone Group attains its maximum development east of Philpstoun, where it has been proved 70 fathoms thick in boring.

Broxburn Marls.—The Broxburn Oil-shales are surmounted by a characteristic set of beds locally known as the "Broxburn Marls," which comprise greenish, marly, or ashy clays, interbedded with carbonaceous shale and ribs of very hard, unfossiliferous cementstone or calcareous bands that vary in thickness from an inch to over a yard. All over the West Calder district the top of the series is characterised by a band of cream-coloured or grey limestone, 3, 4, or 5 feet thick, lying almost immediately under the Fells Shale, and in boring for the latter seam this limestone is regarded as the infallible "mark" of its position. No sandstone is found among the Broxburn Marls as a rule, and this curious series of beds points to a period of tranquillity over a wide area, succeeding the time of rapid currents that rolled along the pebbles and grains of sand during the deposition of the Binny Sandstone.

Houston Coal.—Though a few thin coal seams have been opened out below this horizon, the Houston Coal is practically the lowest bed of workable coal in the Scottish Carboniferous system. With the

exception of the insignificant Two-foot Coal above the Houston Marls, the next bed of workable coal, situated in the Carboniferous Limestone Series, is separated from it by over 1000 feet of sedimentary strata. The Houston Coal is pyritous, of inferior quality, and, on account of its bad roof and soft pavement and the quantity of blaes interbedded with it, has seldom in recent years proved remunerative. That it was formerly extensively wrought near the surface is proved by numerous old outcrop-pits. The last attempts to work this seam were made by several of the oil-shale companies to obtain cheap furnace fuel, but the results were unsuccessful, and the pits and mines are now dismantled.

Houston Marls.—The Houston Marls (so called), overlying the Houston Coal, are massive, amorphous, mudstone-like beds, which are hard when fresh, but crumble down on exposure to the weather. They are usually green, with some reddish or yellow bands. The individual bands vary considerably in thickness, and are separated by thin partings of hard kingle or cementstone that resist the weather and project in ribs beyond the decaying matrix. The Houston Marls appear to be unfossiliferous, and point to a complete change in the geological sequence of events over a wide area. In the West Calder district they reach a thickness of 150 to 200 feet or more, and they clearly indicate a long cessation of the conditions necessary for the deposition of oil-shale in that area. The occurrence of regular well defined parallel beds and bands of different colour points to aqueous action, and the absence of shaly intercalations suggests that the accumulation of this particular material must have been more or less continuous.

Although locally called a "marl," it is doubtful whether this is a correct description in the true acceptation of that term, as marl is a mixture of clay and lime, usually derived from finely divided organic remains, and the only external resemblance between the two rocks is their light colour, amorphous appearance, and the way in which they both crumble down under the influence of the weather. This deposit is not a true marl or mixture of clay and lime, as the chemical analyses which have been made show that the proportion of silica to alumina is too high for ordinary silicate of alumina, which constitutes the basis of pure clay, and the percentage of lime seems too low to class it among true marls.

Palæontological "Zones."—Two highly important marine fossil bands have lately been discovered in the shale-fields. One lies near the top of the group, immediately below the Mungle Shale, while the other is far beneath, close under the Pumpherston Shales. They both contain *Goniatites* and *Orthoceras*, but the Mungle Shell Bed has a much richer fauna in addition, and the fossils are in a better state of preservation.

These bands have a very wide distribution. The Mungle bed has been found in boring at Cobbinshaw, in the extreme south-west corner of the West Lothian Shale-field, and had previously been discovered, with an identical assemblage of fossils, in the Fordel railway cutting east of the Forth Bridge, while it has also been traced down the west side of the Midlothian Basin. The Pumpherston Shell Bed has been noticed in boring between Livingston and Pumpherston, in the heart of the West Lothian area, and has again been found in identical condition in the northern shale-fields at Duddingston and Queensferry; this bed also extends down the Midlothian Basin as far south as Carlops, and across to Burntisland in Fifeshire.

the Crosswood volcanic ash, which outcrops in the stream to the east; 82 fathoms below the ash another band of encrinital limestone was met with resting on a dolerite sill, and the bore ended at 206 fathoms, just below three bands of entomostracan limestone, from 2 to 4 feet thick. Limestones of this type are found three miles to the north resting on the Corston Hill lavas . . . . . No shale seams of any value were found.

'Around Harburn, some 50 fathoms of strata immediately below the Burdiehouse Limestone were proved many years ago by chisel bores, without result. The remaining 20 fathoms, lying above the highest bed in Messrs. Barr and Fraser's bore, probably contain the position of the Pumpherston Shales, but there is no reason whatever to believe that the shales would be workable, bearing in mind the condition of the overlying Camps, Dunnet and Broxburn Shales in this district.'*

Burdiehouse Limestone.—In the Bog Burn below Kiprig, the Burdiehouse Limestone has been mined, and on the east side of the railway it was worked open-cast (Torphin Quarry), being about 17 feet thick in both sections. To the south-west of Harburnhead it was first opened out in a large quarry and afterwards mined. Here the thickness is 23 feet with a fireclay pavement and roof. 'The Camps Shale is not represented, its position being occupied by kingle and sandstone beds. The continuation of the outcrop farther south to the Reservoir House Fault has been proved by boring.

'In 1911, a diamond bore on Cobbinshaw Hill was put down from the outcrop of the Fells Shale, and found the Limestone 25½ feet thick, covered by fireclay and sandstone beds. Both here and in the Harburn mines the limestone is very pure, creamy to grey in colour and with a glassy fracture: a carbonaceous band runs through the centre. The chert bands and the *Platyostomella* pavement found in the Raw Camps district do not occur here.'†

Burdiehouse Limestone to Fells Shale.—The distance separating these two horizons is approximately 163 fms. and the intervening strata include representatives of the Dunnet and Broxburn Shales. The former lies 33 fms. below the Fells, the latter some 50 fms. lower still. The Cobbinshaw Hill bore already referred to furnishes the best section. Above the Burdiehouse Limestone come 66 fms. of greenish-grey sandstones and conglomerates with beds of red, brown and green marl (*Dunnet Sandstone Group*), and then a band of entomostracan limestone about 1 foot thick overlain by a rib of volcanic ash (*Barracks Limestone and Ash*). 'Some fifteen fms. above this horizon there was a limy kingle with *Platyostomella*, followed by dark blaes accompanied by bands of sandstone, thin shale ribs and coaly blaes, the latter full of *Lingula* shells. These strata were about 10 fms. thick, and they represent the position of the Dunnet Shales. Above these were some 40 fms. of banded grey sandstones with thick beds of brown and greenish marl belonging to the Binny Sandstone Series, the marls being very prominent in the middle and lower parts of the section. The Broxburn Shales were represented by a bed of blaes 12 feet thick, with two thin shale

* 'The Oil-Shales of the Lothians,' *Mem. Geol. Surv.*, (1912), p. 17.
† *Ibid.*, p. 18.

b[illegible] an[illegible] ov[illegible]g B[illegible]urn [illegible]s, ou[illegible] [illegible]ous[illegible] of green and grey marls with bands of entomostraca[illegible]este[illegible] limy cements and sandstone.'†

Fells Shale and Limestone.—The Fells Shale is the lowest workable seam in the Cobbinshaw District and has been widely wrought from mines on both sides of the Reservoir and at Tarbrax. A bore put down 1900 feet N.E. of Viewfield House (Lanark 14 N.E.) showed:—

	Ft.	In.
Shaly Blaes, good	0	6
Wild Shale	1	2
Shaly Blaes	0	7
Fakes	0	5½
Shale	3	1½
Shaly Blaes, good	1	1
Greenish fireclay	0	2
Grey blaes, occasional fish scales	1	0
Light green marly sandstone	0	2
Blaes with *Spirorbis*, *Lingula* and fish remains	1	0
Blaes with occasional fish remains	1	0
Limestone, creamy, top half full of entomostraca and *Spirorbis*	3	5

At Tarbrax the Fells Shale reaches 49 inches in bores. Near South Cobbinshaw it is 39 to 50 in. thick, and on North Cobbinshaw averages perhaps 33 in.

The strata between the Fells Shale and Houston Coal vary in thickness from 13 to 21 fms., the lower figure occurring in the southern part of the field at Lawhead. Farther north still, in the Addiewell area, the distance reaches 37 fms. These strata are mainly fakes and sandstones with a little blaes, and no fossiliferous horizons are known to occur.

Houston Coal.—This coal at Cobbinshaw lies about 127 fms. under the Cobbinshaw-Hurlet Limestone, as compared with 165 to 185 fms. at Addiewell. It is generally a coal about 6 ft. thick but this figure includes 3 or more partings. It has been wrought on North Cobbinshaw about 1 mile north by west of the Station and perhaps elsewhere. Two sections from borings show:—

No. 12 Bore, North Cobbinshaw.

	Ft.	In.
Coal	0	4
Fireclay	0	11
Coal and coaly blaes	0	9
Coal	1	3
Fireclay	2	1

No. 13 Bore.

	Ft.	In.
Fireclay and coal strains	2	4
Coal	0	3
Fireclay	0	3
Fireclay and coal rib	0	10
Coal	0	5
Coaly blaes and Coal	1	7
Coal	0	8

It does not appear to have been wrought on South Cobbinshaw, but has been proved in many bores. The section at No. 1 Pit Cobbinshaw may be quoted:—

	Ft.	In.
Fireclay	2	7
Coaly blaes	0	4
Fireclay and ribs	2	6
Fireclay and foul Coal	1	9
Coaly blaes	1	5
Fireclay and foul Coal	1	8
Fireclay	2	2

* 9 and 13 inches. † *Ibid.*, p. 18.

even poorer.

Above the Houston Coal, and separating it from the Houston Marls occur generally three fms. of strata composed usually of fireclay and faky sandstones. These strata increase in thickness to the north and may reach 15 fms. at Addiewell. Here, however, 4 fms. of blaes and fireclay, near the base of which comes the Addiewell *Grey Shale*, intervene between the marls and the fireclays and sandstones above the Houston Coal. This seam, 20 inches thick, was wrought at Addiewell but has so far not been definitely traced south of the Blackbrae Fault. The Houston Marls are in the main greenish in colour, and consist (in the only bore through them that has been examined by the Survey) of alternating hard and soft bands of marl and sandstone often very limy. They occupy the greater part of the distance between the Houston and Two-foot Coals. This distance varies from 16 fms. on North Cobbinshaw to 23 to 28 fms. on South Cobbinshaw.

Two-foot Coal.—This seam lies 14 fms. under the Mungle Shale at South Cobbinshaw, 10½ to 13 fms. on North Cobbinshaw, and about 23 fms. at Addiewell. In the Cobbinshaw district it is extremely poor (a few inches of coal and coaly blaes), but farther north it thickens a little and may reach 25 inches.

Mungle Shale (Stewart's Shale of West Calder area).—This seam was 20 to 24 inches thick at Addiewell, where it was wrought in pits near the Breich Water. It is quite unworkable in the Cobbinshaw field, averaging only 8 inches in six bores on North Cobbinshaw, while three bores on South Cobbinshaw record 8, 11 and 15 inches. Below the shale come two or three fms. of blaes but no marine shells have been obtained at this horizon.

Mungle to Raeburn Shale.—The thickness of the beds intervening between these horizons varies from 10 to 14 fms. in the Cobbinshaw area, but increases to 20 fms. farther north at Hartwood and Addiewell. The beds consist mainly of blaes with a little fireclay and some clayband ironstone ribs. Overlying the Mungle Shale come 5 or 6 fms of blaes containing one or two shaly plies, and directly below the Raeburn Shale is the important index-horizon the Raeburn Shell-bed.

Raeburn Shale and Shell-bed.—The Raeburn Shale averages 25 inches round Cobbinshaw; on North Cobbinshaw it varies from 16 to 34 inches, but has not apparently been wrought there, the shale worked as the 'Raeburn' being probably the Fraser (see below); on South Cobbinshaw the seam formerly worked at a depth of 7 fms. in the pit situated 500 yds. E.S.E. of the village school, was no doubt the Raeburn. The thickness in 9 borings in this area varies from 9 to 37 inches. The Shell-bed immediately underlies the Shale; the section in a boring on South Cobbinshaw records:—

	Ft.	In.
Raeburn Shale	1	6
Blaes and shaly ribs; fish remains near base	3	3
Grey blaes with marine fossils	10	6
Dark blaes	—	—

A list of the fossils obtained is given on p. 94 of the 'Oil Shales of the Lothians.' This shell-bed is wide-spread in its

Carlops in Midlothian, and at Strathaven (Lanarkshire), while what is almost certainly the same bed was obtained in a boring at Blackness below a post of shaly blaes which there seems to represent the Raeburn Shale.*

Raeburn to Fraser Shale.—This distance varies from 13 fms. at Greenfield to 16 or 18 fms. on North and South Cobbinshaw, while it reaches 29 fms. at Addiewell. The intervening beds consist chiefly of blaes with a few intercalations of sandstone or fireclay and one or two poor coals. The coals may locally reach 18 or even 22 inches, but are generally thin and foul.

Fraser Shale.—This seam, like the Raeburn, is underlain by a well-marked marine horizon which has been recorded at Greenfield (No. 6 bore; Lanark 20 N.E.); in a recent bore on Woolfords (Lanark 14 S.E.); and in the bore put down in 1913 at Baads Mine (Edinburgh 11 N.W.). The shale lies 47 fms. below the Cobbinshaw Limestone in the Woolfords bore, 50-52 fms. on Viewfield and Greenfield, and 62 fms. at Baads Mine. In contrast to the Raeburn Shale which is characteristically overlain by three to four fms. of blaes, the Fraser has only 2 to 4 feet of blaes above it. It averages 4½ feet at the south end of Cobbinshaw Reservoir, but locally reaches 6 or even 8 feet. It was formerly wrought at North Cobbinshaw and Greenfield under the name of the Raeburn Shale, and more recently under its own name at Tarbrax and Greenfield.

Fraser Shale to Cobbinshaw Limestone.—Above the 2 to 4 feet of blaes on top of the Fraser Shale comes 5 to 10 fms. of fireclays, greenish sandstones and marls with thin cement limestone ribs. A little higher occurs a variable coal in one or two leaves which lies 1½ to 2½ fms. below a band of shelly blaes containing marine fossils. This band, which corresponds to the Basket Shell-bed of East Kilbride† and to the Cot Castle Shell-bed of Strathaven,‡ has been recorded at Wilsontown, Woolfords Muir and Baads Mine, 23, 35 and 43 fms., respectively, below the Cobbinshaw Limestone. A higher marine horizon corresponding in position to the 'Under Limestone' of Strathaven§ is found at the same localities 15, 22 and 25 fms. below the Cobbinshaw Limestone.

Two or three fathoms below it is a coal and coaly blaes horizon, sometimes recorded when the limestone is not: the coal may be parroty in part and is associated, locally at least, with *Lingula* and fish remains. The only other horizon that need be noted is that of the thin entomostracan limestones, 4 or 5 in number, which lie 3 to 5 fms. below the Cobbinshaw Coal. Encrinites have been reported by Mr. H. R. J. Conacher from a 5-inch band among them in a boring on Woolfords; and it may be suggested that the limestone exposed in the Breich Water, a little below Addiewell Bridge, lies on the same horizon.

M. M.

* See 'Summary of Progress for 1919,' *Mem. Geol. Surv.*, (1920), Appendix II.

† 'Economic Geology of the Central Coalfield, Area VIII,' *Mem. Geol. Surv.*, (1917), pp. 5, 10, 12.

‡ 'Economic Geology of the Central Coalfield, Area IX,' *Mem. Geol. Surv.*, (1921), pp. 21-22.

§ *Ibid.*, pp. 20, 22.