MORGAN AND MORECAMBE OFFSHORE WIND FARMS: TRANSMISSION ASSETS

Environmental Statement

Volume 3, Annex 1.1: Phase 1 Geo-environmental preliminary risk assessment

September 2024
Rev: ES Issue

MOROO1-FLO-CON-ENV-RSA-0004
MRCNS-J3303-RPS-10123

PINS Reference: EN020028
APFP Regulations: 5(2)(a)
Document reference F3.1.1

Document status					
Version	**Purpose of document**	**Approved by**	**Date**	**Approved by**	**Date**
ES	For issue	AS	September 2024	IM	September 2024

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Glossary

Term	Meaning
400 kV grid connection cables	Cables that will connect the proposed onshore substations to the existing National Grid Penwortham substation.
400 kV grid connection cable corridor	The corridor within which the 400 kV grid connection cables will be located.
Groundwater Abstraction License	The authorisation granted by the Environment Agency to allow the removal of groundwater.
Applicants	Morgan Offshore Wind Limited (Morgan OWL) and Morecambe Offshore Windfarm Limited (Morecambe OWL).
Aquifer	A subsurface layer or layers of rock or other geological strata of sufficient porosity and permeability to allow either a significant flow of groundwater or the abstraction of significant quantities of groundwater.
Environmental Impact Assessment	The process of identifying and assessing the significant effects likely to arise from a project. This requires consideration of the likely changes to the environment, where these arise as a consequence of a project, through comparison with the existing and projected future baseline conditions.
Environmental Statement	The document presenting the results of the Environmental Impact Assessment (EIA) process.
Groundwater	Water that is contained in underground rocks and sediments below the ground surface.
Groundwater Body	Groundwater bodies are the discrete groundwater management units defined by the Environment Agency as required under Article 5 of the Water Framework Directive.
Landfall	The area in which the offshore export cables make landfall (come on shore) and the transitional area between the offshore cabling and the onshore cabling. This term applies to the entire landfall area at Lytham St. Annes between Mean Low Water Springs and the transition joint bay inclusive of all construction works, including the offshore and onshore cable routes, intertidal working area and landfall compound(s).
Local Planning Authority	The local government body (e.g., Borough Council, District Council, etc.) responsible for determining planning applications within a specific area.
Morecambe OWL	Morecambe Offshore Windfarm Limited is a joint venture between Zero-E Offshore Wind S.L.U. (Spain) (a Cobra group company) and Flotation Energy Ltd.
Morgan and Morecambe Offshore Wind Farms: Transmission Assets	The offshore and onshore infrastructure connecting the Morgan Offshore Wind Project and the Morecambe Offshore Windfarm to the national grid. This includes the offshore export cables, landfall site, onshore export cables, onshore substations, 400 kV grid connection cables and associated grid connection infrastructure such as circuit breaker compounds. Also referred to in this report as the Transmission Assets, for ease of reading.
Morgan Offshore Wind Project: Transmission Assets	The offshore export cables, landfall and onshore infrastructure required to connect the Morgan Offshore Wind Project to the National Grid.

Term	Meaning
Morgan OWL	Morgan Offshore Wind Limited is a joint venture between bp Alternative Energy investments Limited. and Energie Baden-Württemberg AG (EnBW).
Onshore export cables	The cables which would bring electricity from the landfall to the onshore substations.
Onshore export cable corridor	The corridor within which the onshore export cables will be located.
Onshore Infrastructure Area	The area within the Transmission Assets Order Limits landward of Mean High Water Springs. Comprising the offshore export cables from Mean High Water Springs to the transition joint bays, onshore export cables, onshore substations and 400 kV grid connection cables , and associated temporary and permanent infrastructure including temporary and permanent compound areas and accesses. Those parts of the Transmission Assets Order Limits proposed only for ecological mitigation/biodiversity benefit are excluded from this area.
Onshore substations	The onshore substations will include a substation for the Morgan Offshore Wind Project: Transmission Assets and a substation for the Morecambe Offshore Windfarm: Transmission Assets. These will each comprise a compound containing the electrical components for transforming the power supplied from the generation assets to 400 kV and to adjust the power quality and power factor, as required to meet the UK Grid Code for supply to the National Grid.
Principal Aquifer	A geological unit that yields significant groundwater that support regionally or nationally important supplies and support rivers, lakes and wetlands at a strategic scale.
Secondary A aquifers	A geological unit that provides modest groundwater that can support local water supplies and may form an important source of water to rivers.
Secondary B aquifers	A geological unit that is dominated by low permeability layers that may store and yield limited amounts of groundwater.
Secondary undifferentiated aquifer	Where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type, but generally have only a minor resource value.
Source Protection Zone	Groundwater catchment areas defined by travel time around important potable groundwater abstraction sites to safeguard drinking water quality. Certain land-uses are controlled or prohibited with certain source protection zone areas.
Substation	Part of an electrical transmission and distribution system. Substations transform voltage from high to low, or the reverse by means of electrical transformers.
Transmission Assets	See Morgan and Morecambe Offshore Wind Farms: Transmission Assets (above).
Transmission Assets Order Limits	The area within which all components of the Transmission Assets will be located, including areas required on a temporary basis during construction and/or decommissioning.
Unproductive strata	Geological units that are largely unable to provide usable water supplies and are unlikely to have surface water and wetland ecosystems dependent on them.

Acronyms

Acronym	Meaning
BGS	British Geological Survey
BritPits	British Pits
CSM	Conceptual Site Model
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EIA	Environmental Impact Assessment
EnBW	Energie Baden-Württemberg AG
ES	Environmental Statement
GCR	Geological Conservation Review
LGS	Local Geodiversity Site
MLWS	Mean Low Water Springs
MMG	Mercia Mudstone Group
PFAS	Per- and Polyfluorinated Substances
PRA	Preliminary Risk Assessment
SPZ	Source Protection Zone
SSG	Sherwood Sandstone Group
SSSI	Site of Special Scientific Interest
TFD	Tidal Flat Deposits
UK	United Kingdom
UXO	Unexploded Ordnance

Units

Unit	Description
km	Kilometres
km^2	Kilometres Squared
kV	Kilovolt
m	Metre

1 Phase 1 Geo-environmental preliminary risk assessment

1.1 Introduction

1.1.1.1 This document forms Volume 3, Annex 1.1: Phase 1 Geo-environmental preliminary risk assessment (PRA) of the Environmental Statement (ES) prepared for the Morgan and Morecambe Offshore Wind Farms: Transmission Assets (hereafter referred to as the Transmission Assets).

1.1.1.2 The PRA provides an appraisal of potential areas of land contamination likely to be affected by the Transmission Assets, which require characterisation of the geological, hydrogeological and hydrological setting. This document forms the main source of information in defining the baseline environment (Section 1.6 of Volume 3, Chapter 1: Geology, hydrogeology and ground conditions of the ES). This PRA is based solely on a desktop review of available information (e.g. historical maps and regulatory information) to identify potential pollutant linkages.

1.1.1.3 This PRA forms the initial step in the assessment of potential land contamination. It precedes, any intrusive investigations and subsequent risk assessment with remedial options appraisals, remediation strategy (implementation and verification) where necessary.

1.2 Objectives

1.2.1.1 The principal objectives of this PRA were as follows:

- to assess potential sources of contamination at the site, associated with historical and current land uses both on site and in the surrounding area;
- to review the environmental setting to assess the sensitivity of the surrounding area to contamination/pollution;
- to produce an outline Conceptual Site Model (CSM) detailing how any contamination may impact the identified receptors via pollutant linkages; and
- to conclude on the likely requirement for further assessment and investigation.

1.3 Study area

1.3.1.1 This section defines the areas within which geology, hydrology and ground conditions receptors may be affected by the Transmission Assets. The study area for this assessment extends to an area of 1 km around those parts of the Transmission Assets Order Limits that fall within the scope of this chapter (landward of Mean Low Water Springs (MLWS)), including the following.

- The Transmission Assets Order Limits: Onshore. The area within which all components of the Transmission Assets landward of Mean High Water Springs will be located, including areas required on a temporary basis during construction and/or decommissioning (such as construction compounds). Also referred to in this report as the Onshore Order Limits, for ease of reading.
- The Intertidal Infrastructure Area. This includes all elements of the Transmission Assets landward of MLWS where construction, operation and maintenance and decommissioning activity will occur.

1.3.1.2 The study area of 1 km buffer around these areas is shown on Figure 1.1 (see Volume 3: Figures). This buffer is based on professional judgement and environmental data screening distances.

1.4 Legislation, policy and guidance

1.4.1.1 This report has been produced in general accordance with the following legislation, policy and guidance:

- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017;
- Contaminated Land (England) Regulations 2006;
- Environmental Protection Act 1990 (as amended) - specifically Part IIA (Contaminated Land);
- Environmental Permitting (England and Wales) Regulations 2016;
- National Planning Policy Framework 2023;
- Department for Environmental, Food and Rural Affairs (DEFRA) Environmental Protection Act 1990: Part 2A - Contaminated Land Statutory Guidance 2012;
- Environment Agency (2020) Land Contamination Risk Management (LCRM);
- Construction Industry Research and Information Association (CIRIA) Document C665: Assessing Risks Posed by Hazardous Ground Gases to Buildings (CIRIA, 2007);
- CIRIA Document C552 – Contaminated land risk assessment: A Guide to Good Practice (CIRIA, 2001a);
- CIRIA Document C532 – Control of water pollution from construction sites: Guidance for consultants and contractors (CIRIA, 2001b);
- Buildings Research Establishment (2023) Radon: Guidance on protective measures for new buildings (including supplementary advice for extensions, conversions and refurbishment projects;
- British Standard requirements for the 'Investigation of potentially contaminated sites - Code of practice' (ref. BS10175:2011+A2:2017);

- British Standard requirements for the 'Code of practice for ground investigations' (ref. BS5930:2015+A1:2020).; and
- British Standard requirements for the 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings' (ref BS8485:2015+A1:2019).

1.4.1.2 Where appropriate, consideration has also been given to the following in development of the CSM:

- the potential for environmental liabilities to occur under other associated regimes, for example the Water Resources Act 1991 and the Environmental Damage (Prevention and Remediation) (England) Regulations 2015; and
- key constraints on site redevelopment.

1.5 Methodology

1.5.1 Desk top data sources

1.5.1.1 The data presented in this technical report has been taken from the following sources.

- Publicly available data sources from the following organisations:
  - British Geological Survey (BGS);
  - The Coal Authority;
  - Department for Environment Food and Rural Affairs (DEFRA);
  - Environment Agency (EA);
  - Joint Nature Conservation Committee;
  - Lancashire County Council;
  - local planning authorities including Fylde Council, Blackpool Council, Preston City Council and South Ribble Borough Council;
  - UK Health Security Agency; and
  - Zetica Unexploded Ordnance (UXO).
- Information contained in a Groundsure Insights report commissions for the project. That report includes:
  - general information regarding geological, hydrogeological and hydrological setting;
  - groundwater abstraction licences;
  - current and historical landfill sites;
  - current and historical waste sites;
  - pollution incidents;
  - discharge consents;
  - current and historical land-use;

  - mining and ground working areas (coal and non-mining); and
  - geotechnical constraints.
- Spatial information regarding ground conditions within the geology, hydrogeology and ground conditions study area taken from Groundsure Insights bespoke geographical information systems (GIS) data.
- Historical Ordnance Survey mapping and Getmapping aerial photography.

1.5.1.2 Limitations of this type of assessment are described in Appendix A.

1.5.2 Geology

1.5.2.1 Information on the geological conditions within the study area has been collated from British Geological Survey (BGS) datasets including 1:50,000 scale geological mapping. Nationally, regionally and locally important geological sites are also presented and, where present, include:

- Sites of Special Scientific Interest (SSSIs) of geological and geomorphological importance;
- Geological Conservation Review (GCR) sites as defined by the Joint Nature Conservation Committee; and
- Local Geodiversity Sites (LGS).

1.5.3 Hydrogeology

1.5.3.1 Aquifer units in the bedrock geology and superficial deposits have been determined from the designations provided by the EA.

1.5.3.2 Important groundwater receptors have been reviewed and, where present, include the following:

- licensed groundwater abstractions (active and historical) as presented in the Groundsure Insights report;
- groundwater Source Protection Zones (SPZs) that have been defined to safeguard drinking water quality around important potable groundwater abstraction sites; and
- nationally and locally important ecological sites that may have a groundwater dependence.

1.5.3.3 Details of Private Water Supply Sources within the study area have been sought from local authorities. No records have been identified – further details are provided in Volume 3, Chapter 1: Geology, hydrogeology and ground conditions of the ES.

1.5.4 Ground conditions

1.5.4.1 The desk study has used datasets taken from the Groundsure Insights report, as summarised in **Table 1.1**.

Table 1.1: Summary of the Groundsure Insight report to inform geology, hydrogeology and ground conditions

Title	Extent of data coverage	Contractor	Format	Date
Groundsure Insight PDF	49.37 km^2	Groundsure	Hardcopy report	10/03/2023
Bespoke digital data sets	49.37 km^2	Groundsure	GIS Database	10/03/2023

1.6 Results of desk study

1.6.1 Geology

1.6.1.1 The bedrock geology and superficial deposits mapped by the BGS across the study area are presented in **Figure 1.1A-B** and **Figure 1.2A-B** respectively. Those figures also present:

- the location of designated geological sites; and
- local geological records by way of borehole logs obtained from the BGS Geoindex onshore platform that are provided in **Appendix B**.

1.6.1.2 A summary of the regional geology within the study area is provided in **Table 1.2**.

Table 1.2: Regional geology of the study area

Formation	Description
Superficial Deposits	
Tidal Flat Deposits	Mud flat and sand flat deposits. Unconsolidated sediment, mainly mud and/or sand.
Peat	Anaerobic, waterlogged deposits of organic matter which has been partially carbonised.
Blown Sands	Aeolian deposits of fine to medium grained sands.
Glacial Till (Devensian, diamicton)	Unconsolidated mixed deposit consisting of a clay, sand, gravel, and boulders.
Glaciofluvial Deposits	Unconsolidated material by glacial river waters. Consists of boulders, gravel, sand, silt and clay.
Saltmarsh Deposits	Fine-grained deposits of sand and mud with sporadic shelly layers and rhizoliths.
Alluvium	Sorted/semi-sorted clay, silt, sand and gravel deposited by a river, stream.
Head Deposits	Poorly sorted and poorly stratified, angular rock debris and/or clayey hillwash and soil creep. Can comprise gravel, sand and/or clay.
Tidal River or Creek Deposits	Predominantly silts and clays but may also contain muds, sands, gravels and peat.
Bedrock Geology	

Formation	Description
Sidmouth Mudstone Formation	Breckells Mudstone Member Mudstone, reddish-brown, structureless, commonly brecciated, with common halite and gypsum.
	Kirkham Mudstone Member (Sidmouth Mudstone Formation: Dominantly red-brown mudstone and siltstone with common grey-green reduction patches and spots).
	Singleton Mudstone Member: Halite and mudstone.
Tarporley Siltstone Formation	Interbedded siltstones, mudstones and sandstones in approximately equal proportions.
Sherwood Sandstone Group	Sandstone, red-brown to yellow, generally pebble-free, fine- to medium-grained, cross-stratified.

1.6.1.3 The local geological records provided in **Appendix B** have been used to confirm the expected regional geology and develop the baseline environment relevant to the onshore and intertidal elements of the Transmission Assets. A summary of the geological records is provided in **Table 1.3**.

Table 1.3: Regional geological records of the study area

Location	Key boreholes	Local geological sequence
Landfall: MHWS to A584.	Borehole: SD33SW73 Cross section on BGS Sheet 74 Southport	The surface sequence of superficial deposits comprises blown sand (dunes and littoral sediments) and tidal flat deposits. The depth of these deposits has not been proven. Depth to bedrock is not proven. Bedrock is expected to comprise mudstones of the Mercia Mudstone Group (MMG).
Landfall and onshore export cable corridor: A584 to A583	Boreholes (from west to east): SD33SW73 SD33SW155 SD32NW7/D SD33SW12 SD33SW124 Cross section on BGS Sheet 74 for Southport	Borehole logs demonstrate a surface sequence of superficial deposits more than 30 m thick. That sequence comprises: 2.5 m to 3.8 m of blown sand deposits. 1.7 m to 1.8 m of peat. 0 m to 2.5 m of boulder clay (glacial till) that is typically a grey clay. 3.7 m to 9.9 m of sand (possibly middle sand) that is thickest near coastline. A lower Boulder Clay (glacial till) of unproven thickness but with a depth that exceeds 5 m to 10.6 m and is typically a reddish-brown clay. The depth to bedrock is not proven, although borehole SD33SW12 suggests mudstones of MMG may be present at a depth of 31.6 m.
Onshore export cable corridor: A583 to Freckleton/Hall Cross onshore export cable corridor	SD33SW124 SD33SE39 (EA Baseline) SD32NE34 SD43SW2	Superficial Deposits Western end More than 30 m of superficial deposits are proven and comprise: 3.5 – 8.8 m surface clay and peat (tidal flat deposits or glacial till).

Location	Key boreholes	Local geological sequence
	SD43SW12 SD42NW49 SD43SW61 SD43SW6 (Deep Log but north).	Up to or greater than 10 m of sand and gravel (middle sand). Brown clay (glacial till). Central and eastern section Proven depth of superficial deposits between 30.5 m to 43.9 m. Sequence dominated by glacial till comprising: 18-22 m of surface boulder clay (glacial till). Thin band of sand (middle sand). Brown boulder clay (glacial till) at depth. Bedrock SD43SW12 (in centre of section) red marls and sandstones of the MMG at 43.9 metres below ground level. SD43SW61 (in east) red sandstones of Sherwood Sandstone Group at 30 metres below ground level.
Freckleton/Hall Cross onshore export cable corridor, onshore substations and 400 kV grid connection cable corridor as A584	Boreholes (from north west to south east): SD42NE6 A, B, C SD43SW61 SD42NW49 SD42NW47	Underlain by a thick sequence of superficial deposits (22.7 m to more than 30.7 m). This sequence typically comprises a surface horizon of sand or gravel deposits (6.1 to 15.1 m), which can be overlain by a thin layer of clay (tidal flat deposits or glacial till). These granular deposits overlay brown, boulder clay (i.e., glacial till) that is typically between 7.5 m and 17 m thick. The superficial deposits conceal red sandstones of Sherwood Sandstone Group bedrock at depth. In the north west the Sherwood Sandstone Group is located at depth of approximately 30 m, decreasing to 22.7 m in the south east toward the River Ribble.
400 kV grid connection cable corridor: A584 to Penwortham	Boreholes north of River Ribble: SD42NE6 A, B, C SD42NE204 SD42NE205 SD42NE150 No boreholes located to the South of River Ribble.	The geological sequence is consistent with that seen for the onshore substations, with a thick sequence of superficial deposits concealing bedrock. Superficial deposit typically include a near surface sand unit (13 m to 18 m) although this can be reduced by surface clays that are presumed to be tidal flat deposits. These deposits are underlain by a thick sequence clay deposits typically referred to as boulder clay (i.e., glacial till). Bedrock is encountered at a depth of between 22.3 m and 41 m. Bedrock comprises red sandstones of the Sherwood Sandstone Group. There is no local geological data available for the study area south of the River Ribble. It is reasonable to assume the geology will be similar to that observed north of the River Ribble given their proximity and similarity of historical depositional environments.

Designated geological sites

1.6.1.4 Geological sites of national or local importance identified within the study area are summarised in **Table 1.4** and shown in **Figure 1.1A-B** and **Figure 1.2A-B**.

Table 1.4: Designated sites of geological importance

RPS ID	Site name	Designation	Description and Reason for Notification
PS_01	Lytham St Annes Dunes	SSSI	This is listed as a biological SSSI (it is primarily designated for ecological and habitat interest). It is noted, however, that this site is cited as one of the best examples of a calcareous dune system remaining in Lancashire (as reflected in its local designations below). The designated site extends across the Transmission Assets Order Limits in the landfall area.
LGS_01	Lytham St Annes - Starr Hill Dunes	LGS	Coastal Dunes: Rare dune system. (Covers the same site as Lytham St. Annes Dunes SSSI, although boundary of the LGS is slightly smaller). The designated site extends across the Transmission Assets Order Limits in the landfall area.
GCR_01	Lytham St Annes	Geological Conservation Review (GCR) site	This GCR site is also designated as Lytham Coastal Changes SSSI. The Lytham St Annes GCR site presents an example of coastal Quaternary Geology. It includes a group of four separate sites within the town of Lytham St. Annes (at Fairhaven Dunes, Main Drain and Lytham Dock, Witch Wood and Government Offices) that provide the basic stratigraphical record of coastline changes represented by alternating organic and inorganic deposits. Located outside of the Transmission Assets Order Limits.
PS_02	Lytham Coastal Changes	SSSI	Geological SSSI. A group of four separate sites within the town of Lytham St. Annes (at Fairhaven Dunes, Main Drain and Lytham Dock, Witch Wood and Government Offices) that provide the basic stratigraphical record of coastline changes. The geological interest is preserved in sediments beneath the topsoil and sand dunes of the area and provides a record of sea-level changes which occurred during the Holocene. Located outside of the Transmission Assets Order Limits.

1.6.1.5 The Lytham St Annes Dunes SSSI has been designated as it is one of the best examples of a calcareous dune system in Lancashire, with rare geomorphological features as well as associated ecological communities. The SSSI is located within the Onshore Order Limits in the landfall area. Lytham St Annes Dunes SSSI contains the Starr Hill Dunes LGS. LGS sites are commonly known as Regionally Important Geological Sites in the majority of England and Wales.

1.6.1.6 The Lytham Coastal Changes SSSI, designated on multiple sites as noted in **Table 1.4,** represents important geological outcrops which provide important records of paleo-sea levels. This SSSI lies outside of the Transmission Assets Order Limits. It includes multiple areas, the closest of which is approximately 155 m south of the Transmission Assets Order Limits north east of Lytham. Lytham Coastal Changes is also notified as a GCR site and includes four sites that comprises the Lytham Coastal Changes SSSI, which are situated outside the Transmission Assets Order Limits.

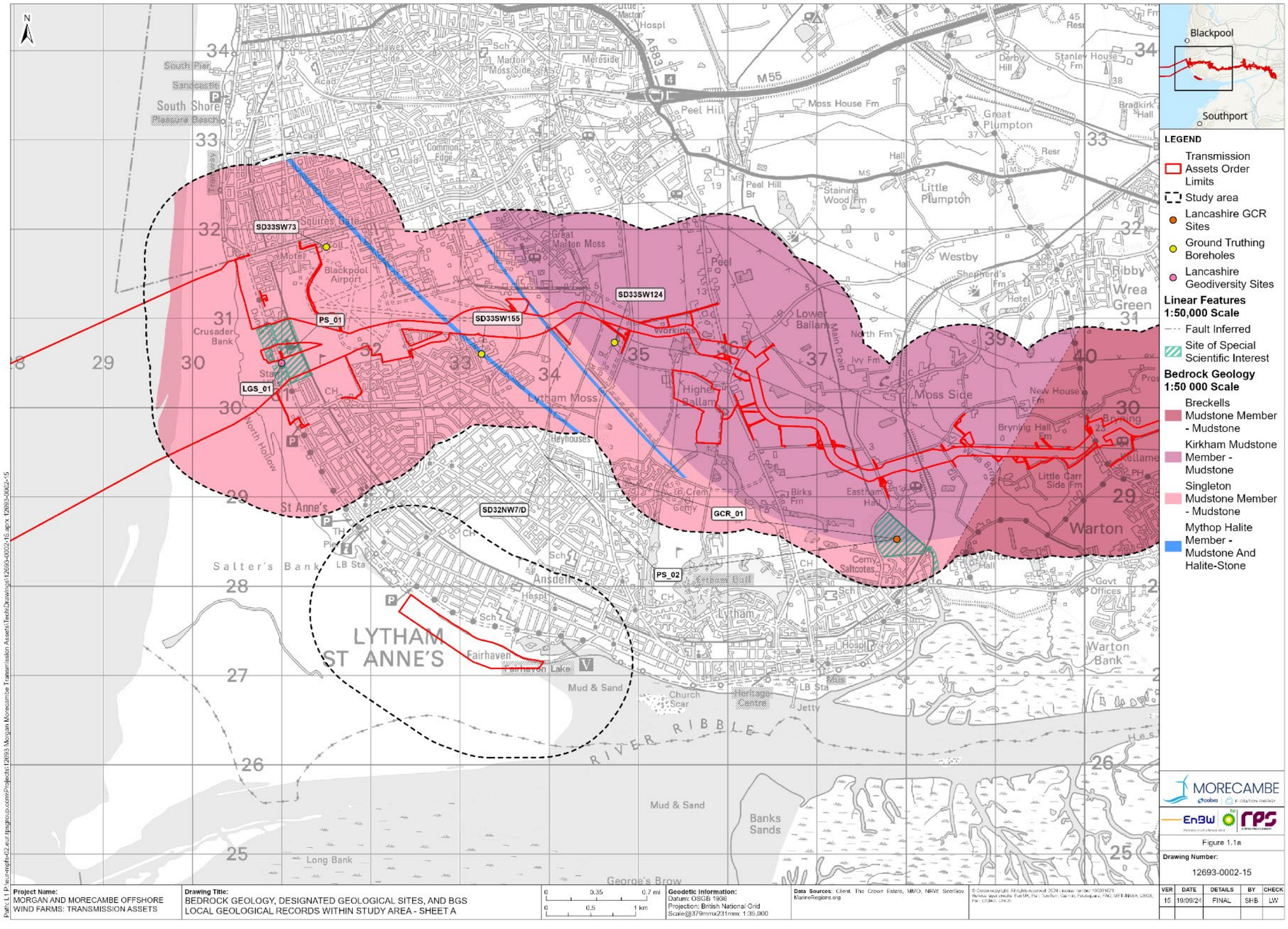


Figure 1.1A: Bedrock geology, designated geological sites and BGS local geological records within the study area – Sheet A

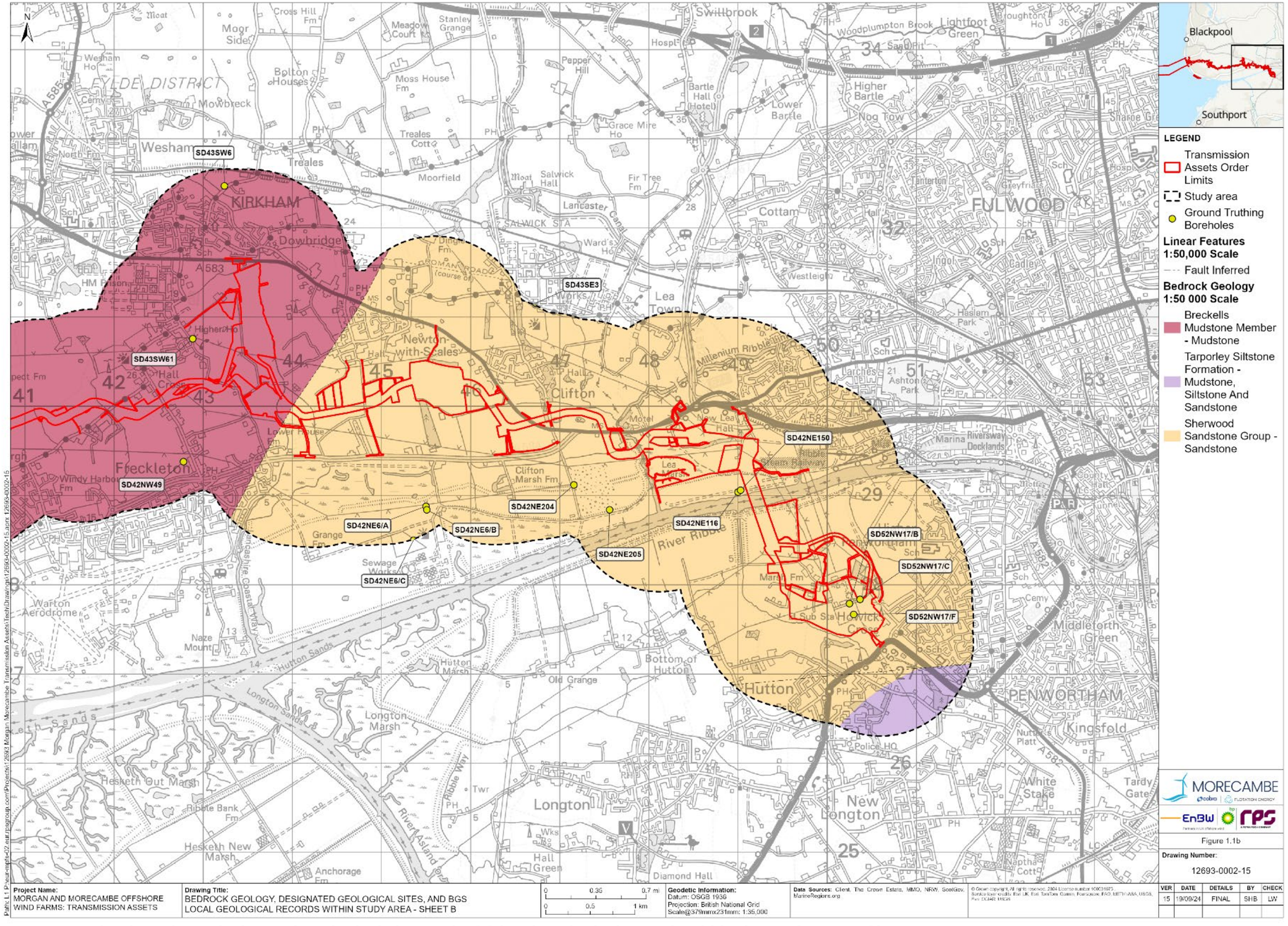


Figure 1.1B: Bedrock geology, designated geological sites and BGS local geological records within the study area – Sheet B

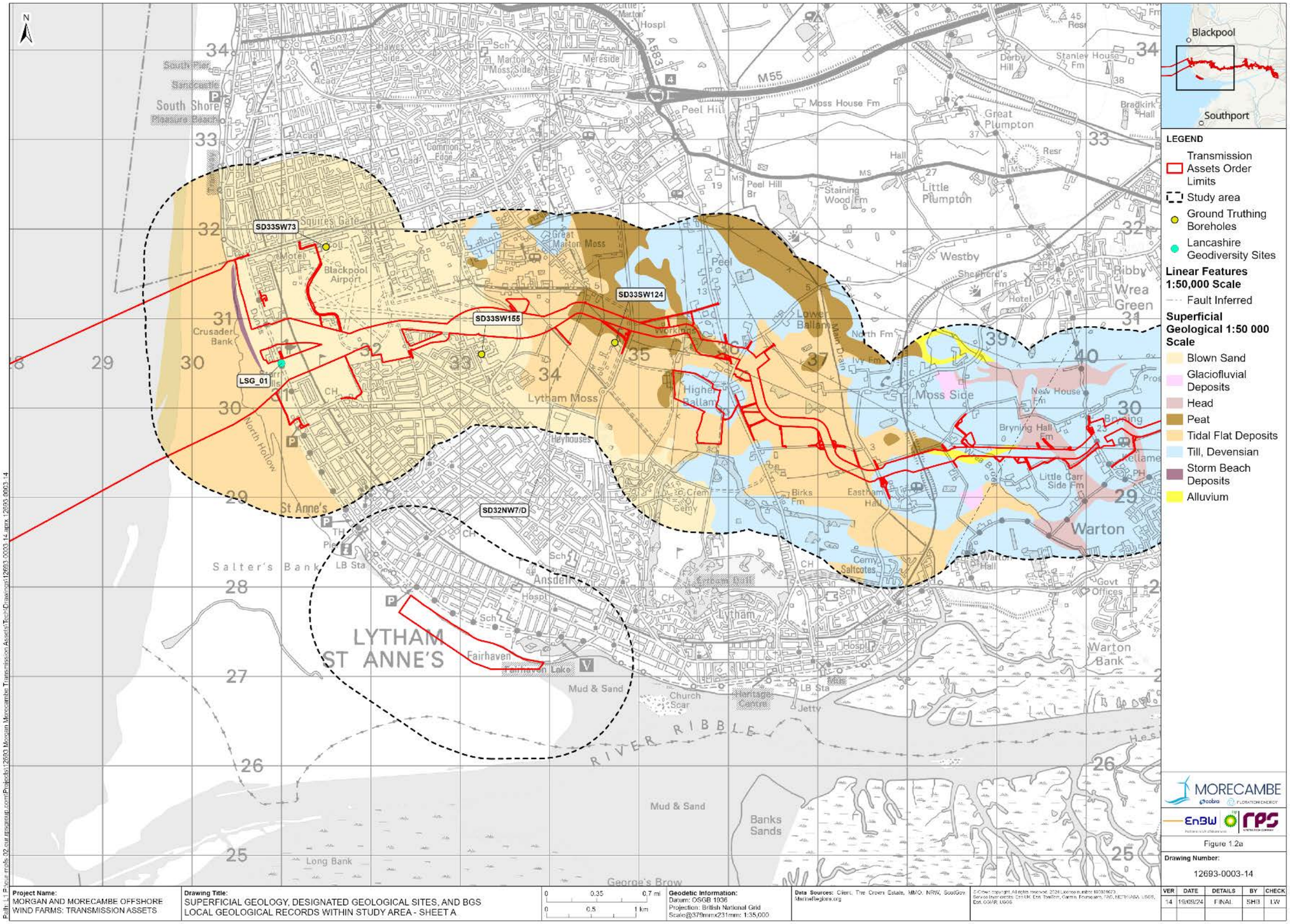


Figure 1.2A: Superficial geology, designated geological sites and BGS local geological records within the study area – Sheet A

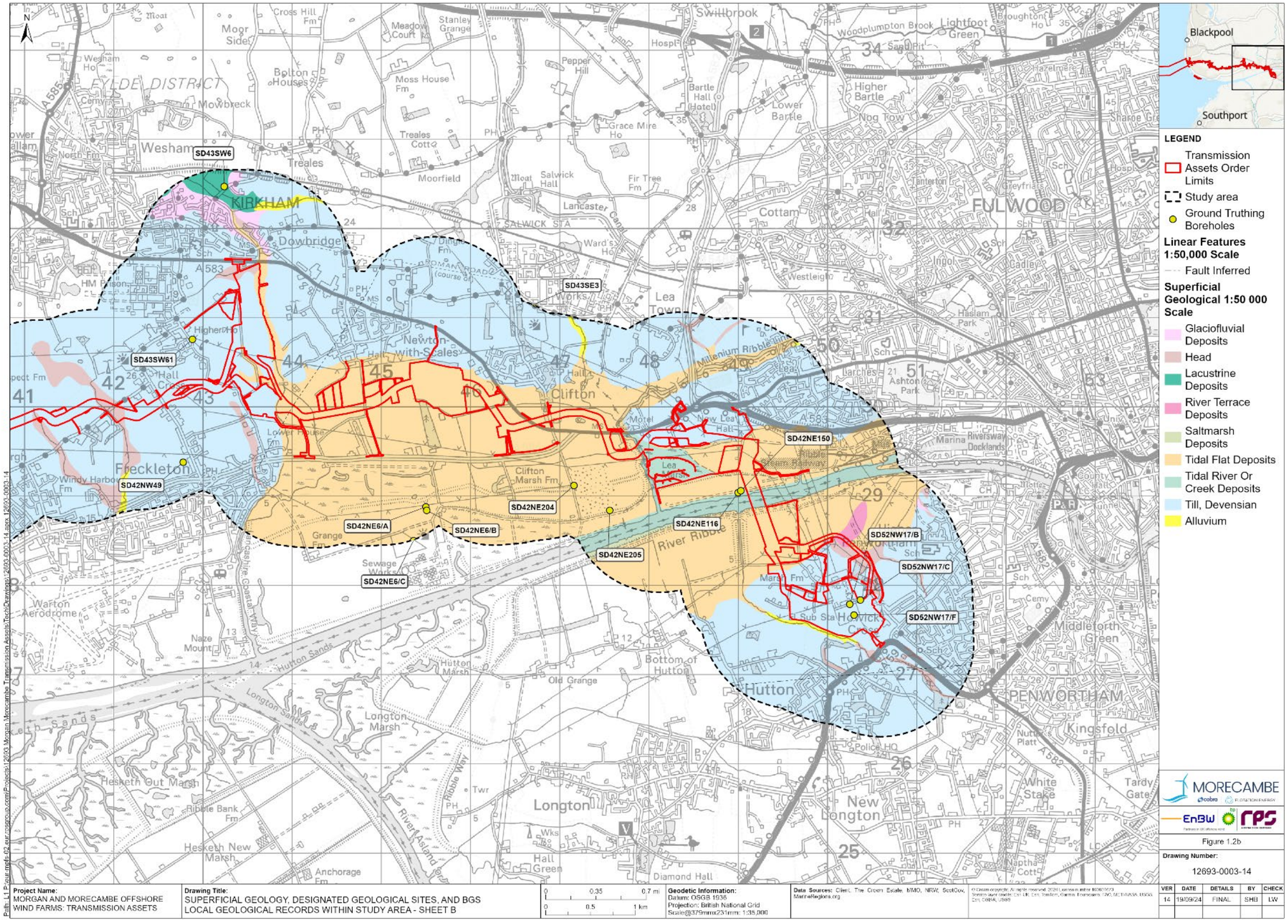


Figure 1.2B: Superficial geology, designated geological sites and BGS local geological records within the study area – Sheet B

1.6.2 Hydrogeology

Groundwater dependent designated sites

1.6.2.1 Volume 3, Chapter 3: Onshore ecology and nature conservation of the ES provides details of the ecological sites in the area. These include the following ecological sites of national or local importance located within the study area:

- Ribble Estuary SSSI;
- Ribble and Alt Estuary Ramsar site and Special Protection Area;
- Newton Marsh SSSI;
- Lytham St Annes Dunes SSSI; and
- Lytham St Annes Local Nature Reserve.

1.6.2.2 These sites are principally designated based on their ecology and are fully assessed in Volume 3, Chapter 3: Onshore ecology and nature conservation of the ES and Volume 3, Chapter 4: Onshore and intertidal ornithology of the ES. The Lytham St Annes Dunes SSSI citation states that the dunes support a wide range of species which vary according to the depth of water and degree of moisture retention in relation to the water table.

Aquifer designation

1.6.2.3 Aquifer designations for the bedrock geology and superficial deposits across the study area are shown in **Figure 1.3A-B** and **Figure 1.4A-B** respectively. The following designations are presented in those drawings.

- **Principal aquifers** – A geological unit that yields significant groundwater that support regionally or nationally important supplies and support rivers, lakes and wetlands at a strategic scale.
- **Secondary A aquifers** – A geological unit that provides modest groundwater that can support local water supplies and may form an important source of water to rivers. They support water supplies at a local scale rather than strategic scale (such as for private supplies) and remain important for rivers, wetlands and lakes.
- **Secondary B aquifers** – Dominated by lower permeability layers that may store and yield limited amounts of groundwater.
- **Secondary undifferentiated aquifer** - Where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type, but generally have only a minor resource value.
- **Unproductive strata** – Unproductive Strata – geological units that have negligible significance for water supply or baseflow to rivers, lakes and wetlands. They consist of bedrock or superficial

deposits with a low permeability that naturally offer protection to any aquifers that may be present beneath.

1.6.2.4 The bedrock geology in the west and central parts of the study area is dominated by Secondary B aquifer units of the Triassic Mercia Mudstone Group. The east end of the study area is underlain by the Principal Aquifer of the Sherwood Sandstone Group.

1.6.2.5 Superficial deposits form a continuous Secondary A aquifer at the western end of the study area, reflecting the extent of blown sand deposits. Central parts of the study area are predominantly underlain by Secondary undifferentiated or Unproductive strata, reflecting the distribution of glacial till and tidal flat deposits respectively. In the east, the majority of the 400 kV grid connection cable corridor is designated as Unproductive strata of the tidal flat deposits. Across small areas of the 400 kV grid connection cable corridor, glacial till forms a Secondary undifferentiated aquifer unit most notably around the existing Penwortham National Grid substation. Underlying the proposed onshore substation sites are Secondary undifferentiated and Secondary A aquifer units.

Licensed groundwater abstractions

1.6.2.6 A total of three active licensed abstractions have been identified in the study area, all within the Transmission Assets Order Limits. These abstractions are shown in **Figure 1.3A-B** and **Figure 1.4A-B**. and are summarised in **Table 1.5**.

Table 1.5 Licensed groundwater abstractions within the study area

RPS ID	Site name	Distance from Transmission Assets	Geology	Licence Number	Description
GWA_01	The St Annes Old Links Golf Club Limited	0 m (within the Transmission Assets Order Limits)	Blown sand/MMG	2671353002	Spray irrigation
GWA_20	Penwortham Golf Club	980 m north west	Glacial till/ Sherwood Sandstone Group (SSG)	2671346006	Spray irrigation - direct
GWA_24	Penwortham Golf Club Limited	980 m north west	Glacial till/SSG	NW/071/0346/001	Spray irrigation - direct

Groundwater Source Protection Zones

1.6.2.7 Groundwater supply sources are afforded protection by the EA through the delineation of SPZs. SPZs define the level of risk to the supply source from contamination. Three zones are defined below.

- Inner protection (SPZ1) - 50 day travel time of pollutant to the source of abstraction or a default 50 m minimum radius.

- Outer protection zone (SPZ2) - 400 day travel time of pollutant to source of abstraction. This zone has a 250 or 500 m minimum radius around the source depending on the amount of water taken.
- Total catchment (SPZ3) - The area around a supply source within which all the groundwater ends up at the abstraction point. This could extend some distance from the source point.

1.6.2.8 The groundwater SPZs are shown in **Figure 1.3A-B**. The total catchment area (Zone III) extends into the 400 kV grid connection cable corridor at the eastern end of the study area. The SPZ relates to multiple groundwater abstraction from the Sherwood sandstone group Principal aquifer that are located more than 4 km north east of the study area. The SPZ terminates on the northern bank of the River Ribble. This implies a general groundwater flow direction to the north east in the bedrock aquifer within the study area. The closest protected abstractions are located at Lightfoot Green Farm and the Royal Preston Hospital, approximately 4.8 km and 5.3 km away from the Transmission Assets Order Limits respectively.

1.6.3 Hydrology

1.6.3.1 The study area to the north of the River Ribble is located within the Ribble management catchment, whilst land to the south is located within the Douglas management catchment. Both management catchments are located within the wider north west river basin district.

Main rivers

1.6.3.2 The following Main Rivers/designated watercourse features are located within the Transmission Order Limits.

- Main Drain and associated tributaries, including Branch Drain.
- Moss Sluice (also known as Liggard Brook downstream of the study area) and associated tributaries.
- Dow Brook and associated tributary.
- Middle Pool.
- Wrea Brook.
- Pool Stream.
- Ribble Link/Savick Brook.
- River Ribble.
- Mill Brook.

Ordinary watercourses

1.6.3.3 The following ordinary watercourse features are located within the Transmission Order Limits.

- Deepdale Brook.

- Tributaries of Moss Sluice.
- Tributaries of Branch Drain and Main Drain.
- Tributaries of Wrea Brook.
- Tributaries of Pool Stream.
- Tributaries of Middle Pool.
- Tributaries of Mill Brook.
- Tributaries of Dow Brook.

Sea

1.6.3.4 The landfall includes works in the intertidal area, at the coast (east Irish Sea).

Licensed surface water abstractions

1.6.3.5 No active licensed surface water abstractions have been identified in the study area.

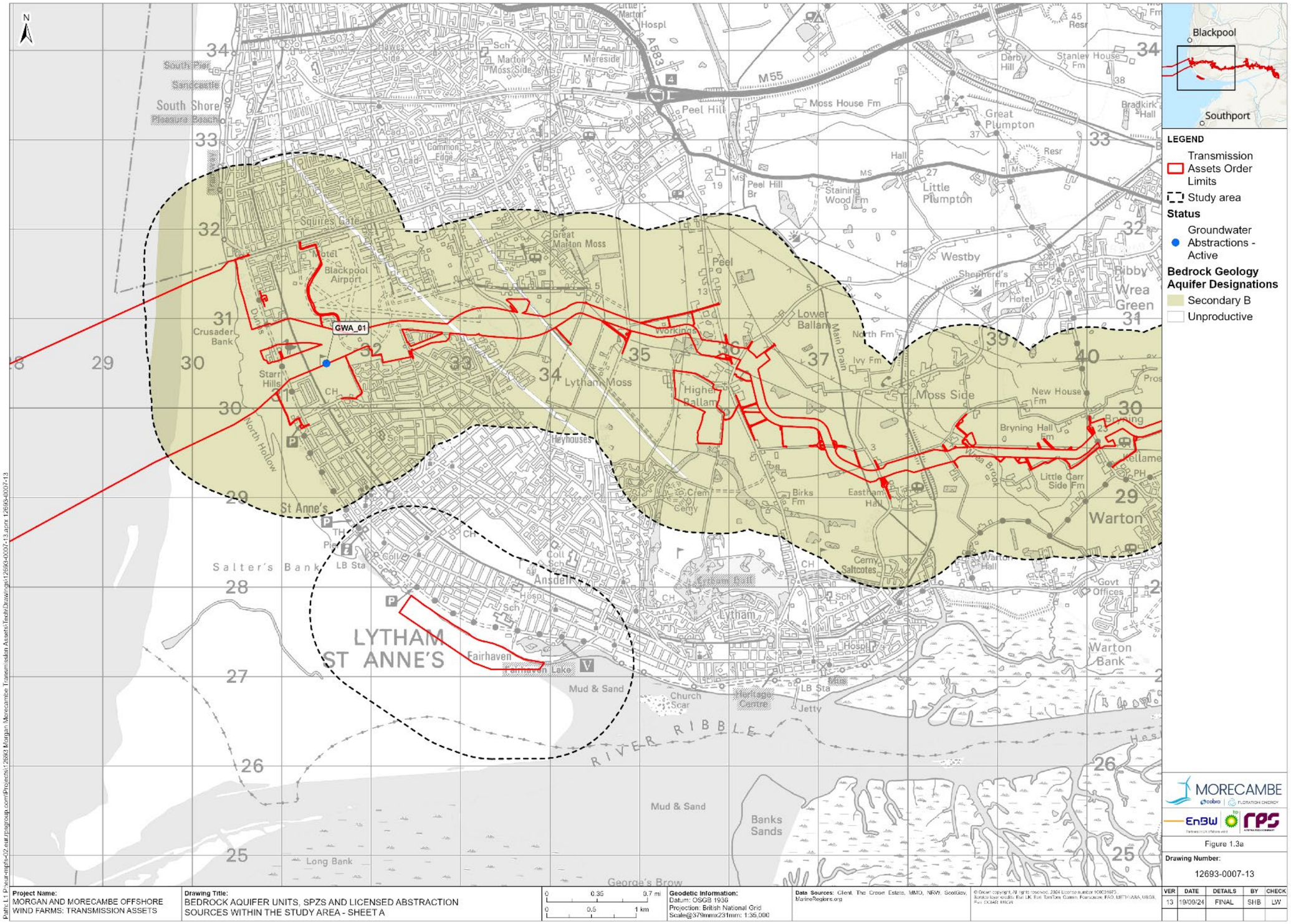


Figure 1.3A: Bedrock aquifer units, SPZs and licensed abstraction sources within the study area – Sheet A

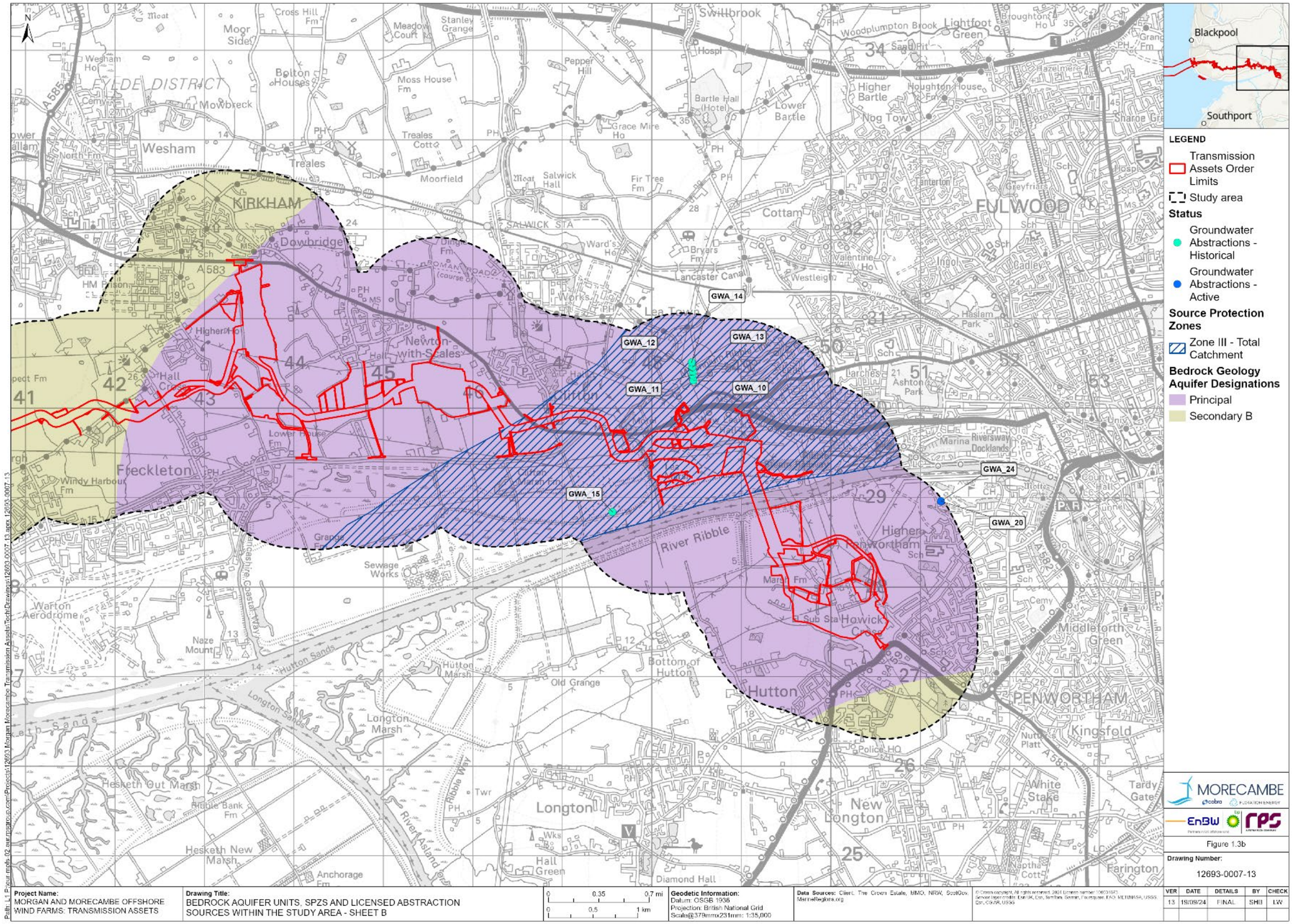


Figure 1.3B: Bedrock aquifer units, SPZs and licensed abstraction sources within the study area – Sheet B

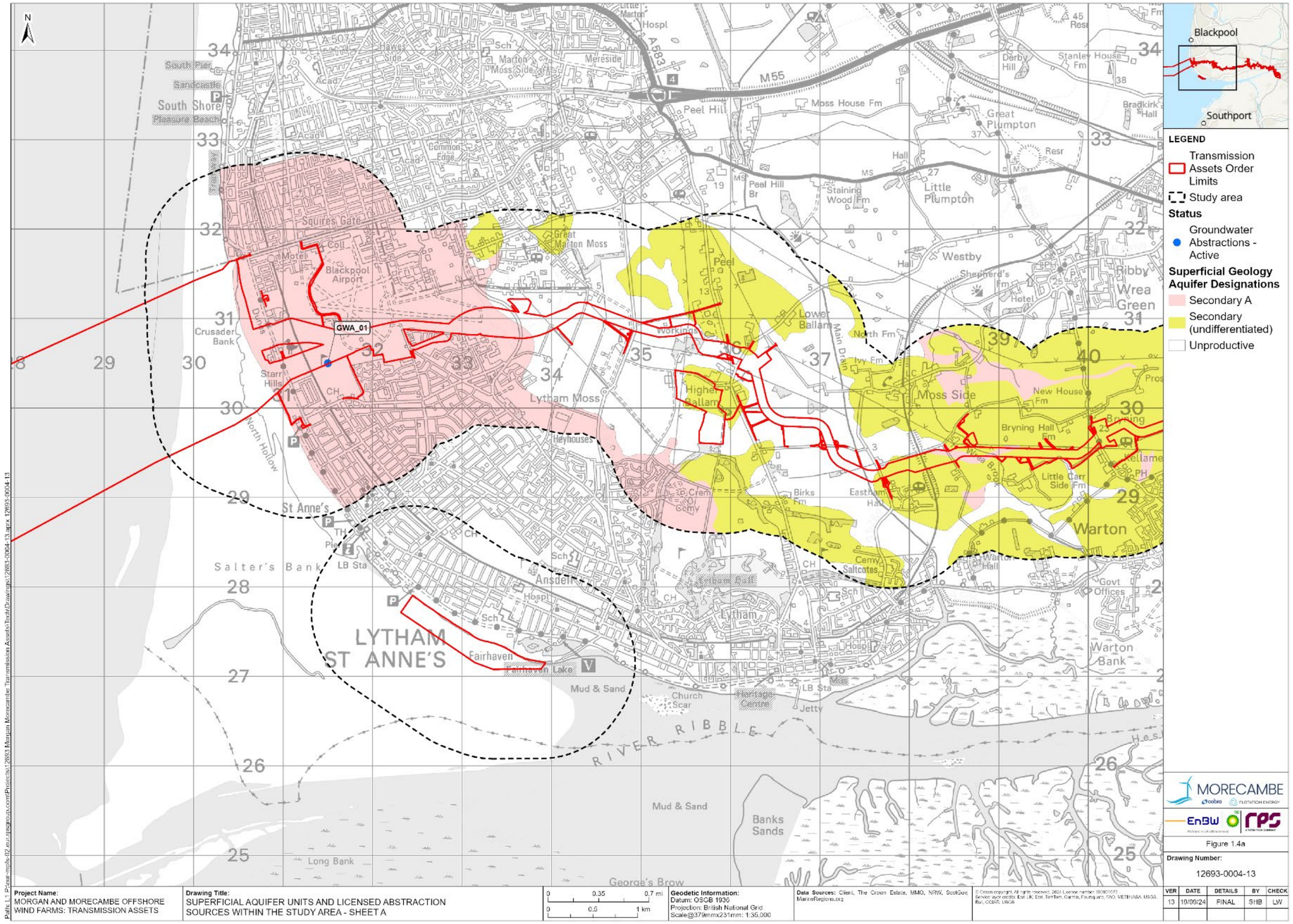


Figure 1.4A: Superficial aquifer units and licensed abstraction sources within the study area – Sheet A

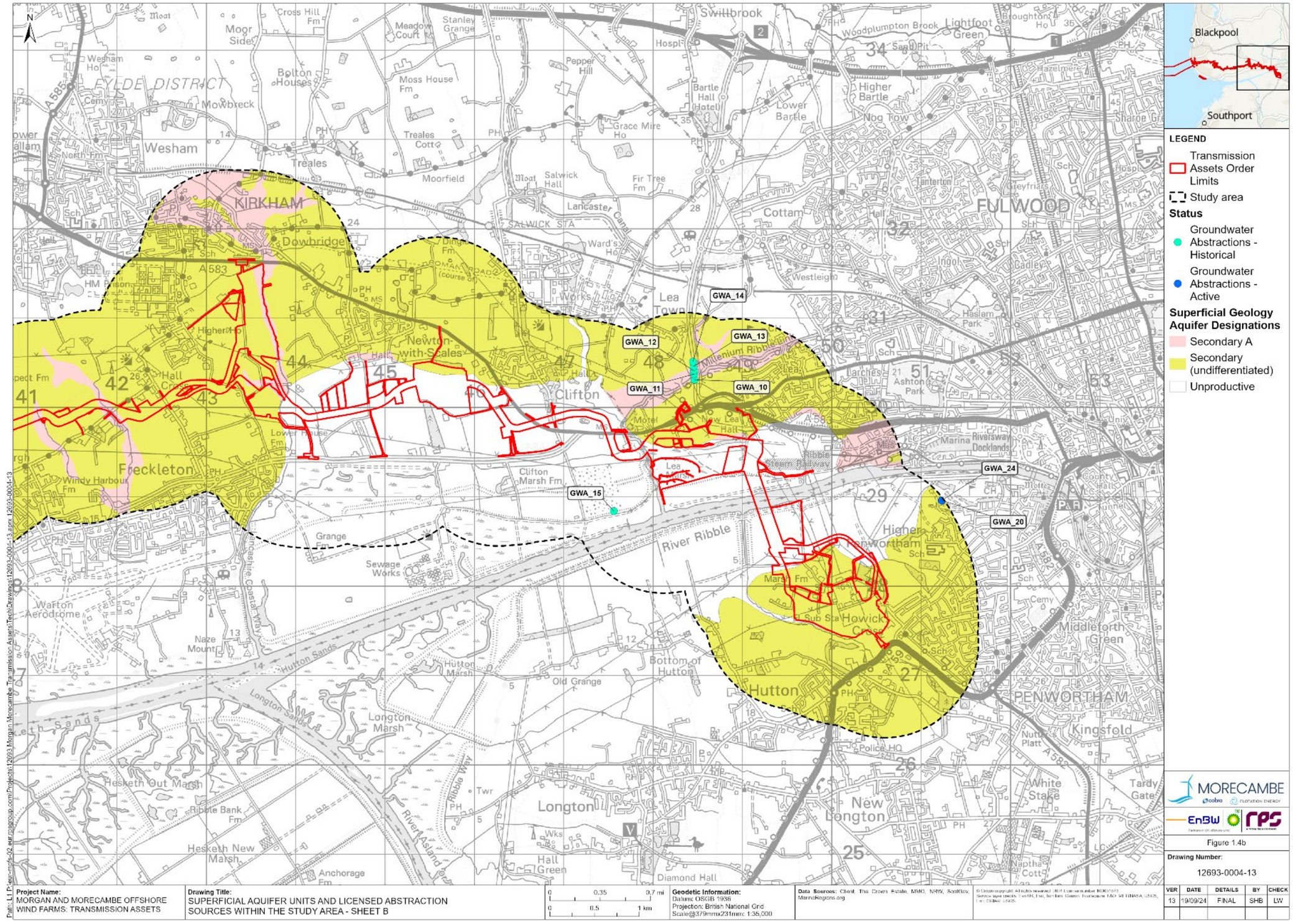


Figure 1.4B: Superficial aquifer units and licensed abstraction sources within the study area – Sheet B

1.6.4 Ground conditions

1.6.4.1 The detailed ground condition constraints maps for the study area are presented in **Figure 1.5A-E**.

Landfill sites

1.6.4.2 Details of the current and historical landfill sites of most concern (based on the nature of waste accepted), as presented in those figures, are summarised in **Table 1.6**.

Table 1.6: Landfill sites (current and historical) within the study area

RPS ID	Site name and status	Waste type accepted	Description
LF_01	Refuse Tip: Historical	Unknown	Unknown waste type but only c. 0.007 km^2 and situated adjacent to the Transmission Assets Order Limits and near the landfall.
LF_02	Clifton Drive North, Near Blackpool Airport, Lytham, St. Annes: Historical	Unknown	Unknown waste covering area of c. 0.002 km^2 and located within the Transmission Assets Order Limits.
LF_03	Leach Lodge Farm, Leach Lane, Blackpool Road North, St Annes: Historical	Industrial, Commercial	Possible biodegradable waste mass, located across the Transmission Assets Order Limits.
LF_04	Snowdon Road, St Annes, Fylde: Historical	Inert, Commercial, Household	Contains potentially biodegradable 'household' waste. Located within the Transmission Assets Order Limits.
LF_05	Refuse Destructor (B): Historical	Unknown	Unknown waste type but only c. 0.003 km^2 and located within the Transmission Assets Order Limits.
LF_06	Blackpool Airport, Common Edge Road, Lytham, Blackpool: Historical	Inert, Household	Contains potentially biodegradable 'household' waste. Located across and adjacent to the Transmission Assets Order Limits.
LF_07	Midgeland Farm, Midgeland Road, Marton, Blackpool, Lancashire: Historical	Inert, Industrial, Commercial, Household	Possible biodegradable waste mass, but historical site situated on mudstone bedrock of the MMG and Glacial Till. Located c. 300 m north of the Transmission Assets Order Limits (north of the onshore export cable corridor).
LF_08	Westby Landfill Site, Annas Road, FY4 5JY: Active or recent	Waste Landfilling Inert, Special, Industrial, Commercial, Household	Active landfill adjacent to the Transmission Assets Order Limits accepting potentially biodegradable household waste.
LF_09	Land off Saltcotes Road, Land off Saltcotes Road, Ballam Road, Lytham, Lancashire - Historical	Inert	Historical landfill located c. 470 m south of the Transmission Assets Order Limits. Only inert waste and measuring c. 0.02 km^2 in size.

RPS ID	Site name and status	Waste type accepted	Description
LF_10	Saltcotes, Lytham Hall Park, Saltcoates Road, Lytham, Lancashire: Historical	Inert, Industrial, Commercial, Household, Liquid sludge	Historical landfill located c. 110 m south of the Transmission Assets Order Limits. Contains potentially biodegradable 'household' waste.
LF_11	Lidum Park Industrial Estate, Boundary Road, Lytham, FY8 5LT: Historical	Unknown	Located c. 800 m south of the Transmission Assets Order Limits. Only measuring c. 0.002 km^2 in size but unknown waste received.
LF_12	Moss Side Lane, Moss Side: Historical	Inert	Historical landfill located c. 640 m north of the Transmission Assets Order Limits. Very small (c. 0.002 km^2) and receiving inert waste.
LF_14	Grange Farm, Lytham Road, Freckleton: Active or Recent	Co-Disposal Landfill Site	Active landfill located c.790 m south of the Transmission Assets Order Limits.
LF_15	Grange Farm No 2, Freckleton: Historical	Inert, Industrial, Household, Liquid sludge	Historical landfill which accepted biodegradable waste c.620 m south of the Transmission Assets Order Limits.
LF_16	Clifton Marsh Landfill, Preston New Road, Freckleton, Preston, Lancashire, PR4 1HN - Active or recent	Unknown	Large (c. 1.0 km^2), active landfill stretching across northern bank of River Ribble, adjacent to the Transmission Assets Order Limits. Waste type unknown excluding low level radioactive waste declared through radioactive substance authorisation (RS_01).
LF_17	Clifton Marsh Landfill Site, Lytham Road, Clifton: Active or Recent	Co-Disposal Landfill Site. Inert, Industrial, Commercial, Liquid Sludge	As LF_16.
LF_19	Clifton Marsh Landfill Site, Lytham Road, Clifton: Historical	Unknown	Historical landfill only measuring c. 0.002 km^2 in size located c. 650 m from the Transmission Assets Order Limits. Waste type unknown.
LF_21	Lea Marsh, Preston: Historical	Inert, Industrial	Sizable (c. 0.26 km^2) historical landfill located across and adjacent to the Transmission Assets Order Limits near the River Ribble.
LF_22	Refuse Tip	Unknown	Unknown waste type but only c. 0.003 km^2 and located adjacent to the Transmission Assets Order Limits near River Ribble.
LF_23	Refuse Tip	Unknown	As LF_22.
LF_24	Refuse Tip	Unknown	As LF_22.
LF_25	Refuse Tip	Unknown	As LF_22.
LF_26	Refuse Tip	Unknown	As LF_22.

Licensed waste sites

1.6.4.3 Details of the 20 licensed waste sites identified in the study area, none of which are located within the Transmission Assets Order Limits are summarised in **Table 1.7**. These have been distinguished using the licence number and are shown in **Figure 1.5A-E**.

Table 1.7: Licensed waste sites within the study area

RPS ID	Site name	Licence number	Description
WS_01	Westby Transfer Station, Annas Road, Peel, Blackpool, Lancashire, FY4 5JX	WES001	Associated with Westby landfill site (LF_08) accepting household, commercial and industrial waste.
WS_02	Saltcotes Road, Lytham St. Annes, Lancashire, FY8 4LS	SIT030	Associated with Lytham household waste centre landfill (LF_10) accepting household, commercial and industrial waste.
WS_03	Saltcotes Road, Lytham St Annes, Lancashire, FY8 4LS	LAN017	Associated with Lytham household waste centre landfill (LF_10) accepting household, waste.
WS_04	Waste Transfer Station, Lindum Park Industrial Estate, Off Boundary Road, Lytham St Annes, Lancashire, FY8 15HU	GIL039	Associated with Lindum Park historical landfill (LF_11). Household, Commercial and Industrial Waste Transfer Station.
WS_05	Carr Farm, Lodge Lane, Warton, Preston, Lancashire, FY8 5RP	FAR062	Biological treatment facility at Carr Farm. Located c. 770 m south of the Transmission Assets Order Limits.
WS_06	Freckleton Road, Kirkham, Lancashire, PR4 2RN	REC017	Waste electrical and electronic equipment treatment facility situated c. 600 m to the west of the Transmission Assets Order Limits.
WS_07	Freckleton Road, Kirkham, Lancashire, PR4 2RN	REC346	As WS_06.
WS_09	Lytham Road, Freckleton, Preston, Lancashire, PR4 1TT	LCC001	Associated with co-disposal landfill site (LF_14).
WS_10	Clifton Marsh L F S, Lytham Road, Preston, Lancashire, PR4 0XE	SIT039	Associated with special waste transfer station at Clifton marsh landfill (LF_16).
WS_11	Clifton Marsh L F S, Lytham Road, Preston, Lancashire, PR4 0XE	SIT204	As WS_10.
WS_12	Clifton Marsh Landfill Site, Lytham Road, Freckleton, Lancashire, PR4 0XE	SIT210	As WS_10.
WS_13	Lytham Road, Clifton, Preston, Lancashire, PR4 0XE	SIT037	Associated with composting facility at Clifton Marsh landfill (LF_16).

RPS ID	Site name	Licence number	Description
WS_14	Lytham Road, Clifton, Preston, Lancashire, PR4 0XE	SIT002	Associated co-disposal landfill site at Clifton Marsh landfill (LF_16).
WS_15	Clifton Marsh Composting Facility, Lytham Road, Clifton, Preston, Lancashire, PR4 0XE	SIT049	As WS_13.
WS_16	Lytham Road, Clifton, Preston, Lancashire, PR4 0XE	SIT038	As WS_14.
WS_17	Ratten Lane, Hutton, Preston, Lancashire, PR4 5TH	TEG001	Composting facility at Sherdley Farm. Located c. 470 m southwest of the Transmission Assets Order Limits. Due to association with established agricultural property and situation above thick layer of glacial till, risk is deemed to be low.
WS_18	Ratten Lane, Hutton, Preston, Lancashire, PR4 5TH	TEG003	As WS_17.
WS_19	Waste Technology Park, Wallend Road, Preston Docks, Preston, Lancashire, PR2 2HW	LAN020	Associated with HCl and asbestos waste at Preston Docks historical landfill (LF_24).
WS_20	Waste Technology Park, Wallend Road, Preston Docks, Preston, Lancashire, PR2 2HW	NEA057	As WS_19.
WS_21	Acrylan Shed, Wall End Road, Off Riversway, Preston, Lancashire, PR2 2HW	MBM001	Associated with household, commercial and industrial waste transfer station at Preston Waste Transfer Station (LF_25).

Pollution incidents

1.6.4.4 Details of the 11 recorded pollution incidents identified in the study area are summarised in **Table 1.8**. Four categories of pollution incident are recorded.

- Category 1 – major, serious and/or extensive impact or effect on the environment, people and/or property.
- Category 2 – significant impact or effect on the environment, people and/or property.
- Category 3 – minor or minimal impact or effect on the environment, people and/or property.
- Category 4 – substantiated incident with no impact.

1.6.4.5 Only the Category 1 and 2 pollution incidents that affect land and water within the study area and that have the potential to be significant, have been presented.

Table 1.8: Environmental pollution incidents within the study area

RPS ID	Incident ID	Principal impacted medium (pollutant)	Severity category	Comments
PI_01	115607F	Land (Biodegradable materials and wastes)	2	Notification date 2002, not within the Transmission Assets Order Limits.
PI_02	1222071	Water (Crude Sewage)	2	Notification date 2014, not within the Transmission Assets Order Limits.
PI_03	371393	Water (Pollutant not identified)	2	Notification date 2006, within the Transmission Assets Order Limits.
PI_04	351641	Water (Unidentified Oil)	2	Notified in 2005, within the Transmission Assets Order Limits.
PI_05	96817	Water (Pollutant not identified)	2	Notified in 2002, adjacent to the Transmission Assets Order Limits.
PI_06	599136	Land (Construction and demolition materials and wastes)	2	Notified in 2008, not within the Transmission Assets Order Limits.
PI_07	1332916	Water (Contaminated Water)	2	Notified in 2015, not within the Transmission Assets Order Limits.
PI_08	371181	Land (Agricultural slurry and dilute slurry)	2	Notified in 2006, not situated within Transmission Assets Order Limits.
PI_09	650564	Water (Sludge)	2	Notified in 2009, situated within the Transmission Assets Order Limits.
PI_11	134994	Water (Food and drink)	2	Notified in 2003, situated adjacent to the Transmission Assets Order Limits, situated c. 150 m from National Grid Penwortham substation.

Licensed discharges to groundwater

1.6.4.6 There were 77 licensed discharges to controlled waters reported within the study area. Of these 77 discharges, none were recorded as discharging to ground and subsequently have been scoped out of impact assessments for the study area.

Fuel stations and garages

1.6.4.7 Fuel stations represent a particular risk to land and groundwater quality. The details of the eight current or historical garages identified in the study area are summarised in **Table 1.9**.

Table 1.9: Recent and historical fuel stations and garages within the study area

RPS ID	Address	Status	Description
FS_01	Midgeland Road, Great Marton Moss, Borough of Blackpool	Open garage	Underlain by alluvium, glacial till and MMG. Located c. 370 m north of the Transmission Assets Order Limits.
FS_02	Co-op Car Park, Lodge Close, Freckleton, Borough of Fylde, Lancashire	Historical garage	Underlain by glacial till and MMG. Located c, 960 m south of the Transmission Assets Order Limits.
FS_03	Landcrest Close, Freckleton, Borough of Fylde, Lancashire	Historical garage	Underlain by glacial till and MMG. Located c. 100 m west of the Transmission Assets Order Limits.
FS_04	Marsh Garage, Preston New Road, Freckleton, Clifton, Borough of Fylde	Open garage	Underlain by alluvium, glacial till and SSG. Located c. 510 m south of the Transmission Assets Order Limits.
FS_05	Motorhome Rent UK, Blackpool Rd, Clifton	Closed garage	Underlain by alluvium, glacial till and sherwood sandstone group. Located adjacent to the Transmission Assets Order Limits.
FS_06	Hallmark Cars, Blackpool Rd, Clifton	Closed service station - now car dealership	Underlain by alluvium, glacial till and sherwood sandstone group. Located adjacent to the Transmission Assets Order Limits.
FS_07	Costa Coffee, Drive Thru, Blackpool Rd, Lea, Preston	Historical garage	Underlain by glacial till and sherwood sandstone group. Located adjacent to the Transmission Assets Order Limits.
FS_08	Wallend Road, Ashton-on-Ribble, Preston, Lancashire	Historical - Now brownfield site	Underlain by alluvium, glacial till (inferred) and SSG. Located adjacent to the Transmission Assets Order Limits.

Radioactive substance authorisations

1.6.4.8 Only one site has been identified within the study area that is licensed for the storage and processing of radioactive substances. That site is summarised in **Table 1.10** and relates to the Clifton Marsh landfill (LF_16). This landfill is located adjacent to the Transmission Assets Order Limits on the northern bank of the River Ribble.

Table 1.10: Radioactive substance authorisations within the study area

RPS ID	Locations	Permission Number	Comments
RS_01	SUEZ Recycling & Recovery (Lancashire) Limited, Clifton Marsh Landfill Site	WB3495DU	Clifton Marsh landfill has an active authorisation to dispose of solid, low level radioactive waste since 2012. Therefore, the mapped landfill can be expected to contain radioactive waste.

Licensed industrial activities

1.6.4.9 Thirty licensed industrial activities are identified with the study area within the Groundsure Insights report. These licensed industrial activities were curated to remove duplicate entries, and activities that were deemed low risk. Licensed industrial activities deemed to be higher risk are presented in **Table 1.11**. These sites are also shown in **Figure 1.5A-E**.

Table 1.11: Licensed industrial activities within the study area

RPS ID	Permit number	Location (Process)	Effective date	Status	Description
IA_01	ZP3637SU	Clifton Marsh Chemical Store (Hazardous waste disposal)	20/06/2006	Superseded	Licensed activity has been superseded by more recent license (IA_03).
IA_03	PP3435DD	Clifton Marsh Chemical Store (Temporary storage of hazardous waste)	30/06/2016	Effective	Effective licence on area underlain by thick glacial till. Located c. 900 m southwest of the Transmission Assets Order Limits.
IA_04	LP3132LC	Clifton Marsh Landfill - Phase 4 (Combustion of waste derived fuel)	29/05/2007	Superseded	Superseded licence on area underlain by thick glacial till. Located c. 820 m southwest of the Transmission Assets Order Limits.
IA_05	PP3135DN	Clifton Marsh Leachate	30/06/2016	Superseded	Superseded licence on area

RPS ID	Permit number	Location (Process)	Effective date	Status	Description
		Treatment Plant (Physico-chemical treatment and disposal of non-hazardous waste)			underlain by thick glacial till. Located c. 740 m south of the Transmission Assets Order Limits.
IA_06	PP3836DX	Marsh Farm Broiler Unit (Intensive farming)	20/09/2018	Effective	Effective licence on area underlain by thick Glacial till. Located c. 470 m south of the Transmission Assets Order Limits.

1.6.4.10 **Table 1.6** to **Table 1.11** identify those activities and land uses that are considered to represent the highest risk with respect to ground conditions within the study area and potentially the most significant constraints for the construction and the operation and maintenance phase of the Transmission Assets.

1.6.4.11 The Groundsure Insights report and associated historical mapping also identifies a wide range of other current, recent or historical activities and land uses from multiple datasets. These features are shown in the constraints mapping in **Figure 1.5 A-E**.

Recent industrial land uses

1.6.4.12 A total of 335 recent industrial land uses were identified in the study area within the Groundsure Insights report. These recent industrial land uses were screened to remove multiple entries assigned from different survey dates and activities that were deemed low risk. Recent industrial land uses deemed to be higher risk are presented in **Table 1.12.** These sites are also shown in **Figure 1.5A-E**.

Table 1.12: Recent Industrial Land Uses within the study area

RPS_ID	Description	Within Transmission Assets Order Limits?
RILU_01	Blackpool Airport - Airports and landing strips	No c. 270 m east
RILU_02	St Annes Radar Station - Telecommunications features	No c. 250 m west
RILU_03	Gas Governor - Gas features	No c. 10 m south
RILU_04	Slurry lagoon - Waste storage, processing and disposal	No c. 50 m north west

RPS_ID	Description	Within Transmission Assets Order Limits?
RILU_05	Slurry bed - Waste storage, processing and disposal	No c. 30 m south east
RILU_06	Water pumping stations	No c. 60 m west
RILU_07	Sewage pumping station - Waste storage, processing and disposal	No c. 60 m west
RILU_08	Sludge pit plantation - Waste storage, processing and disposal	No c. 65 m south
RILU_11	Water pumping stations	No c. 910 m southwest

Historical industrial land uses

1.6.4.13 A total of 514 historical industrial land uses were identified in the study area within the Groundsure Insights report. These historical industrial land uses were screened to remove multiple entries assigned from different survey dates and activities that were deemed lower risk. Historical industrial land uses deemed to be higher risk are presented in **Table 1.13.** These sites are also shown in **Figure 1.5A-E**.

Table 1.13: Historical industrial land uses within the study area

RPS ID	Dates Recorded	Land Use	Within Transmission Assets Order Limits? And Approximate Distance and Direction
HILU_01	1951, 1968, 1981, 1987	Railway sidings	Yes
HILU_02	1951	Refuse heap	No – c. 130 m east
HILU_03	1930, 1938	Miniature rifle range	Yes
HILU_04	1909, 1930, 1938, 1951, 1968	Railway sidings	Yes
HILU_05	1987	Fire station	No – adjacent to boundary
HILU_06	1951, 1968, 1981, 1987	Aerodrome, airport	Yes
HILU_07	1930, 1938	Refuse destructor	Yes
HILU_08	1987	Radar station	No - c. 210 m west
HILU_09	1968	Radar station	No - c. 55 m west
HILU_10	1989	Mortuary	No - c. 610 m south
HILU_11	1846	Brick field	Yes
HILU_12	1909	Old clay pit	No – adjacent to boundary
HILU_13	1909	Old clay pit	No – adjacent to boundary
HILU_14	1951	Gas works	No - c. 210 m east
HILU_15	1909, 1930	Fever hospital	No - c. 510 m north
HILU_16	1930, 1938	Fever hospital	No - c. 510 m north
HILU_17	1909, 1930, 1938	Burial ground	Yes
HILU_18	1846	Refuse heap	No – adjacent to boundary
HILU_20	1951, 1979	Petrol storage tanks, petrol depot	No - c. 35 m north east
HILU_21	1974, 1982, 1990	Petrol depot	No - c. 210 m east
HILU_22	1990	Dock	No - c. 210 m east
HILU_23	1909, 1931	Old clay pit	Yes

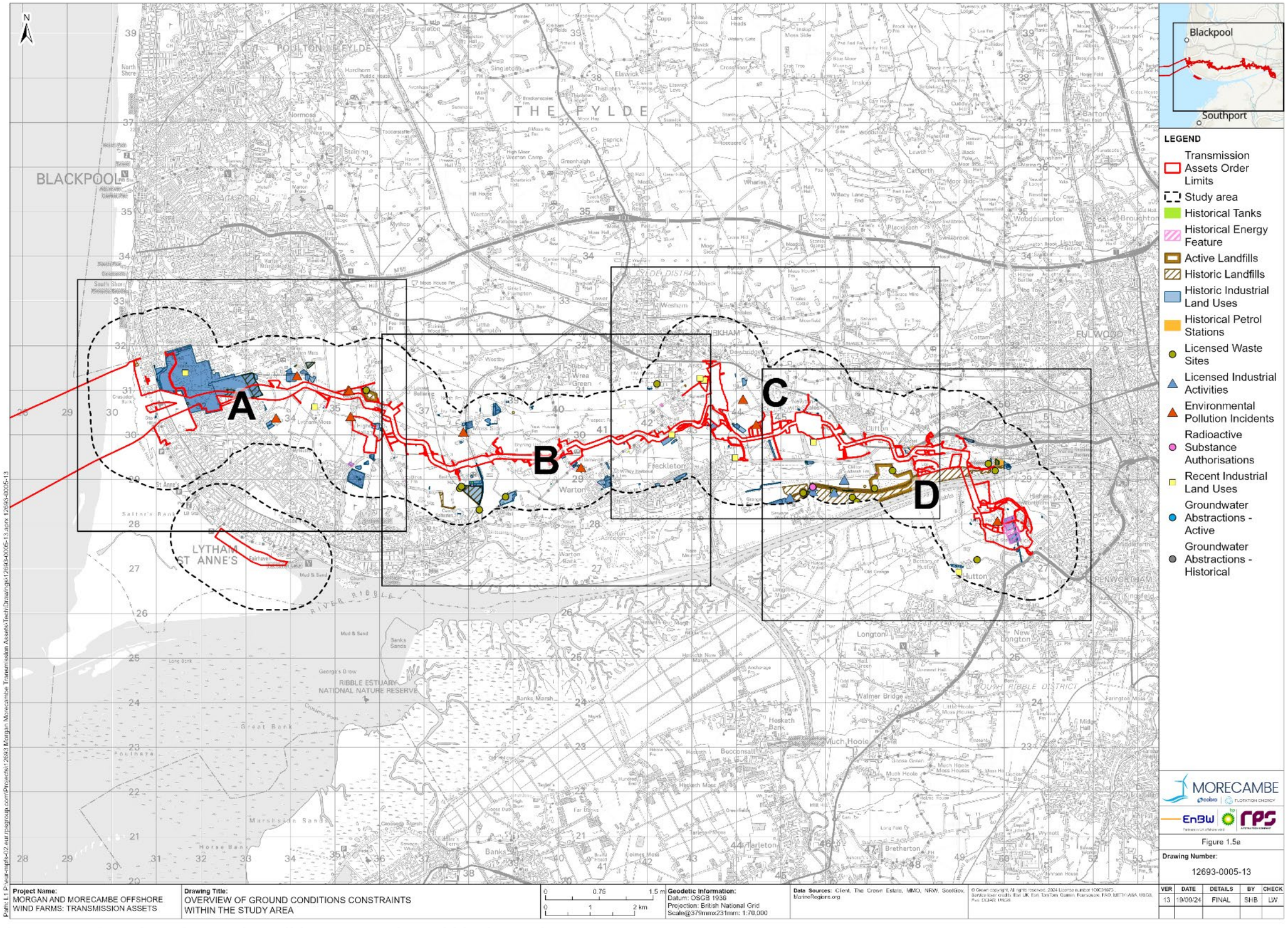


Figure 1.5A: Overview of ground conditions constraints within the study area

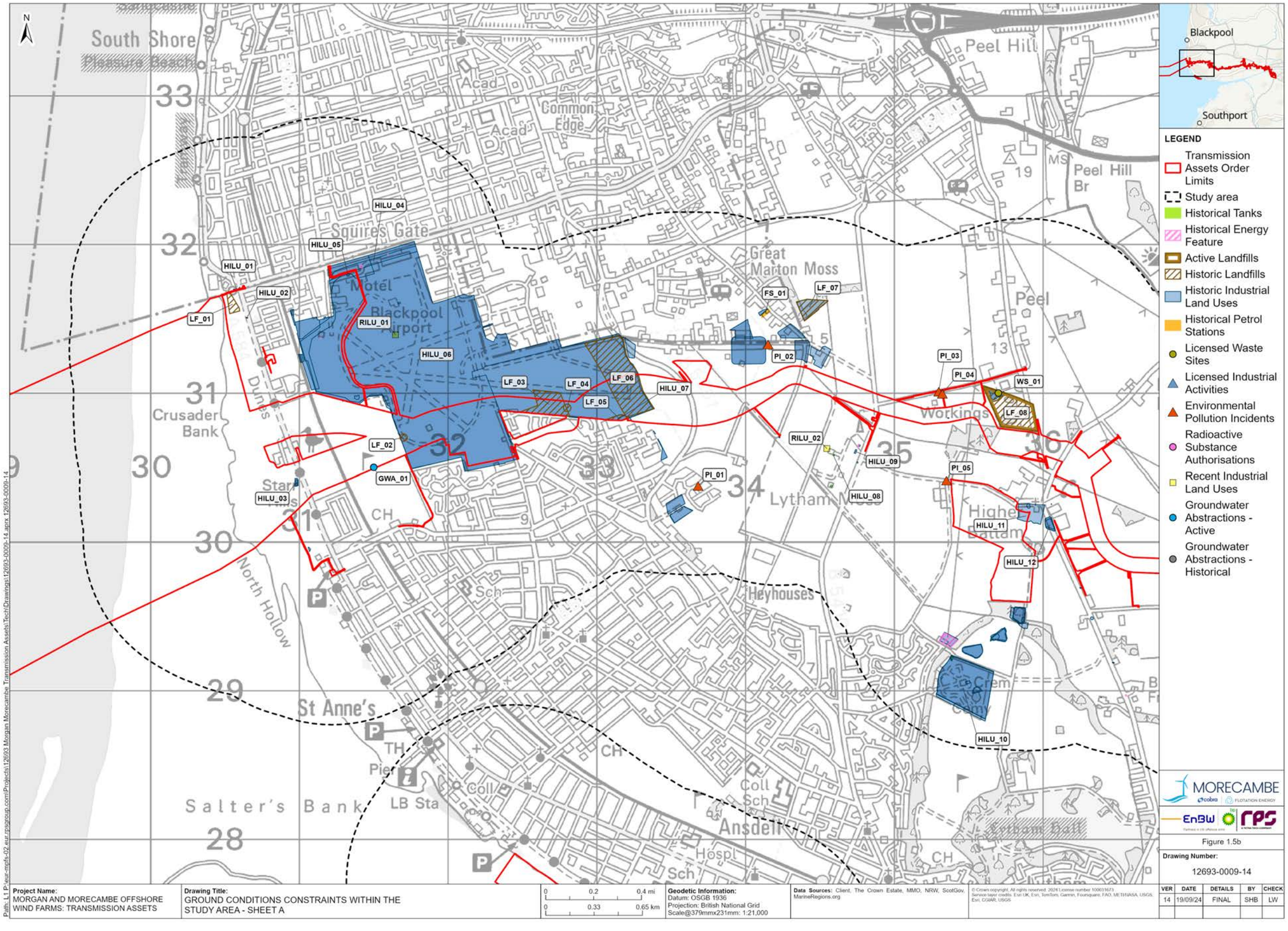


Figure 1.5B: Overview of ground conditions constraints within the study area

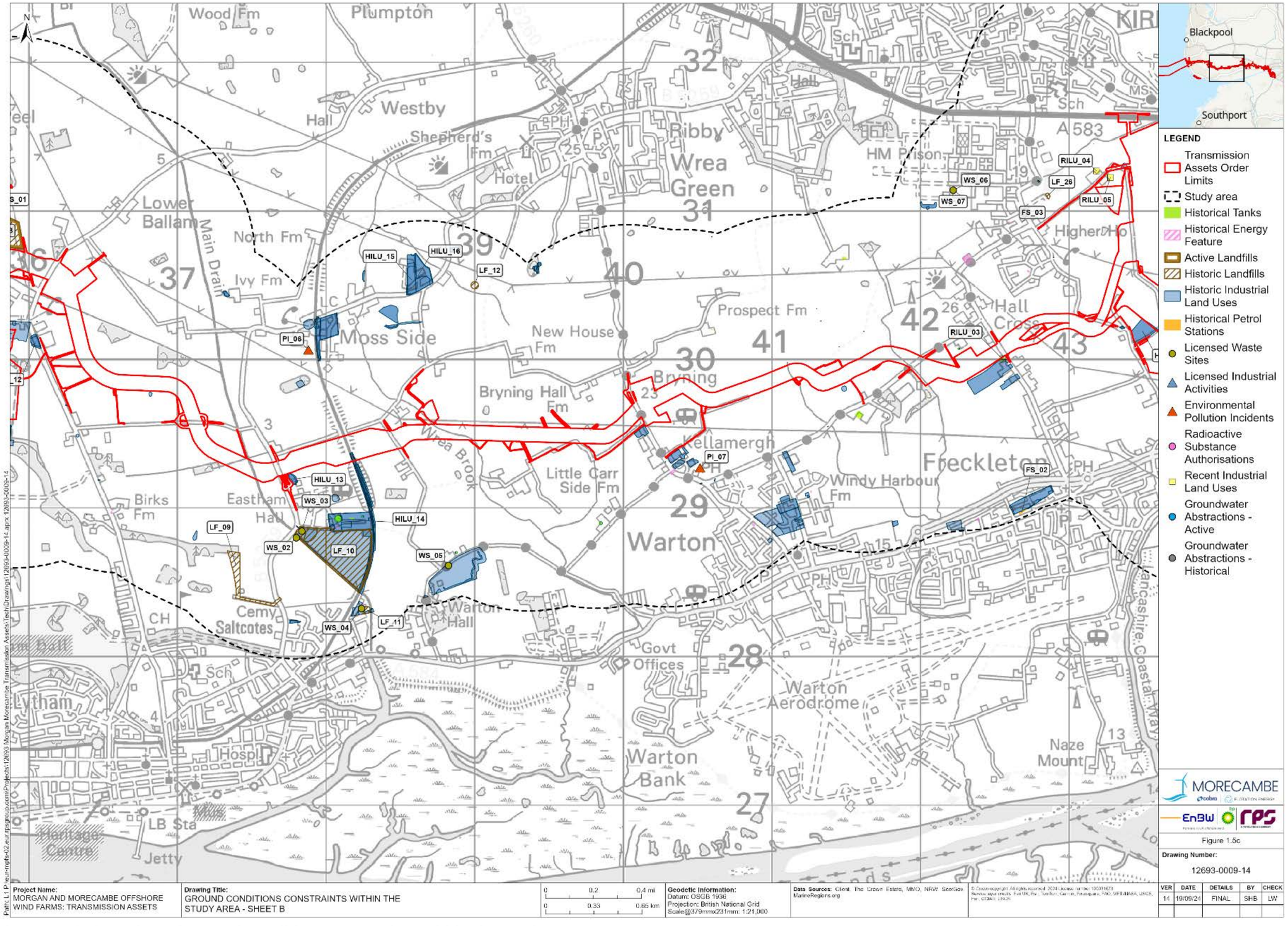


Figure 1.5C: Overview of ground conditions constraints within the study area

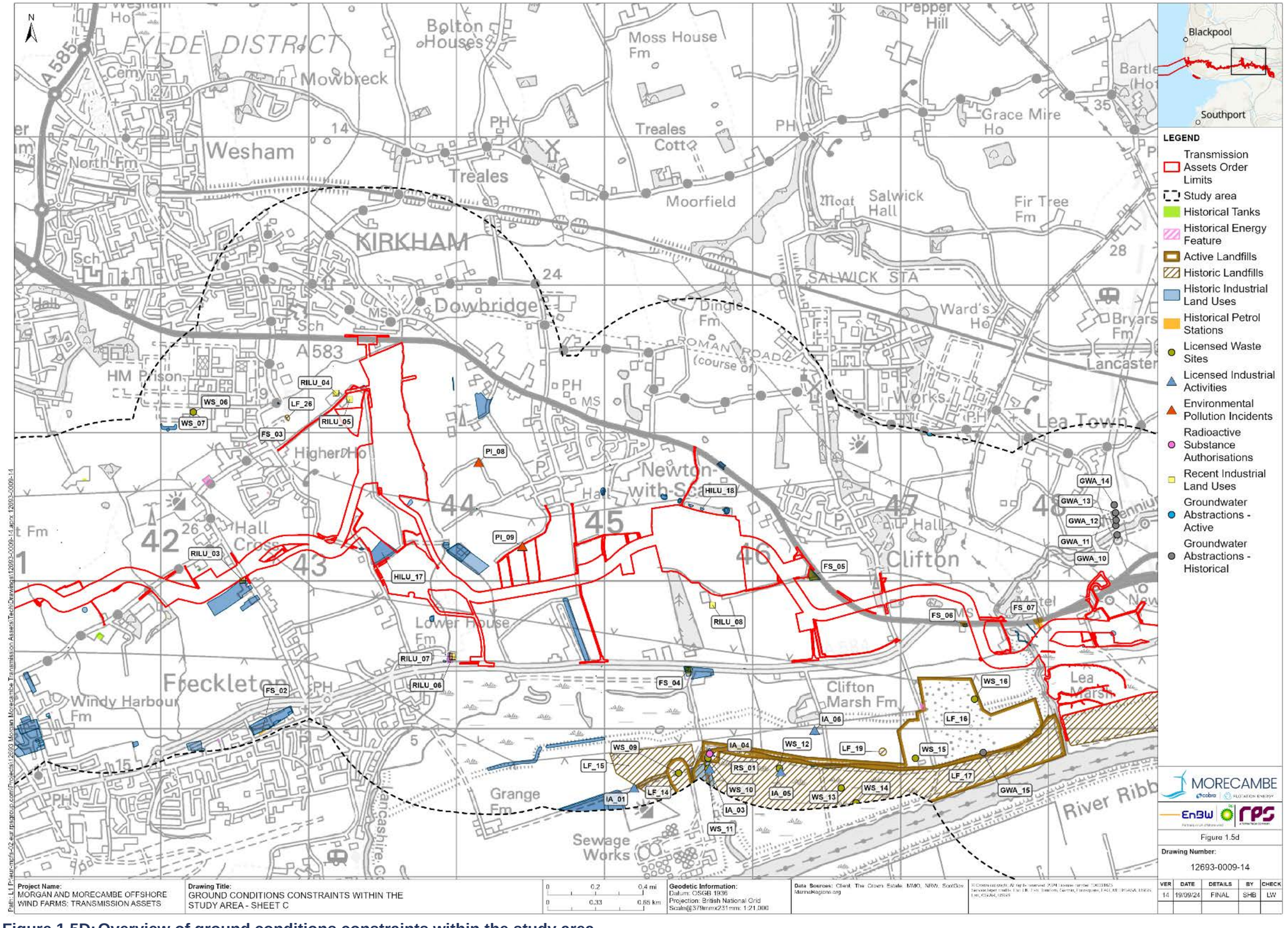


Figure 1.5D: Overview of ground conditions constraints within the study area

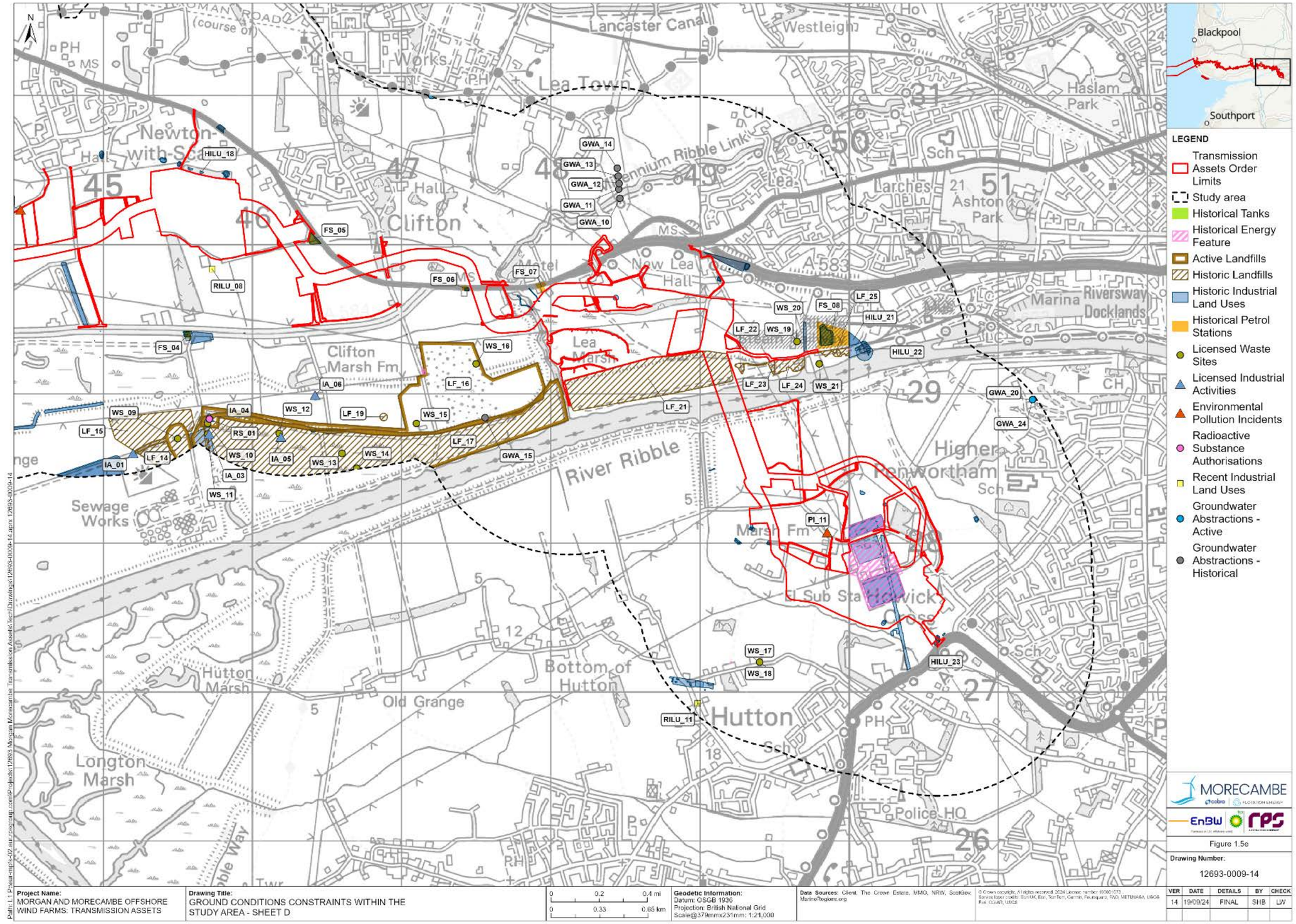


Figure 1.5E: Overview of ground conditions constraints within the study area

Historical mining operations

1.6.4.14 The Groundsure Insights report provides multiple datasets that relate to current and historical mining in the study area most notably:

- surface ground workings from a review of the historical mapping; and
- location of 'British Pits (BritPits)' which are closed or active surface and underground mineral workings obtained from records of the BGS.

1.6.4.15 The digital data for those datasets has been used to produce **Figure 1.6A-B**.

1.6.4.16 Several surface ground workings have been identified within the study area, with some located within the Transmission Assets Order Limits. However, these features are typically very small and almost exclusively relate to ponds. Small ponds are a common feature in the undeveloped parts of the study area and reflect the low permeability glacial till that dominate the surface geology.

1.6.4.17 There are 19 BritPits identified within the study area. BritPits identified within the Transmission Assets Order Limits are limited to one located within an area proposed for use as onshore biodiversity net gain enhancement and/or mitigation and a second within a former foreshore sand working in the west at Lytham St Annes.

1.6.4.18 The BritPits are typically recorded as being former clay or shale workings and they normally correlate with surface ground workings of small spatial extent. Two BritPits relate to sites identified as historical landfills (LF_10 and LF_21 (see **Table 1.6**)) in other datasets reviewed.

1.6.4.19 There are no historical mines reported by the BGS or in the Groundsure data within the study area.

Radon

1.6.4.20 According to the Indicative Atlas of Radon in England and Wales published by the Health Protection Agency (part of Public Health England now UK Health Security Agency) and the BGS, the Transmission Assets Order Limits are located in an area at lowest band of radon potential where less than 1% of homes are at or above the Action Level.

Unexploded Ordnance

1.6.4.21 The Construction Industry Research and Information Association Report C681 (Stone et al., 2009) outlines recommendations for dealing with the potential risk associated with the legacy of Unexploded Ordnance (UXO) risk, largely relating to Word War Two bombing and military sites.

1.6.4.22 Reference to the Zetica Unexploded Bomb Risk mapping indicates that the Transmission Assets is in an area of low potential risk from Unexploded Bombs. As the Transmission Assets is not within an area

of known military history, in general accordance with the CIRIA Report, no further consideration of UXO relating to wartime bombing is considered necessary. However, given the historical presence of a mini rifle range within the area if the landfall, the potential cannot be entirely discounted.

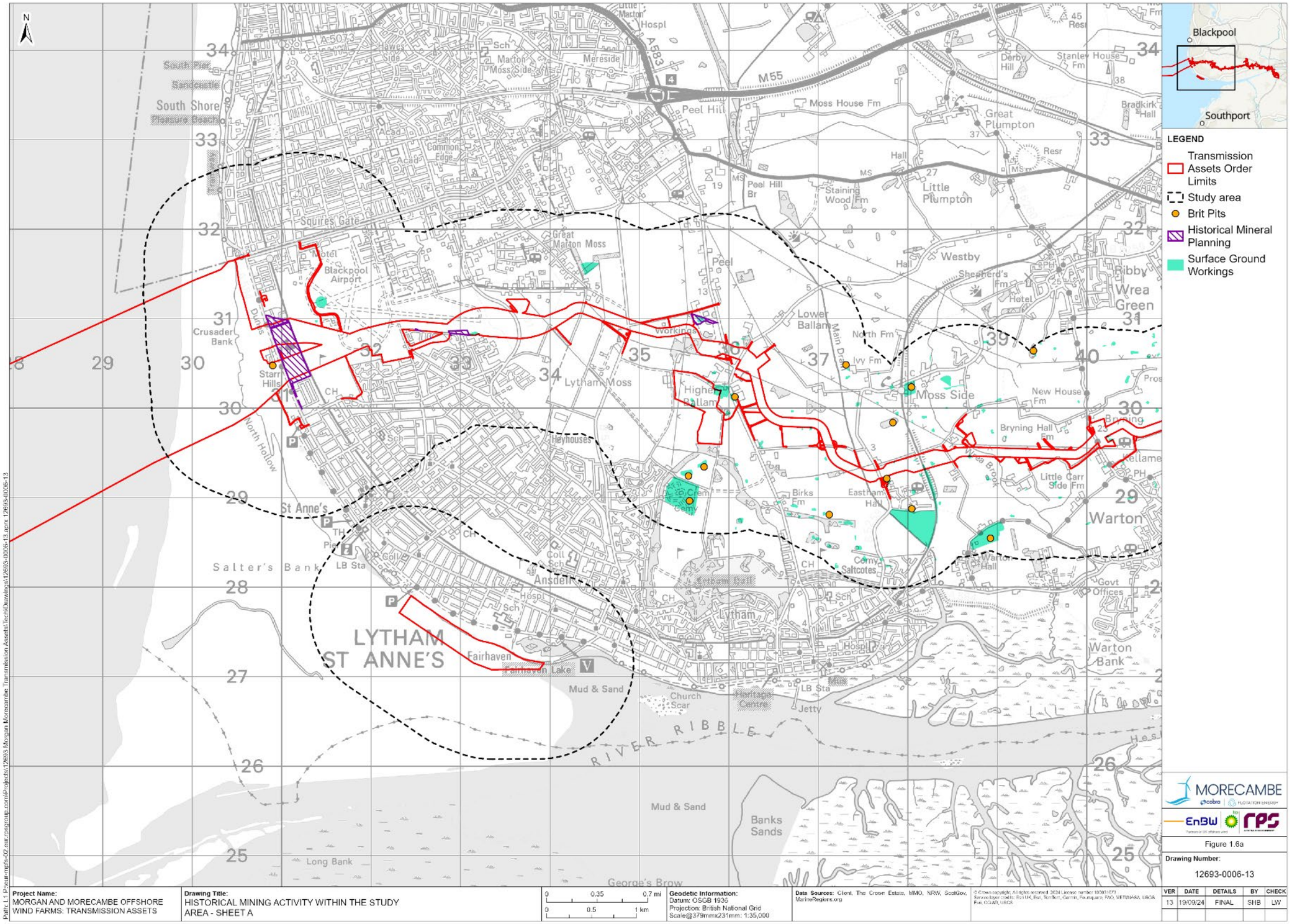


Figure 1.6A: Overview of historical mining activity within the study area – Sheet A

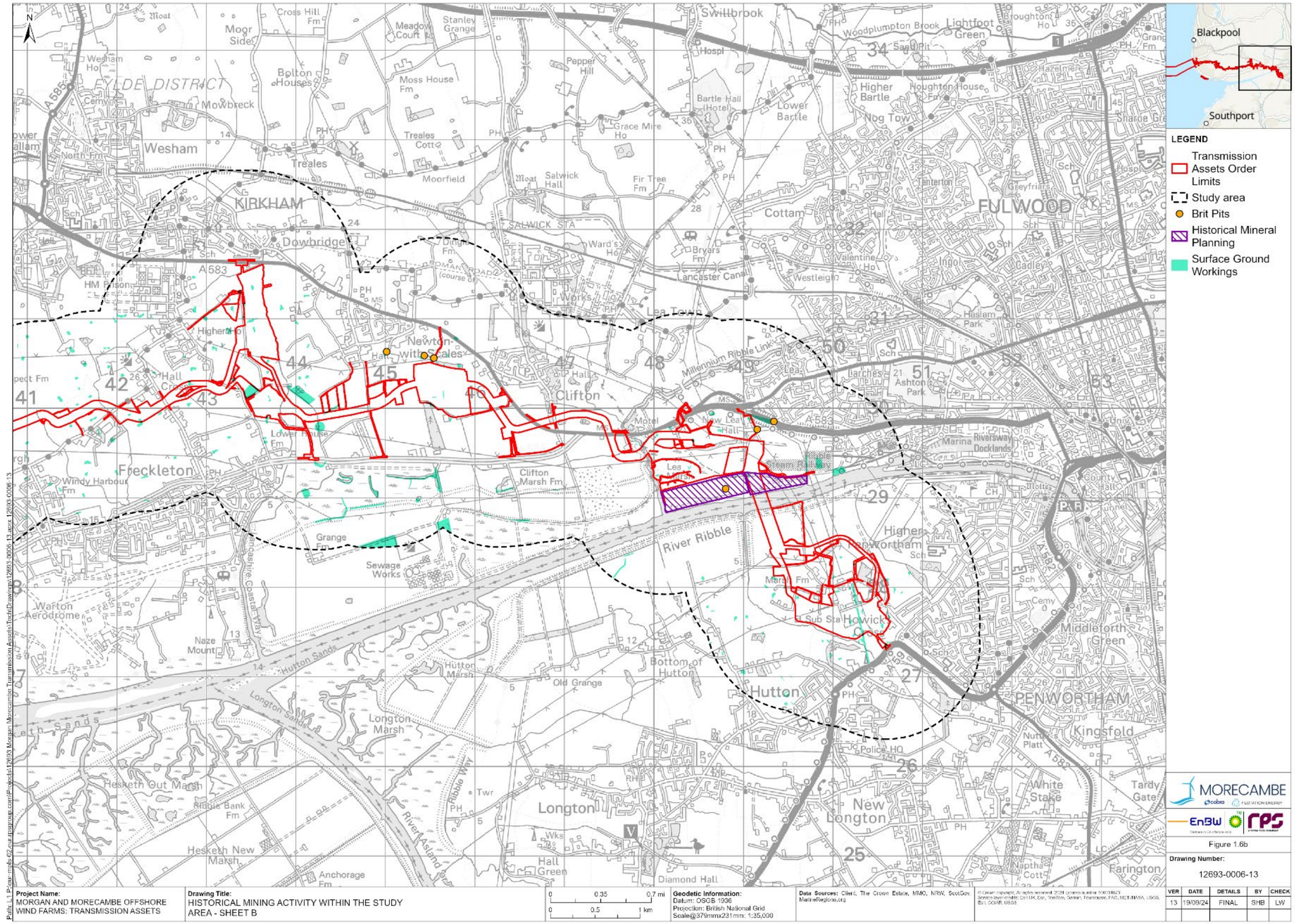


Figure 1.6B: Overview of historical mining activity within the study area – Sheet B

1.7 Outline conceptual site model

1.7.1 Potential pollutant linkages

1.7.1.1 An outline CSM consists of an appraisal of the source-pathway-receptor contaminant linkages which is central to the approach used to determine the existence of contaminated land according to the definition set out under Part 2A of the Environmental Protection Act 1990. For a risk to exist (under Part 2A), all three of the following components must be present to facilitate a potential pollutant linkage. The approach involves the development of a conceptual site model to describe sources of contamination, the potential migration and exposure pathways and potential receptors that may exist and subsequently identify the SPR linkage.

- **Source** referring to the source of contamination (Hazard).
- **Pathway** for the contaminant to move/migrate to receptor(s).
- **Receptor** (Target) that could be affected by the contaminant(s).

1.7.1.2 Receptors include human health, controlled waters, and buildings/structures.

1.7.1.3 As part of the assessment the potential risks to receptors for potential sources is given one of the following classifications.

- **Low risk** - it is considered unlikely that issues within the category will give rise to significant harm to identified receptors.
- **Moderate risk** - it is possible, but not certain that issues within the category will give rise to significant harm to receptors.
- **High risk** - there is a high potential that issues within the category will give rise to significant harm to identified receptors.

1.7.1.4 Each stage of the potential pollutant linkage sequence has been assessed individually on the basis of information obtained during the desk study exercise and are discussed in the following section.

1.7.2 Potential contamination sources

1.7.2.1 Potential contamination sources are identified as onsite (within the Transmission Assets Order Limits) or offsite (outside the Transmission Assets Order Limits and within the study area).

Table 1.14: Potential contamination sources

Onsite/offsite	Current/historical	Potential contamination sources
Onsite	Current	Recent industrial activities (Reference **Table 1.12**) • Landfall and onshore export cable corridor – Blackpool Airport • Substations – National Grid Penwortham substation.
	Historical	Landfills (Reference **Table 1.6**) • Landfall and onshore export cable corridor – Refuse tip – Clifton Drive North – Leach Lodge Farm – Snowdon Road – Refuse destructor – Blackpool Airport • 400 kV grid connection cable corridor – Lea Marsh Pollution incidents (Reference **Table 1.8)** • Landfall and onshore export cable corridor • 400 kV grid connection cable corridor Historical land use activities (Reference **Table 1.13**) • Landfall and onshore export cable corridor – Railway sidings – Refuse heap – Rifle range – Aerodrome – Refuse destructor – Brick field • Substations – Burial ground – Dock • 400 kV grid connection cable corridor – Old clay pit Garages (Reference **Table 1.9**) • 400 kV grid connection cable corridor

Onsite/offsite	Current/historical	Potential contamination sources
Offsite	Current	Recent landfills (Reference **Table 1.6**) • Landfall and onshore export cable corridor – Westby landfill • 400 kV grid connection cable corridor – Grange Farm – Clifton Marsh Radioactive substance authorisation (Reference **Table 1.10**) • 400 kV grid connection cable corridor Licenced waste sites (Reference **Table 1.7**) • Landfall and onshore export cable corridor • 400 kV grid connection cable corridor • Substations Licenced industrial activities (Reference **Table 1.11)** • 400 kV grid connection cable corridor – Clifton Marsh – Marsh Farm Broiler Unit Recent industrial activities (Reference **Table 1.12**) • Landfall and onshore export cable corridor – Radar station – Gas governor • Substations – Slurry bed/lagoon • 400 kV grid connection cable corridor – Sludge pit plantation – Water pumping station Garages (Reference **Table 1.9**) • Landfall and onshore export cable corridor • 400 kV grid connection cable corridor

Onsite/offsite	Current/historical	Potential contamination sources
	Historical	<u>Historical landfills (Reference **Table 1.6**)</u> • Landfall and onshore export cable corridor – Midgeland Farm – Land off Salcotes Road – Salcotes – Lidium Park Industrial – Moss Side Lane • 400 kV grid connection cable corridor – Grange Farm No. 2 – Refuse tips <u>Pollution incidents (Reference **Table 1.8)**</u> • Landfall and onshore export cable corridor • Substations • 400 kV grid connection cable corridor <u>Historical land use activities (Reference **Table 1.13**)</u> • Landfall and onshore export cable corridor – Fire station – Radar stations – Mortuary – Refuse heap – Old clay pits – Gas works – Fever hospital • 400 kV grid connection cable corridor – Petrol storage tanks, depot <u>Fuel stations, depot and garages (Reference **Table 1.9**)</u> • Landfall and onshore export cable corridor • Substations • 400 kV grid connection cable corridor

1.7.3 Potential pathways

1.7.3.1 The potential pollutant pathways include the following:

- inhalation, dermal contact and ingestion of soils/soil derived dusts;
- inhalation, dermal contact and ingestion with contaminants within perched water and shallow groundwater;
- inhalation of volatile contaminants and/or ground gases arising from soils or groundwater;

- migration of ground gases into buildings through foundations and building infrastructure;
- leaching of mobile contaminants within soils;
- surface water run-off mobilising contaminants within soils;
- vertical and lateral migration of contaminants within groundwater in permeable strata; and
- migration of contaminants via construction techniques including Horizontal Direction Drilling (HDD) and piling.

1.7.4 Potential receptors

1.7.4.1 Potential receptors include the following:

- end users (maintenance workers);
- adjacent site users (general public);
- buildings/structures;
- utility infrastructure;
- aquifer units;
- Source Protection Zones;
- groundwater abstractions;
- surface waters including the River Ribble; and
- ecological sites including the Ribble Estuary SSSI and Lytham St. Annes Dunes SSSI and LNR.

1.7.4.2 Geological receptors at the location of the landfall namely the Starr Hills Dunes Local Geodiversity Site has been discounted as there will be no open trenching or construction compounds located within the designated sites and the proposed construction technique i.e., use of HDD (or other trenchless techniques), will pass beneath the designated site.

1.7.4.3 Construction workers are also discounted as a receptor as risks to this receptor will be appropriately assessed and managed through the application of the Construction, Design and Management Regulations 2015.

1.7.5 Outline conceptual site model

1.7.5.1 An outline CSM has been developed on the basis of the desk study findings. The CSM is used to identify potential sources, pathways, and receptors (i.e., potential pollutant linkages) on site post development and is summarised in the table below. Should the development layout plan vary from that reviewed and included as a part of this PRA or a change of proposed site usage be proposed then the CSM and derived risk ratings should be reviewed accordingly.

1.7.5.2 The CSM references the following areas where they are considered beneficial to the assessment:

- landfall;
- onshore export cable corridor;
- 400 kV grid connection cable corridor; and
- other areas focussing on the onshore substations and existing National Grid Penwortham substation.

Table 1.15: Outline Conceptual Site Model

Potential source	Contaminants of concern	Via	Potential pathways	Linkage potentially active?	Receptors	Qualitative risk rating (refer to Section 1.7.1)	Notes
On site – current/historical Industrial activities *Landfall and Onshore Export Cable Corridor* Includes Blackpool Airport, refuse destructor, railway sidings, refuse heap, historical landfills, agricultural land use *400 kV Grid Connection Cable Corridor* Includes historical landfills, pollution incidents, agricultural land use *Other Areas*	Metals, hydrocarbons, PFAS, PCBs, herbicides, pesticides, asbestos	Soil	Direct contact/ingestion	✓	Future site users	Low	No regular occupation of the Transmission Assets post development. During the operational phase of the project, site operatives have the potential to be exposed to contaminants, if present, during maintenance works.
			Inhalation of volatiles	✓	Future site users	Low	No regular occupation of the Transmission Assets post development.
			Airborne migration of soil or dust	✓	Adjacent site users	Low	Potential sources of contamination have been identified within the Transmission Assets Order Limits. Requirements for dust mitigation during construction are assessed further int the be assessed further and implemented through the Dust Management Plan (Document Reference J1.2).

Potential source	Contaminants of concern	Via	Potential pathways	Linkage potentially active?	Receptors	Qualitative risk rating (refer to Section 1.7.1)	Notes
Includes an existing National Grid substation and a burial ground, agricultural land use.			Leaching of mobile contaminants	✓	Superficial deposits aquifers Ecological receptors Utility infrastructure	Moderate to High	*Landfall and onshore export cable corridor* Construction activities associated with the proposed development include trenching, trenchless technologies including direct pipe, haul roads or compounds have the potential to disturb existing ground/groundwater contamination and/or create preferential pathways which could result in contaminant migration to sensitive water resources.
						Moderate to High	*400 kV grid connection cable corridor* As above applicable to micro-tunnelling or direct pipe beneath the River Ribble.
						Moderate	*Other areas* As above applicable to construction of the onshore substations.

Potential source	Contaminants of concern	Via	Potential pathways	Linkage potentially active?	Receptors	Qualitative risk rating (refer to Section 1.7.1)	Notes
Onsite - current/historical As above. **Offsite – current/historical** *Landfall and onshore export cable corridor* Includes Blackpool Airport, historical landfills and waste sites, gas works, pollution incidents, agricultural land use. *400 kV grid connection cable corridor* Includes fuel stations, petrol depot, historical landfills and waste sites, sewage works, pollution incidents, agricultural land use. *Other Areas* Includes sewage works, pollution incidents, agricultural land use.	Metals, hydrocarbons	Groundwater	Vertical and lateral migration in permeable strata	✓	Superficial deposits aquifers and abstractions Surface water bodies Ecological Receptors Utility infrastructure	High	Landfall and onshore export cable corridor Construction activities associated with the proposed development have the potential to disturb existing contamination and/or create preferential pathways which could result in contaminant migration, including that potentially associated with the airport and historical landfills. Possible that the construction could render the abstraction source near Blackpool Airport temporarily unviable.
						Moderate to High	*400 kV grid connection cable corridor* As above with HDD (or other trenchless techniques) beneath the River Ribble.
						Low	*Other areas* Any intrusive groundworks may disturb and/or mobilise potential contamination. Piling may create a new pathway for contamination though high risk areas are generally remote.
			Vertical and lateral migration in	✓	Principal aquifer and abstractions	NA	*Landfall and onshore export cable corridor* No pathways identified.

Potential source	Contaminants of concern	Via	Potential pathways	Linkage potentially active?	Receptors	Qualitative risk rating (refer to Section 1.7.1)	Notes
			permeable strata		SPZ	NA	*400 kV grid connection cable corridor* No pathways identified.
						Low	*Other areas* Where piling is proposed for the onshore substations, there is potential for new contaminant pathways. However, the clay-rich glacial till (boulder clay) that separates the surface aquifer and bedrock aquifer will afford protection to the bedrock aquifer from shallow surface activities.
On and offsite *All areas* Made Ground/landfills/peat/Alluvium or TFD containing peat and other organic material.	Methane/carbon dioxide	Soil	Inhalation of ground gas/explosive risks	✓	Future site users Future and offsite buildings	NA	*Landfall and onshore export cable corridor* No buildings.
						NA	*400 kV grid connection cable corridor* No buildings.
						Moderate	*Other areas* Future usage at substations likely to be restricted to routine maintenance checks.

Note: In the event that a Moderate or High Qualitative Risk Rating is identified further assessment is required.

1.8 Conclusions

1.8.1.1 The outline CSM produced upon completion of the desk study assessment has identified a number of potential pollutant linkages that may be active upon the redevelopment of the site. Those that have been identified are considered to represent from low to high risk.

1.9 Recommendations and commitments

1.9.1.1 Ground investigations are proposed to obtain further information on the contamination status of the soils and groundwater for moderate or high risk potential pollutant linkages identified within **Table 1.15**.

1.9.1.2 Where the results of the ground investigation determine that remediation is required to ensure that the site is suitable for its proposed use, a remediation strategy would be prepared. The strategy would comprise the following:

- implementation plan setting out the objectives and requirements of the remediation;
- validation sampling to confirm that remediation objectives have been met; and
- verification report.

1.9.1.3 The scope of the remediation strategy would be agreed with the Environment Agency/relevant local planning authority prior to its implementation. The verification report would also be sent to the Environment Agency/relevant local planning authority for approval. Subject to the scope and results of the Remediation Strategy, the following would be undertaken where appropriate to inform construction activities and the detailed design of buildings:

- piling risk assessment (in accordance with the Environment Agency guidance (Environment Agency, 2001) including control measures (where appropriate) to mitigate risk to controlled waters during piling installation;
- detailed ground gas risk assessment and gas control measures during construction and to be incorporated into building design (where appropriate); and
- groundwater and/or surface water monitoring.

1.9.1.4 The Project is committed to ensuring potential linkages are appropriately investigated, assessed and mitigated. Further information in relation to these is provided in Volume 3, Chapter 1: Geology, hydrogeology and ground conditions.

1.10 References

British Geological Survey 1:50,000k Data purchased from Bluesky Mapshop. Accessed July 2023.

Groundsure Insight Report: Morgan, Report Ref. GSIP-2023-13424-13080 (1-16). 10th March 2023.

UK Statutory Instrument No. 51 The Construction (Design and Management) Regulations 2015.

Stone. K, Murray. A, Cooke. S, Foran. J, Gooderham. L (2009). C681 Construction industry guidance about Unexploded Ordnance (UXO) risk – a complete guide to the risk management process [Online]. Available at:

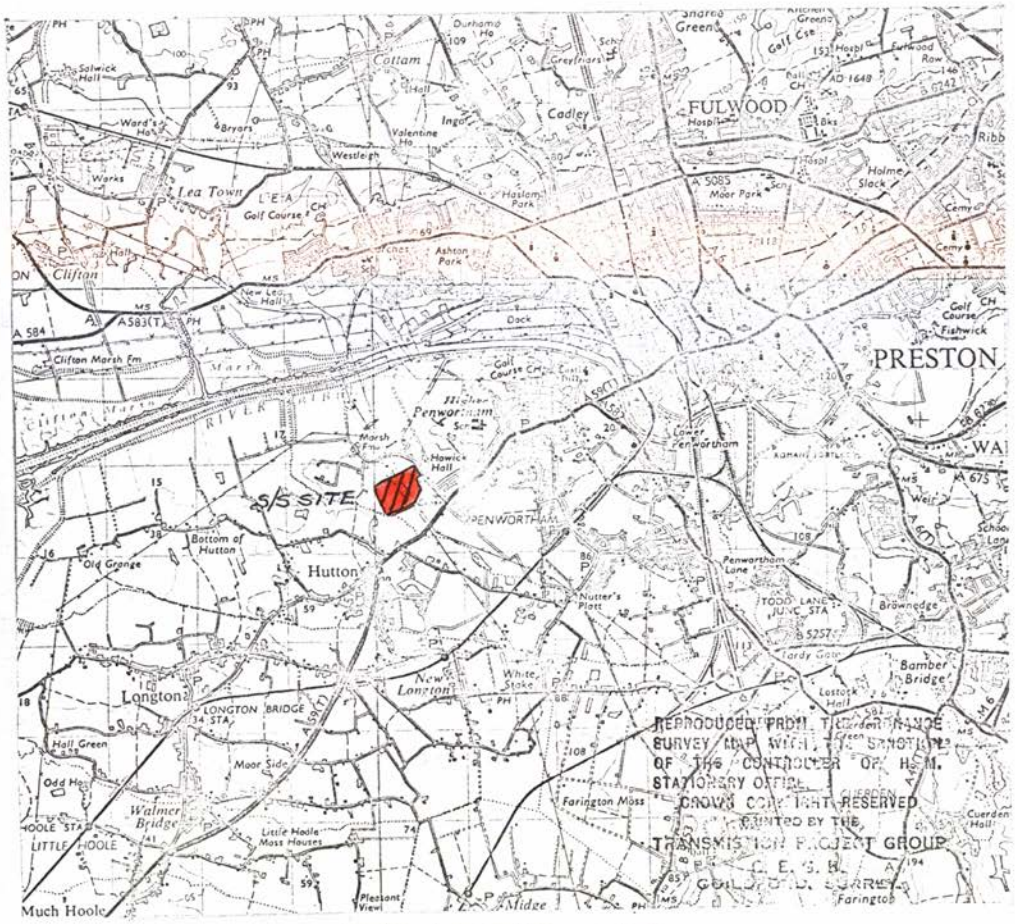
[redacted]

A.1 Appendix A: Assessment Limitations

1. A "desk study" means that no site visits have been carried out as any part thereof, unless otherwise specified.
2. This report provides available factual data for the site obtained only from the sources described in the text and related to the site on the basis of the location information provided by the Client.
3. The desk study information is not necessarily exhaustive and further information relevant to the site may be available from other sources.
4. The accuracy of maps cannot be guaranteed and it should be recognised that different conditions on site may have existed between and subsequent to the various map surveys.
5. No sampling or analysis has been undertaken in relation to this desk study.
6. Any borehole data from British Geological Survey sources is included on the basis that: "The British Geological Survey accept no responsibility for omissions or misinterpretation of the data from their Data Bank as this may be old or obtained from non-BGS sources and may not represent current interpretation".
7. Where any data supplied by the Client or from other sources, including that from previous site investigations, have been used it has been assumed that the information is correct. No responsibility can be accepted by RPS for inaccuracies in the data supplied by any other party.
8. This report is prepared and written in the context of an agreed scope of work and should not be used in a different context. Furthermore, new information, improved practices and changes in legislation may necessitate a re-interpretation of the report in whole or in part after its original submission.
9. The copyright in the written materials shall remain the property of the RPS Company but with a royalty-free perpetual licence to the Client deemed to be granted on payment in full to the RPS Company by the Client of the outstanding amounts.
10. The report is provided for sole use by the Client and is confidential to them, their professional advisors, no responsibility whatsoever for the contents of the report will be accepted to any person other than the Client.

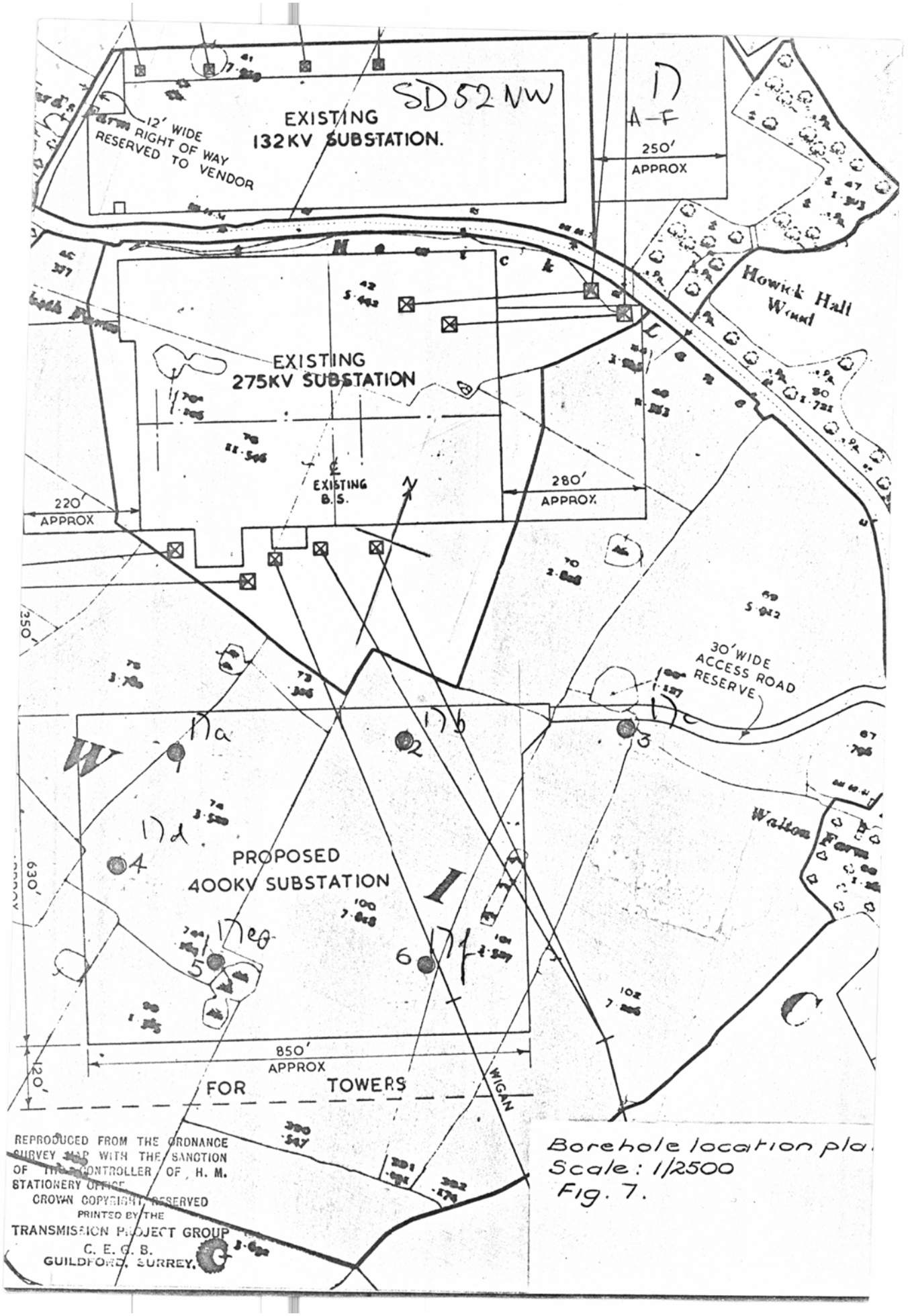
A.2 Appendix B: BGS Borehole Records

SM73



Site location plan
Scale: 1inch/1mile
Fig. 8.

SD52NW 17 a b c d e f



Borehole location pla
Scale: 1/2500
Fig. 7.

BOREHOLE LOG

SD52NW/17/F

BOREHOLE No. 6
BOREHOLE DIAMETER 6"
WATER STRUCK AT

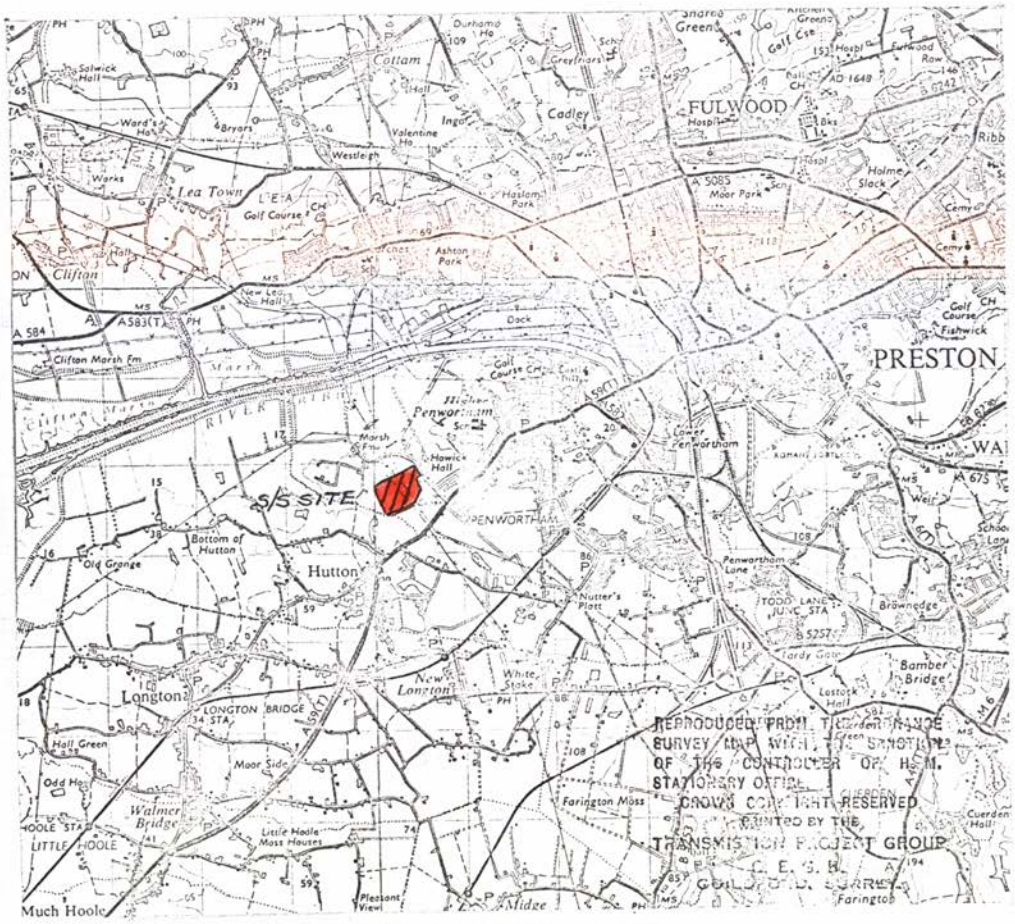
NGR 5029 2767

CE/IPG/ABK/SN73

DATE	WATER LEVEL	DEPTH OF BORING	STRATA DESCRIPTION	DEPTH	O.D. LEVEL	SAMPLE DETAILS: LEVEL	NUMBER OF BLOWS	TYPE AND REF.
3.7.65			Topsoil and subsoil		72.6			
				2' 0"	70.6			
			Reddish brown silty boulder clay (0.61m)			5' 0" to 6' 6"	149	□
3.7.65	Nil	8' 0" (2.44m)				7' 6" to 8' 6"	81	X
4.7.65	Nil					10' 0" to 11' 6"	223	□
						12' 6" to 13' 6"	88	X
						15' 0" to 16' 6"	191	NR □
						17' 6" to 18' 6"	77	X
4.7.65	Nil	21' 6" (6.55m)				20' 0" to 21' 6"	165	NR □
5.7.65	Nil					22' 6" to 23' 6"	72	0 X
						25' 0" to 26' 6"	70	□
						27' 6" to 28' 6"	70	X
						30' 0" to 31' 6"	92	NR □
5.7.65	Nil	33' 6" (10.21m)	(10.21m)	33' 6" Bottom of borehole	39.1	32' 6" to 33' 6"	81	0 X

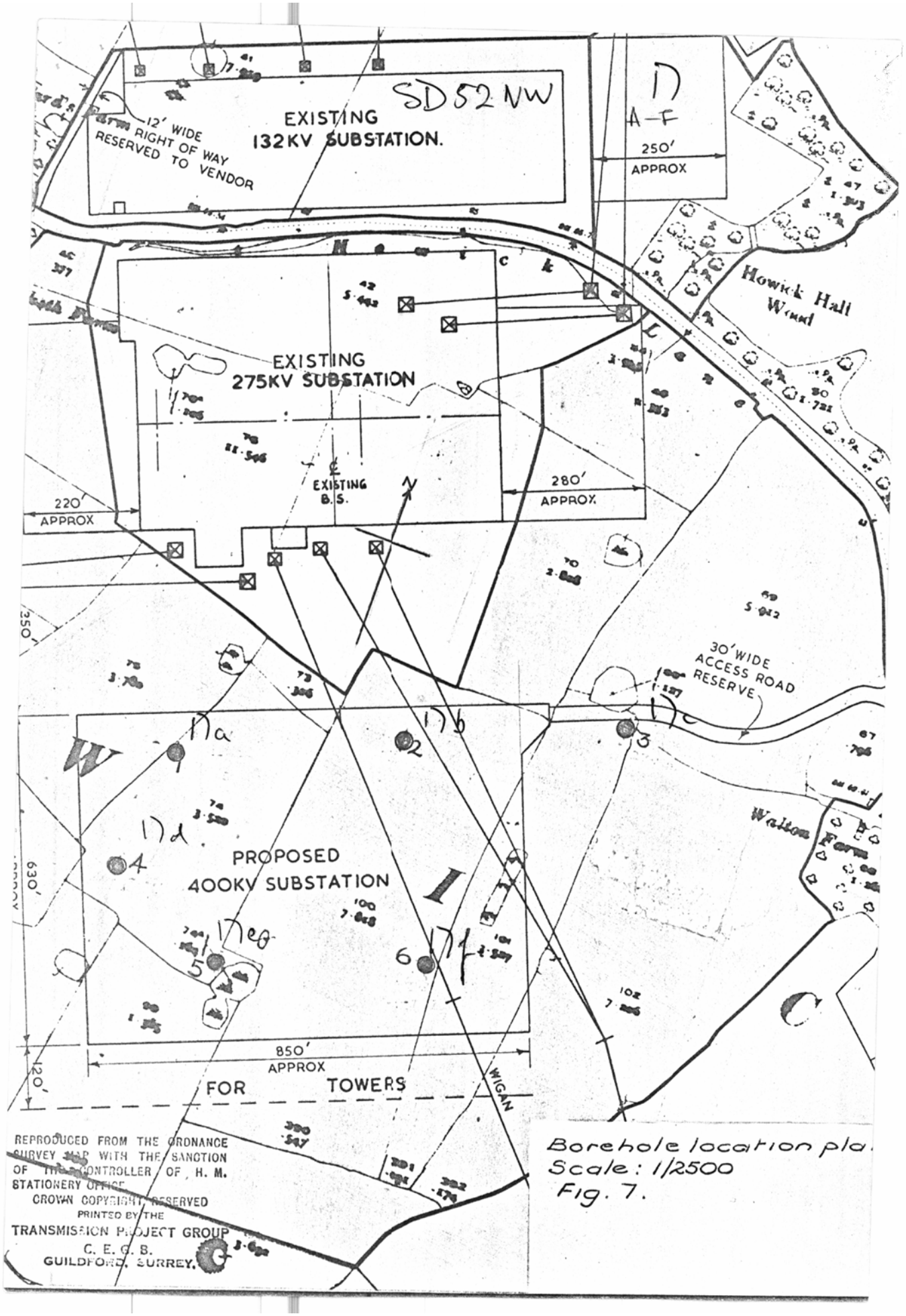
NO RECOVERY OF SAMPLE [ ] NR
UNDISTURBED SAMPLES □ DISTURBED SAMPLES O WATER SAMPLES ▽ S. P. TESTS X

SM73



Site location plan
Scale: 1inch/1mile
Fig. 8.

SD52NW 17 a b c d e f



Borehole location pla
Scale: 1/2500
Fig. 7.

BOREHOLE LOG

SD52NW/17c

BOREHOLE No. 3
BOREHOLE DIAMETER 6"
WATER STRUCK AT 28' 0"

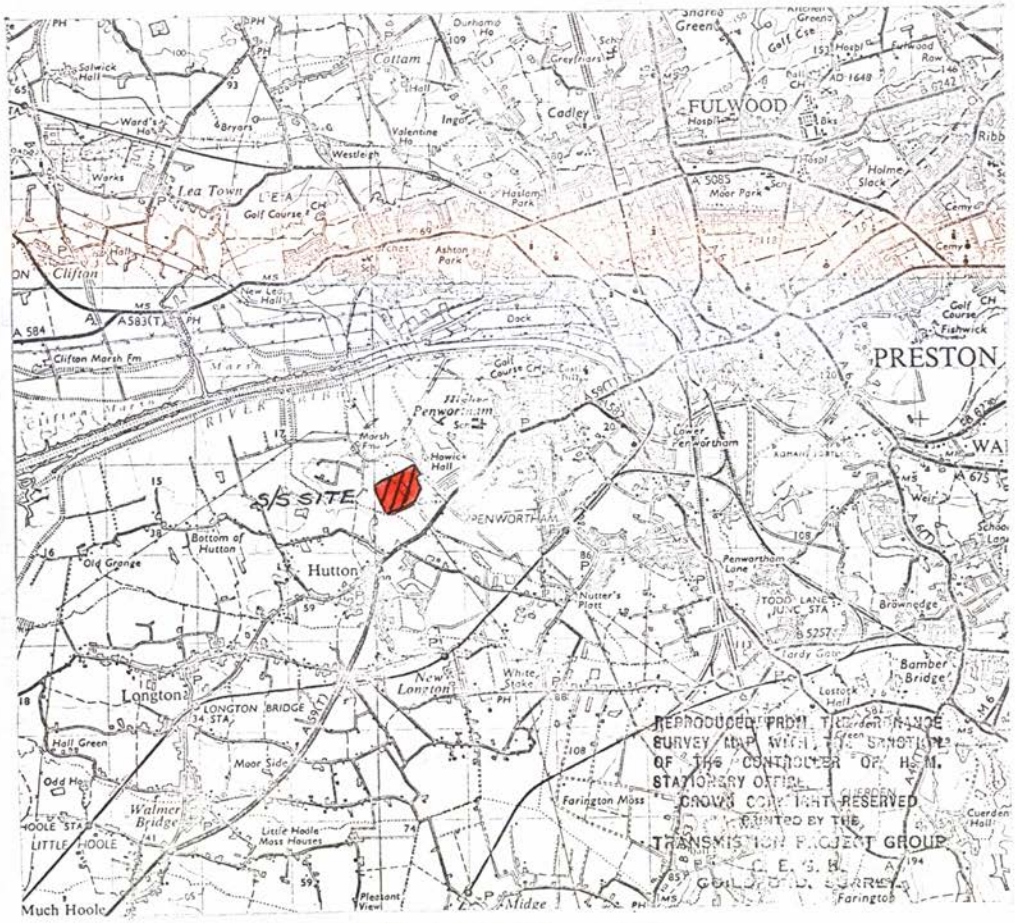
NGR 5037 2784

CE/IPG/JBK/SN73

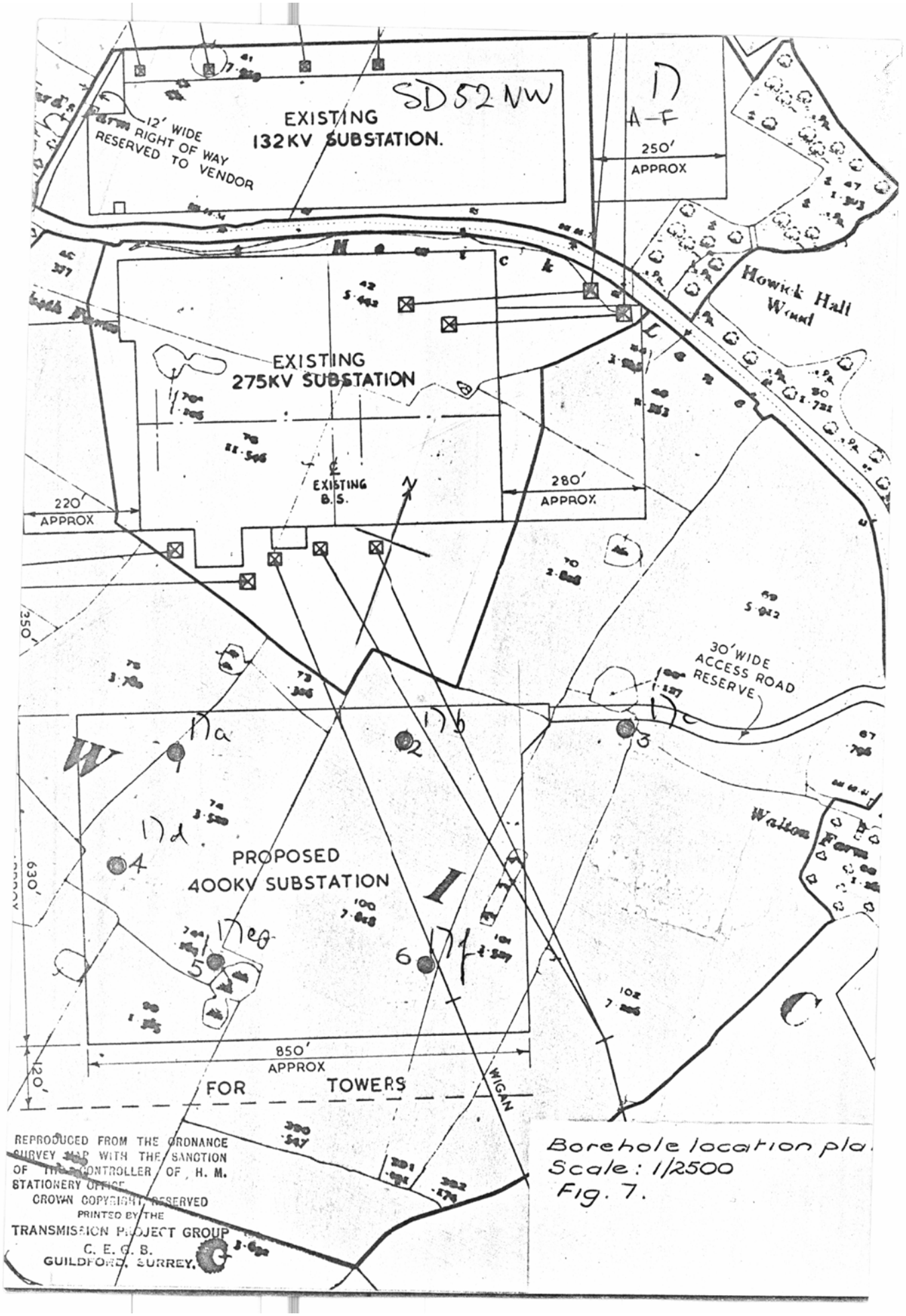
DATE	WATER LEVEL	DEPTH OF BORING	STRATA DESCRIPTION	DEPTH	O.D. LEVEL	SAMPLE DETAILS: LEVEL	NUMBER OF BLOWS	TYPE AND REF.
25.6.65			Topsoil and subsoil		69.7			
				1' 6"	68.2			
			Reddish brown silty boulder clay	(0.46m).				
						5' 0" to 6' 6"	150	□
						7' 0" to 8' 0"	64	X
25.6.65	Nil	10' 0"	(3.05)			10' 0" to 11' 6"	111	□
26.6.65	Nil							
						12' 0" to 13' 6"	52	X
						15' 0" to 16' 6"	150	□ NR
26.6.65	Nil	18' 6"	(5.64m)			17' 6" to 18' 6"	68	0 X
27.6.65	Nil							
						20' 0" to 21' 6"	90	□
						22' 6" to 23' 6"	57	X
						25' 0" to 26' 6"	80	□ NR
						27' 6" to 28' 6"	71	0 X
27.6.65	28' 0"	30' 0"	(9.14m).			30' 0" to 31' 6"	76	□
28.6.65	20' 0"							
						32' 6" to 33' 6"	72	X
						35' 0" to 36' 6"	50	□ NR
						37' 6" to 38' 6"	48	X
						40' 0" to 41' 6"	42	□
			(13.26m)	(13.26m)				
28.6.65	Nil	43' 6"		43' 6" Bottom of borehole	26.2	42' 6" to 43' 6"	55	X

NO RECOVERY OF SAMPLE [ ] NR
UNDISTURBED SAMPLES □ DISTURBED SAMPLES O WATER SAMPLES ▽ S. P. TESTS X

SD52NW 17 a b c d e f



Site location plan
Scale: 1inch/1mile
Fig. 8.



Borehole location pla
Scale: 1/2500
Fig. 7.

BOREHOLE LOG

NGR 5025 2779

SD52NW 17b

BOREHOLE No. 2
BOREHOLE DIAMETER 6"
WATER STRUCK AT 25' 0"

DATE	WATER LEVEL	DEPTH OF BORING	STRATA DESCRIPTION	DEPTH	O.D. LEVEL*	SAMPLE DETAILS: LEVEL	NUMBER OF BLOWS	TYPE AND REF.
29.6.65			Topsoil and subsoil		68.9			
			Reddish brown silty boulder clay	2' 0" (0.61m)	66.9			
						5' 0" to 6' 6"	140	
						7' 6" to 8' 6"	71	X
						10' 0" to 11' 6"	125	
						12' 6" to 13' 6"	37	X
29.6.65	Nil	15' 0" (4.57m)						
30.6.65	Nil					15' 0" to 16' 6"	113	NR
						17' 6" to 18' 6"	48	X
						20' 0" to 21' 6"	65	NR
						22' 0" to 23' 6"	134	0 NR
						24' 0" to 25' 6"	112	
						26' 6" to 27' 6"	60	X
						30' 0" to 31' 6"	117	
30.6.65	Nil	(10.21 m) 33' 6"		(10.21 m) 33' 6" Bottom of borehole	36.4	32' 6" to 33' 6"	59	X

CE/IPG/MBK/SM73

NO RECOVERY OF SAMPLE ☐: NR
UNDISTURBED SAMPLES ☐ DISTURBED SAMPLES O WATER SAMPLES ▽ S. P. TESTS X

Name of site CENTRAL LS. NORTHWEST EA.

FRESHFIELD FARM 75

W R B No. SD 43/36 SD43/36 SD43/SW

Owner [redacted]

Occupier [redacted]

Licence no.
Appn no.
Cancelled
IGS ref. no.

Nat. grid ref. SD 42884 30757

Status [redacted]

Aquifer [redacted]

Code 118.04.

Ground level m OD ft. OD

Level of well top m OD ft. OD

Rest water level m bwt ft. bwt

(Date) m OD ft. OD

Construction: Method Percussion Date Jan '88

Depth bwt	Dia.	Linings (below well top) From	To	Dia.	Type
32.00m					

Single piezometer installed in sandstone

Abstraction rates

gph PWL

gpd

Type of pump

Chem./bact. anal. (YES)/NO

Well driller

If insufficient space has been allowed, continue in 'Notes' overleaf.

Summary of geological section	Thickness	Depth
		m
Drift		30.2
Red Sandstone		32.0

I/5/79/207

SD43SW61

Ground Level Orientation	Sheet 1 of 2	Borehole No 3	Grid Ref. SD 42884 30757
Boring Method Percussion	Permanent Lining Piezometer installed on nominal	Name FRESHFIELD FARM	W.R.B. Ref SD43/36
Contractor [redacted]	[redacted]	Location FRECKLETON	

Progress	Water	Core Recovery	Fractures	Lining	DESCRIPTION OF STRATA	Level (m)	Depth (m)	Sample	Symbolic Log
	21-28/1 19/1 08 1.3m	Sand/ Cement Grout			TOPSOIL	0.2			
18/1					Brown firm sandy boulder CLAY	3.0			
	M				Brown SAND and GRAVEL	6.2			
					Brown soft SILT	6.5			
					Brown firm sandy laminated CLAY	8.6			
19/1		Spoil from borehole			Brown firm sandy boulder CLAY	13.7			
					Brown firm sandy laminated CLAY	15.3			
					Brown firm sandy SILT	16.0			
20/1					Brown firm/stiff sandy laminated boulder CLAY				

EXPLANATION [redacted]

REMARKS

Logged P.A.L. Scale

North West Water

[redacted]

Ground Level Orientation	Sheet 2 of 2	Borehole No 3	Grid Ref.
Boring Method Contractor	Permanent Lining Tube Details	Name FRESHFIELD FARM Location FRECKLETON	W.R.B. Ref SD43/36

Progress	Water	Core Recovery	Fractures	Lining	DESCRIPTION OF STRATA	Level (m)	Depth (m)	Sample	Symbolic Log
21/1					as above		21 22 23 24		
		Bentonite			Brown fine-med. GRAVEL with occasional cobbles	24.8	25 26		
22/1					Red-brown stiff sandy boulder CLAY	27.1	27 28 29		
25/1						30.2	30 31		
26/1		Sand			Red SANDSTONE	32.0			
					BASE OF BOREHOLE				

EXPLANATION

[redacted]

REMARKS WL MEASURED

09/06/1988 3.88 mBD
09/09/1988 3.90 mBD

North West Water

Logged P.A.L. Scale

[redacted]

DATE	NAME	NGR	SUB_DESC	DETCODE	DETNAME	DET_SHORT	DETUNITS	UNIT_SHORT	QUAL	RESULT
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	0050	Lead	Lead - as Pb	MICROGRAM PER LITRE	ug/l	<	50.00000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	0061	pH	pH	PH UNITS	PHUNITS		7.25000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	0077	Conductivity at 25 C	Cond @ 25C	MICROSIEMENS PER CENTIMETRE	uS/cm		1430.00000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	0108	Cadmium	Cadmium - Cd	MICROGRAM PER LITRE	ug/l	<	5.00000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	0111	Ammoniacal Nitrogen as N	Ammonia(N)	MILLIGRAM PER LITRE	mg/l		0.20000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	0117	Nitrate as N	Nitrate-N	MILLIGRAM PER LITRE	mg/l		0.15000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	0118	Nitrite as N	Nitrite-N	MILLIGRAM PER LITRE	mg/l	<	0.02000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	0154	Hardness, Temporary as CaCO3	HdssTempCaCo	MILLIGRAM PER LITRE	mg/l		327.00000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	0155	Hardness, Permanent as CaCO3	HdssPermCaCo	MILLIGRAM PER LITRE	mg/l		349.00000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	0158	Hardness, Total as CaCO3	Hardness	MILLIGRAM PER LITRE	mg/l		676.00000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	0162	Alkalinity to pH 4.5 as CaCO3	Alky pH 4.5	MILLIGRAM PER LITRE	mg/l		327.00000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	0172	Chloride	Chloride Ion	MILLIGRAM PER LITRE	mg/l		58.00000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	0180	Orthophosphate, reactive as P	Orthophospht	MILLIGRAM PER LITRE	mg/l	<	0.05000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	0182	Silica, reactive as SiO2	SiO2 Rv Filt	MILLIGRAM PER LITRE	mg/l		9.90000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	0183	Sulphate as SO4	Sulphate SO4	MILLIGRAM PER LITRE	mg/l		388.00000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	0193	Carbonate as CO3	CarbonateCO3	MILLIGRAM PER LITRE	mg/l	<	3.00000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	0207	Sodium	Sodium - Na	MILLIGRAM PER LITRE	mg/l		69.00000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	0211	Potassium	Potassium- K	MILLIGRAM PER LITRE	mg/l		5.15000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	0237	Magnesium	Magnesium-Mg	MILLIGRAM PER LITRE	mg/l		58.00000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	0241	Calcium	Calcium - Ca	MILLIGRAM PER LITRE	mg/l		175.00000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	3164	Chromium	Chromium -Cr	MICROGRAM PER LITRE	ug/l		10.00000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	6050	Manganese	Manganse-Mn	MICROGRAM PER LITRE	ug/l		1400.00000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	6051	Iron	Iron - as Fe	MICROGRAM PER LITRE	ug/l		6550.00000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	6452	Copper	Copper - Cu	MICROGRAM PER LITRE	ug/l		10.50000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	6455	Zinc	Zinc - as Zn	MICROGRAM PER LITRE	ug/l		120.00000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	6462	Nickel	Nickel - Ni	MICROGRAM PER LITRE	ug/l	<	30.00000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	7599	Laboratory Sample Number	Lab SAMP No	UNITLESS VALUE	UNITLESS		1.00000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	9584	Bicarbonate as HCO3	Bicarb HCO3	MILLIGRAM PER LITRE	mg/l		399.00000
28/01/1988	FRESHFIELD FARM (SD43/36)	SD4288430757	Groundwater	9992	Laboratory Sample Number : Nottingham OMR	OMR Smpl Num	NUMBER	NO.		0.00000

SD 43 SW 12

NOTE ON FIELD SLIP LANCASHIRE 60 NW(W)

SC - 21

Kirkham and Wesham Room and Power Co Ltd
Bankfield Mill [4179 3238]

W.B. bored by J. Thom

Drift to 144' 43·89
Red marl and sst alternating bands to 538' 163·98

No yield and not now used.

R.C.B.J. 2/40

[redacted] SD 43 SW/6 43243247
(For Survey use only)

GEOLOGICAL SURVEY OF GREAT BRITAIN

RECORD OF SHAFT OR BORE FOR MINERALS

6-inch Map Registered No.

Name of Shaft or Bore given by Geological Survey:
Kirkham B.H.

Name and Number given by owner:

Nat. Grid Reference
SD 4324/3247

1" N.S.Map No.	1" O.S.Map No.	Confidential or not

For whom made North Western Gas Board

Town or Village Kirkham County

Exact site { Attach a tracing from a map, or a sketch-map if possible.

Purpose for which made Test for underground gas storage

Ground Level at shaft bore relative to O.D. If not ground level give O.D. of beginning of shaft bore

Made by Foraky Date of sinking 1970

Information from Date received

Examined by A A Wilson

SPECIMEN NUMBERS AND ADDITIONAL NOTES

17 Spore samples for G Warrington at

234/6 (71.48 m)
302/9 (92.28 m)
461/0 (140.51 m)
523/6 (159.56 m)
631/0 (192.33 m)
682/0 (207.87 m)
732/6 (223.27 m)
861/0 (262.43 m)
1007/6 (307.09 m)
1048/0 (319.43 m)
1070/0 (326.14 m)
1111/0 (338.63 m)
1135/6 (346.10 m)
1154/5 (351.87 m)
1176/0 (358.44 m)
1199/7 (365.63 m)
1275/0 (388.62 m)

(For Survey use only) Geological Classification	Description of Strata	Thickness Ft.	Thickness In.	Depth Ft.	Depth In.
	Soil	0	9	0	9
		(0.23 m)		(0.23 m)	
	Clay		4	1	1
		(0.10 m)		(0.33 m)	
PEAT	Peat	17	5	18	6
		(5.31 m)		(5.64 m)	
	Sand and silty clay - samples as follows:				
GLACIAL SANDS AND SILTS	20/0 (6.10 m) fine-grained quartz sand				
	30/0 (9.14 m) probably sandy clay				
	40/0 (12.10 m) fine-grained sand				
	50/0 (15.24 m) coarse sand with rock fragments				
	60/0 (18.29 m) silty clay with very small pebbles				
	70/0 (21.34 m) fine-grained quartz sand				
	80/0 (24.38 m) silty clay with sand grains	66	6	85	0
		(20.27 m)		(25.91 m)	
BOULDER CLAY	Boulder clay - samples as follows:				
	90/0 (27.43 m) drab clay				
	100/0 (30.48 m) drab clay				
	107/0 (32.61 m) reddish-brown compact stony clay				
	carried forward			85	0

(60581/644410 3M 11/70 B&N Ltd. 3639

CONFIDENTIAL

Name and Number of Shaft or Borehole: Kirkham B.H.

6-in Map Registration No. SD43SW/6

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Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			85	0
				(25.91 m)	
	110/0 (33.53 m) pebbles in clay matrix				
	120/0 (36.58 m) pebbles in clay matrix	35	0	120.	0
		(10.67 m)		(36.58 m)	
MERCIA MUDSTONE GROUP [KEUPER MARL]	No recovery, marl	20	0	140	0
		(6.09 m)		(42.67 m)	
dip 15°? at 170/0 (51.82 m)	MUDSTONE, reddish-brown, structureless not silty, no gypsum veins	34	6	174	6
	MUDSTONE, reddish-brown, with some greenish grey, structureless	(10.52)		(53.19 m)	
		1	6	176	0
		(0.45 m)		(53.64 m)	
	MUDSTONE, reddish-brown, structureless slightly silty, with vague silty banding below 177/11 (54.23 m) (core removed from 176/5-177/11 - (53.77 - 54.23 m)	6	0	182	10
	MUDSTONE, reddish brown slightly silty, brecciated at least in part with scattered ~~clasts~~ fragments to 2 cm	(2.09m)		(55.73 m)	
		5	5	188	3
		(1.65 m)		(57.38 m)	
	MUDSTONE, with some siltstone, heavily brecciated reddish brown with some grey, clasts to 5 cm long include smashed sections of vein gypsum and siltstone, some of the latter being buckled	10	9	199	0
		(3.28 m)		(60.66 m)	
dip 55°	MUDSTONE, reddish-brown with some greenish-grey siltstone bands, gypsum veins to 1 cm are somewhat sheared and buckled and in places heavily fragmented	3	3	202	3
BRECKELLS MUDSTONES		(0.99 m)		(61.65 m)	
	MUDSTONE, reddish-brown, some gypsum veins to 1 cm, core smashed in drilling	2	6	204	9
		(0.76 m)		(62.41 m)	
dip 25°	MUDSTONE, reddish-brown well banded with greenish grey siltstone somewhat brecciated in part, low and high angle gypsum veins to 5 mm are buckled in places	2	3	207	0
		(0.68 m)		(63.09 m)	
	MUDSTONE, reddish-brown, silty in part, gypsum veins to 1 cm are crumpled in places, core broekn downwards	3	0	210	0
		(0.92 m)		(64.01 m)	
	carried forward			210	0
				(64.01 m)	

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Name and Number of Shaft or Borehole: Kirkham B.H.

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Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			210	0 (64.01 m)
BRECCIATED MUDSTONES	MUDSTONE reddish-brown with reddish-brown and grey fragments, heavily brecciated with signs of bedding, smashed in situ, in middle portion, low angle gypsum veins to 5 mm, some of them smashed	3	0 (0.91 m)	213	0 (64.92 m)
dip 45° (70° at top)	REDDISH brown mudstone, some bedding, seems brecciated in part	3	4 (1.02 m)	216	4 (65.94 m)
	MUDSTONE slightly silty, seems brecciated in part, no gypsum veins	3	0 (0.91 m)	219	4 (66.85 m)
dip 70°?	MUDSTONE, reddish brown nearly structureless gypsum veins to 4 mm	4	0 (1.22 m)	223	4 (68.07 m)
	No recovery	1	0 (0.31 m)	224	4 (68.38)
KIRKHAM BRECCIATED MUDSTONES	MUDSTONE, reddish-brown, increasingly well banded downwards with 30% greenish grey siltstone bands (dolomatic?) downwards, a few irregular gypsum veins to 1 cm and many 1 mm veins. A few greenish grey reduction spots	6	5 (1.95 m)	230	9 (70.33 m)
dip 48°	MUDSTONE greenish grey with some reddish brown banded with greenish-grey siltstone bands up to 6 cm thick, low angled and a few high angled gypsum veins to 1 cm	4	11 (1.50 m)	235	8 (71.83 m)
	MUDSTONE, silty reddish-brown banded with some greenish grey, low angle gypsum veins	3	4 (1.02 m)	239	0 (72.85 m)
	MUDSTONE, reddish-brown boldly banded with 30% greenish-grey siltstone, 5 mm gypsum veins, rare ripple mark	4	9 (1.45 m)	243	9 (74.30 m)
	MUDSTONE, grey, fine-grained		3 (0.07 m)	244	0 (74.37 m)
dip 55°	SILTSTONE, greenish grey banded with 40% reddish-brown and greenish-grey mudstone	1	0 (0.31 m)	245	0 (74.68 m)
	carried forward			245	0 (74.68 m)

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Name and Number of Shaft or Borehole: Kirkham B.H.

6-in Map Registration No. SD43SW/6

National Grid Reference

Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			245	0
				(74.68 m)	
dip 50°	MUDSTONE, reddish brown and greenish grey, boldly colour-banded with 20% (average) greenish grey siltstone bands, a few gypsum veins to 6 mm	5	3	250	3
		(1.60 m)		(76.28 m)	
	MUDSTONE, reddish-brown with wispy silty banding, gypsum veins to 4 mm	1	3	251	6
		(0.38 m)		(76.66 m)	
dip 50°	MUDSTONE, reddish-brown with some greenish-grey, boldly banded with 30% (average - reaching 70% near base) greenish-grey siltstone, mudcracks? cross the banding in many places, low angle gypsum veins to 1 cm	7	9	259	3
		(2.36 m)		(79.02 m)	
	MUDSTONE, chiefly reddish brown with scattered silty beds, dessication cracks? 1 cm wide cut silty bands, micro-ripple, salt pseudomorphs in siltstone, 2 mm gypsum veins near top only	4	3	263	6
		(1.29 m)		(80.31 m)	
	MUDSTONE, reddish brown, banded with 40% greenish grey siltstone in bands up to 0.18 m thick, gypsum veins to 5 mm	4	9	268	3
		(1.45 m)		(81.76 m)	
	MUDSTONE, greenish-grey banded (rather wispy), with some reddish-brown downwards, convolutions at 269/0 (81.99 m) a few gypsum veins to 5 mm	5	11	274	2
		(1.81 m)		(83.57 m)	
dip 50°	MUDSTONE, reddish-brown, banded with wispy siltstone bands coming in downwards (15%), gypsum nodules to 2 cm at 274/6 (83.07 m), gypsum veins up to 1 cm are especially common and ramifying between 274/6-275/6 (83.67-83.97 m), mudcracks?; convoluted bedding at 286/3 (87.25 m)	12	4	286	6
		(3.76 m)		(87.33 m)	
	carried forward			286	6
				(87.33 m)	

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Name and Number of Shaft or Borehole: Kirkham B.H.

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National Grid Reference

Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			286	6 (87.33 m)
	MUDSTONE, reddish-brown, structureless, with irregular gypsum veins with knots of gypsum where veins join, perhaps a breccia in part but no fragments seen	4	3 (1.30 m)	290	9 (88.62 m)
	MUDSTONE, reddish-brown, banded with 10% greenish-grey siltstone, greenish-grey reduction spots, a few irregular gypsum veins to 5 mm, 2 cm gypsum layer at 292/0 (89.00 m) associated with gypsum aggregates (nodules?)	5	9 (1.75 m)	296	6 (90.37 m)
	MUDSTONE, reddish-brown almost structureless with some wispy banding downwards, a few brecciated bands, irregular gypsum veins to 4 mm	3	1 (0.94 m)	299	7 (91.31 m)
	MUDSTONE, reddish-brown with greenish-grey banding, gypsum veins to 4 mm	1	1 (0.33 m)	300	8 (91.64 m)
	MUDSTONE, greenish-grey, silty in part, well banded with some dark grey fine-textured bands	3	0 (0.92 m)	303	8 (92.56 m)
consistently steep dips	MUDSTONE reddish-brown, structureless with signs of brecciation near base, a few greenish grey blotches, no gypsum veins above 308/0 (93.88 m) rare 4 mm veins below 308 (93.88 m)	7	4 (2.23 m)	311	0 (94.79 m)
	MUDSTONE, reddish-brown with greenish grey siltstone bands, middle beds are richest in siltstone and are buckled and brecciated, gypsum veins rare	5	0 (1.53 m)	316	0 (96.32 m)
dip 40°	MUDSTONE greenish grey, banded, with silty layers, a few low angle gypsum veins, a few clots of gypsum where veins meet at 319/9 (97.46 m)	4	10 (1.47 m)	320	10 (97.79 m)
	carried forward			320	10 (97.79 m)

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Name and Number of Shaft or Borehole: Kirkham B.H.

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Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			320 (97.79 m)	10
	MUDSTONE, reddish-brown structureless, scattered gypsum veins to 1 cm except at 322/6 - 324/0 (98.30 - 98.76 m) where ramifying veins enclose irregular areas of unveined mudstone	11 (3.58 m)	9	332 (101.37 m)	7
	MUDSTONE, reddish-brown, banded with 40% greenish-grey siltstone	1 (0.33 m)	1	333 (101.70 m)	8
dip 65°	MUDSTONE, greenish-grey with some reddish-brown bands, banded with 30% greenish-grey siltstone, some bedding disturbance downwards, a few irregular gypsum veins	11 (3.35 m)	0	344 (105.05 m)	8
dips up to 75°	MUDSTONE, reddish brown streaky fabric with greenish grey siltstone bands (averaging 30%, reaching 50% near base) banding becoming bolder and finer downwards, horizontal shears in middle beds some siltstone bands seem brecciated	7 (2.16 m)	1	351 (107.21 m)	9
	MUDSTONE, reddish-brown; greenish grey below 356/7 (108.69 m) irregularly banded with 15% siltstone, gypsum veins to 5 mm	6 (1.83 m)	0	357 (109.04 m)	9
dip 35°	MUDSTONE reddish brown, with a little greenish grey at top unevenly banded with 25% greenish-grey siltstone bands, scattered short and irregular gypsum veins with a plexus of veins around 361/0 (110.03 m)	7 (2.14 m)	0	364 (111.18 m)	9
	SAMPLE MISSING	1 (0.43 m)	5	366 (111.61 m)	2
	MUDSTONE, greenish grey, seems heavily microbrecciated with some fragments up to 3 cm	1 (0.48 m)	7	367 (112.09 m)	9
	carried forward			367 (112.09 m)	9

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Name and Number of Shaft or Borehole: Kirkham B.H.

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Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			367	9
				(112.09 m)	
	MUDSTONE, reddish-brown with some grey around 372/0 (113.39 m), probably brecciated throughout, rich in crystalline gypsum at several levels, almost all gypsum from 368/6-368/9 (112.32 - 112.40 m)	6	3	374	0
		(1.91 m)		(114.00 m)	
dip seems c 40°	MUDSTONE reddish brown, brecciated in part with a few irregular greenish-grey silty bands. Crystalline (porphroblast) gypsum in vaguely banded form with signs of enterolithic folding	7	0	381	0
		(2.13 m)		(116.13 m)	
	MUDSTONE, reddish brown, structureless, crudely bands of gypsum crystals (porphroblasts)	1	4	382	4
		(0.41 m)		(116.54 m)	
	MUDSTONE, reddish-brown seems brecciated with c 30% areas of ramifying gypsum, crudely banded	3	8	386	0
		(1.11 m)		(117.65 m)	
dip 20°	MUDSTONE, reddish-brown seems brecciated with some wispy banding, a few crude beds up to 4 cm thick of gypsum aggregates	5	6	391	6
		(1.68 m)		(119.33 m)	
	MUDSTONE, reddish brown streaky fabric with a few irregular bands and areas of greenish-grey, 20% siltstone bands at top, signs of brecciation at top, a few gypsum veins, a few crude beds rich in gypsum aggregates	8	9	400	3
		(2.67 m)		(122.0 m)	
	SAMPLE MISSING	1	4	401	7
		(0.40 m)		(122.40 m)	
	MUDSTONE, reddish-brown, rich in ramifying masses of gypsum crystals (30% of whole rock)	1	5	403	0
		(0.43 m)		(122.83 m)	
dip c 40°	MUDSTONE reddish-brown and greenish-grey in alternation, signs of discordance (slippage) at one colour junction	2	7	405	7
		(0.79 m)		(123.62 m)	
	carried forward			405	7
				(123.62 m)	

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National Grid Reference

Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			405	7 (123.62 m)
dip 17°	MUDSTONE reddish-brown with some greenish grey patches seems brecciated, otherwise structureless, gypsum veins very rare except for a ramifying plexus around 410/0 (124.97 m)	5 (1.70 m)	7	411	2 (125.32 m)
	MUDSTONE reddish-brown with 40% crystalline gypsum in rather irregular masses but with definite signs of bedding	3 (1.01 m)	4	414	6 (126.34 m)
	MUDSTONE, greenish-grey irregularly banded with 13 cm band with 60% irregular crystalline gypsum	1 (0.38 m)	3	415	9 (126.72 m)
	MUDSTONE, reddish-brown with some greenish-grey, probably brecciated at least in part, scattered levels rich in irregular ramifications of gypsum	12 (3.66 m)	0	427	9 (130.38 m)
LEVEL AT WHICH PRESSAM SAMP SHOULD OCCUR	MUDSTONE, reddish-brown, vague indications of bedding, irregular bands up to 10 cm thick rich in crystalline gypsum, especially abundant (80%) from 436/2-436/11 (132.94-133.17 m)	9 (2.79 m)	2	436	11 (133.17 m)
dip 50° decreasing gradually to 15° downwards	MUDSTONE, reddish-brown, with a few greenish grey bands heavily microbrecciated, irregular areas of crystalline gypsum (40%) with vague indications of banding, some bands soft and clayey are possibly residual after halite, a few small voids could be after halite	13 (3.99 m)	1	450	0 (137.16 m)
	MUDSTONE reddish-brown and greenish-grey, probably brecciated, scattered gypsum morphroblasts	1 (0.53 m)	9	451	9 (137.69 m)
dip seems c 20°	MUDSTONE, reddish-brown with some greenish-grey between 452/9-455/10 (138.00-138.94 m) gypsum rare brecciated, heavily in places, with semblance of bedding below 457/4 (139.40 m)	8 (2.59 m)	6	460	3 (140.28 m)
	carried forward			460 (140.28 m)	3

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Name and Number of Shaft or Borehole: Kirkham B.H.

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National Grid Reference

Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			460 (140.28 m)	3
	MUDSTONE, greenish-grey, a few low angled gypsum veins to 2 cm	1 (0.44 m)	5	461 (140.72 m)	8
	MUDSTONE, reddish-brown, structureless, low angle gypsum veins to 1 cm chiefly in upper beds	3 (1.06 m)	6	465 (141.78 m)	2
	MUDSTONE, silty, reddish-brown	2 (0.71 m)	4	467 (142.49 m)	6
	SAMPLE MISSING	(0.26 m)	10	468 (142.75 m)	4
	MUDSTONE reddish-brown with some greenish-grey at base, gypsum veins to 1½ cm	1 (0.56 m)	10	470 (143.31 m)	2
	MUDSTONE, reddish-brown, brecciated, especially downwards, fragments to 2 cm, irregular gypsum veins to 1 cm	4 (1.34 m)	5	474 (144.65 m)	7
	MUDSTONE, reddish-brown, structureless many gypsum veins to 5 mm, seems disturbed	(0.23 m)	9	475 (144.88 m)	4
dip c 45° except at base	MUDSTONE, greenish-grey and reddish-brown, banded, somewhat disturbed especially at base (contact dips at 70°) very many gypsum veins to 2 cm	3 (0.97 m)	2	478 (145.85 m)	6
	MUDSTONE, greenish-grey banded with siltstone near top, a few gypsum veins to 1 cm	2 (0.66 m)	2	480 (146.51 m)	8
	MUDSTONE reddish-brown structureless, gypsum veins to 1 cm	3 (0.96 m)	2	483 (147.47 m)	10
	SAMPLES MISSING	2 (0.82 m)	8	486 (148.29 m)	6
	MUDSTONE, reddish-brown, largely structureless, but sporadically banded, signs of brecciation with irregular masses of gypsum, scattered gypsum veins throughout	8 (2.46 m)	1	494 (150.75 m)	7
	carried forward			494 (150.75 m)	7

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Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			494 (150.75 m)	7
	GYPSUM or anhydrite, pinkish-grey irregularly banded		7 (0.18 m)	495 (150.93 m)	2
	MUDSTONE, reddish-brown, structureless with rare greenish-grey bands in above 499/10 (152.35 m), gypsum veins to 1 cm, becoming abundant and rather irregular (possibly brecciation) around 503/0-503/9 (153.31-153.54 m)	9 (2.84 m)	4	504 (153.77 m)	6
dip 32°	MUDSTONE, reddish-brown, banded with a few indistinctly defined greenish grey and reddish-brown silty layers, signs of brecciation at 509/0-509/6, (155.14-155.30 m) a few low angled gypsum veins to 1 cm	6 (1.83 m)	0	510 (155.60 m)	6
	MUDSTONE reddish-brown with some greenish grey, reddish-brown siltstone bands downwards, brecciated in varying degree	2 (0.69 m)	3	512 (156.29 m)	9
dip 45°	MUDSTONE reddish-brown boldly banded with 50% reddish-brown and greenish grey siltstone bands, a few salt pseudomorphs on bedding planes, a few gypsum veins to 1 cm, becoming twisted and fractured (of Flexible Limestone of Durham) below 515/0 (156.97 m)	3 (1.04 m)	5	516 (157.33 m)	2
KIRKHAM MUDSTONES	SILTSTONE greenish-grey boldly banded with 30% greenish-grey and reddish-brown mudstone bands	2 (0.68 m)	3	518 (158.01 m)	5
	MUDSTONE, greenish-grey, with a little reddish-brown, banded in varying degree, with siltstone bands downwards, small load casts	3 (1.04 m)	5	521 (159.05 m)	10
dip 43°	SILTSTONE greenish grey bodly banded with 30% greenish-grey mudstone gypsum veins to 1 cm only at top	4 (1.27 m)	2	526 (160.32 m)	0
	carried forward			526 (160.32 m)	0

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Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			526	0
				(160.32 m)	
	SILTSTONE, greenish grey with reddish tinge downwards boldly banded with 40% reddish brown mudstone ripples?, small faults and load casts gypsum veins only near base	3	0	529	0
		(0.92 m)		(161.24 m)	
dip 35°	SILTSTONE, greenish-grey boldly banded with individual beds up to 6 in (0.15 m) thick with 40% greenish-grey mudstone, reddish brown in part near top, a few low angle gypsum veins to 1 cm, load casts, ripples	12	6	541	6
		(3.81 m)		(165.05 m)	
	SILTSTONE, greenish-grey well banded with 50% reddish brown and rare dark grey mudstone partings rare load casts rare dessication cracks? rare gypsum veins to 5 mm, a few 1 cm throw faults	2	8	544	2
		(0.81 m)		(165.86 m)	
	SAMPLE MISSING	1	4	545	6
		(0.41)		(166.27 m)	
	MUDSTONE reddish-brown structureless a few gypsum veins to 5 mm rare fish eyes	1	4	546	10
		(0.40 m)		(166.67 m)	
dip 37°	SILTSTONE, pale reddish-brown with average of 40% reddish brown mudstone beds, chiefly in lower beds a few pinhole voids (after halite?) a few gypsum veins to 8 mm load casts	2	10	549	8
		(0.87 m)		(167.54 m)	
	MUDSTONE, reddish-brown banded with 40% greenish grey and some pale reddish-brown siltstone bands, mudcracks?, gypsum veins rare except near base; with etched out 5 mm halite veins near base	8	4	558	0
		(2.54 m)		(170.08 m)	
dip 38°	MUDSTONE, greenish-grey well banded with 30% greenish-grey siltstone bands attaining 50% downwards, gypsum veins to 1 cm with halite selvage to gypsum, especially downwards, siltstone band at 563/4-563/9 (171.70-171.83 m)	8	9	566	9
		(2.67 m)		(172.75 m)	
	carried forward			566 (172.75 m)	9

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Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			566 (172.75 m)	9
	SILTSTONE, greenish-grey, banded becoming bolder near base with 20% greenish grey mudstone bands (40% from 566/9-568/6) up to 10 cm thick, a few load casts, ripplemark, micro-ripplemark below 572/0 (174.35 m) some sheeny mica, a few pinhole voids (after halite?) near base, a few low angle gypsum veins becoming very rare downwards organic trail at 575/4 (175.36 m), plant fragment at 575/6 (175.41 m)	9 (2.79 m)	2	575 (175.54 m)	11
	MUDSTONE, reddish-brown with abundant irregularly shaped gypsum nodules to 5 cm	(0.18 m)	7	576 (175.72 m)	6
	SILTSTONE, greenish grey, passing down into reddish brown, banded with reddish-brown mudstone, gypsum veins chiefly near top connect up with the nodules above, some sheeny mica	3 (1.06 m)	6	580 (176.78 m)	0
	MUDSTONE reddish-brown with 20% reddish-brown siltstone bands dying out downwards	2 (0.69 m)	3	582 (177.47 m)	3
	SILTSTONE pale reddish brown and reddish-brown mudstone, wavy banding, podding and contortion of silt gypsum veins to 1½ cm	(0.28 m)	11	583 (177.75 m)	2
	SILTSTONE, greenish grey well banded with 20% greenish grey mudstone bands, a few pinhole voids, rare gypsum veins to 1 cm	2 (0.86 m)	10	586 (178.61 m)	0
dip 35°	SILTSTONE, pale reddish-brown, bolding banded with 40% reddish-brown mudstone numerous good ripplemarks. A few gypsum veins to 1 cm and halite veins to 2 mm (etched out)	2 (0.71 m)	4	588 (179.32 m)	4
	MUDSTONE, reddish-brown, vaguely banded with wiltstone, a few gypsum veins to 5 mm	2 (0.82 m)	8	591 (180.14 m)	0
	carried forward			591 (180.14 m)	0

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Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			591	0 (180.14 m)
	MUDSTONE, reddish-brown, structureless, a few low angle gypsum veins to 1 cm, very rare 1 mm low angle halite veins (voids), gypsum nodules to 2 cm from 594/9-595/0 (181.28-181.36 m)	4	0 (1.22 m)	595	0 (181.36 m)
	SILTSTONE pale reddish-brown, wavily banded with 40% reddish-brown mudstone, a few halite and halite/gypsum veins to 1 cm, small pinhole voids. Nodules? of gypsum associated with plexus of veins and bedding disturbance at 601/4-601/8 (183.29-183.39 m)	8	0 (2.43 m)	603	0 (183.79 m)
	SILTSTONE, reddish-brown, podded and irregularly banded with 50% reddish-brown mudstone, many gypsum veins to 1 cm	1	2 (0.36 m)	604	2 (184.15 m)
	SILTSTONE, greenish-grey, well banded with 50% greenish-grey mudstone, showing some podded fabric. Numerous low angled gypsum veins to 1 cm, with halite cross connectors up to 5 mm thick	3	10 (1.17 m)	608	0 (185.32 m)
dip 38°	MUDSTONE greenish-grey, boldly banded with 40% greenish-grey siltstone bands, a few load casts and mudcracks? A few gypsum and gypsum/halite veins (halite etched out)	6	6 (1.98 m)	614	6 (187.30 m)
dip 34°	SILTSTONE, reddish brown and greenish-grey boldly banded with 50% alternating runs of reddish-brown and greenish grey mudstone, a few halite veins (voids) to 5 mm, low angled gypsum veins to 1 cm, nodular gypsum at four levels between 614/8-617/8 (187.35-188.26 m)	6	2 (1.88 m)	620	8 (189.18 m)
	SILTSTONE, greenish-grey boldly banded with 50% reddish-brown mudstone, mudcracks?, discontinuous gypsum layer 1 cm thick at 621/9 (189.51 m)	2	4 (0.71 m)	623	0 (189.89 m)
	carried forward			623	0 (189.89 m)

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Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward	2 (0.71 m)	4	623 (189.89 m)	0
	Mudstone, reddish-brown well banded with 40% - 50% pale reddish-brown siltstone bands mud cracks? slight convolutions, a few etched out halite veins in upper half, a few gypsum veins to 1 cm in lower half, 1 cm tonstein-like band at 627/6 (191.26m)	8 (2.44 m)	0	631 (192.33 m)	0
	Mudstone, reddish-brown and greenish grey, well bedded with 30 - 50% siltstone bands (highest proportion downwards) a few low angle gypsum veins to 1.5 cm.	4 (1.22 m)	0	635 (193.55 m)	0
	Mudstone, reddish-brown, banded with reddish brown siltstone, gypsum nodules to 2 cm of irregular shape.	1 (0.30 m)	0	636 (193.85 m)	0
	Mudstone, reddish-brown with wispy siltstone bands near top, gypsum nodules to 2 cm near bottom	3 (0.97 m)	2	639 (194.82 m)	2
KIRKHAM MUDSTONES.	Mudstone, reddish-brown with reddish brown siltstone bands increasing to 70% downwards. Ripple mark. Gypsum/halite veins to 2 cm (halite member to 5 mm) Gypsum nodules to 1 cm at 641/3 (195.45 m)	2 (0.81 m)	8	641 (195.63 m)	10
dip 40°	Mudstone, reddish-brown, structureless, a few low angle gypsum veins to 4 mm	1 (0.41 m)	4	643 (196.04 m)	2
	Mudstone, reddish-brown, becoming boldly banded downwards with siltstone attaining 50% downwards ripple mark, mud cracks? a few gypsum/halite veins to 1 cm, gypsum nodules to 1 cm at 646/0 (196.90 m)	5 (1.52 m)	0	648 (197.56 m)	2
	Mudstone, reddish-brown with wispy siltstone bands, gypsum and gypsum/halite veins to 1 cm	1 (0.56 m)	10	650 (198.12 m)	0
	Siltstone greenish grey with a little reddish-brown banded with 30% greenish grey mudstone bands attaining 50% below 655/4 (199.75 m),				
	Carried forward			650 (198.12 m)	0

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Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			650	0
				(198.12 m)	
	banding bolder downwards, rather wispy near top many low angled gypsum veins to 2 cm with rare halite a few small salt pseudomorphs	6	10	656	10
		(2.08 m)		(200.20 m)	
	Siltstone, greenish-grey boldly banded with 40% greenish-grey mudstone, mudcracks, a few low angle gypsum veins	2	2	659	0
		(0.66 m)		(200.86 m)	
	Siltstone, greenish-grey and reddish-brown with 20% mudstone bands, seems collapsed, with small faults, numerous low angled gypsum veins to 1 cm	1	7	660	7
		(0.47 m)		(201.35 m)	
	Siltstone, greenish-grey well banded with 20% greenish-grey mudstone bands. Individual siltstone bands to 5 cm. Low angle gypsum/halite veins. Bedding disturbed and faulted, probably by collapse.	3	11	664	6
		(1.19 m)		(202.54 m)	
dip 40°	Siltstone, well banded with 50% reddish-brown mudstone bands, attaining 60% below 666/6 (203.15 m), ripple marks, a few gypsum/halite veins.	3	4	667	10
		(1.02 m)		(203.56 m)	
	Mudstone reddish-brown vaguely banded with 40% wispy siltstone bands	3	11	671	9
	Siltstone pale reddish brown well banded with reddish-brown mudstone bands, 40% above 678/0 (206.65 m), 50% below 678/0 (206.65 m), 2 cm gypsum nodules at 676/5, 676/8, 678/10 (206.17, 206.25, 206.91 m), numerous mud cracks?, slight convolutions, a few low angle gypsum veins downwards, some mud cracks have gypsiferous infillings.	9	1	680	10
		(2.77 m)		(207.52 m)	
	Mudstone, greenish grey boldly banded with 40% greenish grey siltstone bands, includes a 2 cm layer of gypsum.	1	5	682	3
	Carried forward	(0.43 m)		(207.95 m)	

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Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			682	3
				(207.95 m)	
dip 47°	Siltstone, greenish-grey, wispy banding, 10% greenish-grey mudstone bands downwards gypsum/halite veins to 2 cm. Some convoluted bedding near top of siltstone.	2	8	684	11
		(0.81 m)		(208.76 m)	
	Siltstone, greenish-grey with 50% greenish-grey mudstone (less near top, more near bottom) well banded with crinkly banding in part, a few low angle gypsum veins.	4	3	689	2
		(1.30 m)		(210.06 m)	
	Siltstone, reddish-brown with 20% wispy reddish-brown mudstone bands, scattered 2cm gypsum nodules above 691/0 (210.62 m), no vein gypsum	3	3	692	5
		(0.99 m)		(211.05 m)	
	Siltstone pale reddish-brown, well banded with 20% reddish-brown mudstone.	2	7	695	0
		(0.79 m)		(211.84 m)	
	Siltstone greenish-grey, well banded with 40% greenish-grey mudstone with a few reddish-brown bands slight convolutions, superb ripplemark, cross lamination and cut and fill structures at 697/6 (212.60 m) birds-eye? at 701/10 (213.92 m). Individual siltstone bands to 8 cm low angle gypsum veins to 3cm, with some halite.	7	0	702	0
		(2.13 m)		(213.97 m)	
	Siltstone reddish-brown, banded with 40% reddish-brown mudstone layers a few grey bands near base. Superb ripplemarks above 708/0 (215.80 m), rare below 708/0 (215.80 m), mud-cracks? associated with up-doming. Gypsum nodules to 2 cm at 704/2, 706/9 (214.63, 215.42 m). Layers of gypsum to 1 cm at 707/0,-707/2 (215.49 - 215.54 m). A few low angle halite veins to 5 mm.	7	7	709	7
		(2.31 m)		(216.28 m)	
	Siltstone, greenish-grey with 40% greenish-grey mudstone bands including some reddish-brown mudstone below 718/9 (219.08 m), a few				
	Carried forward			709	7

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Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			709	7
dip 40°	convolutions, thin gypsum bands at 713/4, 713/6, (217.42, 217.47 m), gypsum nodules at 711/6, 714/3 (216.87, 217.70 m), some brecciation between 718/9 – 722/8 (219.08–220.27 m) a few gypsum veins to 1½ cm.	13	9	723	4
		(4.19 m)		(220.47 m)	
	Mudstone, reddish-brown, faulted at top (possibly tectonic).	1	1	724	5
		(0.33 m)		(220.80 m)	
	Mudstone, reddish-brown, structureless with 40% wispy siltstone beds above 725/4 (221.08 m) a few gypsum veins to 5 mm	3	9	728	2
		(1.15 m)		(221.95 m)	
	Mudstone, reddish-brown with 20% siltstone bands, faulted base may be collapse, a few gypsum veins.	2	1	730	3
		(0.63m)		(222.58 m)	
	Siltstone greenish-grey with 35% greenish-grey mudstone bands, banding rather indistinct, becoming bold downwards, increasingly collapsed and brecciated downwards, but banding still visible.	3	10	734	1
		(1.17m)		(223.75 m)	
dip 30°	Siltstone greenish-grey with 50% greenish-grey mudstone bands, with a little reddish-brown mudstone disturbed as if by penecontemporaneous faulting at two levels, brecciation associated in one instance with 4 cm gypsum vein, rare low angle halite veins to 5 mm.	3	8	737	9
		(1.19m)		(224.87 m)	
	Siltstone, greenish-grey, banded with 20% greenish-grey mudstone passing down into reddish-brown mudstone, more or less brecciated, especially near base, low angle gypsum veins to 5 mm.	1	1	738	10
		(0.33m)		(225.20 m)	
	Mudstone, reddish-brown, brecciated, angular fragments to 3 cm.	1	0	739	10
		(0.30m)		(225.50 m)	
	Siltstone greenish-grey, with 40% greenish-grey mudstone bands above 742/4 (226.26 m)				
	Carried forward			739	10

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Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			739	10
				(225.50 m)	
	and below 744/2 (226.82 m), brecciation-in-situ (with plastic distortion of fragments) above 742/4 (226.26 m). This breccia intrudes downwards into the bed below.				
	Rare gypsum veins to 1 cm.	5	0	744	10
				(227.03 m)	
Vague dip 70°	Mudstone, greenish-grey and reddish-brown, brecciated.	1	2	746	0
		(0.35 m)		(227.38 m)	
	Mudstone, reddish-brown and greenish-grey banded.	2	0	748	0
		(0.61 m)		(227.99 m)	
	Mudstone, reddish-brown with some greenish-grey, brecciated, with signs of disturbed bedding in parts, breccia fragments 1 mm - 4 cm, a few gypsum veins to 1 cm.	1	10	749	10
		(0.56 m)		(228.55 m)	
	Mudstone, reddish-brown, almost structureless with a little wispy silt, bedding vague and possibly disturbed, a few gypsum veins to 1 cm.	2	4	752	2
		(0.71 m)		(229.26 m)	
	Sample missing	1	7	753	9
		(0.48 m)		(229.74 m)	
	Mudstone, reddish-brown with greenish-grey silty blotches, brecciated, fragments to 4cm	5	3	759	0
		(1.60 m)		(231.34 m)	
	Mudstone, reddish-brown, a few greenish-grey blotches, structureless. A few gypsum veins to 2 cm.	2	8	761	8
		(0.82 m)		(232.16 m)	
	Siltstone, pale reddish-brown with 40% reddish-brown silty mudstone, streaky fabric with breccia fragments to 2 cm, vague signs of bedding, becoming better defined below 768/0½, (234.40 m) 4 cm low angle vein of fibrous gypsum at 767/11 - 468/0½ (234.06 - 234.10 m).	7	10	769	6
		(2.38 m)		(234.54 m)	
	Carried forward			769	6
				(234.54 m)	

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CORRELATION IN CONFIDENCE

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Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			769	6
				(234.54 m)	
	Mudstone, reddish-brown, structureless, a few greenish-grey blotches, a few gypsum veins to 5 mm.	2	0	771	6
		(0.61 m)		(235.15 m)	
	Siltstone, pale greenish-grey and pale reddish-brown with 50% reddish-brown mudstone; brecciated and disturbed, vague signs of bedding, irregular gypsum veins, becoming more common downwards.	5	2	776	8
		(1.58 m)		(236.73 m)	
	Siltstone, greenish-grey, banded with greenish-grey mudstone.		8	777	4
		(0.20 m)		(236.93 m)	
	Mudstone, reddish-brown structureless, a few gypsum veins to 1 cm.	4	5	781	9
		(1.35 m)		(238.28 m)	
	Mudstone, silty, reddish-brown, with blotches of greenish-grey, disturbed fabric with some breccia fragments visible, a few irregular gypsum veins to 2 cm.	4	3	786	0
		(1.29 m)		(239.57 m)	
	Mudstone, reddish-brown, structureless with a few greenish-grey patches and signs of brecciation below 790/5 (240.92 m) a few gypsum veins to 3 cm.	8	8	794	8
		(2.64 m)		(242.21 m)	
dip 35°	Siltstone, greenish-grey, banded with reddish-brown mudstone, some brecciated patches, a few irregular gypsum veins to 5 cm.	1	6	796	2
		(0.46 m)		(242.67 m)	
	Mudstone, reddish-brown, structureless, a few irregular gypsum veins to 1 cm, a few silty bands below 804/10 (245.31 m)	10	4	806	6
		(3.15 m)		(245.82 m)	
	Mudstone, reddish-brown well banded with 30% greenish-grey and reddish-brown siltstone bands.	1	5	807	11
		(0.43 m)		(246.25 m)	
	Mudstone, reddish-brown with a few wispy greenish-grey and reddish-brown siltstone				
	Carried forward			807	11
				(246.25 m)	

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Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			807	11
				(246.25 m)	
	bands, a few gypsum veins to 5 mm.	1	2	809	1
		(0.36 m)		(246.61 m)	
	Mudstone, reddish-brown wispy texture, a few irregular gypsum veins to 2 cm.	3	0	812	1
		(0.91 m)		(247.52 m)	
	Siltstone, reddish-brown well banded with 50% reddish-brown mudstone, slight brecciation or mud crack, irregular gypsum veins to 5mm.	2	5	814	6
		(0.74 m)		(248.26 m)	
	Mudstone, reddish-brown silty, banded with disturbed bedding and brecciation of siltstone bands into 4 cm fragments irregular gypsum veins to 5 mm.	2	10	817	4
		(0.86 m)		(249.12 m)	
dip 20°	Mudstone, reddish-brown banded with 30% greenish-grey siltstone, a few gypsum veins to 5 mm.	1	6	818	10
		(0.46 m)		(249.58 m)	
	Mudstone, reddish-brown, nearly structureless, traces of bedding, a few gypsum veins to 1cm	4	0	822	10
		(1.22 m)		(250.80 m)	
	Mudstone, reddish-brown with greenish-grey and reddish-brown siltstone bands with some brecciated patches below 824/0 (251.16 m) a few gypsum veins to 3 cm.	3	4	826	2
		(1.02 m)		(251.82 m)	
	Mudstone, reddish-brown, with a few greenish-grey blotches, structureless, a few gypsum veins to 1 cm.	5	10	832	0
		(1.77 m)		(253.59 m)	
dip 40°	Mudstone, reddish-brown, banded with reddish-brown and greenish-grey silty bands, bedding broken near middle a few gypsum veins to 4mm	3	8	835	8
		(1.12 m)		(254.71 m)	
dip 70°	Mudstone, reddish-brown, vaguely banded, high dips probably due to collapse.	2	10	838	6
		(0.86 m)		(255.57 m)	
dip c 40°	Siltstone, reddish-brown with 50% reddish-brown mudstone bands, a few low angle gypsum veins.	3	8	842	2
	Carried forward	(1.12 m)		(256.69 m)	

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Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			842	2
				(256.69 m)	
	Mudstone, reddish-brown with greenish-grey siltstone bands, chiefly near top, rare below 845/0 (257.56 m) a few gypsum veins to 1 cm.	5	8	847	10
		(1.73 m)		(258.42 m)	
	Siltstone, reddish-brown banded with 20% reddish-brown mudstone, incipient brecciation-in-situ, bedding twisted, gypsum veins to 5 mm.	1	1	848	11
		(0.33 m)		(258.75 m)	
	Mudstone, reddish-brown rather silty structureless.	1	2	850	1
		(0.36 m)		(259.11 m)	
	Mudstone, silty, reddish-brown, banded with signs of collapse, a few gypsum veins to 4mm	4	3	854	4
		(1.29 m)		(260.40 m)	
dip 35°	Siltstone, reddish-brown, with some greenish-grey upwards banded with reddish-brown mudstone 50%, falling to 20% downwards, probable ripple mark, a few low angle gypsum veins.	3	10	858	2
		(1.17 m)		(261.57 m)	
	Mudstone, reddish-brown, faintly banded, a few gypsum veins to 2 cm.	2	8	860	10
		(0.81 m)		(262.38 m)	
dip 25°	Siltstone, greenish-grey, banded with 20% greenish-grey mudstone, low angle gypsum veins to 1 cm.	2	6	863	4
		(0.76 m)		(263.14 m)	
	Siltstone, reddish-brown and mudstone, seems brecciated with signs of bedding, irregular gypsum veins to 1½ cm.	1	4	864	8
		(0.41 m)		(263.55 m)	
	Siltstone, pale reddish-brown, blotchy staining	2	1	866	9
		(0.64 m)		(264.19 m)	
	Mudstone, reddish-brown, structureless except for some silty banding above 867/10 (264.52 m) signs of incipient brecciation-in-situ a few irregular gypsum veins to 3cm	7	3	874	0
		(2.21 m)		(266.40 m)	
	Carried forward			874	0

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	Brought Forward			874	0
				(266.40 m)	
	Mudstone, reddish-brown, poorly banded with several concentrations of greenish-grey and reddish-brown siltstone bands, one 4 cm gypsum vein.	4	6	878	6
		(1.37 m)		(267.77 m)	
	Mudstone, reddish-brown with wispy silt bands near middle and base, fabric disturbed in places (buckling) and also some brecciation, irregular gypsum veins to 2 cm.	3	0	881	6
		(0.91 m)		(268.68 m)	
	Mudstone, reddish-brown, structureless, irregular gypsum veins to 1 cm, some of which are faulted up to 2 cm.	4	9	886	3
		(1.45 m)		(270.13 m)	
	Mudstone, reddish-brown, rather silty, structureless except for a few irregular bands of greenish-grey siltstone above 892/0 (271.88 m); one such siltstone band 4 cm thick is broken into fragments up to 6 cm long a few gypsum veins to 5 mm.	9	9	896	0
		(2.97 m)		(273.10 m)	
dip 65° some bedding disturbance hereabouts.	Mudstone, reddish-brown faintly banded 25% reddish-brown siltstone bands a few gypsum veins to 5 mm.	3	1	899	1
		(0.94 m)		(274.04 m)	
SINGLETON MUDSTONE.	Mudstone, reddish-brown, faintly banded, wispy siltstone bands below 903/0 (275.23 m), signs of brecciation from 899/1 - 903/0 (274.04 - 275.23 m), brecciated with fragments to 4 cm from 906/0 - 907/2 (276.15 - 276.50 m).	8	11	908	0
		(2.72 m)		(276.76 m)	
	Mudstone, reddish-brown, somewhat silty, structureless, a few gypsum veins to 2 cm.	2	4	910	4
		(0.71 m)		(277.47 m)	
	Siltstone, with mudstone bands, banded reddish-brown and greenish-grey.		8	911	0
		(0.20 m)		(277.67 m)	
	Mudstone, reddish-brown, structureless core broken and listric downwards, gypsum veins				
	Carried forward			911	0

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	Brought Forward			911	0
				(277.67 m)	
	to 1 cm in lower beds.	2	10	913	10
		(0.86 m)		(278.54 m)	
	Mudstone, reddish-brown and siltstone reddish-brown, all more or less brecciated, especially downwards, fragments to 4 cm, a few irregular gypsum veins to 1 cm.	3	2	917	0
		(0.97 m)		(279.50 m)	
	Mudstone, reddish-brown, structureless, a few gypsum veins to 5 mm.	3	4	920	4
		(1.02 m)		(280.52 m)	
	Siltstone, reddish-brown and greenish-grey (downwards) banded with mudstone, reddish-brown, brecciated and collapsed with bedding twisted in all directions, basal contact irregular, a few gypsum veins to 3 cm.	4	8	925	0
		(1.42 m)		(281.94 m)	
	Siltstone, greenish-grey well banded with 30% greenish-grey mudstone bands, some wispy bedding and 'flame' structures, signs of minor collapse in bedding, a few gypsum veins up to 4 cm, granular banded gypsum present between 925/0 - 925/6 (281.94-282.09m)	1	8	926	8
		(0.51 m)		(282.45 m)	
dip 50°	Mudstone, reddish-brown with 20% reddish-brown siltstone bands, well banded above 929/0 (283.16 m), but more wispy and indistinct below 929/0 (283.16 m), rare gypsum veins to 3 cm, ripple mark in lower half.	9	4	936	0
		(2.84 m)		(285.29 m)	
	Siltstone, reddish-brown and 50% reddish-brown mudstone, brecciated, gypsum vein.	1	9	937	9
		(0.54 m)		(285.83 m)	
	Mudstone, reddish-brown, structureless, gypsum veins to 1 cm chiefly near base.	1	5	939	2
		(0.43 m)		(286.26 m)	
	Siltstone, reddish-brown and reddish-brown mudstone wispy texture with some brecciation downwards.	1	1	940	3
		(0.33 m)		(286.59 m)	
	Mudstone, reddish-brown with much greenish-				
	Carried forward			940	3

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	Brought Forward			940	3
				(286.59 m)	
	grey siltstone (80% between 944/3 - 945/6 - 287.81 - 288.19 m), brecciated with signs of bedding, angular fragments 1 - 10 cm, a few irregular gypsum veins chiefly in upper half and some interstitial gypsum in breccia.	8	5	948	8
		(2.56 m)		(289.15 m)	
	Siltstone, greenish-grey banded with 20% greenish-grey mudstone, some crinkly bedding.	1	4	950	0
		(0.41 m)		(289.56 m)	
	Siltstone, greenish-grey with 40% reddish-brown mudstone bands, signs of buckling and collapse, rare gypsum veins.	1	8	951	8
		(0.51 m)		(290.07 m)	
	Mudstone, reddish-brown, structureless, a few greenish-grey blotches, some in situ brecciation downwards, no gypsum veins.	2	0	953	8
		(0.61 m)		(290.68 m)	
	Siltstone, greenish-grey boldly banded with 40% reddish-brown mudstone partings, some local brecciation, ripple mark, false bedding, poor salt pseudomorphs no gypsum veins	5	2	958	10
		(1.57 m)		(292.25 m)	
	Mudstone, reddish-brown and 40% reddish-brown siltstone heavily brecciated (fragments to 4 cm) above 959/9 (292.53 m) no gypsum veins.	2	5	961	3
		(0.74 m)		(292.99 m)	
	Mudstone, reddish-brown with irregular greenish-grey silty blotches, incipient and actual brecciation especially in lower half no gypsum veins.	6	9	968	0
		(2.06 m)		(295.05 m)	
dip 50°	Mudstone, reddish-brown slightly silty brecciated throughout (fragments to 8 cm), greenish-grey siltstone fragments abundant in parts of core, traces of bedding with steep dips and overturning no gypsum veins.	5	0	973	0
		(1.52 m)		(296.57 m)	
	Mudstone, reddish-brown, slightly silty, largely structureless, banding visible between 975/0 - 976/0 (297.18 - 297.48 m)	8	0	981	0
	Carried forward	(2.44 m)		(299.01 m)	

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	Brought Forward			981	0
				(299.01 m)	
	Mudstone, greenish-grey, possibly breccia, broken by drilling.		8	981	8
		(0.20 m)		(299.21 m)	
	Mudstone, reddish-brown with traces of greenish-grey, breccia, with angular fragments to 4 cm.	3	10	985	6
		(1.17 m)		(300.38 m)	
	Mudstone, reddish-brown, structureless.	1	1	986	7
		(0.33 m)		(300.71 m)	
	Mudstone, reddish-brown with 30% greenish-grey indistinct siltstone bands.	1	7	988	2
		(0.48 m)		(301.19 m)	
	Mudstone, reddish-brown with subsidiary greenish-grey, streaky texture throughout, more or less brecciated, fragments tend to be pod shaped.	6	2	994	4
		(1.88 m)		(303.07 m)	
	Mudstone, reddish-brown, seems structureless except for a few wispy siltstone bands downwards.	3	8	998	0
		(1.12 m)		(304.19 m)	
dip 17°	Siltstone, chiefly greenish-grey boldly banded with 50% greenish-grey and reddish-brown mudstone, ripple marks, false bedding.	4	7	1002	7
		(1.40 m)		(305.59 m)	
	Mudstone, reddish-brown, slightly silty, almost structureless mud cracks at 1007/6 (307.09 m)	6	5	1009	0
		(1.95 m)		(307.54 m)	
	Mudstone, reddish-brown, microbreccia	3	2	1012	2
		(0.97 m)		(308.51 m)	
dip 18°	Mudstone, reddish-brown alternating with runs of greenish-grey; boldly banded with 30% greenish-grey siltstone, false bedding, ripple mark.	7	8	1019	10
		(2.34 m)		(310.85 m)	
	Mudstone, reddish-brown almost structureless with rare silty bands, greenish-grey blotches	4	7	1024	5
		(1.39 m)		(312.24 m)	
	Mudstone, reddish-brown well banded becoming indistinct downwards with 40% reddish-brown				
	Carried forward			1024	5

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	Brought Forward			1024	5
				(312.24 m)	
	siltstone bands, ripple marks, load casts;				
	'birdseye' in 1 cm siltstone.	3	4	1027	9
		(1.02 m)		(313.26 m)	
	Mudstone, reddish-brown slightly silty				
	structureless, no gypsum.	3	3	1031	0
		(0.99 m)		(314.25 m)	
	Mudstone, reddish-brown banded, some				
	brecciation at top, ripple mark, 'birdseye'				
	in siltstone.	2	0	1033	0
		(0.61 m)		(314.86 m)	
dip 25°	Mudstone, reddish-brown, indistinctly banded				
	with 40% siltstone, false bedding mud crack?	3	0	1036	0
		(0.91 m)		(315.77 m)	
	Mudstone, reddish-brown, structureless, no				
	gypsum veins.	3	9	1039	9
		(1.15 m)		(316.92 m)	
	Mudstone, reddish-brown, brecciated 'in situ'				
	fragments to 2 cm throughout no gypsum				
	veins, one undisturbed silty band seen with				
	false bedding.	5	7	1045	4
		(1.70 m)		(318.62 m)	
	Siltstone, reddish-brown banded with 50%				
	reddish-brown mudstone.		8	1046	0
		(0.20 m)		(318.82 m)	
dip 16°	Mudstone, greenish-grey well banded with 40%				
	greenish-grey siltstone, false bedding, a				
	few salt pseudomorphs.	2	6	1048	6
		(0.76 m)		(319.58 m)	
	Mudstone, reddish-brown, nearly structureless,				
	slightly silty with a little silty banding				
	near top, no gypsum veins.	3	3	1051	9
		(0.99 m)		(320.57 m)	
	Mudstone, reddish-brown with 40% indistinct				
	reddish-brown siltstone bands.	1	9	1053	6
		(0.54 m)		(321.11 m)	
	Mudstone, somewhat silty reddish-brown				
	structureless, no gypsum veins.	7	8	1061	2
		(2.33 m)		(323.44 m)	
	Siltstone pale reddish-brown well and closely				
	banded with 30% reddish-brown mudstone				
	Carried forward			1061	2

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	Brought Forward			1061	2
				(323.44 m)	
	partings, attaining 60% near base some streaky texture; pellet conglomerate at 1061/4 (323.49 m), ripple marks, mud cracks?, no gypsum veins.	4	7	1065	9
		(1.40 m)		(324.84 m)	
dip 12°	Mudstone, greenish-grey with a run of reddish-brown, well and closely banded with 40% greenish-grey siltstone, a few ripple marks, a few salt pseudomorphs, cross lamination, mud cracks.	7	8	1073	5
		(2.34 m)		(327.18 m)	
	Mudstone, reddish-brown with 10% streaky siltstone bands, boldly convoluted near middle, mud crack?	1	0	1074	5
		(0.30 m)		(327.48 m)	
	Siltstone, greenish-grey with 40% reddish-brown and greenish-grey mudstone partings, false bedding.		4	1074	9
		(0.10m)		(327.58 m)	
	Mudstone silty reddish-brown almost structureless, a few wispy siltstone bands.	1	4	1076	1
		(0.41 m)		(327.99 m)	
	Mudstone, reddish-brown well banded with 40% pale reddish-brown siltstone, ripple mark, mud crack?	1	8	1077	9
		(0.51 m)		(328.50 m)	
dip 13°	Mudstone, greenish-grey (near grey) well banded with variable amounts of siltstone, averaging 40%, ripple mark, load cast, salt pseudomorphs possible etched out halite veins at 1080/9 (329.41 m).	5	6	1083	3
		(1.67 m)		(330.17 m)	
	Mudstone, reddish-brown, almost structureless with 10% siltstone in faint bands.	1	4	1084	7
		(0.41 m)		(330.58 m)	
	Mudstone, reddish-brown, finely banded with some blotchy greenish-grey layers, fabric podded on a small scale in two runs 6 cm thick	3	6	1088	1
		(1.07 m)		(331.65 m)	
	Siltstone, reddish-brown with 40% reddish-				
	Carried forward			1088	1

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	Brought Forward			1088	1
				(331.65 m)	
	brown mudstone bands attaining 60% at top, a few individual siltstone bands attain 8cm but average 1 cm, abundant ripple mark, false bedding (small scale) cut and fill mud crack.	5	3	1093	4
		(1.60 m)		(333.25 m)	
	Mudstone, reddish-brown with c. 20% (30% downwards) thin pale reddish-brown siltstone bands, rather streaky fabric in middle position	4	0	1097	4
		(1.22 m)		(334.47 m)	
dip 13°	Mudstone, greenish-grey with a little reddish-brown near top, boldly banded with 30% greenish-grey siltstone, cut and fill, rare ripples, giant salt pseudomorph; Euestheria at 1099/8 (335.18 m)	3	1	1100	5
		(0.94 m)		(335.41 m)	
	Sample missing	1	3	1101	8
		(0.38 m)		(335.79 m)	
	Mudstone greenish-grey, boldly banded with 30% greenish-grey siltstone, mud crack.	1	2	1102	10
		(0.35 m)		(336.14 m)	
	Siltstone pale reddish-brown with a little greenish-grey boldly banded with 50% reddish-brown mudstone, probable mud cracks especially common downwards, mica quite common in the 1 - 2 cm siltstone bands.	4	8	1107	6
		(1.43 m)		(337.57 m)	
	Mudstone greenish-grey (near grey) boldly banded with 30% greenish-grey siltstone, with 22 cm of reddish-brown mudstone near middle; ripple mark.	3	8	1111	2
		(1.11 m)		(338.68 m)	
	Mudstone, reddish-brown banded with 20% reddish-brown siltstone bands, rupple mark.	3	0	1114	2
		(0.92 m)		(339.60 m)	
	Siltstone, greenish-grey and pale reddish-brown well banded with 50% mudstone in similar colours, much ripple mark, a few calcite veins with vugs.	3	8	1117	10
	Carried forward	(1.12 m)		(340.72 m)	

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	Brought Forward			1117	10
				(340.72 m)	
dip 10°	Siltstone, greenish-grey closely banded with 50% greenish-grey mudstone bands ripple mark, a few 1 mm calcite veins downwards.	5	1	1122	11
		(1.55 m)		(342.27 m)	
	Mudstone, greenish-grey banded with 20% greenish-grey siltstone, soft with closely spaced joints, disturbed bedding might be faulting or due to penecontemporaneous disturbance.	1	3	1124	2
		(0.38 m)		(342.65 m)	
dip 17°	Siltstone, greenish-grey boldly banded with 50% greenish-grey (near grey) mudstone ripple mark, calcite veins to 2 mm and calcite films on bedding.	4	0	1128	2
		(1.22 m)		(343.87 m)	
	Siltstone, greenish-grey, a few mudstone partings, mudstone flake conglomerate shards to 2 cm long.	1	0	1129	2
		(0.30 m)		(344.17 m)	
	Mudstone, greenish-grey with wispy siltstone bands, cross bedding, mica.	3	7	1132	9
		(1.09 m)		(345.26 m)	
	Mudstone, grey (faint greenish tinge) banded with 20% greenish-grey siltstone, mud cracks, mudstone flake breccia layers, salt pseudomorphs common, irregular calcite veins to 2 mm.	5	4	1138	1
		(1.63 m)		(346.89 m)	
dip 12°	Siltstone, grey, boldly banded with 40% grey mudstone, a few siltstones to 8 cm but much of banding is very fine, cross lamination ripple mark clay flake conglomerate some mica, rare possible mud cracks, a few calcite veins.	4	11	1143	0
		(1.50 m)		(348.39 m)	
	Siltstone, greenish-grey and reddish-brown banded with 50% mudstone in similar colours, ripple mark, mudstone flake conglomerate, 2 mm calcite vein.	1	5	1144	5
		(0.43 m)		(348.82 m)	
	Mudstone, greenish-grey becoming grey below				
	Carried forward			1144	5

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	Brought Forward			1144	5
				(348.82 m)	
	1149/0 (350.22 m) well banded with 20% greenish-grey siltstone, (40% between 1147/6-1148/6 349.76-350.06 m) salt pseudomorphs, rare load casts, calcite veins throughout.	15	7	1160	0
dip 12°		(4.75 m)		(353.57 m)	
	Siltstone, grey with mudstone bands, mudstone flake breccia layers.	1	0	1161	0
		(0.30 m)		(353.87 m)	
	Mudstone, grey, banded with thin highly porous calcitic fine grained sandstone layers, excellent salt pseudomorphs to 2 cm wide, ripple mark, load casts, abundant calcite veins	2	6	1163	6
		(0.76 m)		(354.63 m)	
	Sandstone, fine-grained calcitic, highly porous, with 50% grey mudstone bands, clay flake in one sandstone band calcite veins.	2	6	1166	0
HAMBLETON MUDSTONES		(0.77 m)		(355.40 m)	
	Mudstone grey with calcitic sandstone, disturbed fabric with high dips and injected sediment.	2	4	1168	4
		(0.71 m)		(356.11 m)	
	Mudstone, grey, with a few silty bands calcite veins.		11	1169	3
		(0.28 m)		(356.39 m)	
	Mudstone, grey with 40% porous calcitic fine-grained sandstone bands.		5	1169	8
		(0.12 m)		(356.51 m)	
	Mudstone grey well and closely banded with 30% siltstone partings, a few bands of calcitic fine-grained sandstone, a few salt pseudomorphs, calcite veins.	3	4	1173	0
		(1.02 m)		(357.53 m)	
dips up to 50°	Mudstone, grey, with siltstone, chiefly as a matrix, appears to be injected in places, bedding buckled and disturbed, perhaps a seismite.	3	5	1176	5
		(1.04 m)		(358.57 m)	
dip 60° at 1179/9 (359.59 m)	Mudstone, grey banded with 20% greenish-grey siltstone, bedding slightly buckled (steepening downwards), some calcite veins.	3	7	1180	0
	Carried forward	(1.09 m)		(359.66 m)	

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	Brought Forward			1180	0
				(359.66 m)	
	Mudstone, grey with some siltstone, boldly banded, broken bedding with plastic deformation of fragments, possible seismite.	4	4	1184	4
		(1.32 m)		(360.98 m)	
	Mudstone, grey with a few siltstone bands chiefly near top, one 5 cm siltstone band is highly micaceous.	2	8	1187	0
		(0.82 m)		(361.80 m)	
dip 22°	Siltstone, grey, well but not very regularly banded with 20% grey mudstone bands, ripple mark, mudstone flake breccia.	3	5	1190	5
		(1.04 m)		(362.84 m)	
	Siltstone grey and pale reddish-brown boldly and rather irregularly banded with 40% reddish-brown mudstone, ripple mark, cross bedding.	1	1	1191	6
		(0.33 m)		(363.17 m)	
	Sandstone, fine-grained, banded, pale grey with pink tinge.		11	1192	5
		(0.28 m)		(363.45 m)	
	Siltstone, reddish-brown with some greenish-grey boldly banded with 50% reddish-brown mudstone bands, some siltstone bands are nearly sandstone, specimen missing between 1195/1 - 1196/0 (364.26 - 364.54 m)	5	3	1197	8
		(1.60 m)		(365.05 m)	
	Mudstone, greenish-grey banded with a few siltstone bands near base, possible dolomite band at 1199/7 - 1199/8 (365.63-365.66 m)	2	0	1199	8
		(0.61 m)		(365.66 m)	
	Sandstone, fine-grained greenish-grey,		6	1200	2
		(0.15 m)		(365.81 m)	
	Mudstone, greenish-grey with irregular reddish-brown streaky banding.	1	0	1201	2
		(0.30 m)		(366.11 m)	
	Mudstone, reddish-brown.		3	1201	5
		(0.08 m)		(366.19 m)	
	Sandstone, fine-grained pale reddish-brown, heavy mesh of calcite veins.	4	5	1205	10
		(1.35 m)		(367.54 m)	
	Carried forward			1205	10

16958/644410 3M 11/70 B&N Ltd. 3639

COMMERCIAL IN CONFIDENCE

Name and Number of Shaft or Borehole: Kirkham BH

6-in Map Registration No. SD 43 SW/6

National Grid Reference

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Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			1205	10
				(367.54 m)	
	Sandstone, fine-grained pale reddish-brown with some grey near top.	2	2	1208	0
		(0.66 m)		(368.20 m)	
	Sandstone, medium-grained reddish-brown and grey sandstone with blotchy colouration, some millet seed grains.	6	6	1214	6
		(1.98 m)		(370.18 m)	
	Sandstone, fine-grained, fine-to-medium grained below 1222/0 (372.47 m), deep reddish-brown with a few large grey blotches, silty banding at 1221/0-1221/2 (372.16 - 372.21 m) indications of current bedding, some milletseed grains below 1234/0 (376.12 m)	29	6	1244	0
		(8.99 m)		(379.17 m)	
apparent dip 24°	Sandstone, fine to medium-grained, traces of faint banding reddish-brown with four banded grey bands up to 6 cm thick and one 18 cm thick.	7	9	1251	9
		(2.36 m)		(381.53 m)	
	Sandstone, fine-grained deep reddish-brown, even grain size, one grey blotch.	7	2	1258	11
		(2.19 m)		(383.72 m)	
SHERWOOD SST Gpup	Sandstone, fine to medium-grained deep reddish-brown poorly sorted, some grey blotches, signs of false bedding, podded fabric at 1275/0 (388.62) may be biological in origin.	17	3	1276	2
		(5.26 m)		(388.98 m)	
apparent dip 20°	Sandstone fine to medium-grained deep reddish-brown, well banded with some podded fabric, poorly sorted.	6	0	1282	2
		(1.82 m)		(390.80 m)	
	Sandstone fine-grained with mudstone flake breccia, a few pebbles.		6	1282	8
		(0.16 m)		(390.96 m)	
	Sandstone fine to medium-grained reddish-brown with a few paler blotches a few mudstone flakes, some milletseed grains, false bedding.	8	8	1291	4
	Carried forward	(2.64 m)		(393.60 m)	

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COMMERCIAL IN CONFIDENCE

Name and Number of Shaft or Borehole: Kirkham BH

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Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			1291	4
				(393.60 m)	
	Sandstone, medium-grained, reddish-brown scattered milletseed grains.	12	8	1304	0
		(3.86 m)		(397.46 m)	
apparent dip 23°	Sandstone, fine-grained, reddish-brown, some milletseed grains.	11	10	1315	10
		(3.61 m)		(401.07 m)	
	Sandstone, greenish-grey with layers of greenish-grey mudstone.		1½	1315	11½
		(0.03 m)		(401.10 m)	
	Sandstone, medium-grained, deep reddish-brown, good milletseed grains.	4	6½	1320	6
		(1.39 m)		(402.49 m)	
	Sandstone fine to medium grained reddish-brown	3	3	1323	9
		(0.99 m)		(403.48 m)	
	Sandstone fine-grained greenish-grey and pale reddish-brown banded.		8	1324	5
		(0.20 m)		(403.68 m)	
	Mudstone, reddish-brown, structureless, listric	2	1	1326	6
		(0.64 m)		(404.32 m)	
	Sandstone very fine grained, deep reddish-brown two 2 cm silty beds near top.	7	9	1334	3
		(2.36 m)		(406.68 m)	
	Sandstone fine to medium-grained, deep reddish-brown, poorly cemented becoming tougher downwards with some banding.	12	4	1346	7
		(3.76 m)		(410.44 m)	
	Sandstone fine and medium-grained false-bedded, a little mica.	9	10	1356	5
		(3.00 m)		(413.44 m)	
	Sandstone fine-grained grey, micaceous compact		3	1356	8
		(0.07 m)		(413.51 m)	
	Sandstone, medium grained, gradually becoming fine grained downwards, reddish-brown.	5	6	1362	2
		(1.68 m)		(415.19 m)	
	Mudstone, reddish-brown.		½	1362	2½
		(0.01 m)		(415.20 m)	
	Sandstone, medium-grained with mudstone flake conglomerate.		½	1362	3
		(0.01 m)		(415.21 m)	
	Carried forward			1362	3

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Name and Number of Shaft or Borehole: Kirkham BH

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Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			1362	3
				(415.21 m)	
apparent dip 20°	Mudstone, reddish-brown, very finely micaceous		1	1362	4
		(0.03 m)		(415.24 m)	
	Sandstone, medium-grained, milletseed grains, particularly well seen near top.	4	8	1367	0
		(1.42 m)		(416.66 m)	
	Mudstone, reddish-brown, silty with siltstone bands near top and base, listric.	1	3	1368	3
		(0.38 m)		(417.04 m)	
	Sandstone, fine to medium-grained deep reddish-brown with rare greenish-grey bands to 5 cm thick, deep reddish-brown muddy clots from 1372/0 - 1374/8 (418.19 - 419.00 m) some milletseed below 1377/9 (419.94 m), false bedding common below 1376/0 (419.40 m).	17	2	1385	5
		(5.24 m)		(422.28 m)	
	Sandstone, medium-grained reddish-brown, several bands rich in 'milletseed' grains mudstone pebbles to 6 cm wide at 1389/0 (423.37 m).	6	0	1391	5
		(1.82 m)		(424.10 m)	
apparent dip 20°	Sandstone, fine-grained reddish-brown finely laminated micaceous, compact.		9	1392	2
		(0.23 m)		(424.33 m)	
	Sandstone, medium-grained, reddish-brown false bedded, some milletseed grains.	11	3	1403	5
		(3.43 m)		(427.76 m)	
	Sandstone medium-grained reddish-brown several bands rich in milletseed grains.	6	2	1409	7
		(1.88 m)		(429.64 m)	
	Mudstone silty micaceous reddish-brown and greenish-grey.		1	1409	8
		(0.03 m)		(429.67 m)	
	Sandstone fine to medium-grained, with micaceous reddish-brown mudstone plane 2 mm thick.		7	1410	3
		(0.17 m)		(429.84 m)	
	Sandstone fine to medium-grained some milletseed, becoming abundant downwards, mudstone pebbles around 1417/6 (432.05 m)	9	7	1419	10
	Carried forward	(2.93 m)		(432.77 m)	

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Geological Classification	Description of Strata	Thickness Ft	Thickness In	Depth Ft	Depth In
	Brought Forward			1419	10
				(432.77 m)	
	Siltstone, greenish-grey micaceous and reddish-brown fine grained mudstone.		2	1420	0
		(0.05 m)		(432.82 m)	
	Sandstone, fine to medium-grained deep reddish-brown, milletseed grains.	8	4	1428	4
		(2.54 m)		(435.36 m)	
	Sandstone, fine-grained pale reddish-brown tough micaceous.	2	0	1430	4
		(0.61 m)		(435.97 m)	
	Sandstone fine to medium grained, with milletseed grains.	3	11	1434	3
		(1.19 m)		(437.16 m)	
apparent dip 20°	Sandstone, fine-grained, reddish-brown, banded with a few small mudstone pebbles near base, a few mica flakes, tough.	2	9	1437	0
		(0.84 m)		(438.00 m)	
	Sandstone, medium-grained, deep reddish-brown, soft with abundant excellent milletseed grains core sample missing 1442/6-1443/11 (439.67-440.11 m).	7	1	1444	1
		(2.16 m)		(440.16 m)	
	Sandstone, fine-grained grey, with milletseed grains.		3	1444	4
		(0.07 m)		(440.23 m)	
	Sandstone, medium-grained, deep reddish-brown, soft with milletseed grains, especially abundant and of excellent shape downwards.	15	5	1459	9
	bottom of hole	(4.70 m)		(444.93 m)	

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Kirkham B.H. (summary log)

SD 43/20

North Western Gas Board
Kirkham
SD 4324 3247
570 yd E by N of St. Michael's Church

Foraky 1970

A A Wilson

Provisional Summary log only, to ~~1970/6~~ 1296/2

	Peat	18	6	18	6
	Sand	35	6	54	0
	Silty Clay	11	0	65	0
	Sand	20	0	85	0
	Stoney clay	35	0	120	0
	Mudstone, not cored	20	0	140	0
	Mudstone, reddish-brown, structureless free of gypsum veins	42	10	182	10
	Mudstone, reddish-brown, brecciated at several levels; breccia fragments include smashed gypsum veins	36	6	219	4
dip about 45°, locally steeper	Mudstone, reddish-brown with minor thin runs of greenish-grey mudstone; thin siltstone bands common at several levels and a few breccia horizons; gypsum veins	145	8	365	0
	Mudstone, reddish-brown, brecciated at several levels; gypsum porphroblasts common	95	3	460	3
	Mudstone, reddish-brown with minor thin runs of greenish-grey; gypsum veins	55	11	516	2
dip about 30° locally steeper	Mudstone, greenish-grey and reddish-brown in alternate runs 5-25 ft thick. Both contain thin siltstone bands sometimes in dominant amounts, chiefly greenish-grey and sometimes reddis.. brown;				

SD 43/20

Kirkham B.H. (summary log)

				516	2
dip about 35°	ripple marks, probable mud-cracks, gypsum veins; ~~gypsum nodules at several levels~~. Organic trail at 575/4, plant fragment at 575/6	228	10	745	0
dip about 35°, locally steeper	Mudstone, reddish-brown with some runs containing siltstone; scattered thin brecciated horizons, gypsum veins	161	0	906	0
	Mudstone, reddish-brown with several brecciated horizons up to 9 ft thick; gypsum veins above 951/8 only	88	0	994	0
dip 15°	Mudstone, reddish-brown, chiefly structureless with minor thin runs of greenish-grey mudstone, scattered siltstone bands; no gypsum veins	76	6	1070 ~~1065~~	6 ~~5~~
dip about 12°	Mudstone, reddish-brown and greenish-grey, in alternating runs 5-10 ft thick, with siltstone bands, ripple marks, mud-cracks, free of gypsum veins, Euestheria at 1099/8	47	4	1117	10
dip about 12°	Mudstone, grey with slight green tinge near top, with thin bands of siltstone and fine-grained calcareous sandstone; salt pseudomorphs, calcite veining	55	2	1173	0
	Mudstone, grey with many siltstone bands, brecciated and deformed whilst in a plastic state	11	4	1184	4
	Mudstone, grey with siltstone bands	6	8	1191	0
	Mudstone, reddish brown with some greenish grey runs; siltstone bands	8	8	1199	8
dip seems about 20°	Sandstone; fine and fine to medium-grained, deep reddish with a few grey bands; close banding seen at several levels, some 'milletseed' grains	96	6	1296	2

drilling continues

CONFIDENTIAL

SD 43 SW/6 43245247

(For Survey use only)

GEOLOGICAL SURVEY OF GREAT BRITAIN

RECORD OF SHAFT OR BORE FOR MINERALS

6-inch Map Registered No.

Name of Shaft or Bore given by Geological Survey: SD 43/15 20

Kirkham B.H.

Name and Number given by owner:

Nat. Grid Reference SD 4324/3247

1" N.S.Map No.	1" O.S.Map No.	Confidential or not

For whom made North Western Gas Board

Town or Village Kirkham County

Exact site { Attach a tracing from a map, or a sketch-map, if possible.

Purpose for which made Test for underground gas storage

Ground Level at shaft bore relative to O.D. If not ground level give O.D. of beginning of shaft bore

Made by Foraky Date of sinking 1970

Information from Date received

Examined by A A Wilson

SPECIMEN NUMBERS AND ADDITIONAL NOTES

17 Spore samples for G Warrington at

234/6 (71.48 m)
302/9 (92.28 m)
461/0 (140.51 m)
523/6 (159.56 m)
631/0 (192.33 m)
682/0 (207.87 m)
732/6 (223.27 m)
861/0 (262.43 m)
1007/6 (307.09 m)
1048/0 (319.43 m)
1070/0 (326.14 m)
1111/0 (338.63 m)
1135/6 (346.10 m)
1154/5 (351.87 m)
1176/0 (358.44 m)
1199/7 (365.63 m)
1275/0 (388.62 m)

(For Survey use only) Geological Classification	Description of Strata	Thickness Ft.	Thickness In.	Depth Ft.	Depth In.
	Soil	0	9	0	9
		(0.23 m)		(0.23 m)	
	Clay		4	1	1
		(0.10 m)		(0.33 m)	
PEAT	Peat	17	5	18	6
		(5.31 m)		(5.64 m)	
	Sand and silty clay - samples as follows:				
GLACIAL SANDS AND SILTS	20/0 (6.10 m) fine-grained quartz sand				
	30/0 (9.14 m) probably sandy clay				
	40/0 (12.10 m) fine-grained sand				
	50/0 (15.24 m) coarse sand with rock fragments				
	60/0 (18.29 m) silty clay with very small pebbles				
	70/0 (21.34 m) fine-grained quartz sand				
	80/0 (24.38 m) silty clay with sand grains	66	6	85	0
		(20.27 m)		(25.91 m)	
BOULDER CLAY	Boulder clay - samples as follows:				
	90/0 (27.43 m) drab clay				
	100/0 (30.48 m) drab clay				
	107/0 (32.61 m) reddish-brown compact stony clay				
	carried forward			85	0

SD43 Reamb Dent Cons 6

Kirkham B.H.

SD 43SW/6 SD43/20 2

			85 0 (25.91 m)
	110/0 (33.53 m) pebbles in clay matrix 120/0 (36.58 m) pebbles in clay matrix	35 0 (10.67 m)	120. 0 (36.58 m)
KEUPER MARL	No recovery, marl	20 0 (6.09 m)	140 0 (42.67 m)
dip 15°? at 170/0 (51.82 m)	MUDSTONE, reddish-brown, structureless not silty, no gypsum veins	34 6 (10.52)	174 6 (53.19 m)
	MUDSTONE, reddish-brown, with some greenish grey, structureless	1 6 (0.45 m)	176 0 (53.64 m)
	MUDSTONE, reddish-brown, structureless slightly silty, with vague silty banding below 177/11 (54.23 m) (core removed from 176/5-177/11 - (53.77 - 54.23 m)	6 0 (2.09m)	182 10 (55.71m)
	MUDSTONE, reddish brown slightly silty, brecciated at least in part with scattered clasts fragments to 2 cm	5 5 (1.65 m)	188 3 (57.38 m)
	MUDSTONE, with some siltstone, heavily brecciated reddish brown with some grey, clasts to 5 cm long include smashed sections of vein gypsum and siltstone, some of the latter being buckled	10 9 (3.28 m)	199 0 (60.66 m)
dip 55°	MUDSTONE, reddish-brown with some greenish-grey siltstone bands, gypsum veins to 1 cm are somewhat sheared and buckled and in places heavily fragmented	3 3 (0.99 m)	202 3 (61.65 m)
	MUDSTONE, reddish-brown, some gypsum veins to 1 cm, core smashed in drilling	2 6 (0.76 m)	204 9 (62.41 m)
dip 25°	MUDSTONE, reddish-brown well banded with greenish grey siltstone somewhat brecciated in part, low and high angle gypsum veins to 5 mm are buckled in places	2 3 (0.68 m)	207 0 (63.09 m)
	MUDSTONE, reddish-brown, silty in part, gypsum veins to 1 cm are crumpled in places, core broken downwards	3 0 (0.92 m)	210 0 (64.01 m)
	carried forward		210 0 (64.01 m)

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Kirkham B.H.

SD43/20

3

	210 0 (64.01 m)	
MUDSTONE reddish-brown with reddish-brown and grey fragments, heavily brecciated with signs of bedding, smashed in situ, in middle portion, low angle gypsum veins to 5 mm, some of them smashed	3 0 (0.91 m)	213 0 (64.92 m)
dip 15° (70° at top) REDDISH brown mudstone, some bedding, seems brecciated in part	3 4 (1.02 m)	216 4 (65.94 m)
MUDSTONE slightly silty, seems brecciated in part, no gypsum veins	3 0 (0.91 m)	219 4 (66.85 m)
dip 70° MUDSTONE, reddish brown nearly structureless gypsum veins to 4 mm	4 0 (1.22 m)	223 4 (68.07 m)
No recovery	1 0 (0.31 m)	224 4 (68.38)
MUDSTONE, reddish-brown, increasingly well banded downwards with 30% greenish grey siltstone bands (dolomatic?) downwards, a few irregular gypsum veins to 1 cm and many 1 mm veins. A few greenish grey reduction spots	6 5 (1.95 m)	230 9 (70.33 m)
dip 48° MUDSTONE greenish grey with some reddish brown banded with greenish-grey siltstone bands up to 6 cm thick, low angled and a few high angled gypsum veins to 1 cm	4 11 (1.50 m)	235 8 (71.83 m)
MUDSTONE, silty reddish-brown banded with some greenish grey, low angle gypsum veins	3 4 (1.02 m)	239 0 (72.85 m)
MUDSTONE, reddish-brown boldly banded with 30% greenish-grey siltstone, 5 mm gypsum veins, rare ripple mark	4 9 (1.45 m)	243 9 (74.30 m)
MUDSTONE, grey, fine-grained	3 (0.07 m)	244 0 (74.37 m)
dip 55° SILTSTONE, greenish grey banded with 40% reddish-brown and greenish-grey mudstone	1 0 (0.31 m)	245 0 (74.68 m)
carried forward		245 0 (74.68 m)

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Kirkham B.H.

245 0
(74.68 m)

dip 50°

MUDSTONE, reddish brown and greenish grey, boldly colour-banded with 20% (average) greenish grey siltstone bands, a few gypsum veins to 6 mm

5 3 (1.60 m) 250 3 (76.28 m)

MUDSTONE, reddish-brown with wispy silty banding, gypsum veins to 4 mm

1 3 (0.38 m) 251 6 (76.66 m)

MUDSTONE, reddish-brown with some greenish-grey, boldly banded with 30% (average - reaching 70% near base) greenish-grey siltstone, mudcracks? cross the banding in many places, low angle gypsum veins to 1 cm

dip 50°

7 9 (2.36 m) 259 3 (79.02 m)

MUDSTONE, chiefly reddish brown with scattered silty beds, dessiccation cracks? 1 cm wide cut silty bands, micro-ripple, salt pseudomorphs in siltstone, 2 mm gypsum veins near top only

4 3 (1.29 m) 263 6 (80.31 m)

MUDSTONE, reddish brown, banded with 40% greenish grey siltstone in bands up to 0.18 m thick, gypsum veins to 5 mm

4 9 (1.45 m) 268 3 (81.76 m)

MUDSTONE, greenish-grey banded (rather wispy), with some reddish-brown downwards, convolutions at 269/0 (81.99 m) a few gypsum veins to 5 mm

5 11 (1.81 m) 274 2 (83.57 m)

MUDSTONE, reddish-brown, banded with wispy siltstone bands coming in downwards (15), gypsum nodules to 2 cm at 274/6 (83.07 m), gypsum veins up to 1 mm are especially common and ramifying between 274/6-275/6 (83.67-83.97 m), mudcracks?; convoluted bedding at 286/3 (87.25 m)

dip 50°

12 4 (3.76 m) 286 6 (87.33 m)

carried forward 286 6 (87.33 m)

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Kirkham B.H. SD43/20 5

		286 6 (87.33 m)	
MUDSTONE, reddish-brown, structureless, with irregular gypsum veins with knots of gypsum where veins join, perhaps a breccia in part but no fragments seen	4 3 (1.30 m)	290 9 (88.62 m)	
MUDSTONE, reddish-brown, banded with 10% greenish-grey siltstone, greenish-grey reduction spots, a few irregular gypsum veins to 5 mm, 2 cm gypsum layer at 292/0 (89.00 m) associated with gypsum aggregates (nodules?)	5 9 (1.75 m)	296 6 (90.37 m)	
MUDSTONE, reddish-brown almost structureless with some wispy banding downwards, a few brecciated bands, irregular gypsum veins to 4 mm	3 1 (0.94 m)	299 7 (91.31 m)	
MUDSTONE, reddish-brown with greenish-grey banding, gypsum veins to 4 mm	1 1 (0.33 m)	300 8 (91.64 m)	
MUDSTONE, greenish-grey, silty in part, well banded with some dark grey fine-textured bands	3 0 (0.92 m)	303 8 (92.56 m)	
consistently steep dips	MUDSTONE reddish-brown, structureless with signs of brecciation near base, a few greenish grey blotches, no gypsum veins above 308/0 (93.88 m) rare 4 mm veins below 308 (93.88 m)	7 4 (2.23 m)	311 0 (94.79 m)
MUDSTONE, reddish-brown with greenish grey siltstone bands, middle beds are richest in siltstone and are buckled and brecciated, gypsum veins rare	5 0 (1.53 m)	316 0 (96.32 m)	
dip 40°	MUDSTONE greenish grey, banded, with silty layers, a few low angle gypsum veins, a few clots of gypsum where veins meet at 319/9 (97.46 m)	4 10 (1.47 m)	320 10 (97.79 m)
	carried forward		320 10 (97.79 m)

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Kirkham B.H. SD43/20 6

			320 10 (97.79 m)
	MUDSTONE, reddish-brown structureless, scattered gypsum veins to 1 cm except at 322/6 - 324/0 (98.30 - 98.76 m) where ramifying veins enclose irregular areas of unveined mudstone	11 9 (3.58 m)	332 7 (101.37 m)
	MUDSTONE, reddish-brown, banded with 40% greenish-grey siltstone	1 1 (0.33 m)	333 8 (101.70 m)
dip 65°	MUDSTONE, greenish-grey with some reddish-brown bands, banded with 30% greenish-grey siltstone, some bedding disturbance downwards, a few irregular gypsum veins	11 0 (3.35 m)	344 8 (105.05 m)
dips up to 75°	MUDSTONE, reddish brown streaky fabric with greenish grey siltstone bands (averaging 30%, reaching 50% near base) banding becoming bolder and finer downwards, horizontal shears in middle beds some siltstone bands seem brecciated	7 1 (2.16 m)	351 9 (107.21 m)
	MUDSTONE, reddish-brown; greenish grey below 356/7 (108.69 m) irregularly banded with 15% siltstone, gypsum veins to 5 mm	6 0 (1.83 m)	357 9 (109.04 m)
dip 35°	MUDSTONE reddish brown, with a little greenish grey at top unevenly banded with 25% greenish-grey siltstone bands, scattered short and irregular gypsum veins with a plexus of veins around 361/0 (110.03 m)	7 0 (2.14 m)	364 9 (111.18 m)
	SAMPLE MISSING	1 5 (0.43 m)	366 2 (111.61 m)
	MUDSTONE, greenish grey, seems heavily microbrecciated with some fragments up to 3 cm	1 7 (0.48 m)	367 9 (112.09 m)
	carried forward		367 9 (112.09 m)

SD 43 SW/6

Kirkham B.H.

SD43/20 7

		367 9 (112.09 m)	
MUDSTONE, reddish-brown with some grey around 372/0 (113.39 m), probably brecciated throughout, rich in crystalline gypsum at several levels, almost all gypsum from 368/6-368/9 (112.32 - 112.40 m)	6 3 (1.91 m)	374 0 (114.00 m)	
MUDSTONE reddish brown, brecciated in part with a few irregular greenish-grey silty bands. Crystalline (porphroblast) gypsum in vaguely banded form with signs of enterolithic folding — dip seems c 40°	7 0 (2.13 m)	381 0 (116.13 m)	
MUDSTONE, reddish brown, structureless, crudely bands of gypsum crystals (porphroblasts)	1 4 (0.41 m)	382 4 (116.54 m)	
MUDSTONE, reddish-brown seems brecciated with c 30% areas of ramifying gypsum, crudely banded	3 8 (1.11 m)	386 0 (117.65 m)	
MUDSTONE, reddish-brown seems brecciated with some wispy banding, a few crude beds up to 4 cm thick of gypsum aggregates — dip 20°	5 6 (1.68 m)	391 6 (119.33 m)	
MUDSTONE, reddish brown streaky fabric with a few irregular bands and areas of greenish-grey, 20% siltstone bands at top, signs of brecciation at top, a few gypsum veins, a few crude beds rich in gypsum aggregates	8 9 (2.67 m)	400 3 (122.0 m)	
SAMPLE MISSING	1 4 (0.40 m)	401 7 (122.40 m)	
MUDSTONE, reddish-brown, rich in ramifying masses of gypsum crystals (30% of whole rock)	1 5 (0.43 m)	403 0 (122.83 m)	
MUDSTONE reddish-brown and greenish-grey in alternation, signs of discordance (slippage) at one colour junction — dip c 40°	2 7 (0.79 m)	405 7 (123.62 m)	
carried forward		405 7 (123.62 m)	

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			405 7 (123.62 m)
dip 17°	MUDSTONE reddish-brown with some greenish grey patches seems brecciated, otherwise structureless, gypsum veins very rare except for a ramifying plexus around 410/0 (124.97 m)	5 7 (1.70 m)	411 2 (125.32 m)
→	MUDSTONE reddish-brown with 40% crystalline gypsum in rather irregular masses but with definite signs of bedding	3 4 (1.01 m)	414 6 (126.34 m)
	MUDSTONE, greenish-grey irregularly banded with 13 cm band with 60% irregular crystalline gypsum	1 3 (0.38 m)	415 9 (126.72 m)
	MUDSTONE, reddish-brown with some greenish-grey, probably brecciated at least in part, scattered levels rich in irregular ramifications of gypsum	12 0 (3.66 m)	427 9 (130.38 m)
	MUDSTONE, reddish-brown, vague indications of bedding, irregular bands up to 10 cm thick rich in crystalline gypsum, especially abundant (80%) from 436/8-436/11 (132.94-133.17 m)	9 2 (2.79 m)	436 11 (133.17 m)
dip 30° decreasing gradually to 15° downwards	MUDSTONE, reddish-brown, with a few greenish grey bands heavily microbrecciated, irregular areas of crystalline gypsum (40%) with vague indications of banding, some bands soft and clayey are possibly residual after halite, a few small voids could be after halite	13 1 (3.99 m)	450 0 (137.16 m)
	MUDSTONE reddish-brown and greenish-grey, probably brecciated, scattered gypsum porphroblasts	1 9 (0.53 m)	451 9 (137.69 m)
dip seems c 20°	MUDSTONE, reddish-brown with some greenish-grey between 452/9-455/10 (138.00-138.94 m) gypsum rare brecciated, heavily in places, with semblance of bedding below 457/4 (139.40 m)	8 6 (2.59 m)	460 3 (140.28 m)
	carried forward		460 3 (140.28 m)

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		460 3 (140.28 m)	
MUDSTONE, greenish-grey, a few low angled gypsum veins to 2 cm	1 5 (0.44 m)	461 8 (140.72 m)	
MUDSTONE, reddish-brown, structureless, low angle gypsum veins to 1 cm chiefly in upper beds	3 6 (1.06 m)	465 2 (141.78 m)	
MUDSTONE, silty, reddish-brown	2 4 (0.71 m)	467 6 (142.49 m)	
SAMPLE MISSING	10 (0.26 m)	468 4 (142.75 m)	
MUDSTONE reddish-brown with some greenish-grey at base, gypsum veins to 1½ cm	1 10 (0.56 m)	470 2 (143.31 m)	
MUDSTONE, reddish-brown, brecciated, especially downwards, fragments to 2 cm, irregular gypsum veins to 1 cm	4 5 (1.34 m)	474 7 (144.65 m)	
MUDSTONE, reddish-brown, structureless many gypsum veins to 5 mm, seems disturbed	9 (0.23 m)	475 4 (144.88 m)	
dip c 45° except at base MUDSTONE, greenish-grey and reddish-brown, banded, somewhat disturbed especially at base (contact dips at 70°) very many gypsum veins to 2 cm	3 2 (0.97 m)	478 6 (145.85 m)	
MUDSTONE, greenish-grey banded with siltstone near top, a few gypsum veins to 1 cm	2 2 (0.66 m)	480 8 (146.51 m)	
MUDSTONE reddish-brown structureless, gypsum veins to 1 cm	3 2 (0.96 m)	483 10 (147.47 m)	
SAMPLES MISSING	2 8 (0.82 m)	486 6 (148.29 m)	
MUDSTONE, reddish-brown, largely structureless, but sporadically banded, signs of brecciation with irreg lar masses of gypsum, scattered gypsum veins throughout	8 1 (2.46 m)	494 7 (150.75 m)	
carried forward		494 7 (150.75 m)	

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	494 7 (150.75 m)	
GYPSUM or anhydrite, pinkish-grey irregularly banded	7 (0.18 m)	495 2 (150.93 m)
MUDSTONE, reddish-brown, structureless with rare greenish-grey bands in above 499/10 (152.35 m), gypsum veins to 1 cm, becoming abundant and rather irregular (possibly brecciation) around 503/0-503/9 (153.31-153.54 m)	9 4 (2.84 m)	504 6 (153.77 m)
MUDSTONE, reddish-brown, banded with a few indistinctly defined greenish grey and reddish-brown silty layers, signs of brecciation at 509/0-509/6, (155.14-155.30 m) a few low angled gypsum veins to 1 cm dip 32°	6 0 (1.83 m)	510 6 (155.60 m)
MUDSTONE reddish-brown with some greenish grey, reddish-brown siltstone bands downwards, brecciated in varying degree	2 3 (0.69 m)	512 9 (156.29 m)
MUDSTONE reddish-brown boldly banded with 50% reddish-brown and greenish grey siltstone bands, a few salt pseudomorphs on bedding planes, a few gypsum veins to 1 cm, becoming twisted and fractured (c.f. Flexible Limestone of Durham) below 515/0 (156.97 m) dip 45°	3 5 (1.04 m)	516 2 (157.33 m)
SILTSTONE greenish-grey boldly banded with 30% greenish-grey and reddish-brown mudstone bands	2 3 (0.68 m)	518 5 (158.01 m)
MUDSTONE, greenish-grey, with a little reddish-brown, banded in varying degree, with siltstone bands downwards, small load casts	3 5 (1.04 m)	521 10 (159.05 m)
SILTSTONE greenish grey boldly banded with 30% greenish-grey mudstone gypsum veins to 1 cm only at top dip 43°	4 2 (1.27 m)	526 0 (160.32 m)
carried forward		526 0 (160.32 m)

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		526 0 (160.32 m)	
SILTSTONE, greenish grey with reddish tinge downwards boldly banded with 40% reddish brown mudstone ripples?, small faults and load casts gypsum veins only near base	3 0 (0.92 m)	529 0 (161.24 m)	
SILTSTONE, greenish-grey boldly banded with individual beds up to 6 in (0.15 m) thick with 40% greenish-grey mudstone, reddish brown in part near top, a few low angle gypsum veins to 1 cm, load casts, ripples dip 35°	12 6 (3.81 m)	541 6 (165.05 m)	
SILTSTONE, greenish-grey well banded with 50% reddish brown and rare dark grey mudstone partings rare load casts rare desiccation cracks? rare gypsum veins to 5 mm, a few 1 cm throw faults	2 8 (0.81 m)	544 2 (165.86 m)	
SAMPLE MISSING	1 4 (0.41)	545 6 (166.27 m)	
MUDSTONE reddish-brown structureless a few gypsum veins to 5 mm rare fish eyes	1 4 (0.40 m)	546 10 (166.67 m)	
SILTSTONE, pale reddish-brown with average of 40% reddish brown mudstone beds, chiefly in lower beds a few pinhole voids (after halite?) a few gypsum veins to 8 mm load casts dip 37°	2 10 (0.87 m)	549 8 (167.54 m)	
MUDSTONE, reddish-brown banded with 40% greenish grey and some pale reddish-brown siltstone bands, mudcracks?, gypsum veins rare except near base; with etched out 5 mm halite veins near base	8 4 (2.54 m)	558 0 (170.08 m)	
MUDSTONE, greenish-grey well banded with 30% greenish-grey siltstone bands attaining 50% downwards, gypsum veins to 1 cm with halite selvage to gypsum, especially downwards, siltstone band at 563/4-563/9 (171.70-171.83 m) dip 39°	8 9 (2.67 m)	566 9 (172.75 m) carried forward 566 9 (172.75 m)	

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566 9
(172.75 m)

SILTSTONE, greenish-grey, banded becoming bolder near base with 20% greenish grey mudstone bands (40% from 566/9-568/6) up to 10 cm thick, a few load casts, ripplemark, micro-ripplemark below 572/0 (174.35 m) some sheeny mica, a few pinhole voids (after halite?) near base, a few low angle gypsum veins becoming very rare downwards organic trail at 575/4 (175.36 m), plant fragment at 575/6 (175.41 m)

9 2 (2.79 m) — 575 11 (175.54 m)

MUDSTONE, reddish-brown with abundant irregularly shaped gypsum nodules to 5 cm

7 (0.18 m) — 576 6 (175.72 m)

SILTSTONE, greenish grey, passing down into reddish brown, banded with reddish-brown mudstone, gypsum veins chiefly near top connect up with the nodules above, some sheeny mica

3 6 (1.06 m) — 580 0 (176.78 m)

MUDSTONE reddish-brown with 20% reddish-brown siltstone bands dying out downwards

2 3 (0.69 m) — 582 3 (177.47 m)

SILTSTONE pale reddish brown and reddish-brown mudstone, wavy banding, podding and contortion of silt gypsum veins to 1½ cm

11 (0.28 m) — 583 2 (177.75 m)

SILTSTONE, greenish grey well banded with 20% greenish grey mudstone bands, a few pinhole voids, rare gypsum veins to 1 cm

2 10 (0.86 m) — 586 0 (178.61 m)

SILTSTONE, pale reddish-brown, bolding banded with 40% reddish-brown mudstone numerous good ripplemarks. A few gypsum veins to 1 cm and halite veins to 2 mm (etched out)

dip 35°

2 4 (0.71 m) — 588 4 (179.32 m)

MUDSTONE, reddish-brown, vaguely banded with siltstone, a few gypsum veins to 5 mm

2 8 (0.82 m) — 591 0 (180.14 m)

carried forward

591 0
(180.14 m)

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591 0 (180.14 m)

MUDSTONE, reddish-brown, structureless, a few low angle gypsum veins to 1 cm, very rare 1 mm low angle halite veins (voids), gypsum nodules to 2 cm from 594/9-595/0 (181.28-181.36 m)

4 0 (1.22 m) 595 0 (181.36 m)

SILTSTONE pale reddish-brown, wavily banded with 40% reddish-brown mudstone, a few halite and halite/gypsum veins to 1 cm, small pinhole voids. Nodules? of gypsum associated with plexus of veins and bedding disturbance at 601/4-601/8 (183.29-183.39 m)

8 0 (2.43 m) 603 0 (183.79 m)

SILTSTONE, reddish-brown, podded and irregularly banded with 50% reddish-brown mudstone, many gypsum veins to 1 cm

1 2 (0.36 m) 604 2 (184.15 m)

SILTSTONE, greenish-grey, well banded with 50% greenish-grey mudstone, showing some podded fabric. Numerous low angled gypsum veins to 1 cm, with halite cross connectors up to 5 mm thick

3 10 (1.17 m) 608 0 (185.32 m)

MUDSTONE greenish-grey, boldly banded with 40% greenish-grey siltstone bands, a few load casts and mudcracks? A few gypsum and gypsum/halite veins (halite etched out)

dip 38°

6 6 (1.98 m) 614 6 (187.30 m)

SILTSTONE, reddish brown and greenish-grey boldly banded with 50% alternating runs of reddish-brown and greenish grey mudstone, a few halite veins (voids) to 5 mm, low angled gypsum veins to 1 cm, nodular gypsum at four levels between 614/8-617/8 (187.35-188.26 m)

dip 34°

6 2 (1.88 m) 620 8 (189.18 m)

SILTSTONE, greenish-grey boldly banded with 50% reddish-brown mudstone, mudcracks?, discontinuous gypsum layer 1 cm thick at 621/9 (189.51 m)

2 4 (0.71 m) 623 0 (189.89 m)

carried forward 623 0 (189.89 m)

CENTRAL WATER PLANNING UNIT
WELL RECORD

W.R.D. REF. NO. SD43/20

R.A. LICENCE NO.

1. WELL IDENTITY

NATIONAL GRID REFERENCE 4327 3248

Well at Kirkham Bhl.

I.G.S. REF. NO.

RIVER AUTHORITY

Town

HYDROMETRIC AREA

County

SUB-CATCHMENT

Owner of well

Well made by

Date of sinking

Information from NWWA

Date received May 1979

ADDITIONAL NOTES:

Ob. Bhl.

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		(0.71 m)	(189.89 m)
Mudstone, reddish-brown well banded with 40 - 50% pale reddish-brown siltstone bands mud cracks? slight convolutions, a few etched out halite veins in upper half a few gypsum veins to 1 cm in lower half, 1 cm tonstein-like band at 627/6 (191.26m)	8 0	631 0	
	(2.44 m)	(192.33 m)	
Mudstone, reddish-brown and greenish grey, well bedded with 30 - 50% siltstone bands (highest proportion downwards) a few low angle gypsum veins to 1.5 cm.	4 0	635 0	
	(1.22 m)	(193.55 m)	
Mudstone, reddish-brown, banded with reddish brown siltstone, gypsum nodules to 2 cm of irregular shape.	1 0	636 0	
	(0.30 m)	(193.85 m)	
Mudstone, reddish-brown with wispy siltstone bands near top, gypsum nodules to 2 cm near bottom	3 2	639 2	
	(0.97 m)	(194.82 m)	
Mudstone, reddish-brown with reddish brown siltstone bands increasing to 70% downwards. Ripple mark. Gypsum/halite veins to 2 cm (halite member to 5 mm) Gypsum nodules to 1 cm at 641/3 (195.45 m)	2 8	641 10	
	(0.81 m)	(195.63 m)	
dip 40° Mudstone, reddish-brown, structureless, a few low angle gypsum veins to 4 mm	1 4	643 2	
	(0.41 m)	(196.04 m)	
Mudstone, reddish-brown, becoming boldly banded downwards with siltstone attaining 50% downwards ripple mark, mud cracks? a few gypsum/halite veins to 1 cm, gypsum nodules to 1 cm at 646/0 (196.90 m)	5 0	648 2	
	(1.52 m)	(197.56 m)	
Mudstone, reddish-brown with wispy siltstone bands, gypsum and gypsum/halite veins to 1 cm	1 10	650 0	
	(0.56 m)	(198.12 m)	
Siltstone greenish grey with a little reddish-brown banded with 30% greenish grey mudstone band attaining 50% below 655/4 (199.75 m),			
Carried forward		650 0	
		(198.12 m)	

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			650	0
			(198.12 m)	
banding bolder downwards, rather wispy near top many low angled gypsum veins to 2 cm with rare halite a few small salt pseudomorphs		6 10	656	10
		(2.08 m)	(200.20 m)	
Siltstone, greenish-grey boldly banded with 40% greenish-grey mudstone, nodules, a few low angle gypsum veins		2 2	659	0
		(0.66 m)	(200.86 m)	
Siltstone, greenish-grey and reddish-brown with 20% mudstone bands, seems collapsed, with small faults, numerous low angled gypsum veins to 1 cm		1 7	660	7
		(0.47 m)	(201.35 m)	
Siltstone, greenish-grey well banded with 20% greenish-grey mudstone bands. Individual siltstone bands to 5 cm. Low angle gypsum/halite veins. Bedding disturbed and faulted, probably by collapse.		3 11	664	6
		(1.19 m)	(202.54 m)	
Siltstone, well banded with 30% reddish-brown mudstone bands, attaining 60% below 666/6 (203.15 m), ripple marks, a few gypsum/halite veins. dip 40°		3 4	667	10
		(1.02 m)	(203.56 m)	
Mudstone reddish-brown vaguely banded with 40% wispy siltstone bands		3 11	671	9
Siltstone pale reddish brown well banded with reddish-brown mudstone bands, 40% above 670/0 (206.65 m), 50% below 670/0 (206.65 m), 2 cm gypsum nodules at 676/5, 676/8, 676/10 (206.17, 206.25, 206.31 m), numerous mud cracks?, slight convolutions, a few low angle gypsum veins downwards, some mud cracks have gypsiferous infillings.		9 1	680	10
		(2.77 m)	(207.52 m)	
Mudstone, greenish grey boldly banded with 40% greenish grey siltstone bands, includes a 2 cm layer of gypsum.		1 5	682	3
	Carried forward	(0.43 m)	(207.95 m)	

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				692	3
				(207.95 m)	
	Siltstone, greenish-grey, wispy banding, 10% greenish-grey mudstone bands downwards gypsum/halite veins to 2 cm. Some convoluted bedding near top of siltstone.	2	8	694	11
dip 47°		(0.81 m)		(208.76 m)	
	Siltstone, greenish-grey with 50% greenish-grey mudstone (less near top, more near bottom) well banded with crinkly banding in part, a few low angle gypsum veins.	4	3	699	2
		(1.30 m)		(210.06 m)	
	Siltstone, reddish-brown with 20% wispy reddish-brown mudstone bands, scattered 2cm gypsum nodules above 691/0 (210.62 m), no vein gypsum	3	3	692	5
		(0.99 m)		(211.05 m)	
	Siltstone pale reddish-brown, well banded with 20% reddish-brown mudstone.	2	7	695	0
		(0.79 m)		(211.84 m)	
	Siltstone greenish-grey, well banded with 40% greenish-grey mudstone with a few reddish-brown bands slight convolutions, superb ripplemark, cross lamination and cut and fill structures at 697/6 (212.60 m) birds-eye? at 701/10 (213.92 m). Individual siltstone bands to 8 cm low angle gypsum veins to 3cm, with some halite.	7	0	702	0
		(2.13 m)		(213.97 m)	
	Siltstone reddish-brown, banded with 40% reddish-brown mudstone layers a few grey bands near base. Superb ripplemarks above 703/0 (215.90 m), rare below 703/0 (215.80 m), mud-cracks? associated with up-doming Gypsum nodules to 2 cm at 704/2, 706/9 (214.63, 215.42 m). Layers of gypsum to 1 cm at 707/0,-707/2 (215.49 - 215.54 m). A few low angle halite veins to 5 cm.	7	7	709	7
		(2.31 m)		(216.28 m)	
	Siltstone, greenish-grey with 40% greenish-grey mudstone bands including some reddish-brown mudstone below 718/9 (219.08 m), a few				
	Carried forward			709	7

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				709	7
dip 40°	convolutions, thin gypsum bands at 713/4, 713/6, (217.42, 217.47 m), gypsum nodules at 711/6, 714/3 (216.87, 217.70 m), some brecciation between 718/9 - 722/8 (219.06-220.27 m) a few gypsum veins to 1½ cm.	13	9	723	4
		(4.19 m)		(220.47 m)	
	Mudstone, reddish-brown, faulted at top (possibly tectonic).	1	1	724	5
		(0.33 m)		(220.80 m)	
	Mudstone, reddish-brown, structureless with 40% wispy siltstone beds above 725/4 (221.08 m) a few gypsum veins to 5 mm	3	9	728	2
		(1.15m)		(221.95 m)	
	Mudstone, reddish-brown with 20% siltstone bands, faulted base may be collapse, a few gypsum veins.	2	1	730	3
		(0.63m)		(222.58 m)	
	Siltstone greenish-grey with 35% greenish-grey mudstone bands, banding rather indistinct, becoming bold downwards, increasingly collapsed and brecciated downwards, but banding still visible.	3	10	734	1
		(1.17m)		(223.75 m)	
dip 30°	Siltstone greenish-grey with 50% greenish-grey mudstone bands, with a little reddish-brown mudstone disturbed as if by penecontemporaneous faulting at two levels, brecciation associated in one instance with 4 cm gypsum vein, rare low angle halite veins to 5 mm.	3	8	737	9
		(1.12m)		(224.87 m)	
	Siltstone, greenish-grey, banded with 20% greenish-grey mudstone passing down into reddish-brown mudstone, more or less brecciated, especially near base, low angle gypsum veins to 5 mm.	1	1	738	10
		(0.53 m)		(225.20 m)	
	Mudstone, reddish-brown, brecciated, angular fragments to 3 cm.	1	0	739	10
		(0.30m)		(225.50 m)	
	Siltstone greenish-grey, with 40% greenish-grey mudstone bands above 742/4 (226.26 m)				
	Carried forward			739	10

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				739	10
				(225.50 m)	
	and below 744/2 (226.82 m), brecciation-in-situ (with plastic distortion of fragments) above 742/4 (226.26 m). This breccia intrudes downwards into the bed below. Rare gypsum veins to 1 cm.	5	0	744	10
				(227.03 m)	
Vague dip 70°	Mudstone, greenish-grey and reddish-brown, brecciated.	1	2	746	0
		(0.35 m)		(227.30 m)	
	Mudstone, reddish-brown and greenish-grey banded.	2	0	748	0
		(0.61 m)		(227.99 m)	
	Mudstone, reddish-brown with some greenish-grey, brecciated, with signs of disturbed bedding in parts, breccia fragments 1 mm - 4 cm, a few gypsum veins to 1 cm.	1	10	749	10
		(0.56 m)		(228.55 m)	
	Mudstone, reddish-brown, almost structureless with a little wispy silt, bedding vague and possibly disturbed, a few gypsum veins to 1 cm.	2	4	752	2
		(0.71 m)		(229.26 m)	
	Sample missing	1	7	753	9
		(0.48 m)		(229.74 m)	
	Mudstone, reddish-brown with greenish-grey silty blotches, brecciated, fragments to 4cm	5	3	759	0
		(1.60 m)		(231.34 m)	
	Mudstone, reddish-brown, a few greenish-grey blotches, structureless. A few gypsum veins to 2 cm.	2	8	761	8
		(0.82 m)		(232.16 m)	
	Siltstone, pale reddish-brown with 40% reddish-brown silty mudstone, streaky fabric with breccia fragments to 2 cm, vague signs of bedding, becoming better defined below 768/0½, (234.40 m) 4 cm low angle vein of fibrous gypsum at 767/11 - 468/0½ (234.06 - 234.10 m).	7	10	769	6
		(2.38 m)		(234.54 m)	
	Carried forward			769	6
				(234.54 m)	

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		Thickness		Depth	
				769	6
				(234.54 m)	
	Mudstone, reddish-brown, structureless, a few greenish-grey blotches, a few gypsum veins to 5 mm.	2	0	771	6
		(0.61 m)		(235.15 m)	
	Siltstone, pale greenish-grey and pale reddish-brown with 50% reddish-brown mudstone; brecciated and disturbed, vague signs of bedding, irregular gypsum veins, becoming more common downwards.	5	2	776	8
		(1.58 m)		(236.73 m)	
	Siltstone, greenish-grey, banded with greenish-grey mudstone.		8	777	4
		(0.20 m)		(236.93 m)	
	Mudstone, reddish-brown structureless, a few gypsum veins to 1 cm.	4	5	781	9
		(1.35 m)		(238.28 m)	
	Mudstone, silty, reddish-brown, with blotches of greenish-grey, disturbed fabric with some breccia fragments visible, a few irregular gypsum veins to 2 cm.	4	3	786	0
		(1.29 m)		(239.57 m)	
	Mudstone, reddish-brown, structureless with a few greenish-grey patches and signs of brecciation below 790/5 (240.92 m) a few gypsum veins to 3 cm.	8	8	794	8
		(2.64 m)		(242.21 m)	
dip 35°	Siltstone, greenish-grey, banded with reddish-brown mudstone, some brecciated patches, a few irregular gypsum veins to 5 cm.	1	6	796	2
		(0.46 m)		(242.67 m)	
	Mudstone, reddish-brown, structureless, a few irregular gypsum veins to 1 cm, a few silty bands below 804/10 (245.31 m)	10	4	806	6
		(3.15 m)		(245.82 m)	
	Mudstone, reddish-brown well banded with 30% greenish-grey and reddish-brown siltstone bands.	1	5	807	11
		(0.43 m)		(246.25 m)	
	Mudstone, reddish-brown with a few wispy greenish-grey and reddish-brown siltstone				
	Carried forward			807	11
				(246.25 m)	

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			807	11
			(246.25 m)	
	bands, a few gypsum veins to 5 mm.	1 2	809	1
		(0.36 m)	(246.61 m)	
	Mudstone, reddish-brown wispy texture, a few irregular gypsum veins to 2 cm.	3 0	812	1
		(0.91 m)	(247.52 m)	
	Siltstone, reddish-brown well banded with 50% reddish-brown mudstone, slight brecciation or mud crack, irregular gypsum veins to 5mm.	2 5	814	6
		(0.74 m)	(248.26 m)	
	Mudstone, reddish-brown silty, banded with disturbed bedding and brecciation of siltstone bands into 4 cm fragments irregular gypsum veins to 5 mm.	2 10	817	4
		(0.86 m)	(249.12 m)	
	Mudstone, reddish-brown banded with 30%			
dip 20°	greenish-grey siltstone, a few gypsum veins to 5 mm.	1 6	818	10
		(0.46 m)	(249.58 m)	
	Mudstone, reddish-brown, nearly structureless, traces of bedding, a few gypsum veins to 1cm	4 0	822	10
		(1.22 m)	(250.80 m)	
	Mudstone, reddish-brown with greenish-grey and reddish-brown siltstone bands with some brecciated patches below 824/0 (251.16 m) a few gypsum veins to 3 cm.	3 4	826	2
		(1.02 m)	(251.82 m)	
	Mudstone, reddish-brown, with a few greenish-grey blotches, structureless, a few gypsum veins to 1 cm.	5 10	832	0
		(1.77 m)	(253.59 m)	
dip 40°	Mudstone, reddish-brown, banded with reddish-brown and greenish-grey silty bands, bedding broken near middle a few gypsum veins to 4mm	3 8	835	8
		(1.12 m)	(254.71 m)	
	Mudstone, reddish-brown, vaguely banded, high			
dip 70°	dips probably due to collapse.	2 10	838	6
		(0.86 m)	(255.57 m)	
	Siltstone, reddish-brown with 50% reddish-			
dip c 40°	brown mudstone bands, a few low angle gypsum veins.	3 8	842	2
	Carried forward	(1.12 m)	(256.69 m)	

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Kirkham BH

			842	2
			(256.69 m)	
Mudstone, reddish-brown with greenish-grey siltstone bands, chiefly near top, rare below 845/0 (257.56 m) a few gypsum veins to 1 cm.	5	8	847	10
	(1.73 m)		(258.42 m)	
Siltstone, reddish-brown banded with 20% reddish-brown mudstone, incipient brecciation-in-situ, bedding twisted, gypsum veins to 5 mm.	1	1	848	11
	(0.33 m)		(258.75 m)	
Mudstone, reddish-brown rather silty structureless.	1	2	850	1
	(0.36 m)		(259.11 m)	
Mudstone, silty, reddish-brown, banded with signs of collapse, a few gypsum veins to 4mm	4	3	854	4
	(1.29 m)		(260.40 m)	
Siltstone, reddish-brown, with some greenish-grey upwards banded with reddish-brown mudstone 50%, falling to 20% downwards, probable ripple mark, a few low angle gypsum veins. dip 35°	3	10	858	2
	(1.17 m)		(261.57 m)	
Mudstone, reddish-brown, faintly banded, a few gypsum veins to 2 cm.	2	8	860	10
	(0.81 m)		(262.38 m)	
Siltstone, greenish-grey, banded with 20% greenish-grey mudstone, low angle gypsum veins to 1 cm. dip 25°	2	6	863	4
	(0.76 m)		(263.14 m)	
Siltstone, reddish-brown and mudstone, seems brecciated with signs of bedding, irregular gypsum veins to 1½ cm.	1	4	864	8
	(0.41 m)		(263.55 m)	
Siltstone, pale reddish-brown, botchy staining	2	1	866	9
	(0.64 m)		(264.19 m)	
Mudstone, reddish-brown, structureless except for some silty banding above 867/10 (264.52 m) signs of incipient brecciation-in-situ a few irregular gypsum veins to 3cm	7	3	874	0
	(2.21 m)		(266.40 m)	
Carried forward			874	0

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Kirkham BH

		874	0
		(266.40 m)	
Mudstone, reddish-brown, poorly banded with several concentrations of greenish-grey and reddish-brown siltstone bands, one 4 cm gypsum vein.	4 6	878	6
	(1.37 m)	(267.77 m)	
Mudstone, reddish-brown with wispy silt bands near middle and base, fabric disturbed in places (buckling) and also some brecciation, irregular gypsum veins to 2 cm.	3 0	881	6
	(0.91 m)	(268.68 m)	
Mudstone, reddish-brown, structureless, irregular gypsum veins to 1 cm, some of which are faulted up to 2 cm.	4 9	886	3
	(1.45 m)	(270.13 m)	
Mudstone, reddish-brown, rather silty, structureless except for a few irregular bands of greenish-grey siltstone above 892/0 (271.98 m); one such siltstone band 4 cm thick is broken into fragments up to 6 cm long a few gypsum veins to 5 mm.	9 9	896	0
	(2.77 m)	(273.10 m)	
dip 65° some bedding disturbance horizontal. Mudstone, reddish-brown faintly banded 25% reddish-brown siltstone bands a few gypsum veins to 5 mm.	3 1	899	1
	(0.94 m)	(274.04 m)	
Mudstone, reddish-brown, faintly banded, wispy siltstone bands below 903/0 (275.23 m), signs of brecciation from 899/1 - 903/0 (274.04 - 275.23 m), brecciated with fragments to 4 cm from 906/0 - 907/2 (276.15 - 276.90 m).	8 11	908	0
	(2.72 m)	(276.76 m)	
Mudstone, reddish-brown, somewhat silty, structureless, a few gypsum veins to 2 cm.	2 4	910	4
	(0.71 m)	(277.47 m)	
Siltstone, with mudstone bands, banded reddish-brown and greenish-grey.	8	911	0
	(0.20 m)	(277.67 m)	
Mudstone, reddish-brown, structureless core broken and listric downwards, gypsum veins			
Carried forward		911	0

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Kirkham BH

			911	0
			(277.67 m)	
to 1 cm in lower beds.	2	10	913	10
	(0.86 m)		(278.54 m)	
Mudstone, reddish-brown and siltstone reddish-brown, all more or less brecciated, especially downwards, fragments to 4 cm, a few irregular gypsum veins to 1 cm.	3	2	917	0
	(0.97 m)		(279.50 m)	
Mudstone, reddish-brown, structureless, a few gypsum veins to 5 cm.	3	4	920	4
	(1.02 m)		(280.52 m)	
Siltstone, reddish-brown and greenish-grey (downwards) banded with mudstone, reddish-brown, brecciated and collapsed with bedding twisted in all directions, basal contact irregular, a few gypsum veins to 3 cm.	4	8	925	0
	(1.42 m)		(281.94 m)	
Siltstone, greenish-grey well banded with 30% greenish-grey mudstone bands, some wispy bedding and 'flame' structures, signs of minor collapse in bedding, a few gypsum veins up to 4 cm, granular banded gypsum present between 925/0 - 925/6 (281.94-282.09m)	1	8	926	8
	(0.51 m)		(282.45 m)	
Mudstone, reddish-brown with 20% reddish-brown siltstone bands, well banded above 929/0 (283.16 m), but more wispy and indistinct below 929/0 (283.16 m), rare gypsum veins to 3 cm, ripple mark in lower half. dip 50°	9	4	936	0
	(2.84m)		(285.29 m)	
Siltstone, reddish-brown and 50% reddish-brown mudstone, brecciated, gypsum vein.	1	9	937	9
	(0.54m)		(285.83 m)	
Mudstone, reddish-brown, structureless, gypsum veins to 1 cm chiefly near base.	1	5	939	2
	(0.43m)		(286.26 m)	
Siltstone, reddish-brown and reddish-brown mudstone wispy texture with some brecciation downwards.	1	1	940	3
	(0.33 m)		(286.59 m)	
Mudstone, reddish-brown with much greenish-				
Carried forward			940	3

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Kirkham MI

			94.0	3
			(286.59 m)	
grey siltstone (90% between 944/3 - 945/6 - 287.81 - 288.19 m), brecciated with signs of bedding, angular fragments 1 - 10 cm, a few irregular gypsum veins chiefly in upper half and some interstitial gypsum in breccia.	8	5	94.8	8
	(2.56 m)		(289.15 m)	
Siltstone, greenish-grey banded with 20% greenish-grey mudstone, some crinkly bedding.	1	4	950	0
	(0.41 m)		(289.56 m)	
Siltstone, greenish-grey with 40% reddish-brown mudstone bands, signs of buckling and collapse, rare gypsum veins.	1	8	951	8
	(0.51 m)		(290.07 m)	
Mudstone, reddish-brown, structureless, a few greenish-grey blotches, some in situ brecciation downwards, no gypsum veins.	2	0	953	8
	(0.61 m)		(290.68 m)	
Siltstone, greenish-grey boldly banded with 40% reddish-brown mudstone partings, some local brecciation, ripple mark, false bedding, poor salt pseudomorphs no gypsum veins	5	2	958	10
	(1.57 m)		(292.25 m)	
Mudstone, reddish-brown and 40% reddish-brown siltstone heavily brecciated (fragments to 4 cm) above 959/9 (292.53 m)no gypsum veins.	2	5	961	3
	(0.74 m)		(292.99 m)	
Mudstone, reddish-brown with irregular greenish-grey silty blotches, incipient and actual brecciation especially in lower half no gypsum veins.	6	9	968	0
	(2.06 m)		(295.05 m)	
dip 50° Mudstone, reddish-brown slightly silty brecciated throughout (fragments to 8 cm), greenish-grey siltstone fragments abundant in parts of core, traces of bedding with steep dips and overturning no gypsum veins.	5	0	973	0
	(1.52 m)		(296.57 m)	
Mudstone, reddish-brown, slightly silty, largely structureless, banding visible between 975/0 - 976/0 (297.18 - 297.48 m)	8	0	981	0
Carried forward	(2.44 m)		(299.01 m)	

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Kirkham III

			981 0 (299.01 m)
Mudstone, greenish-grey, possibly breccia, broken by drilling.		8 (0.20 m)	981 8 (299.21 m)
Mudstone, reddish-brown with lenses of greenish-grey, breccia, with angular fragments to 4 cm.		3 10 (1.17 m)	985 6 (300.38 m)
Mudstone, reddish-brown, structureless.		1 1 (0.33 m)	986 7 (300.71 m)
Mudstone, reddish-brown with 30% greenish-grey indistinct siltstone bands.		1 7 (0.48 m)	988 2 (301.19 m)
Mudstone, reddish-brown with subsidiary greenish-grey, streaky texture throughout, more or less brecciated, fragments tend to be pod shaped.		6 2 (1.88 m)	994 4 (303.07 m)
Mudstone, reddish-brown, seems structureless except for a few wispy siltstone bands downwards.		3 8 (1.12 m)	998 0 (304.19 m)
Siltstone, chiefly greenish-grey boldly banded with 50% greenish-grey and reddish-brown mudstone, ripple marks, false bedding.	dip 17°	4 7 (1.40 m)	1002 7 (305.59 m)
Mudstone, reddish-brown, slightly silty, almost structureless mud cracks at 1007/7 (307.09 m)		6 5 (1.95 m)	1009 0 (307.54 m)
Mudstone, reddish-brown, microbreccia		3 2 (0.97 m)	1012 2 (308.51 m)
Mudstone, reddish-brown alternating with runs of greenish-grey; boldly banded with 30% greenish-grey siltstone, false bedding, ripple mark.	dip 18°	7 8 (2.34 m)	1019 10 (310.85 m)
Mudstone, reddish-brown almost structureless with rare silty bands, greenish-grey blotches		4 7 (1.39 m)	1024 5 (312.24 m)
Mudstone, reddish-brown well banded becoming indistinct downwards with 40% reddish-brown			
Carried forward			1024 5

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Kirkham RH

			1024	5
			(312.24 m)	
	siltstone bands, ripple marks, lead casts; 'birdseye' in 1 cm siltstone.	3 4 (1.02 m)	1027	9
			(313.26 m)	
	Mudstone, reddish-brown slightly silty structureless, no gypsum.	3 3 (0.99 m)	1031	0
			(314.25 m)	
	Mudstone, reddish-brown banded, some brecciation at top, ripple mark, 'birdseye' in siltstone.	2 0 (0.61 m)	1033	0
			(314.86 m)	
dip 25°	Mudstone, reddish-brown, indistinctly banded with 40% siltstone, false bedding mud cracks?	3 0 (0.91 m)	1036	0
			(315.77 m)	
	Mudstone, reddish-brown, structureless, no gypsum veins.	3 9 (1.15 m)	1039	9
			(316.92 m)	
	Mudstone, reddish-brown, brecciated 'in situ' fragments to 2 cm throughout no gypsum veins, one undisturbed silty band seen with false bedding.	5 7 (1.70 m)	1045	4
			(318.62 m)	
	Siltstone, reddish-brown banded with 50% reddish-brown mudstone.	8 (0.20 m)	1046	0
			(318.82 m)	
dip 16°	Mudstone, greenish-grey well banded with 40% greenish-grey siltstone, false bedding, a few salt pseudomorphs.	2 6 (0.76 m)	1048	6
			(319.58 m)	
	Mudstone, reddish-brown, nearly structureless, slightly silty with a little silty banding near top, no gypsum veins.	3 3 (0.99 m)	1051	9
			(320.57 m)	
	Mudstone, reddish-brown with 40% indistinct reddish-brown siltstone bands.	1 9 (0.54 m)	1053	6
			(321.11 m)	
	Mudstone, somewhat silty reddish-brown structureless, no gypsum veins.	7 8 (2.33 m)	1061	2
			(323.44 m)	
	Siltstone pale reddish-brown well and closely banded with 30% reddish-brown mudstone			
	Carried forward		1061	2

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Kirkham BH

			1061	2
			(323.44 m)	
	partings, attaining 60% near base some streaky texture; pellet conglomerate at 1061/4 (323.49 m), ripple marks, mud cracks?, no gypsum veins.	4 7 (1.40 m)	1065	9
			(324.84 m)	
dip 12°	Mudstone, greenish-grey with a run of reddish-brown, well and closely banded with 40% greenish-grey siltstone, a few ripple marks, a few salt pseudomorphs, cross lamination, mud cracks.	7 8 (2.34 m)	1073	5
			(327.18 m)	
	Mudstone, reddish-brown with 10% streaky siltstone bands, boldly convoluted near middle, mud crack?	1 0 (0.30 m)	1074	5
			(327.48 m)	
	Siltstone, greenish-grey with 40% reddish-brown and greenish-grey mudstone partings, false bedding.	4 (0.10m)	1074	9
			(327.58 m)	
	Mudstone silty reddish-brown almost structureless, a few wispy siltstone bands.	1 4 (0.41 m)	1076	1
			(327.99 m)	
	Mudstone, reddish-brown well banded with 40% pale reddish-brown siltstone, ripple mark, mud crack?	1 8 (0.51 m)	1077	9
			(328.50 m)	
dip 13°	Mudstone, greenish-grey (near grey) well banded with variable amounts of siltstone, averaging 40%, ripple mark, load cast, salt pseudomorphs possible etched out halite veins at 1080/9 (329.41 m).	5 6 (1.67 m)	1083	3
			(330.17 m)	
	Mudstone, reddish-brown, almost structureless with 10% siltstone in faint bands.	1 4 (0.41 m)	1084	7
			(330.58 m)	
	Mudstone, reddish-brown, finely banded with some blotchy greenish-grey layers, fabric podded on a small scale in two runs 6 cm thick	3 6 (1.07 m)	1088	1
			(331.65 m)	
	Siltstone, reddish-brown with 40% reddish-			
	Carried forward		1088	1

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Kirkham BH

		1088	1
		(331.65 m)	
brown mudstone bands attaining 6cm at top, a few individual siltstone bands attain 8cm but average 1 cm, abundant ripple mark, false bedding (small scale) cut and fill and crack.	5 3 (1.60 m)	1093	4
		(333.25 m)	
Mudstone, reddish-brown with c. 20% (30% downwards) thin pale reddish-brown siltstone bands, rather streaky fabric in middle position	4 0 (1.22 m)	1097	4
		(334.47 m)	
Mudstone, greenish-grey with a little reddish-brown near top, boldly banded with 30% greenish-grey siltstone, cut and fill, rare ripples, giant salt pseudomorph; Neoteberia at 1099/3 (335.18 m) dip 13°	3 1 (0.94 m)	1100	5
		(335.41 m)	
Sample missing	1 3 (0.38 m)	1101	8
		(335.79 m)	
Mudstone greenish-grey, boldly banded with 30% greenish-grey siltstone, mud crack.	1 2 (0.35 m)	1102	10
		(336.14 m)	
Siltstone pale reddish-brown with a little greenish-grey boldly banded with 50% reddish-brown mudstone, probable mud cracks especially common downwards, mica quite common in the 1 - 2 cm siltstone bands.	4 8 (1.43 m)	1107	6
		(337.57 m)	
Mudstone greenish-grey (near grey) boldly banded with 30% greenish-grey siltstone, with 22 cm of reddish-brown mudstone near middle; ripple mark.	3 8 (1.11 m)	1111	2
		(338.68 m)	
Mudstone, reddish-brown banded with 20% reddish-brown siltstone bands, ripple mark.	3 0 (0.92 m)	1114	2
		(339.60 m)	
Siltstone, greenish-grey and pale reddish-brown well banded with 50% mudstone in similar colours, much ripple mark, a few calcite veins with vugs.	3 8 (1.12 m)	1117	10
Carried forward		(340.72 m)	

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Kirkham BH

			1117 10 (340.72 m)
dip 10°	Siltstone, greenish-grey closely banded with 50% greenish-grey mudstone bands ripple mark, a few 1 mm calcite veins downwards.	5 1 (1.55 m)	1122 11 (342.27 m)
	Mudstone, greenish-grey banded with 20% greenish-grey siltstone, soft with closely spaced joints, disturbed bedding might be faulting or due to penecontemporaneous disturbance.	1 3 (0.38 m)	1124 2 (342.65 m)
dip 17°	Siltstone, greenish-grey boldly banded with 50% greenish-grey (near grey) mudstone ripple mark, calcite veins to 2 mm and calcite films on bedding.	4 0 (1.22 m)	1128 2 (343.87 m)
	Siltstone, greenish-grey, a few mudstone partings, mudstone flake conglomerate shards to 2 cm long.	1 0 (0.30 m)	1129 2 (344.17 m)
	Mudstone, greenish-grey with wispy siltstone bands, cross bedding, mica.	3 7 (1.09 m)	1132 9 (345.26 m)
	Mudstone, grey (faint greenish tinge) banded with 20% greenish-grey siltstone, mud cracks, mudstone flake breccia layers, salt pseudomorphs common, irregular calcite veins to 2 mm.	5 4 (1.63 m)	1138 1 (346.89 m)
dip 12°	Siltstone, grey, boldly banded with 40% grey mudstone, a few siltstones to 8 cm but much of banding is very fine, cross lamination ripple mark clay flake conglomerate some mica, rare possible mud cracks, a few calcite veins.	4 11 (1.50 m)	1143 0 (348.39 m)
	Siltstone, greenish-grey and reddish-brown banded with 50% mudstone in similar colours, ripple mark, mudstone flake conglomerate, 2 mm calcite vein.	1 5 (0.43 m)	1144 5 (348.82 m)
	Mudstone, greenish-grey becoming grey below	Carried forward	1144 5

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Kirkham BH

			1144 5 (348.82 m)
	1149/9 (350.22 m) well banded with 20% greenish-grey siltstone, (40% between 1147/6-1148/6 349.76-350.06 m) salt pseudomorphs, rare load casts, calcite veins throughout.	15 7 (4.75 m)	1160 0 (353.57 m)
	Siltstone, grey with mudstone bands, mudstone flake breccia layers.	1 0 (0.30 m)	1161 0 (353.87 m)
	Mudstone, grey, banded with thin highly porous calcitic fine grained sandstone layers, excellent salt pseudomorphs to 2 cm wide, ripple mark, load casts, abundant calcite veins	2 6 (0.76 m)	1163 6 (354.63 m)
	Sandstone, fine-grained calcitic, highly porous, with 50% grey mudstone bands, clay flake in one sandstone band calcite veins.	2 6 (0.77 m)	1166 0 (355.40 m)
	Mudstone grey with calcitic sandstone, disturbed fabric with high dips and injected sediment.	2 4 (0.71 m)	1168 4 (356.11 m)
	Mudstone, grey, with a few silty bands calcite veins.	11 (0.28 m)	1169 3 (356.39 m)
	Mudstone, grey with 40% porous calcitic fine-grained sandstone bands.	5 (0.12 m)	1169 8 (356.51 m)
	Mudstone grey well and closely banded with 30% siltstone partings, a few bands of calcitic fine-grained sandstone, a few salt pseudomorphs, calcite veins.	3 4 (1.02 m)	1173 0 (357.53 m)
dips up to 50°	Mudstone, grey, with siltstone, chiefly as a matrix, appears to be injected in places, bedding buckled and disturbed, perhaps a seismite.	3 5 (1.04 m)	1176 5 (358.57 m)
dip 60° at 1179/9 (359.59 m)	Mudstone, grey banded with 20% greenish-grey siltstone, bedding slightly buckled (steepening downwards), some calcite veins.	3 7 (1.09 m)	1180 0 (359.66 m)
	Carried forward		

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Kirkham BH

				1180 0 (359.66 m)
	Mudstone, grey with some siltstone, boldly banded, broken bedding with plastic deformation of fragments, possible seismite.	4	4 (1.32 m)	1184 4 (360.98 m)
	Mudstone, grey with a few siltstone bands chiefly near top, one 5 cm siltstone band is highly micaceous.	2	8 (0.82 m)	1187 0 (361.80 m)
dip 22°	Siltstone, grey, well but not very regularly banded with 20% grey mudstone bands, ripple mark, mudstone flake breccia.	3	5 (1.04 m)	1190 5 (362.84 m)
	Siltstone grey and pale reddish-brown boldly and rather irregularly banded with 40% reddish-brown mudstone, ripple mark, cross bedding.	1	1 (0.33 m)	1191 6 (363.17 m)
	Sandstone, fine-grained, banded, pale grey with pink tinge.		11 (0.28 m)	1192 5 (363.45 m)
	Siltstone, reddish-brown with some greenish-grey boldly banded with 50% reddish-brown mudstone bands, some siltstone bands are nearly sandstone, specimen missing between 1195/1 - 1196/0 (364.26 - 364.54 m)	5	3 (1.60 m)	1197 8 (365.05 m)
	Mudstone, greenish-grey banded with a few siltstone bands near base, possible dolomite band at 1199/7 - 1199/8 (365.63-365.66 m)	2	0 (0.61 m)	1199 8 (365.66 m)
	Sandstone, fine-grained greenish-grey,		6 (0.15 m)	1200 2 (365.81 m)
	Mudstone, greenish-grey with irregular reddish-brown streaky banding.	1	0 (0.30 m)	1201 2 (366.11 m)
	Mudstone, reddish-brown.		3 (0.08 m)	1201 5 (366.19 m)
	Sandstone, fine-grained pale reddish-brown, heavy mesh of calcite veins.	4	5 (1.35 m)	1205 10 (367.54 m)
	Carried forward			1205 10

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Kirkham RH

			1205 10 (367.54 m)
Sandstone, fine-grained pale reddish-brown with some grey near top.	2 2 (0.66 m)	1203 0 (368.20 m)
Sandstone, medium-grained reddish-brown and grey sandstone with blotchy colouration, some millet seed grains.	6 6 (1.98 m)	1214 6 (370.18 m)
Sandstone, fine-grained, fine-to-medium grained below 1222/0 (372.47 m), deep reddish-brown with a few large grey blotches, silty banding at 1221/0-1221/2 (372.16 - 372.21 m) indications of current bedding, some milletseed grains below 1234/0 (376.12 m)	29 6 (8.99 m)	1244 0 (379.17 m)
apparent dip 24° Sandstone, fine to medium-grained, traces of faint banding reddish-brown with four banded grey bands up to 6 cm thick and one 18 cm thick.	7 9 (2.36 m)	1251 9 (381.53 m)
Sandstone, fine-grained deep reddish-brown, even grain size, one grey blotch.	7 2 (2.19 m)	1258 11 (383.72 m)
Sandstone, fine to medium-grained deep reddish-brown poorly sorted, some grey blotches, signs of false bedding, podded fabric at 1275/0 (388.62) may be biological in origin.	17 3 (5.26 m)	1276 2 (388.98 m)
apparent dip 20° Sandstone fine to medium-grained deep reddish-brown, well banded with some podded fabric, poorly sorted.	6 0 (1.82 m)	1282 2 (390.80 m)
Sandstone fine-grained with mudstone flake breccia, a few pebbles.	6 (0.16 m)	1282 8 (390.96 m)
Sandstone fine to medium-grained reddish-brown with a few paler blotches a few mudstone flakes, some milletseed grains, false bedding.	8 8 (2.64 m)	1291 4 (393.60 m)
Carried forward		

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Kirkham BH

			1291	4
			(393.60 m)	
	Sandstone, medium-grained, reddish-brown sconttered milletseed grains.	12 8	1304	0
		(3.86 m)	(397.46 m)	
apparent dip 25°	Sandstone, fine-grained, reddish-brown, some milletseed grains.	11 10	1315	10
		(3.61 m)	(401.07 m)	
	Sandstone, greenish-grey with layers of greenish-grey mudstone.	1½	1315	11½
		(0.03 m)	(401.10 m)	
	Sandstone, medium-grained, deep reddish-brown, good milletseed grains.	4 6½	1320	6
		(1.39 m)	(402.49 m)	
	Sandstone fine to medium grained reddish-brown	3 3	1323	9
		(0.99 m)	(403.48 m)	
	Sandstone fine-grained greenish-grey and pale reddish-brown banded.	6	1324	5
		(0.20 m)	(403.68 m)	
	Mudstone, reddish-brown, structureless, listric	2 1	1326	6
		(0.64 m)	(404.32 m)	
	Sandstone very fine grained, deep reddish-brown two 2 cm silty beds near top.	7 9	1334	3
		(2.36 m)	(406.68 m)	
	Sandstone fine to medium-grained, deep reddish-brown, poorly cemented becoming tougher downwards with some banding.	12 4	1346	7
		(3.76 m)	(410.44 m)	
	Sandstone fine and medium-grained false-bedded, a little mica.	9 10	1356	5
		(3.00 m)	(413.44 m)	
	Sandstone fine-grained grey, micaceous compact	3	1356	8
		(0.07 m)	(413.51 m)	
	Sandstone, medium grained, gradually becoming fine grained downwards, reddish-brown.	5 6	1362	2
		(1.68 m)	(415.19 m)	
	Mudstone, reddish-brown.	½	1362	2½
		(0.01 m)	(415.20 m)	
	Sandstone, medium-grained with mudstone flake conglomerate.	½	1362	3
		(0.01 m)	(415.21 m)	
	Carried forward		1362	3

SD43SW/6

SD43/20

Kirkham BH

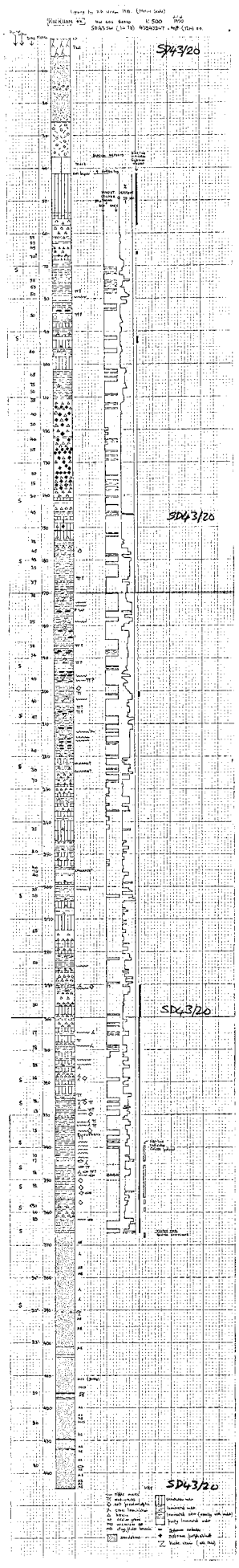
			1362	3
			(415.21 m)	
apparent dip 20°	Mudstone, reddish-brown, very finely micaceous	1	1362	4
		(0.03 m)	(415.24 m)	
	Sandstone, medium-grained, milletseed grains, particularly well seen near top.	4 8	1367	0
		(1.42 m)	(416.66 m)	
	Mudstone, reddish-brown, silty with siltstone bands near top and base, listric.	1 3	1368	3
		(0.38 m)	(417.04 m)	
	Sandstone, fine to medium-grained deep reddish-brown with rare greenish-grey bands to 5 cm thick, deep reddish-brown muddy slots from 1372/0 - 1374/8 (418.19 - 419.00 m) some milletseed below 1377/9 (419.94 m), false bedding common below 1376/0 (419.40 m).	17 2	1385	5
		(5.24 m)	(422.28 m)	
	Sandstone, medium-grained reddish-brown, several bands rich in 'milletseed' grains mudstone pebbles to 6 cm wide at 1389/0 (423.57 m).	6 0	1391	5
		(1.82 m)	(424.10 m)	
apparent dip 20°	Sandstone, fine-grained reddish-brown finely laminated micaceous, compact.	9	1392	2
		(0.25 m)	(424.33 m)	
	Sandstone, medium-grained, reddish-brown false bedded, some milletseed grains.	11 3	1403	5
		(3.43 m)	(427.76 m)	
	Sandstone medium-grained reddish-brown several bands rich in milletseed grains.	6 2	1409	7
		(1.88 m)	(429.64 m)	
	Mudstone silty micaceous reddish-brown and greenish-grey.	1	1409	8
		(0.03 m)	(429.67 m)	
	Sandstone fine to medium-grained, with micaceous reddish-brown mudstone plane 2 mm thick.	7	1410	3
		(0.17 m)	(429.84 m)	
	Sandstone fine to medium-grained some milletseed, becoming abundant downwards, mudstone pebbles around 1417/6 (432.05 m)	9 7	1419	10
	Carried forward	(2.93 m)	(432.77 m)	

SD 43 SW/6

SD43/20

Kirkham BH

			1419 10 (432.77 m)
Siltstone, greenish-grey micaceous and reddish-brown fine grained mudstone.		2 (0.05 m)	1420 0 (432.82 m)
Sandstone, fine to medium-grained deep reddish-brown, milletseed grains.		8 4 (2.54 m)	1428 4 (435.36 m)
Sandstone, fine-grained pale reddish-brown tough micaceous.		2 0 (0.61 m)	1430 4 (435.97 m)
Sandstone fine to medium grained, with milletseed grains.		3 11 (1.19 m)	1434 3 (437.16 m)
apparent dip 20°	Sandstone, fine-grained, reddish-brown, banded with a few small mudstone pebbles near base, a few mica flakes, tough.	2 9 (0.84 m)	1437 0 (438.00 m)
	Sandstone, medium-grained, deep reddish-brown, soft with abundant excellent milletseed grains core sample missing 1442/6-1443/11 (439.67-440.11 m).	7 1 (2.16 m)	1444 1 (440.16 m)
	Sandstone, fine-grained grey, with milletseed grains.	3 (0.07 m)	1444 4 (440.23 m)
	Sandstone, medium-grained, deep reddish-brown, soft with milletseed grains, especially abundant and of excellent shape downwards.	15 5 (4.70 m)	1459 9 (444.93 m)
	bottom of hole		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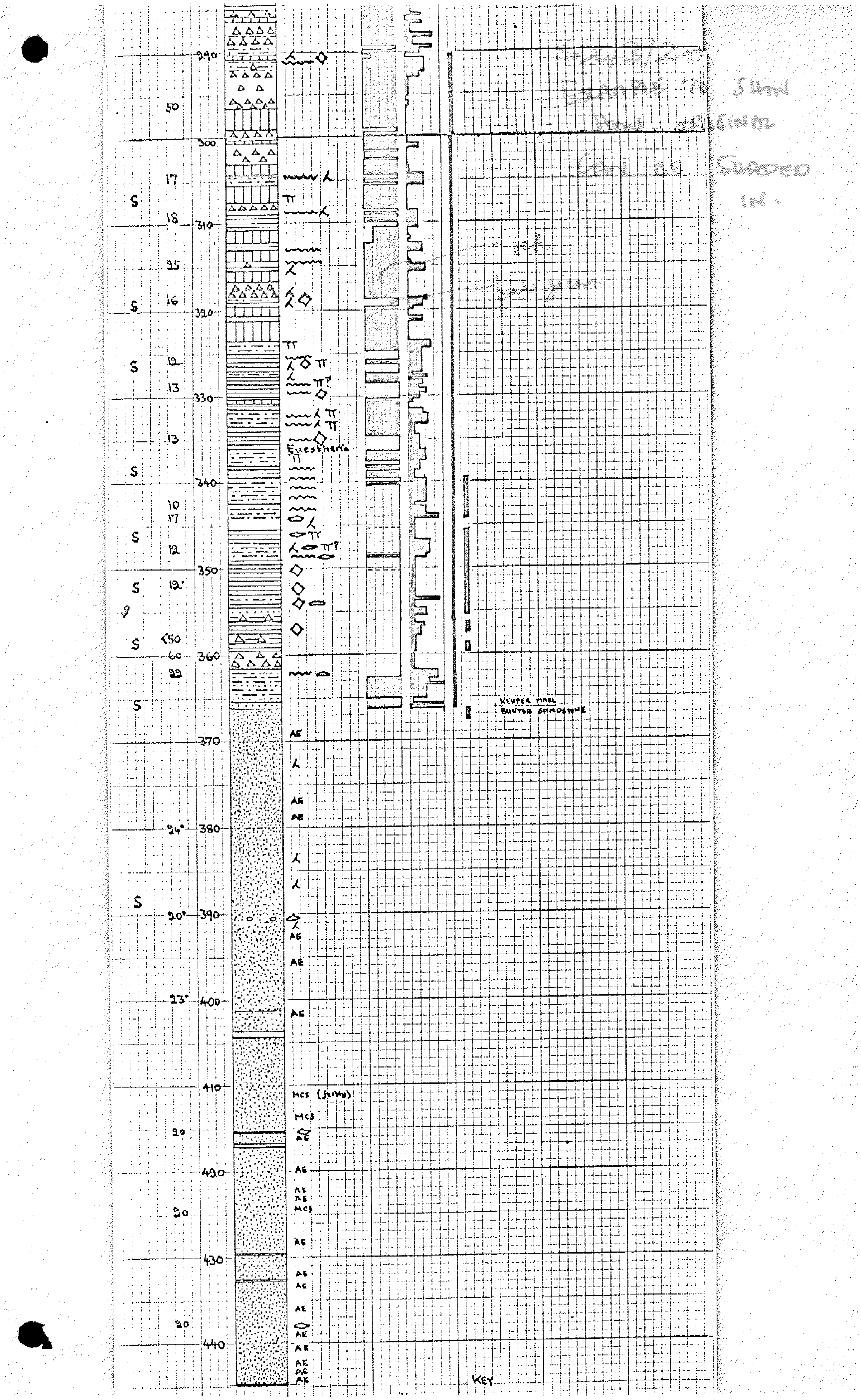
SD43/20


290
300
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380
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Euestheria
KEUPER MARL
BUNTER SANDSTONE
MCS
AE
KEY

File record no SD 43/20

WATER RESOURCES BOARD

WELL RECORD

SHEET 1

W.R.B. REF. No. SD 43/20

R.A. LICENCE No.

1. WELL IDENTITY

NATIONAL GRID REFERENCE SD 4327 3248

Well at KIRKHAM B/H

I.G.S. REF. No. 75/-

RIVER AUTHORITY Lancashire.

Town

HYDROMETRIC AREA

County

SUB-CATCHMENT

Owner of well

Well made by

Date of sinking

Information from Lancashire River Authority North West Water Authority

Date received

2. WELL DESCRIPTION

Level at ground surface / O.D. of measuring Pt. 10.37 m.

If well top is not at above* m.

above sea level (O.D.) ft.

ground level how far below ft.

Shaft m. deep; Diameter at top mm.; at bottom mm.
ft. in. in.

Bore 44.5 m. deep; Diameter at top 20.3 Cms mm.; at bottom 20.3 Cms mm.
ft. in. in.

Details of headings

DETAILS OF PERMANENT LINING TUBES

Length Plain m. ft.; Diam. mm. in.; Length Slotted m. ft.; Diam. mm. in.; Top m. ft. above* / below surface

Length Plain m. ft.; Diam. mm. in.; Length Slotted m. ft.; Diam. mm. in.; Top m. ft. above* / below surface

Length Plain m. ft.; Diam. mm. in.; Length Slotted m. ft.; Diam. mm. in.; Top m. ft. above* / below surface

Details of well screen

DETAILS OF REST WATER LEVELS DURING CONSTRUCTION

Water struck at depths of below well top

Rest level of water m. ft. above* / below O.D.* well top when bore m. ft. deep. Date

Rest level of water m. ft. above* / below O.D.* well top when bore m. ft. deep. Date

Rest level of water on completion of bore m. ft. above* / below O.D.* well top when bore m. ft. deep. Date

Method of drilling

Brief details of well development e.g. acid treatment etc.

* delete as applicable

(18127/1)

SP43/20

DETAILS OF PUMPING TEST

Water level depressed from ..... m. / ..... ft. above* / below well top to ..... m. / ..... ft. below well top, pumping at ..... l/s / ..... galls/hr.

Water level depressed from ..... m. / ..... ft. above* / below well top to ..... m. / ..... ft. below well top, pumping at ..... l/s / ..... galls/hr.

Water level depressed from ..... m. / ..... ft. above* / below well top to ..... m. / ..... ft. below well top, pumping at ..... l/s / ..... galls/hr.

Suction at ..... ft. below well top. Capacity of pump ..... l/s / galls/hr. Test from ..../..../19.... to ..../..../19....

DETAILS OF PERMANENT PUMPING EQUIPMENT

Make and/or type ..... Motive Power .....

Capacity ..... l/s / galls/hr. Suction at ..... m. / ..... ft. below well top.

Amount pumped ..... m^3/day* / galls/day. Pumping for ..... hrs./day.

Estimated consumption ..... m^3/week* / galls/week ..... m^3/year* / galls/year

3. WELL DATA

WELL USE. Abstraction ☐, Recharge ☐, Observation ☒, Disused ☐, Filled-in ☐

WATER USE. Public Supply ☐, Industrial ☐, Irrigation ☐, Agriculture ☐, Domestic ☐, Unused ☐, Misc. ☐

WATER LEVEL OBSERVATIONS

	Rest Water Level	Pumping Water Level	Depression	Rate of Pumping	Date
(1)	..... m. / ..... ft. O.D.	..... m. / ..... ft. O.D.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....
(2)	..... m. / ..... ft. O.D.	..... m. / ..... ft. O.D.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....
(3)	..... m. / ..... ft. O.D.	..... m. / ..... ft. O.D.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....
(4)	..... m. / ..... ft. O.D.	..... m. / ..... ft. O.D.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....

GEOPHYSICAL DATA AVAILABLE

Resistivity ☐ Conductivity ☐ Temperature ☐ Any other logs .....

PARTIAL ANALYSIS DETAILS in milligrams per litre

Date	TDS	Tot H	Carb H	Non-Carb H	Alk	SO4	Cl	E.C.

Site marked on: 1 inch (print) ....., 1 inch (master) ....., 2½ inch ..... (use symbol and give data)

(18127/1)

WATER RESOURCES BOARD

WELL RECORD

SHEET 2

W.R.B. REF No. SD 43/20

R.A. LICENCE No.

4. HYDROGEOLOGY

Topography AT WELL SITE

Local depression ☐, Flat surface ☐, Hill top ☐, Hillside ☐, Valley bottom ☐, Terrace ☐

MAJOR AQUIFER PERMO TRIAS SANDSTONE Lithology .....

Depth to top of aquifer ..... m. / ..... ft. Thickness penetrated ..... m. / ..... ft.

Top of aquifer ..... m. / ..... ft. AOD* / BOD Total thickness of aquifer ..... m. / ..... ft.

Coefficient of storage ..... Transmissivity ..... m²/day* / galls/day/ft.

MINOR AQUIFER ..... Lithology .....

Depth to top of aquifer ..... m. / ..... ft. Thickness penetrated ..... m. / ..... ft.

Top of aquifer ..... m. / ..... ft. AOD* / BOD Total thickness of aquifer ..... m. / ..... ft.

Coefficient of storage ..... Transmissivity ..... m²/day* / galls/day/ft.

ADDITIONAL NOTES:

An observation well of Lancanshire River Authority measured manually.

* delete as applicable

RR 18127/1/2173 5m 5/71 TP

5. STRATA

GEOLOGICAL CLASSIFICATION	NATURE OF STRATA	THICKNESS	DEPTH	DEPTH	
		METRES	METRES	FEET	IN

RR 18127/1/2173 5m 5/71 TP

NGR. c. 4118 3114

7

RECORD OF WELL (SHAFT OR BORE)

SD 43 SW 2

1" N.S. 75 1
1" O.S. 89 NW
Grid Ref. 75/51

At WILSON PEAT ESQ

Town or Village AIBBY County LANCASHIRE Six-inch quarter sheet 59 NE

Exact site HILL FARM, AIBBY, KIRKHAM nr PRESTON } (A rough sketch-map or a tracing from a map is very desirable)
in parish of }

Level of ground surface above sea-level (O.D.) ft. If well starts below ground surface, state how far ft.

Shaft ft., diameter ft. Bore 84 ft. Diameter of bore: at top 11½ ins.; at bottom ins.

Details of permanent lining tubes (internal diameters preferred)

Water struck at depths of (feet)

Rest-level of water below / above top of well feet. Suction at feet. Yield on hours' / days' test gallons per (with pump of capacity g.p.h.); depressing water level to feet below top. Time of recovery hrs. Amount normally pumped daily g.p.h. for hours.

Quality (attach copy of analysis if available)

Sunk by Thos. Matthews for Mr. Date of well 1936

Information from

(For Survey use only). GEOLOGICAL CLASSIFICATION.	NATURE OF STRATA (and any additional remarks).	THICKNESS Feet.	THICKNESS Inches.	DEPTH Feet.	DEPTH Inches.
	Boulder clay	51	8	51	8
	Sandy marl & gravel	3	0	54	8
	Boulder	3	4	58	0
	Sandy marl	3	0	61	0
	Brown sand	–	10	61	10
	Small gravel	4	2	66	0
	Sandy marl & gravel	8	0	74	0
	Sand & gravel	10	0	84	0

SD	43	SW/2	
15	75	15	75
0	91	16	66
1	01	17	67
0	92	18	59
0	26	18	85
1	27	20	12
2	44	22	56
3	04	25	60

[redacted]

[redacted]

For Survey use only

Date received	G.S.M. Office File No.	Site marked on 1" map (use symbol)

GEOLOGICAL SURVEY AND MUSEUM, SOUTH KENSINGTON, LONDON, S.W.7.

(7993) Wt.36064/0349 5,000 12/38 A.&E.W.Ltd. Gp.686

SD43 SW/2

75/10

SD43/5

RECORD OF WELL (SHAFT OR BORE)

SD43SW 412 311

1" N.S. 75
1" O.S. 89 NW
Grid Ref. 75/51

1

At WILSON PEAT ESQ

Town or Village LIBBY County LANCASHIRE Six-inch quarter sheet 59 NE

Exact site HILL FARM, LIBBY, KIRKHAM nr PRESTON in parish of

(A rough sketch-map or a tracing from a map is very desirable)

Level of ground surface above sea-level (O.D.) ft. If well starts below ground surface, state how far ft.

Shaft ft., diameter ft. Bore 84 ft. Diameter of bore: at top 11½ ins.; at bottom ins.

Details of permanent lining tubes (internal diameters preferred)

Water struck at depths of (feet)

Rest-level of water below / above top of well feet. Suction at feet. Yield on hours' / days' test gallons per (with pump of capacity g.p.h.); depressing water level to feet below top. Time of recovery hrs. Amount normally pumped daily g.p.h. for hours.

Quality (attach copy of analysis if available)

Sunk by Thos. Matthews for Mr. Date of well 1936

Information from

(For Survey use only). GEOLOGICAL CLASSIFICATION.	NATURE OF STRATA (and any additional remarks).	THICKNESS Feet.	THICKNESS Inches.	DEPTH Feet.	DEPTH Inches.
PRE-GLACIAL BOULDER CLAY + GLACIAL SAND + GRAVEL	Boulder clay			51	8
	Sandy marl & gravel			54	8
	Boulder			58	0
	Sandy marl			61	0
	Brown sand			61	10
	Small gravel			66	0
	Sandy marl & gravel			74	0
	Sand & gravel			84	0
3/7/19					

GEOLOGICAL SURVEY AND MUSEUM, SOUTH KENSINGTON, LONDON, S.W.7.

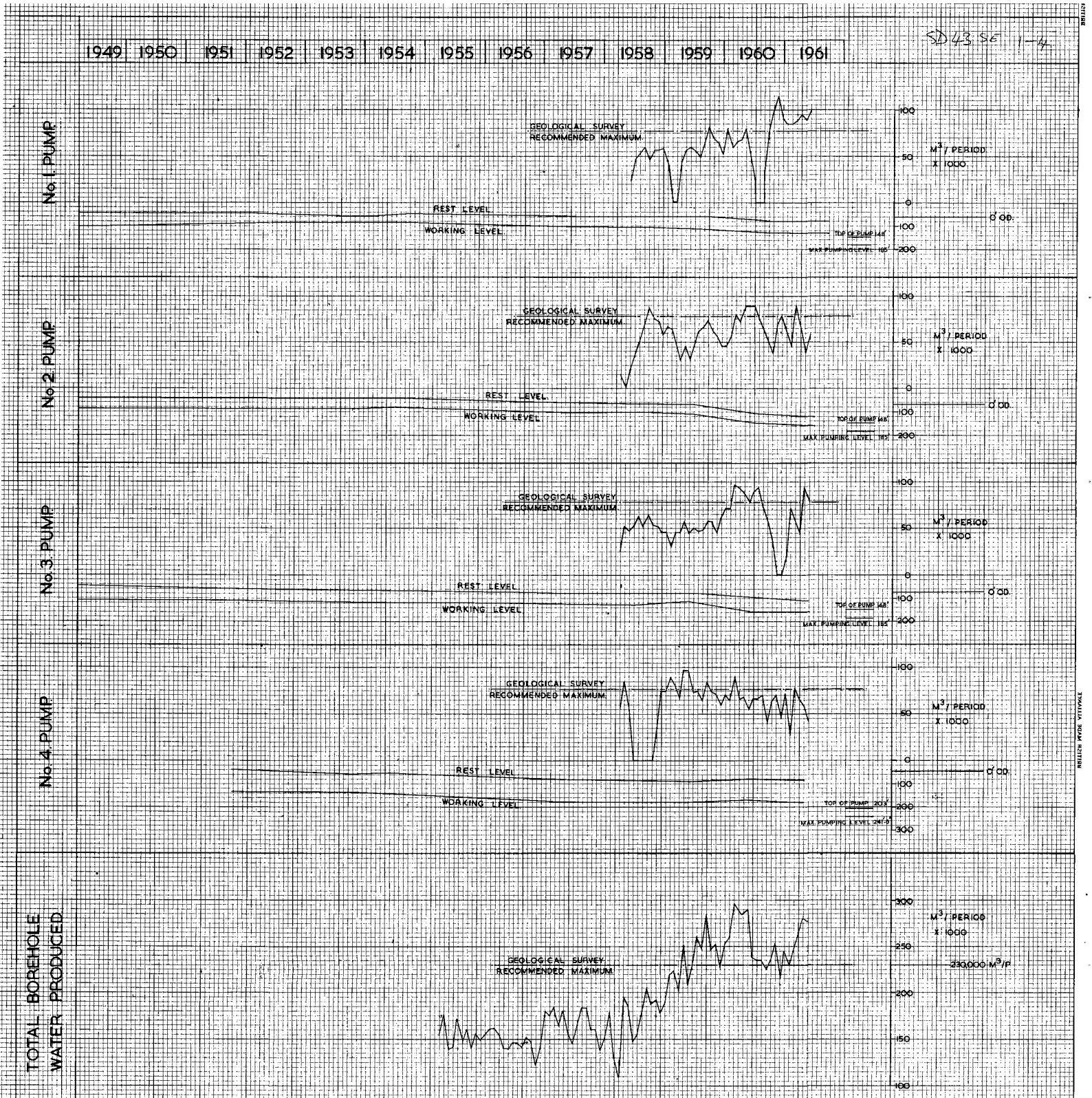
For Survey use only

Date received	G.S.M. Office File No.	Site marked on 1" map (size symbol)

(7982) WL30024/6040 5,000 12/28 A.&E.W.Ltd. Gp.656

SD43 SE 1-4

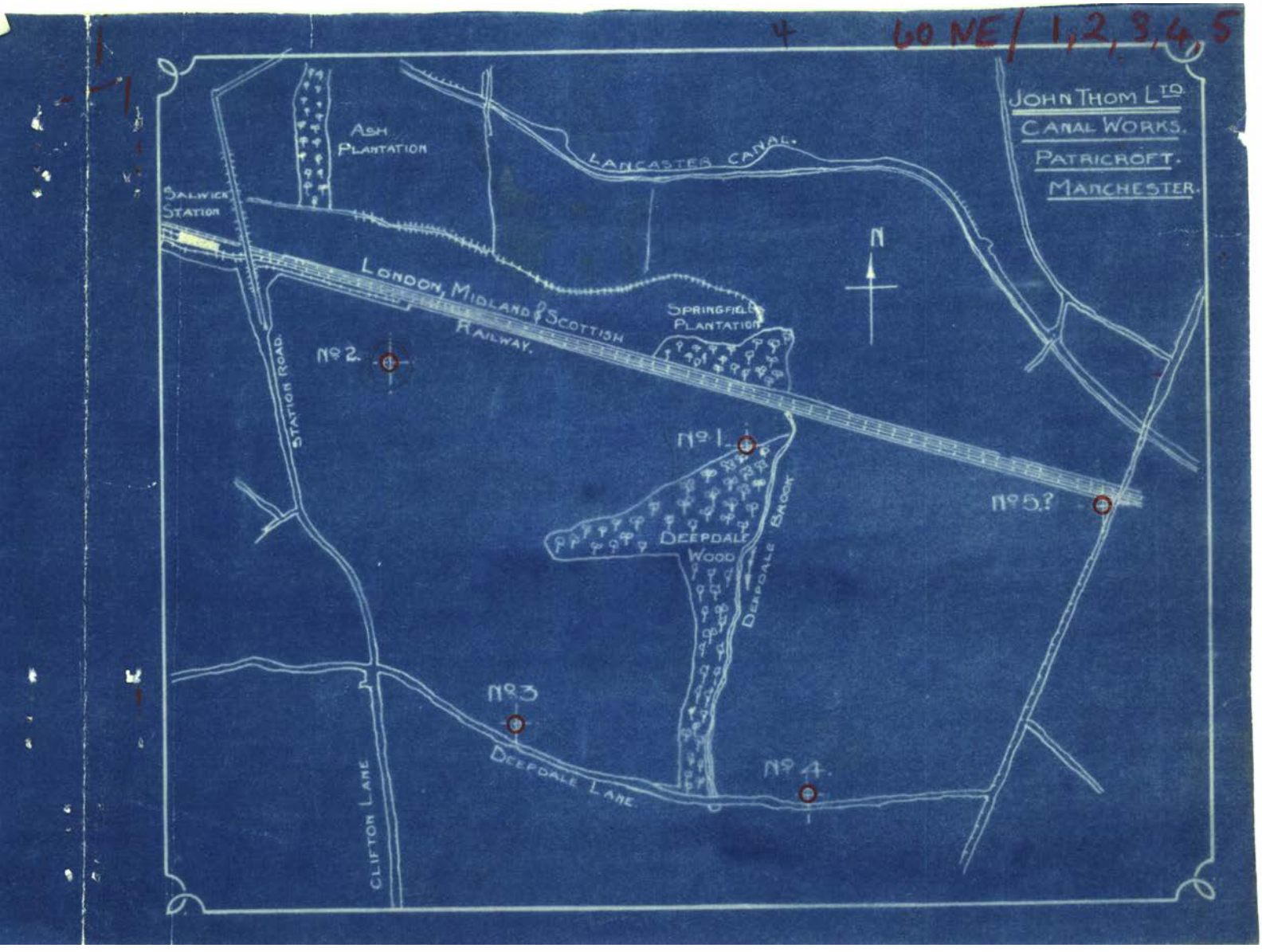
1949 | 1950 | 1951 | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 | 1960 | 1961



NOTE — 1M³ = 220 GALLS.

U.K.A.E.A. SPRINGFIELDS WORKS
RECORD OF BOREHOLE WATER ABSTRACTION.

DRG. No. A 277
16. 8. '61.


60 NE/ 1,2,3,4,5
JOHN THOM LTD
CANAL WORKS.
PATRICROFT.
MANCHESTER.
ASH PLANTATION
LANCASTER CANAL.
SALWICK STATION
LONDON, MIDLAND & SCOTTISH RAILWAY.
SPRINGFIELD PLANTATION
STATION ROAD.
N
No 2.
No 1.
No 5?
DEEPDALE WOOD
DEEPDALE BROOK
No 3
No 4.
DEEPDALE LANE.
CLIFTON LANE

NGR 4674 3118 SD 43 SE 3

RECORD OF WELL (SHAFT OR BORE)

13
1" N.S. 75
1" O.S.
Grid Ref. G.S.M. 3

SD 43 SE/3

County

6" Quarter Sheet

At Messrs. I.C.I. Castner-Kellner Alkali Co. Ltd. No 3

Town or Village Springfields County Lancashire Six-inch quarter sheet 60 NE

Exact site 1100 S. 35° E. of Salwick Station. (A rough sketch-map or a tracing from a map is very desirable)

in parish of Preston.

Level of ground surface above sea-level (O.D.) ft. If well starts below ground surface, state how far ft.

Shaft ft., diameter ft. Bore ft. Diameter of bore: at top ins.; at bottom ins.

Details of permanent lining tubes (internal diameters preferred) (See below)

Water struck at depths of (feet)

Rest-level of water below / above top of well 26½ feet. Suction at feet. Yield on hours' / days' test gallons per (with pump of capacity g.p.h.); depressing water level to feet below top. Time of recovery hrs. Amount normally pumped daily g.p.h. for hours.

Quality (attach copy of analysis if available)

Sunk by John Thom Ltd. for Mr. Date of well 1941.

Information from Messrs. John Thom Ltd., Canal Works, Patricroft.

(For Survey use only). GEOLOGICAL CLASSIFICATION.	NATURE OF STRATA (and any additional remarks).	THICKNESS Feet.	THICKNESS Inches.	DEPTH Feet.	DEPTH Inches.	THICKNESS metric		DEPTH metric	
	Surface Soil	1	6	1	6	0	46	0	46
	Yellowish Clay	2	-	3	6	0	61	1	07
	Hard Brown Clay and Stones	10	6	14	-	3	20	4	27
	Softer Brown Clay and Stones	11	-	25	-	3	35	7	62
	Harder Brown Clay and Stones	5	-	30	-	1	52	9	14
	Very Hard Clay and Stones	3	-	33	-	0	92	10	06
	Hard Brown Clay and Stones	6	-	39	-	1	83	11	89
	Softer Brown Clay and Stones	5	-	44	-	1	52	13	41
	Very Hard Clay and Stones	3	-	47	-	0	92	14	33
	Very Hard Sand and Gravel	2	6	49	6	0	76	15	09
	Soft very sandy Clay		9	50	3	0	23	15	32
	Very Hard Sand and Gravel	2	9	53	-	0	83	16	15
	Sand	39	6	92	6	12	04	28	19
	Hard Very Sandy Clay with a lot of Stones	5	6	98	-	1	68	29	87
	Sand and Gravel	6	-	104	-	1	83	31	70
	Sand and Gravel (with a little clay)	3	-	107	-	0	91	32	61
	Gravel	7	9	114	9	2	37	34	98
	Sandstone	1	-	115	9	0	30	35	28
	Red Sandstone (no core)	3	3	119	-	0	99	36	27
	Red Sandstone		9	119	9	0	23	36	50
	Red Sandstone (coring)	9	-	128	9	2	76	39	24
	Red Sandstone with Grey Bands (coring)	5	-	133	9	1	53	40	77
	Red Sandstone with thin bands of marl through it	10	3	144	-	3	12	43	89
	Red Sandstone with Grey Bands	22	-	166	-	6	71	50	60
	Red Sandstone	20	-	186	-	6	09	56	69
	Red Sandstone and Marl	2	6	188	6	0	77	57	46
	Red Sandstone	12	6	201	-	3	81	61	27
	Red Sandstone with Grey Bands	10	-	211	-	3	04	64	31
	Red Sandstone	33	-	244	-	10	08	74	37
	Grey Sandstone	1	6	245	6	0	46	74	83

GEOLOGICAL SURVEY AND MUSEUM, SOUTH KENSINGTON, LONDON, S.W.7.

For Survey use only

Date received	G.S.M. Office File No.	Site marked on 1" map (use symbol)

(*11815) Wt.29051/O.369 10,000 9/39 A.& E.W.Ltd. Gp.686

(*11932) Wt.30370/0370 10,000 9/39 A & E.W.Ltd. Gp.685

SD 43 SE 3 (2).

Name and Number of Shaft or Bore given by Geological Survey:
Messrs. I.C.I. Castner-Kellner Alkali Co. Ltd.

County Lancashire 13
6" Quarter Sheet 60 NE

Geological Classification	Description	Thickness Ft.	Thickness In	Depth Ft.	Depth In.
				245	6
	~~Grey Sandstone~~	~~1~~	~~6~~		
	Red Sandstone with Grey Bands	14	6	260	-
	Red Sandstone	24	-	284	-
	Red Sandstone with Grey Bands	16	-	300	-
	Red Sandstone	64	-	364	-
	Red Sandstone with Grey Bands	36	-	400	-
	Red Sandstone	18	-	418	-
	Red Sandstone with Grey Bands	32	-	450	-
	Red Sandstone with Grey Bands and traces of Pebbles	10	-	460	-
	Red Sandstone	9	2	469	2
	Marl		10	470	-
	Red Sandstone and Grey Bands	34	-	504	-

Total Depth ..... 504 ft.

Tubes:- 18'10" of 30" i.d. down to 20'0" } withdrawn
59' 9" of 27" i.d. down to 59'0" }
108'9" of 24" i.d. down to 114'9"
133' 1" of 21" i.d. down to 133'6"

Yield of 24,700 G. per 24 hrs from 140 ft. (standing level 63 ft.) during 7 day test in Dec /41 when all four wells were being tested together

Return 31 Oct 49.
Total abstraction 61,225,500 galls.
Rest level 63ft, Working level 102ft, pumping rate 36000 gph.

		74	83
4	42	79	25
7	31	86	56
4	88	91	44
9	51	110	95
10	97	121	92
5	49	127	41
9	75	137	16
3	05	140	21
2	79	143	00
0	26	143	26
10	36	153	62

SD 43 SE/3

[redacted]

14 (4), SD43SE3 CORE 5

JOHN THOM LIMITED. CANAL WORKS. PATRICROFT.

1100 SE 35°E of Salwick Stn

JOURNAL OF NO. 3. BOREHOLE PUT DOWN
FOR MESSRS I.C.I. CASTNER KELLNER ALKALI CO. LTD.
AT SALWICK SITE. SPRINGFIELDS. NR. PRESTON.

1' 6"	Surface Soil.	1' 6"
2' 0"	Yellowish Clay.	3' 6"
10' 6"	Hard Brown Clay and Stones.	14' 0"
11' 0"	Softer Brown Clay and Stones.	25' 0"
5' 0"	Harder Brown Clay and Stones.	30' 0"
3' 0"	Very Hard Clay and Stones.	33' 0"
6' 0"	Hard Brown Clay and Stones.	39' 0"
5' 0"	Softer Brown Clay and Stones.	44' 0"
3' 0"	Very Hard Clay and Stones.	47' 0"
2' 6"	Very Hard Sand and Gravel.	49' 6"
9"	Soft very sandy Clay.	50' 3"
2' 9"	Very Hard Sand and Gravel.	53' 0"
39' 6"	Sand.	92' 6"
5' 6"	Hard Very Sandy Clay with a lot of Stones.	98' 0"
6' 0"	Sand and Gravel.	104' 0"
3' 0"	Sand and gravel (with a little clay)	107' 0"
7' 9"	Gravel.	114' 9"
1' 0"	Sandstone.	115' 9"
3' 3"	Red Sandstone (no core)	119' 0"
9"	Red Sandstone.	119' 9"
9' 0"	Red Sandstone (coring)	128' 9"
5' 0"	Red Sandstone with Grey Bands (coring)	133' 9"
10' 3"	Red Sandstone with thin bands of marl through it.	144' 0"
22' 0"	Red Sandstone with Grey Bands.	166' 0"
20' 0"	Red Sandstone.	186' 0"
2' 6"	Red Sandstone and Marl.	188' 6"
12' 6"	Red Sandstone.	201' 0"
10' 0"	Red Sandstone with Grey Bands.	211' 0"
33' 0"	Red Sandstone.	244' 0"
1' 6"	Grey Sandstone.	245' 6"
14' 6"	Red Sandstone with Grey Bands.	260' 0"
24' 0"	Red Sandstone.	284' 0"
16' 0"	Red Sandstone with Grey Bands.	300' 0"
64' 0"	Red Sandstone.	364' 0"
36' 0"	Red Sandstone with Grey Bands.	400' 0"
18' 0"	Red Sandstone.	418' 0"
32' 0"	Red Sandstone with Grey Bands.	450' 0"
10' 0"	Red Sandstone with Grey Bands and traces of Pebbles.	460' 0"
9' 2"	Red Sandstone.	469' 2"
10"	Marl.	470' 0"
34' 0"	Red Sandstone and Grey Bands.	504' 0"

TOTAL DEPTH..... 504' 0"

REST WATER LEVEL..... 26' 6"

TUBES:- 18'10" of 30" i.d. down to 20' 0" } Withdrawn.
59'9" of 27" i.d. down to 59' 0" }
108' 9" of 24" i.d. down to 114' 9"
133' 1" of 21" i.d. down to 133' 6"

Not yet tested 26.11.41

NGR. 4725 3102 SD43SE SD 43 SE 4

RECORD OF WELL (SHAFT OR BORE)

1" N.S. 75
1" O.S.
Grid Ref. GSM 4.

SD 43 SE/4

County
6" Quarter Sheet

At Messrs. I.C.I. Castner-Kellner Alkali Co. Ltd., No2

Town or Village Springfields County Lancashire Six-inch quarter sheet 60 NE

Exact site 1750 yds. E. 43° S of Salwick Station. (A rough sketch-map or a tracing from a map is very desirable)

in parish of Preston.

Level of ground surface above sea-level (O.D.) ft. If well starts below ground surface, state how far ft.

Shaft ft., diameter ft. Bore – ft. Diameter of bore: at top ins.; at bottom ins.

Details of permanent lining tubes (internal diameters preferred) (See below)

Water struck at depths of (feet)

Rest-level of water below / above top of well feet. Suction at feet. Yield on hours' / days' test

gallons per (with pump of capacity g.p.h.); depressing water level to feet

below top. Time of recovery hrs. Amount normally pumped daily g.p.h. for hours.

Quality (attach copy of analysis if available)

Sunk by John Thom Ltd. for Mr. Date of well 1941.

Information from Messrs. John Thom Ltd., Canal Works, Patricroft.

(For Survey use only). GEOLOGICAL CLASSIFICATION.	NATURE OF STRATA (and any additional remarks).	THICKNESS Feet.	THICKNESS Inches.	DEPTH Feet.	DEPTH Inches.
	Surface Soil	1	-	1	-
	Hard Clay and Stones	7	-	8	-
	Softer Brown Clay and Stones	13	-	21	-
	Brown Clay and Stones	18	-	39	-
	Sand	2	-	41	-
	Brown Clay and Stones	4	-	45	-
	Very Hard Sand	20	9	65	9
	Hard Sand	11	3	77	-
	Clay with a lot of Stones	2	9	79	9
	Red Sandstone	2	3	82	-
	Red Sandstone (No Core)	11	6	93	6
	Red Sandstone (Coring)	4	-	97	6
	Red Sandstone (No Core)	3	-	100	6
	Red Sandstone (Coring)	9	10	110	4
	Red Sandstone	38	5	148	9
	Grey Sandstone	4	-	152	9
	Red Sandstone	1	3	154	-
	Red Sandstone with Grey Bands	13	-	167	-
	Red Sandstone	1	-	168	-
	Grey Sandstone	3	9	171	9
	Red Sandstone	7	9	179	6
	Red Sandstone with Grey Bands	8	6	188	0
	Brown and Grey Sandstone	3	6	191	6
	Red Sandstone	7	6	199	-
	Red Sandstone with Grey Bands	10	-	209	-
	Red Sandstone	2	6	211	6
	Brown Sandstone	4	9	216	3
	Red Sandstone	3	9	220	-
	Brown and Grey Sandstone (Badly Broken)	5	-	225	-
	Red Sandstone	2	9	227	9
	Red Sandstone (No Core)	7	3	235	-
	Red Sandstone with Grey Bands	10	-	245	-

THICKNESS Thickness metric		DEPTH metric	
0	30	0	30
2	14	2	44
3	96	6	40
5	49	11	89
0	61	12	50
1	22	13	72
6	32	20	04
3	43	23	47
0	84	24	31
0	68	24	99
3	51	28	50
1	22	29	72
0	91	30	63
3	00	33	63
11	71	45	34
1	22	46	56
0	38	46	94
3	96	50	90
0	31	51	21
1	14	52	35
2	36	54	71
2	39	57	30
1	07	58	37
2	29	60	66
3	04	63	70
0	77	64	47
1	44	65	91
1	15	67	06
1	52	68	58
0	84	69	42
2	21	71	63
3	05	74	68

GEOLOGICAL SURVEY AND MUSEUM, SOUTH KENSINGTON, LONDON, S.W.7.

For Survey use only

Date received	G.S.M. Office File No.	Site marked on 1" map (use symbol)

(*11815) Wt.29051/O.369 10,000 9/39 A.& E.W.Ltd. Gp.686

Central N.W. region

Name of site

WARTON BANK.

W R B No.

SD 42/19
75 SD42NW/5

Owner	Licence no. Appn no. Cancelled	Nat. grid ref.	SD 4043 2794
Occupier	IGS ref. no.	Status	North West Water investigation borehole drilled for the G.W. + S.W. section.
Ground level	m OD ft. OD	Aquifer	
Level of well top	m OD ft. OD	Code	
Rest water level	m bwt ft. bwt		
(Date)	m OD ft. OD		
Construction: Method Percussion	Date Jan '88		

Depth bwt	Dia.	Linings (below well top) From	To	Dia.	Type
	[redacted]				

Summary of geological section	Thickness	Depth
		m
Drift		20.4 B.Clay
Mercia Mudstones		26.0 *

Abstraction rates
gph PWL
gpd

Type of pump
Chem./bact. anal. YES/NO
Well driller

If insufficient space has been allowed, continue in 'Notes' overleaf.

1/5/79/207

* 'Mercia Mudstones' are indicated approx 250 m to SE of borehole drawn on 1982 edition. They may be part of transition from Sherwood Sst. to Mercia Mudst.?

[redacted]

SD 42 NW 15

Ground Level Orientation	Sheet 1 of 2	Borehole No 4	Grid Ref. SD 4043 2794
Boring Method Percussion Contractor Geo Research	Permanent Lining Tube Backfilled Details	Name WARTON BANK Location WARTON	W.R.B. Ref [redacted]

Progress	Water	Core Recovery	Fractures	Lining	DESCRIPTION OF STRATA	Level (m)	Depth (m)	Sample	Symbolic Log
1/2					TOPSOIL	0.2	1		
					Brown firm/stiff sandy boulder CLAY		2		
							3		
							4		
						5.3	5		
					Brown firm laminated sandy CLAY		6		
							7		
							8		
							9		
						9.9	10		
2/2					Brown to Red-brown firm/stiff sandy boulder CLAY with occasional thin sand lenses		11		
	3/2						12		
							13		
							14		
							15		
							16		
							17		
							18		
	M						19		

B. Clay

EXPLANATION

See General Key

REMARKS

Logged P.A.L.

Scale

North West Water

SD 4?2 NW/5

Ground Level Orientation	Sheet 2 of 2	Borehole No 4	Grid Ref.
Boring Method Contractor	Permanent Lining Tube Details	Name WARTON BANK Location WARTON	W.R.B. Ref SD 42/19

Progress	Water	Core Recovery	Fractures	Lining	DESCRIPTION OF STRATA	Level (m)	Depth (m)	Sample	Symbolic Log
					As above	20.4			
3/2					Red-brown weathered MUDSTONE with traces of gypsum		21 22 23 24 25		
4/2						26.0			
					BASE OF BOREHOLE				

Mercia mudst.)

J. Conway 26.7.90

EXPLANATION

See General Key

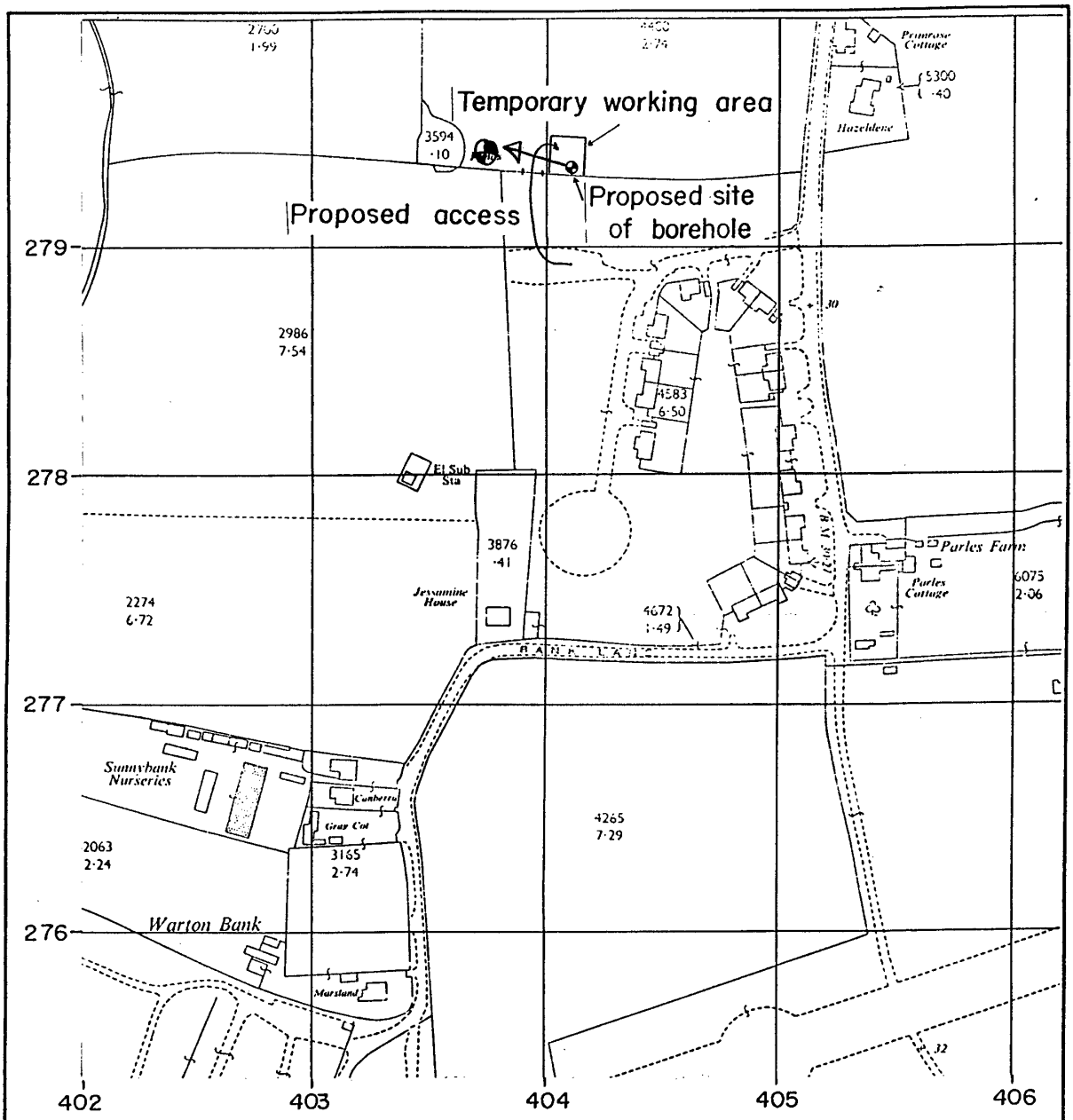
REMARKS

Logged P.A.L.

Scale

North West Water

SD 42 NW 5



LOCATION OF PROPOSED INVESTIGATION BOREHOLE AT WARTON BANK

North West Water

Department of Planning and Engineering
New Town House
P O Box 30
Buttermarket Street
Warrington WA1 2QG

SURVEYED	TRACED	DATE
	EN	SEPT '87
DRAWN	CHECKED	SCALE
PAL		
		DRAWING NO

Central N.W. region

Name of site

WARTON BANK.

W R B No.

SD 42/19

75 SD42NW/5

Owner		Licence no. Appn no. Cancelled	Nat. grid ref. SD 4043 2794
Occupier		IGS ref. no.	Status North West Water investigation borehole drilled for the G.W. & S.W. section.
Ground level	m OD	ft. OD	Aquifer
Level of well top	m OD	ft. OD	Code
Rest water level	m bwt	ft. bwt	
(Date)	m OD	ft. OD	

Construction: Method Percussion Date Jan '88

Depth bwt	Dia.	Linings (below well top) From	To	Dia.	Type

Abstraction rates

gph PWL

gpd

Type of pump

Chem./bact. anal. YES/NO

Well driller

Summary of geological section	Thickness	Depth
		m
Drift		20.4
Meria Mudstones		26.0

If insufficient space has been allowed, continue in 'Notes' overleaf.

I/5/79/207

SD42/19

Ground Level Orientation	Sheet 1 of 2	Borehole No 4	Grid Ref. SD 4043 2794
Boring Method Percussion Contractor Geo Research	Permanent Lining Tube Details Backfilled	Name WARTON BANK Location WARTON	W.R.B. Ref SD42/19

Progress	Water	Core Recovery	Fractures	Lining	DESCRIPTION OF STRATA	Level (m)	Depth (m)	Sample	Symbolic Log
1/2					TOPSOIL	0·2			
					Brown firm/stiff sandy boulder CLAY				
					Brown firm laminated sandy CLAY	5·3			
2/2	3/2 ▽				Brown to Red-brown firm/stiff sandy boulder CLAY with occasional thin sand lenses	9·9			

EXPLANATION

See General Key

REMARKS

Logged P.A.L.

Scale

North West Water

SD42/19

Ground Level Orientation	Sheet 2 of 2	Borehole No 4	Grid Ref.
Boring Method Contractor	Permanent Lining Tube Details	Name WARTON BANK Location WARTON	W.R.B. Ref SD 42/19

Progress	Water	Core Recovery	Fractures	Lining	DESCRIPTION OF STRATA	Level (m)	Depth (m)	Sample	Symbolic Log
					As above	20.4	21		
3/2					Red-brown weathered MUDSTONE with traces of gypsum		22		
							23		
							24		
4/2							25		
						26.0			
					BASE OF BOREHOLE				

EXPLANATION

See General Key

REMARKS

North West Water

Logged P.A.L.

Scale

Name of site: AC NO 47676
'Clifton Marsh Landfill Abh 2.

W R B No. SD42/37 SD42NE/

Owner		Licence no. Appn no. Cancelled	
Occupier		IGS ref. no.	
Ground Level	m OD		ft. OD
Level of well top	m OD		ft. OD
Rest water level 1.90	m bwt		ft. bwt
(Date 3/4/08)	m OD		ft. OD
Construction: Method		Date 4/08	

Nat. grid ref. SU 4756 2334
Status Abh
Aquifer [redacted]
Code

Depth bwt	Dia.	Linings (below well top) From	To	Dia.	Type
52m					

Summary of geological section	Thickness	Depth
Drift	41m	41m
Sandstone	11 m	52m
Full log in BH log file		

Abstraction rates
gph PWL
gph
Type of pump
Chem./bact. anal. YES/NO
Well driller Blair Drilling

If insufficient space has been allowed, continue in 'Notes' overleaf.

Lockie 162

[redacted]

SD42/37

FORM WR –38
Water Resources Act 1991 Section 32

ENVIRONMENT AGENCY

Consent No:

BOREHOLE RECORD

A. SITE DETAILS

Borehole drilled for: SITA

Location: SITA No 2 : CLIFTON MARSH LANDFILL SITE, FRECKLETON

NGR (8 fig): ~~SD 4756 2883~~ 4756 2884 Please attach site plan ✓

Ground Level (if known): ≈ 3.80m OD

Drilling Company: BLAIR WATER WELL DRILLING

Date drilling Commenced: 31/03/04 Completed: 03/04/08

B. CONSTRUCTION DETAILS

Borehole datum (if not ground level) [redacted]
(point from which all measurements of depth are taken eg flange, edge of chamber, etc)

Borehole drilled diameter

..... diameter 280	.... mm from 0.00	to 18.00	m/depth
..... diameter 180	.... mm from 18.00	to 52.00	m/depth
..... diameter	.... mm from	to	m/depth

Casing material and type (eg plain steel, plastic slotted)

Plain Steel ..... diameter 200	.... mm from 0.00	to 18.00	m/depth
Plain Steel ..... diameter 150	.... mm from 18.00	to 43.00	m/depth
..... diameter	.... mm from	to	m/depth
..... diameter	.... mm from	to	m/depth

Grouting details: .....

Water struck at: 17.50 m (depth below datum - mbd)
52.00 m (depth below datum - mbd)
41.00 m " "

Rest water level on completion 1.90 m (depth below datum - mbd)

C. TEST PUMPING SUMMARY (Please supply full details on Form WR-39)

Test Pumping Datum (if different from borehole datum): GL ....m (depth below datum - mbd)

Pump Suction Depth: 50.00 .....mbd

Water Level (Start of Test): 1.910 .....mbd

Water Level (End of Test): 14.734 .....mbd

Pumping rate: 22.26 m³/hr for 3 days/hours ..... m³/d:l/s

Recovery to 2.778 .....mbd in ~~mins : hrs : days~~ 1day:2hrs:0 mins
(from end of pumping)

Date(s) of measurements

Please Supply Chemical Analysis if Available Attached Appendix 4

[redacted]

SITE No 2

D. STRATA LOG

Geological Classification (BGS only)	Description of Strata	Thickness m	Depth m
	Sand	3.00	3.00
	Wet Sand	11.50	14.50
	Gravel with water	2.50	17.00
	Clay	15.00	32.00
	Gravel with Water	2.50	34.50
	Clay	6.50	41.00
	Sandstone with water		52.00
	[continue on separate page if necessary]		
	Other Comments (eg gas encountered, saline water intercepted, etc)		

FOR OFFICIAL USE ONLY

FILE ..... CONSENT NO ..... BGS REF NO .....

LICENCE NO ..... USE OF BH ..... NGR.....

[redacted]

TerraConsult

Site: Clifton Marsh Phase 4 C3 - Abstraction Well - Pumping Test - Abstraction **Job No.: 0836**

Date & Time (dd/mm/yyyy hh:mm:ss)	Water Level (m bgl)
10/05/2006 14:02:30	1.910
10/05/2006 14:03:00	2.836
10/05/2006 14:03:30	4.131
10/05/2006 14:04:00	4.412
10/05/2006 14:04:30	4.486
10/05/2006 14:05:00	4.546
10/05/2006 14:05:30	4.614
10/05/2006 14:06:00	4.734
10/05/2006 14:06:30	4.748
10/05/2006 14:07:00	4.801
10/05/2006 14:07:30	4.860
10/05/2006 14:08:00	4.855
10/05/2006 14:08:30	4.895
10/05/2006 14:09:00	5.257
10/05/2006 14:09:30	5.471
10/05/2006 14:10:00	5.512
10/05/2006 14:10:30	5.578
10/05/2006 14:11:00	5.579
10/05/2006 14:11:30	5.659
10/05/2006 14:12:00	5.673
10/05/2006 14:12:30	5.726
10/05/2006 14:13:00	5.740
10/05/2006 14:18:00	6.008
10/05/2006 14:23:00	6.182
10/05/2006 14:28:00	7.710
10/05/2006 14:33:00	7.992
10/05/2006 14:38:00	8.193
10/05/2006 14:43:00	8.353
10/05/2006 14:48:00	8.528
10/05/2006 14:53:00	8.675
10/05/2006 14:58:00	8.809
10/05/2006 15:03:00	8.930
10/05/2006 15:18:00	9.276
10/05/2006 15:33:00	9.587
10/05/2006 15:48:00	9.841
10/05/2006 16:03:00	10.058
10/05/2006 16:18:00	10.284
10/05/2006 16:33:00	10.485
10/05/2006 16:48:00	10.650
10/05/2006 17:03:00	10.780
10/05/2006 17:18:00	10.914
10/05/2006 17:33:00	11.008
10/05/2006 17:48:00	11.115
10/05/2006 18:03:00	11.189
10/05/2006 18:33:00	11.289
10/05/2006 19:03:00	11.410
10/05/2006 19:33:00	11.557
10/05/2006 20:03:00	11.745
10/05/2006 20:33:00	11.919
10/05/2006 21:03:00	12.080
10/05/2006 21:33:00	12.241
10/05/2006 22:03:00	12.402
10/05/2006 23:03:00	12.683
11/05/2006 00:03:00	12.898
11/05/2006 01:03:00	13.065
11/05/2006 02:03:00	13.219
11/05/2006 03:03:00	13.353
11/05/2006 04:03:00	13.434
11/05/2006 05:03:00	13.541
11/05/2006 06:03:00	13.488
11/05/2006 07:03:00	13.394
11/05/2006 08:03:00	13.407
11/05/2006 10:03:00	13.882
11/05/2006 12:03:00	13.917
11/05/2006 14:03:00	14.064
11/05/2006 16:03:00	14.144
11/05/2006 18:03:00	14.171
11/05/2006 20:03:00	13.957
11/05/2006 22:03:00	14.064
12/05/2006 00:03:00	14.276
12/05/2006 02:03:00	14.386
12/05/2006 04:03:00	14.426
12/05/2006 06:03:00	14.480
12/05/2006 08:03:00	14.225
12/05/2006 10:03:00	14.239
12/05/2006 12:03:00	14.439
12/05/2006 14:03:00	14.560
12/05/2006 18:03:00	14.627
12/05/2006 22:03:00	14.399
13/05/2006 02:03:00	14.654
13/05/2006 06:03:00	14.734
13/05/2006 10:03:00	14.480
13/05/2006 14:03:00	14.734

Data Summary
Site 2

No.	Readings	Length
1	21	00:00:30
2	10	00:05:00
3	12	00:15:00
4	8	00:30:00
5	10	01:00:00
6	15	02:00:00
7	12	04:00:00

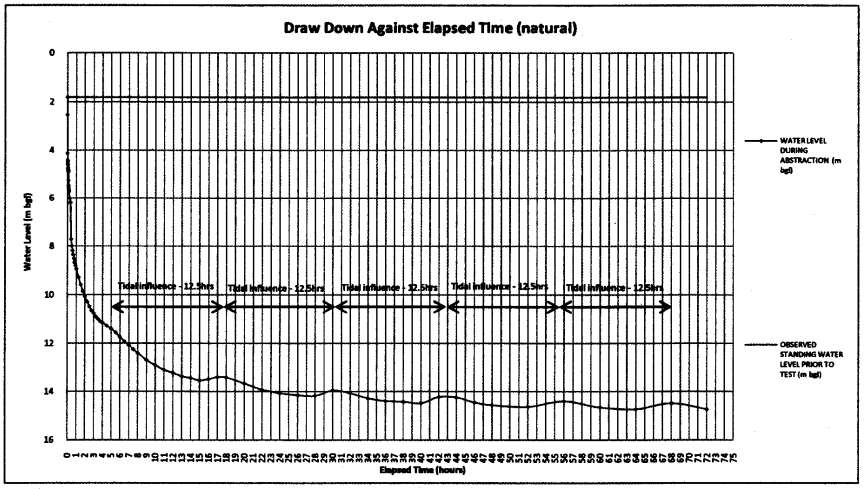
Time of upload 12-May-2006 10:03:22
Time of measure 09-May-2006 10:03:00
82 Readings taken
Data ranging from 14.734 to 1.910

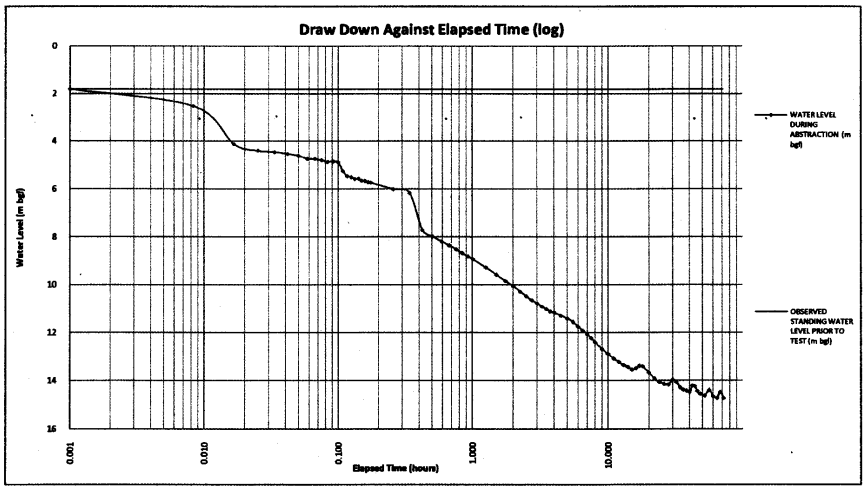
0836 - Well Abstraction - Clifton Marsh.xls

[redacted]

TerraConsult

Site: Clifton Marsh Phase 4 C3 - Abstraction Well - Pumping Test **Job No.:** 0836





0836 - Well Abstraction - Clifton Marsh.xls

TerraConsult

Site: Clifton Marsh Phase 4 C3 - Abstraction Well - Pumping Test - Recovery **Job No.: 0836**

Date & Time (dd/mm/yyyy hh:mm:ss)	Water Level (m bgl)
13/05/2008 14:30:00	14.722
13/05/2008 14:30:30	11.082
13/05/2008 14:31:00	10.285
13/05/2008 14:31:30	10.486
13/05/2008 14:32:00	10.473
13/05/2008 14:32:30	10.406
13/05/2008 14:33:00	10.325
13/05/2008 14:33:30	10.298
13/05/2008 14:34:00	10.204
13/05/2008 14:34:30	10.151
13/05/2008 14:35:00	10.097
13/05/2008 14:35:30	10.044
13/05/2008 14:36:00	9.990
13/05/2008 14:36:30	9.950
13/05/2008 14:37:00	9.910
13/05/2008 14:37:30	9.869
13/05/2008 14:38:00	9.816
13/05/2008 14:38:30	9.789
13/05/2008 14:39:00	9.749
13/05/2008 14:39:30	9.709
13/05/2008 14:40:00	9.655
13/05/2008 14:45:00	9.347
13/05/2008 14:50:00	9.092
13/05/2008 14:55:00	8.877
13/05/2008 15:00:00	8.690
13/05/2008 15:05:00	8.515
13/05/2008 15:10:00	8.368
13/05/2008 15:15:00	8.221
13/05/2008 15:20:00	8.087
13/05/2008 15:25:00	7.966
13/05/2008 15:30:00	7.845
13/05/2008 15:45:00	7.524
13/05/2008 16:00:00	7.255
13/05/2008 16:15:00	7.014
13/05/2008 16:30:00	6.800
13/05/2008 16:45:00	6.599
13/05/2008 17:00:00	6.424
13/05/2008 17:15:00	6.263
13/05/2008 17:30:00	6.116
13/05/2008 17:45:00	5.969
13/05/2008 18:00:00	5.835
13/05/2008 18:15:00	5.714
13/05/2008 18:30:00	5.593
13/05/2008 18:00:00	5.379
13/05/2008 19:30:00	5.191
13/05/2008 20:00:00	5.017
13/05/2008 20:30:00	4.816
13/05/2008 21:00:00	4.628
13/05/2008 21:30:00	4.440
13/05/2008 22:00:00	4.266
13/05/2008 22:30:00	4.119
13/05/2008 23:30:00	3.918
14/05/2008 00:30:00	3.797
14/05/2008 01:30:00	3.703
14/05/2008 02:30:00	3.623
14/05/2008 03:30:00	3.542
14/05/2008 04:30:00	3.462
14/05/2008 05:30:00	3.381
14/05/2008 06:30:00	3.301
14/05/2008 07:30:00	3.234
14/05/2008 08:30:00	3.140
14/05/2008 10:30:00	2.805
14/05/2008 12:30:00	2.738
14/05/2008 14:30:00	2.778
14/05/2008 16:30:00	2.778

Data Summary
Site 2 recov

No.	Readings	Length
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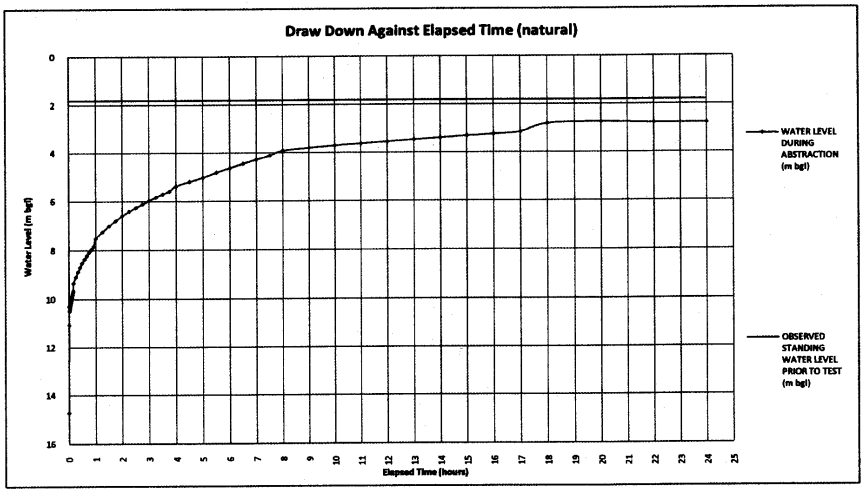
3	12	00:15:00
4	8	00:30:00
5	10	01:00:00
6	15	02:00:00
7	12	04:00:00

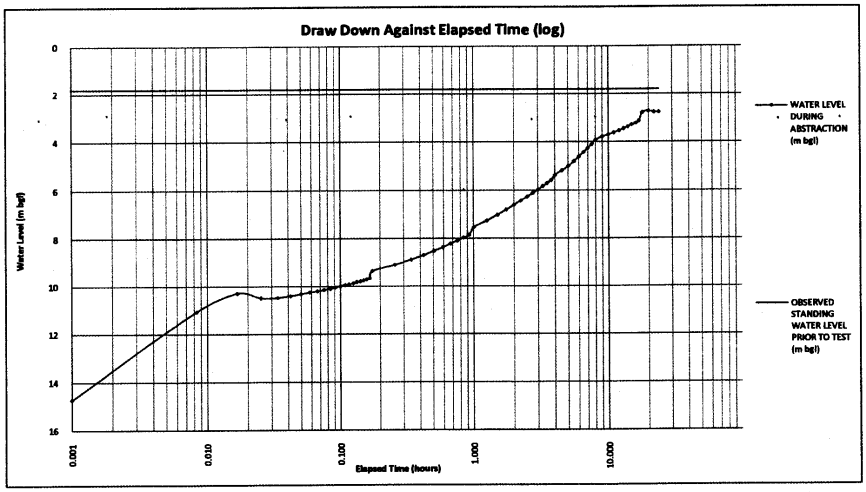
Time of upload 13-May-2008 13:06:59
Time of measure 12-May-2008 10:30:00
85 Readings taken
Data ranging from 14.722 to 2.738

0836 - Well Recovery - Clifton Marsh.xls

TerraConsult

Site: Clifton Marsh Phase 4 C3 - Abstraction Well - Pumping Test **Job No.:** 0836





0836 - Well Recovery - Clifton Marsh.xls

Name of site AC NO 41676

Clifton Marsh Landfill Abh 1. 75
NORTH EAST EA

W R B No. SD42/36 (SD42NE)

Owner		Licence no. Appn no. Cancelled	
Occupier		IGS ref. no.	
Ground Level	m OD		ft. OD
Level of well top	m OD		ft. OD
Rest water level	m bwt		ft. bwt
(Date)	m OD		ft. OD
Construction: Method		Date	3/03

Depth bwt	Dia.	Linings (below well top) From	To	Dia.	Type
61m					

Abstraction rates	Type of pump
gph PWL	Chem./bact. anal. YES/NO
gph	Well driller Blair Drilling

If insufficient space has been allowed, continue in 'Notes' overleaf.

Nat. grid ref. SU 4716 2912

Status Abh – Abandoned

Aquifer Superficials

Code 111

Summary of geological section	Thickness	Depth
Borehole log + casing details in BH log File		

Lockie 162

RECEIVED FROM
- 4 JUN 2008
ENVIRON AGENCY

[redacted]

SD42/36

ENVIRONMENT AGENCY

FORM WR –38
Water Resources Act 1991 Section 32

Consent No: 1551

BOREHOLE RECORD

A. SITE DETAILS

Borehole drilled for: SITA

Location: SITA No 1 : CLIFTON MARSH LANDFILL SITE, FRECKLETON

NGR (8 fig): ~~SD 4718 2910~~ 4716 2912 Please attach site plan ✓

Ground Level (if known): 4.60 m OD

Drilling Company: BLAIR WATER WELL DRILLING

Date drilling Commenced: 12/03/08 Completed: 27/03/08

B. CONSTRUCTION DETAILS

Borehole datum (if not ground level) ..... ~~m below~~ GL
(point from which all measurements of depth are taken eg flange, edge of chamber, etc)

Borehole drilled diameter

..... diameter 220	.... mm from GL	to 27.00	m/depth
..... diameter 150	.... mm from 27.00	to 61.00	m/depth
..... diameter	.... mm from	to	m/depth

Casing material and type (eg plain steel, plastic slotted)

Plain Steel ..... diameter 200	mm from GL	to 27.00	m/depth
Plain Steel ..... diameter 150	mm from 27.0	to 61.00	m/depth
..... diameter	.... mm from	to	m/depth
..... diameter	.... mm from	to	m/depth

Grouting details: .....

Water struck at: 3.00 m (depth below datum - mbd)
59.00 m (depth below datum - mbd)

Well abandoned at 61.0m due to encountering saline water in pebble beds.

Rest water level on completion ✓ m (depth below datum - mbd)

Unable to progress borehole further

C. TEST PUMPING SUMMARY (Please supply full details on Form WR-39)

Test Pumping Datum (if different from borehole datum) .....m (depth below datum - mbd)

Pump Suction Depth N/A .....mbd

Water Level (Start of Test) .....mbd

Water Level (End of Test) .....mbd

Pumping rate .....m³/d:l/s

.....for.....days/hours

Recovery to (from end of pumping) .....mbd in.....mins : hrs : days

Date(s) of measurements

Please Supply Chemical Analysis if Available

[redacted]

SITA No 1

D. STRATA LOG

Geological Classification (BGS only)	Description of Strata	Thickness m	Depth m
	Sand	3.00	3.00
	Wet Sand	6.50	9.50
	Grey Sand & Gravel	4.00	13.50
	Clay	23.50	37.00
	Running Sand	3.00	40.00
	Clay	8.00	48.00
	Running Sand	11.00	59.00
	Gravel	1.00	60.00
	Pebble Beds	1.00	61.00
	[continue on separate page if necessary]		

Other Comments (eg gas encountered, saline water intercepted, etc)

Saline water encountered at 59.00m

FOR OFFICIAL USE ONLY

FILE ..... CONSENT NO ..... BGS REF NO .....

LICENCE NO ..... USE OF BH ..... NGR .....

[redacted]

LANCASHIRE COUNTY COUNCIL

BOREHOLE DATA SHEET No. 1 OF 5

JOB No. 473 R1

B.H. No.

SCHEME PRESTON WESTERLY BY-PASS

DEPTH 41.1 m

LOCATION RIBBLE CROSSING (N. SIDE) PRELIMINARY BOREHOLE

GROUND LEVEL 9.5 m

Description of Stratum	Depth	Sample 1 2 3 Key	M.C.	LL/PL/PI Core Rec'y	Class'n	N Value	Water & Casing Details
FILL Loose mid brown fine SAND		SP	10.0			N = 8	Started 23.1.76 200mm Casing.
			20.6		SU/F		
	1.5						
FILL Loose to medium dense dark grey-black organic silty fine SAND		SP				N = 11	
			33.7		SF/F		
	3.4						Slight WE. 3.2m
FILL Loose to medium dense dark grey-black medium SAND with fine to medium gravel and pockets of clay		SP				N = 10	
					SU/F		
	4.9	SP	26.8				
TOPSOIL	5.2					N = 20	23.1.76 pm. 'Dry' Casing to 4.8m 26.1.76 am. 'Wet'
			29.3				
Medium dense light brown silty fine SAND (with occasional bands of grey sandy silt)							
		SP	17.8	Grading	SF	N = 21	
	7.0						
Medium dense brown fine to medium SAND (with occasional bands of grey sandy silt)					SU		
	8.2						Slight WE. 8.25m
Medium dense brown medium SAND with occasional fine gravel		SP				N = 11	
					SU		26.1.76 pm. SWL 7.7m
							Casing to 8.25m 27.1.76 am. SWL. 7.5m Sand level 7.9m WE. 9.75m rose to 8.1m in 5min/8.0m in 1(

STRENGTH TEST RESULTS

Depth of Sample	Bulk Dens'y (kg/m3)	Dry Dens'y (kg/m3)	M.C. (%)	Comp. Stress (kN/m2)	Cohesion (kN/m2)	Ø	Remarks

COMPACTION AND OTHER TEST RESULTS

Depth of Sample	Compaction	Dry Dens'y (kg/m3)	M.C. (%)	S.G.	Air Voids	C.B.R.	SO_3 gm/litre	pH	Remarks or other tests

GENERAL REMARKS

C87A L6272 TeyPig

LANCASHIRE COUNTY COUNCIL

BOREHOLE DATA SHEET No. 2 OF 5

JOB No. 473

B.H. No. R1

SCHEME PRESTON WESTERLY BY-PASS

DEPTH 41.1 m

LOCATION RIBBLE CROSSING (N. SIDE) PRELIMINARY BOREHOLE

GROUND LEVEL 9.5 m

Description of Stratum	Depth	Sample 1 2 3 Key	M.C.	LL/PL/PI Core Rec'y	Class'n	N Value	Water & Casing Details
	10.5	SP				N = 10	
Medium dense grey silty fine SAND with traces of fine gravel (occasionally more silty or clayey)					SF		
		SP				N = 15	
	13.7						
Dense mid-brown medium SAND with fine to coarse GRAVEL and occasional bands of silt becoming well graded SAND and GRAVEL		SP		Grading	Gp	N = 45	27.1.76 pm. SWL 9.4m Casing to 14.4m
							28.1.76 am. SWL 7.5m S. and G. level 12.6m
		SP		Grading	Gw		28.1.76 pm. SWL. 8.3m Casing to 16.0m
							29.1.76 am. SWL 7.6m
							S. and G. level 15.8m
	18.0	SP				N = 15	29.1.76 pm. SWL 8.7m Casing to 17.7m
Stiff mid-brown sandy silty CLAY with fine to medium gravel sized stones		U4	17.2				30.1.76 am. SWL 7.6m
	19.4		21.4				30.1.76 pm. SWL 8.3m Casing to 18.5m
See Sheet No. 3							2.2.76 am. SWL 7.9m

STRENGTH TEST RESULTS

Depth of Sample	Bulk Dens'y (kg/m3)	Dry Dens'y (kg/m3)	M.C. (%)	Comp. Stress (kN/m2)	Cohesion (kN/m2)	Ø	Remarks
18.5 - 19.0	2180	1860	17.2	168	84	-	100mm U.C.T.

COMPACTION AND OTHER TEST RESULTS

Depth of Sample	Compaction	Dry Dens'y (kg/m3)	M.C. (%)	S.G.	Air Voids	C.B.R.	SO_3 gm/litre	pH	Remarks or other tests

GENERAL REMARKS Slow progress driving casing. Sand and gravel rising up casing down to 18m.

C87A L6272 TayPig

LANCASHIRE COUNTY COUNCIL

BOREHOLE DATA SHEET No. 3 OF 5

JOB No. 473

B.H. No. R1

SCHEME PRESTON WESTERLY BY-PASS

LOCATION RIBBLE CROSSING (N. SIDE) PRELIMINARY BOREHOLE

DEPTH 41.1 m

GROUND LEVEL 9.5 m

Description of Stratum	Depth	Sample 1 2 3 Key	M.C.	LL/PL/PI Core Rec'y	Class'n	N Value	Water & Casing Details
							Change to 150mm Casing
Firm to stiff brown smooth laminated silty CLAY with occasional bands of brown sandy silty boulder clay		U4	24.4				2.2.76 pm. SWL. 8.4m
			26.6				Casing to 19.2m
							3.2.76 am. SWL. 8.3m
			20.9				3.2.76 pm. SWL. 13.7m
							4.2.76 am. SWL. 7.3m
			19.4				4.2.76 pm. SWL. 9.0m
		U4	26.5				5.2.76 am. SWL 7.8m
			25.0	46/22/24	CI		
	23.3	U4	8.7				
Very stiff red brown very sandy CLAY with gravel sized stones and bands of sand and gravel.			9.7				5.2.76 pm. SWL. 9.9m
		SP	10.2		CL/SC	N = 53	Casing to 23.3
							6.2.76 am. SWL. 8.0m
							Sand level to 22.1m
							6.2.76 pm. SWL. 12.8m
							Casing to 24.5
		SP				N = 69	9.2.76 am. SWL 8.2m
							9.2.76 pm. SWL. 11.8m
	27.1						Casing to 26.0m
Soft, very broken, red brown very weathered fine grained SANDSTONE with bands of harder thinly bedded sandstone		SP				N = 97 For 150mm	11.2.76 am. SWL 7.0m Sand level 25.0m
					Sa		11.2.76 pm. SWL. 9.9m BH. to 27.5m
							13.2.76 am. SWL 7.8m
		SP				N = 103 For 75mm	Sand level 26.4m
							13.2.76 pm. SWL. 9.3
							Casing to 28.6m
							16.2.76 am. SWL. 7.0m
							Sand level 27.1m

STRENGTH TEST RESULTS

Depth of Sample	Bulk Dens'y (kg/m3)	Dry Dens'y (kg/m3)	M.C. (%)	Comp. Stress (kN/m2)	Cohesion (kN/m2)	Ø	Remarks
20.2 - 20.6	2040	1640	24.4	168	84	-	100mm U.C.T.
21.8 - 22.2	2030	1600	26.5	144	72	-	100mm U.C.T.
23.3 - 23.8	2370	2180	8.7	118	59	-	100mm U.C.T.

COMPACTION AND OTHER TEST RESULTS

Depth of Sample	Compaction	Dry Dens'y (kg/m3)	M.C. (%)	S.G.	Air Voids	C.B.R.	SO_3 gm/litre	pH	Remarks or other tests

GENERAL REMARKS

Slow progress due to water in borehole, unable to seal off water. Sand and gravel rising up casing. Large boulders at 26.8 to 27.1m

C87A L6272 TayPtg

LANCASHIRE COUNTY COUNCIL

BOREHOLE DATA SHEET No. 4 OF 5

JOB No. 473

B.H. No. R1

SCHEME PRESTON WESTERLY BY-PASS

DEPTH 41.1 m

LOCATION RIBBLE CROSSING (N. SIDE) PRELIMINARY BOREHOLE

GROUND LEVEL 9.5 m

Description of Stratum	Depth	Sample 1 2 3 Key	M.C.	LL/PL/PI Core Rec'y	Class'n	CORE RECOVERY	Water & Casing Details
See Sheet No. 3						75%	Air Flush Water not sealed off
	31.3					100%	
Hard, fairly massive, red brown fine to medium grained SANDSTONE with partings up to 150mm and band of soft massive light grey very weakly cemented sandstone at 32.2 - 32.4 Horizontally bedded						100% 100% 100%	
	36.0					100%	
Soft, very broken, weathered red-brown thinly bedded fine grained SANDSTONE with bands of harder massive sandstone and occasional bands of marl							
	38.0					100%	
Alternate, very soft light grey, uncemented fine to medium SANDSTONE and red brown thinly parted (25mm) weakly cemented fine sandstone with bands of marl							

STRENGTH TEST RESULTS

Depth of Sample	Bulk Dens'y (kg/m3)	Dry Dens'y (kg/m3)	M.C. (%)	Comp. Stress (kN/m2)	Cohesion (kN/m2)	Ø	Remarks

COMPACTION AND OTHER TEST RESULTS

Depth of Sample	Compaction	Dry Dens'y (kg/m3)	M.C. (%)	S.G.	Air Voids	C.B.R.	SO_3 gm/litre	pH	Remarks or other tests

GENERAL REMARKS

C87A L6272 TayPtg

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LANCASHIRE COUNTY COUNCIL

BOREHOLE DATA SHEET No. 5 OF 5

JOB No. 473

B.H. No. R1

SCHEME PRESTON WESTERLY BY-PASS

DEPTH 41.1 m

LOCATION RIBBLE CROSSING (N. SIDE) PRELIMINARY BOREHOLE

GROUND LEVEL 9.5 m

Description of Stratum	Depth	Sample 1 2 3 Key	M.C.	LL/PL/PI Core Rec'y	Class'n	CORE RECOVERY	Water & Casing Details
See Sheet No. 4						100%	
	41.1						B.H. Complete

STRENGTH TEST RESULTS

Depth of Sample	Bulk Dens'y (kg/m3)	Dry Dens'y (kg/m3)	M.C. (%)	Comp. Stress (kN/m2)	Cohesion (kN/m2)	Ø	Remarks

COMPACTION AND OTHER TEST RESULTS

Depth of Sample	Compaction	Dry Dens'y (kg/m3)	M.C. (%)	S.G.	Air Voids	C.B.R.	SO_3 gm/litre	pH	Remarks or other tests

GENERAL REMARKS

C87A L6272 TayPtg

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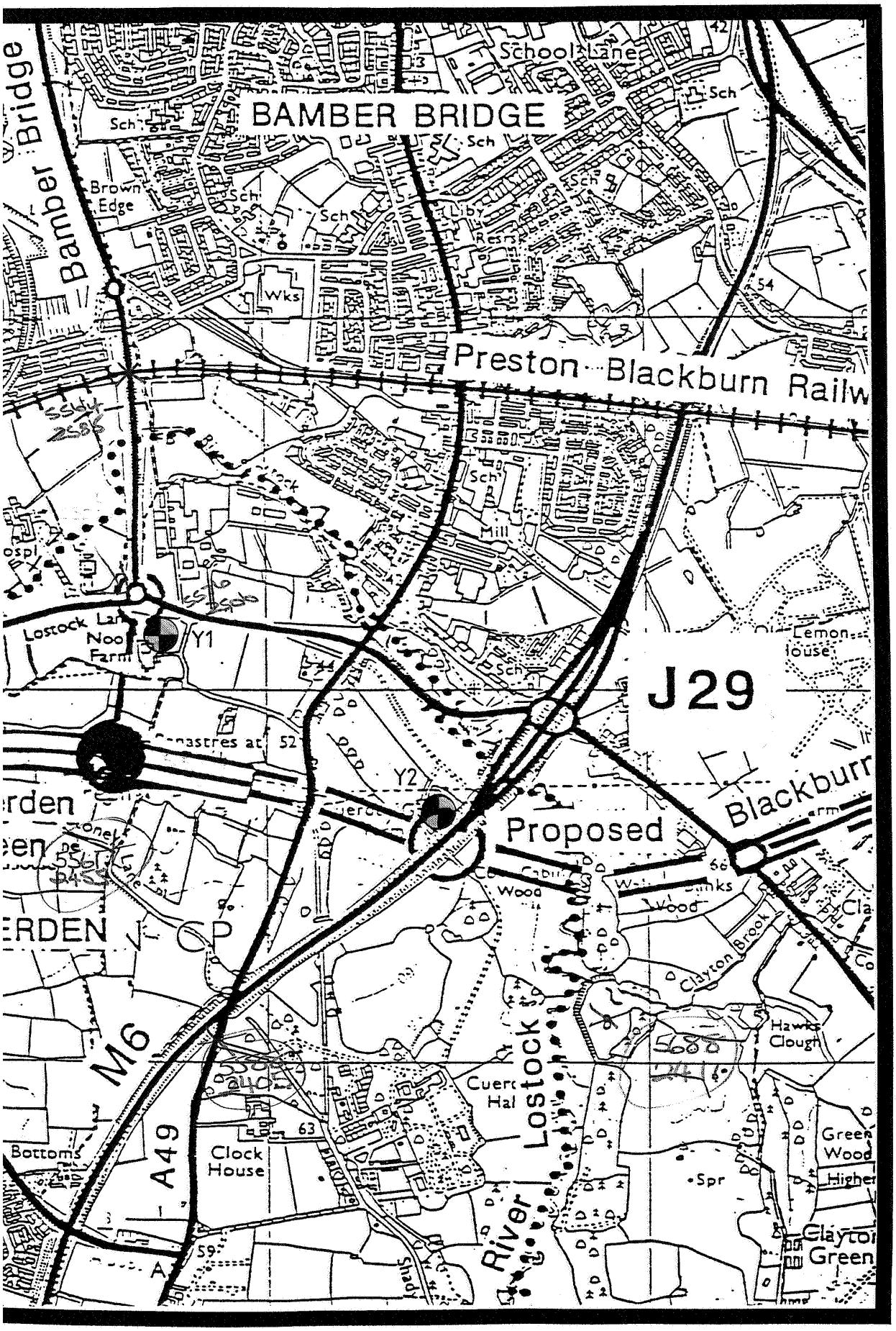

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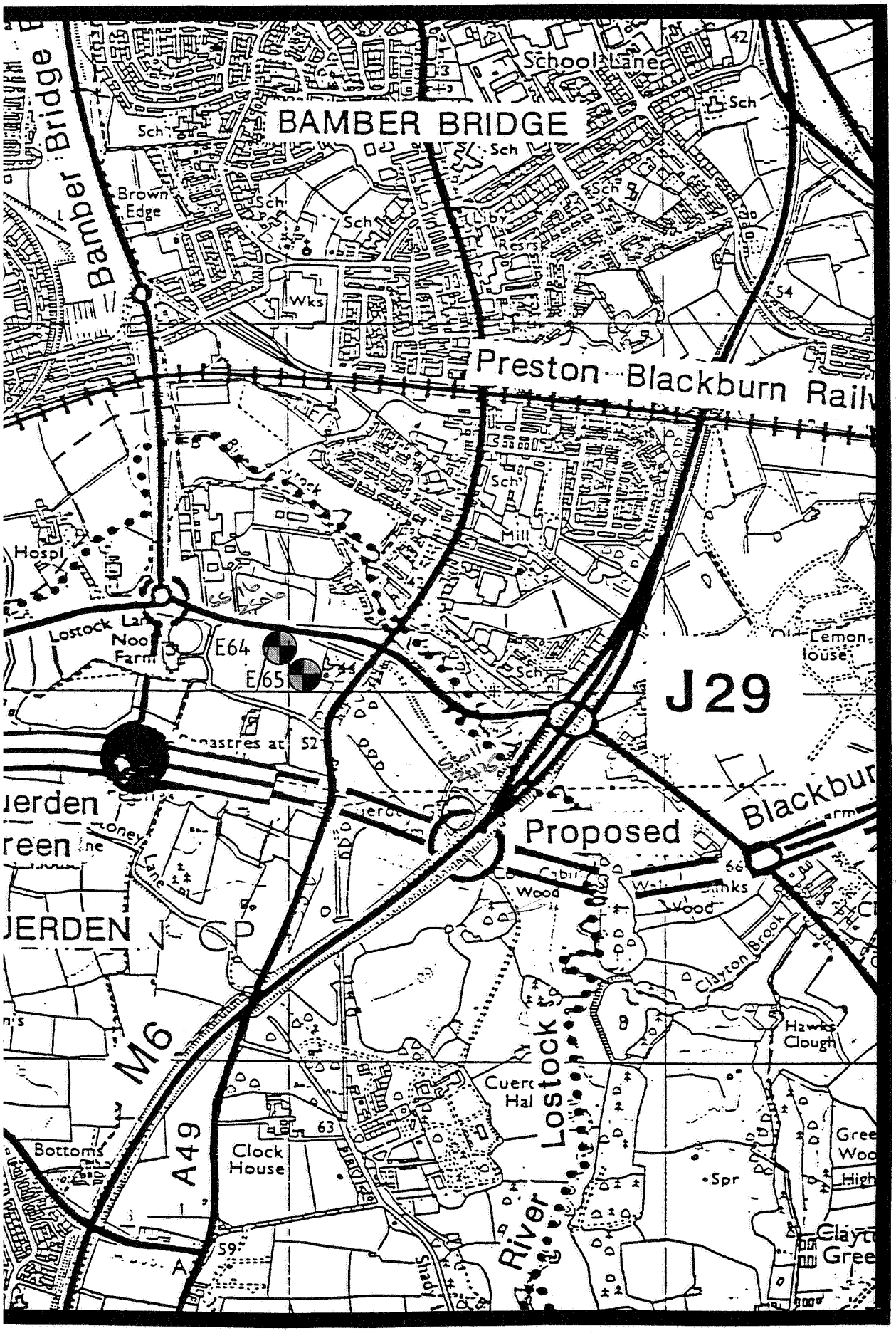

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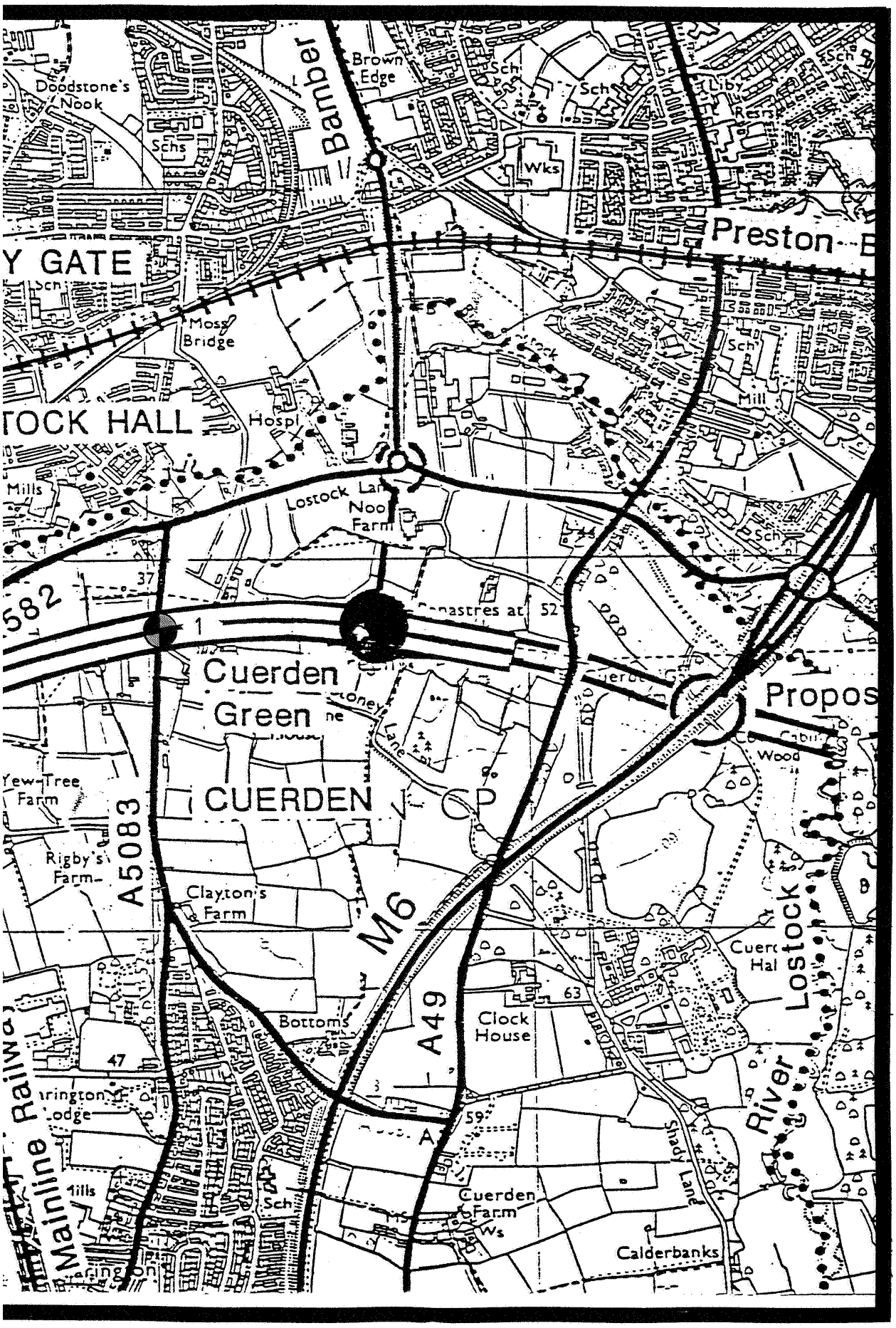

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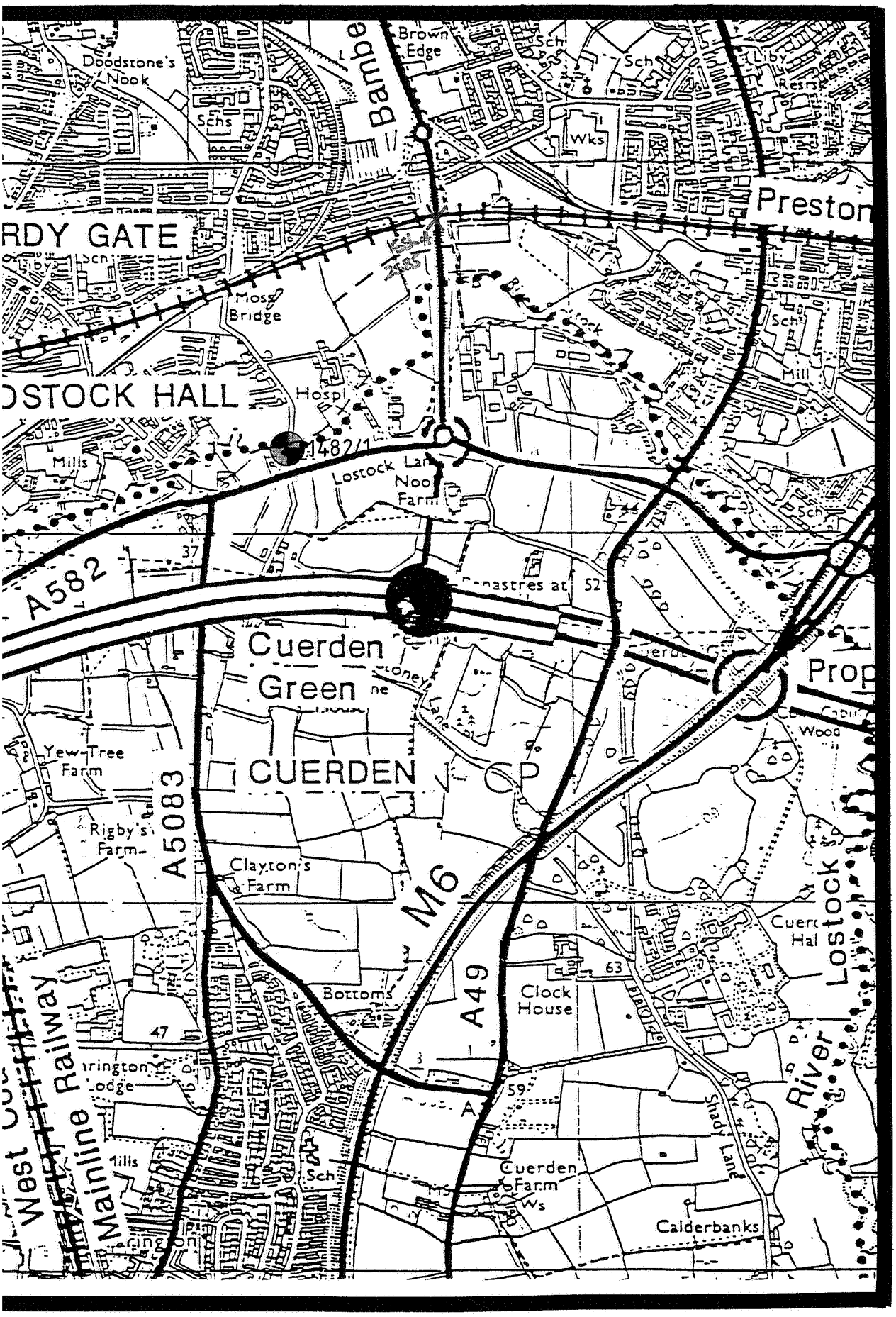

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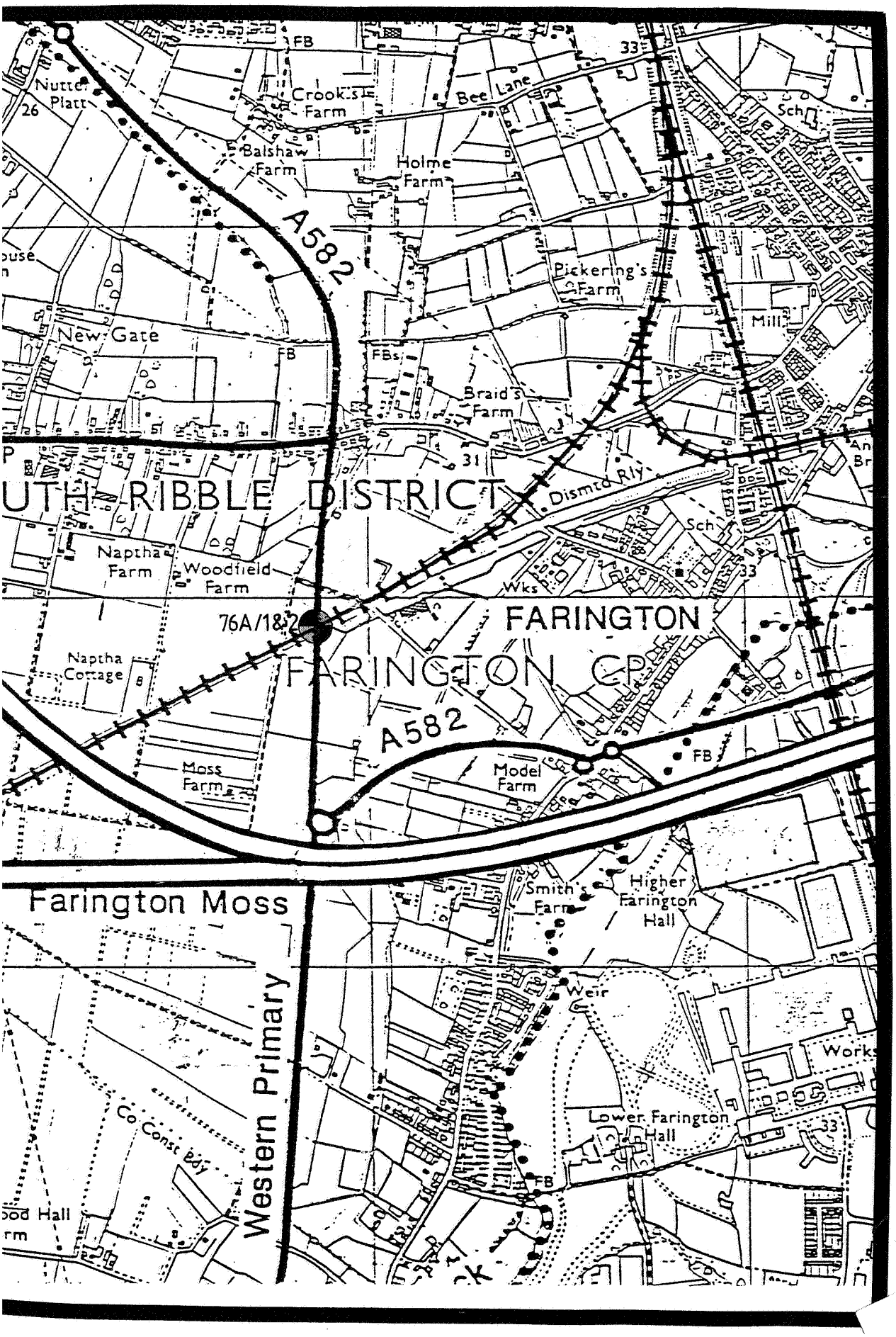

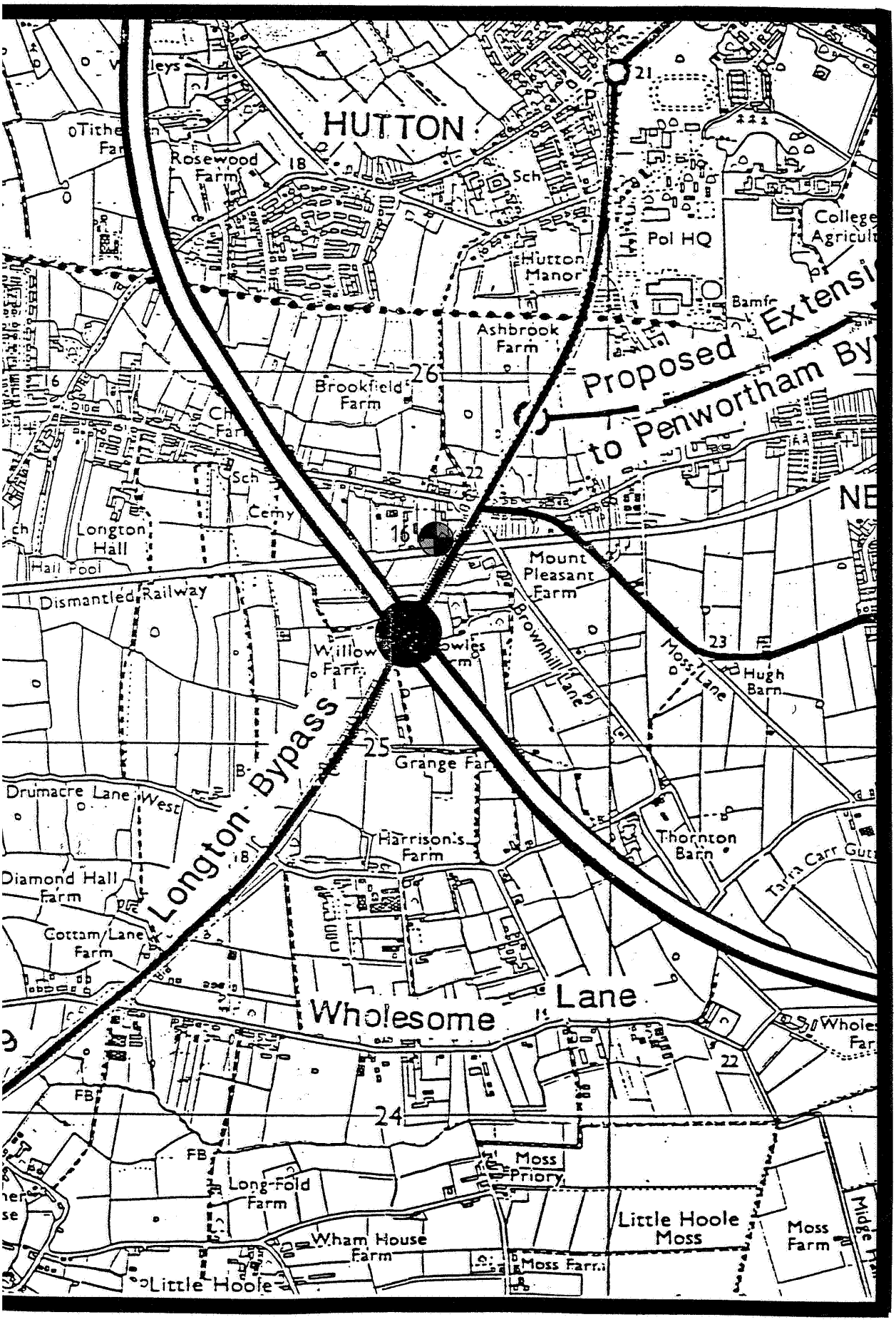
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Ashbrook Farm
Brookfield Farm
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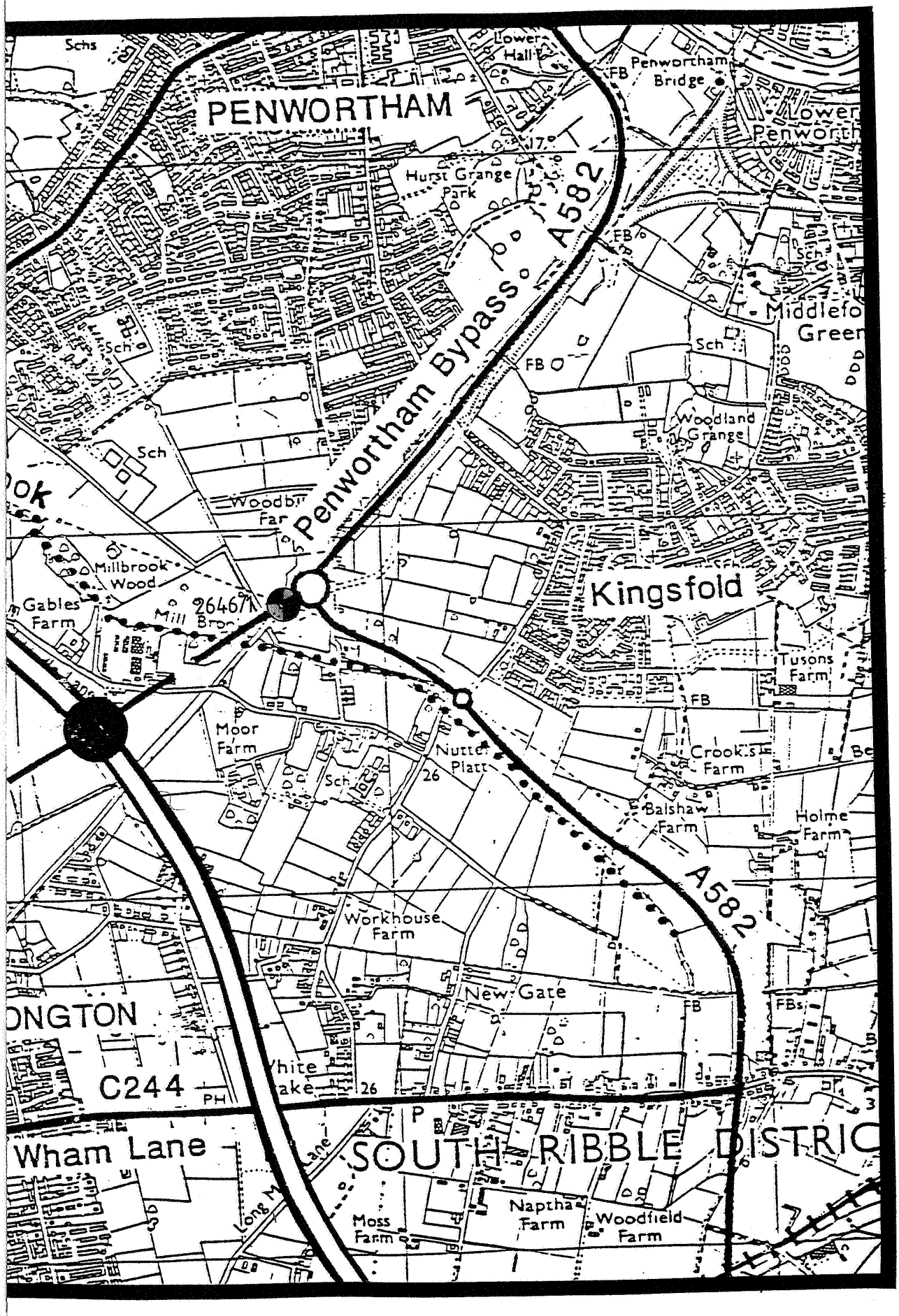
to Penwortham By
Longton Hall
Hall Pool
Dismantled Railway
Mount Pleasant Farm
Willow Farm
Brownhill Lane
Moss Lane
Hugh Barn
Grange Farm
Drumacre Lane West
Longton Bypass
Harrison's Farm
Thornton Barn
Diamond Hall Farm
Cottam Lane Farm
Wholesome Lane
Moss Priory
Long-fold Farm
Little Hoole Moss
Moss Farm
Wham House Farm
Moss Farm
Little Hoole


PENWORTHAM
Penwortham Bypass
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Hurst Grange Park
Lower Hall
Penwortham Bridge
Middlefo
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Woodland Grange
Kingsfold
Tusons Farm
Crooki.s Farm
Balshaw Farm
Holme Farm
Moor Farm
Nutter Platt
Millbrook Wood
Gables Farm
Mill Brow
Workhouse Farm
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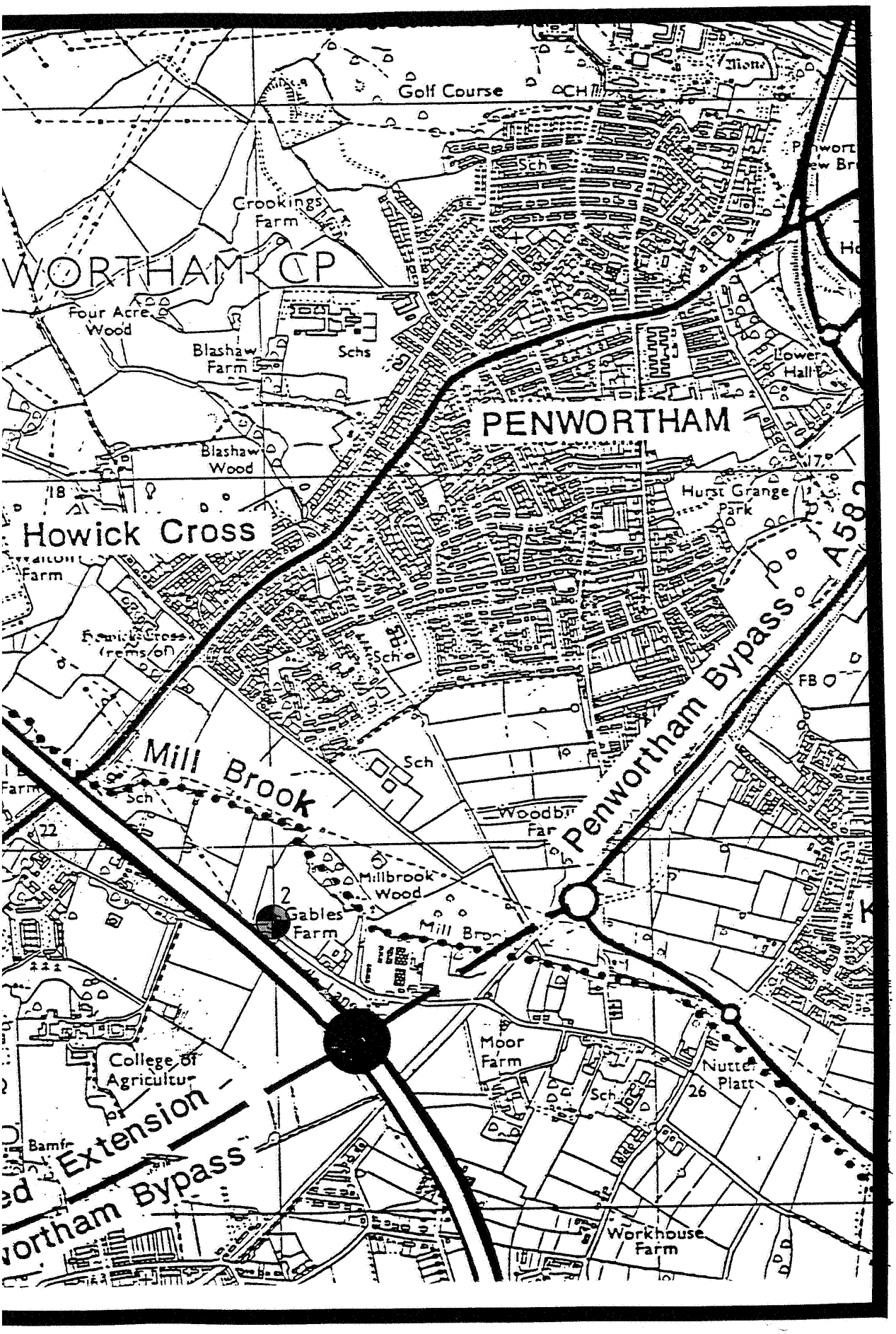

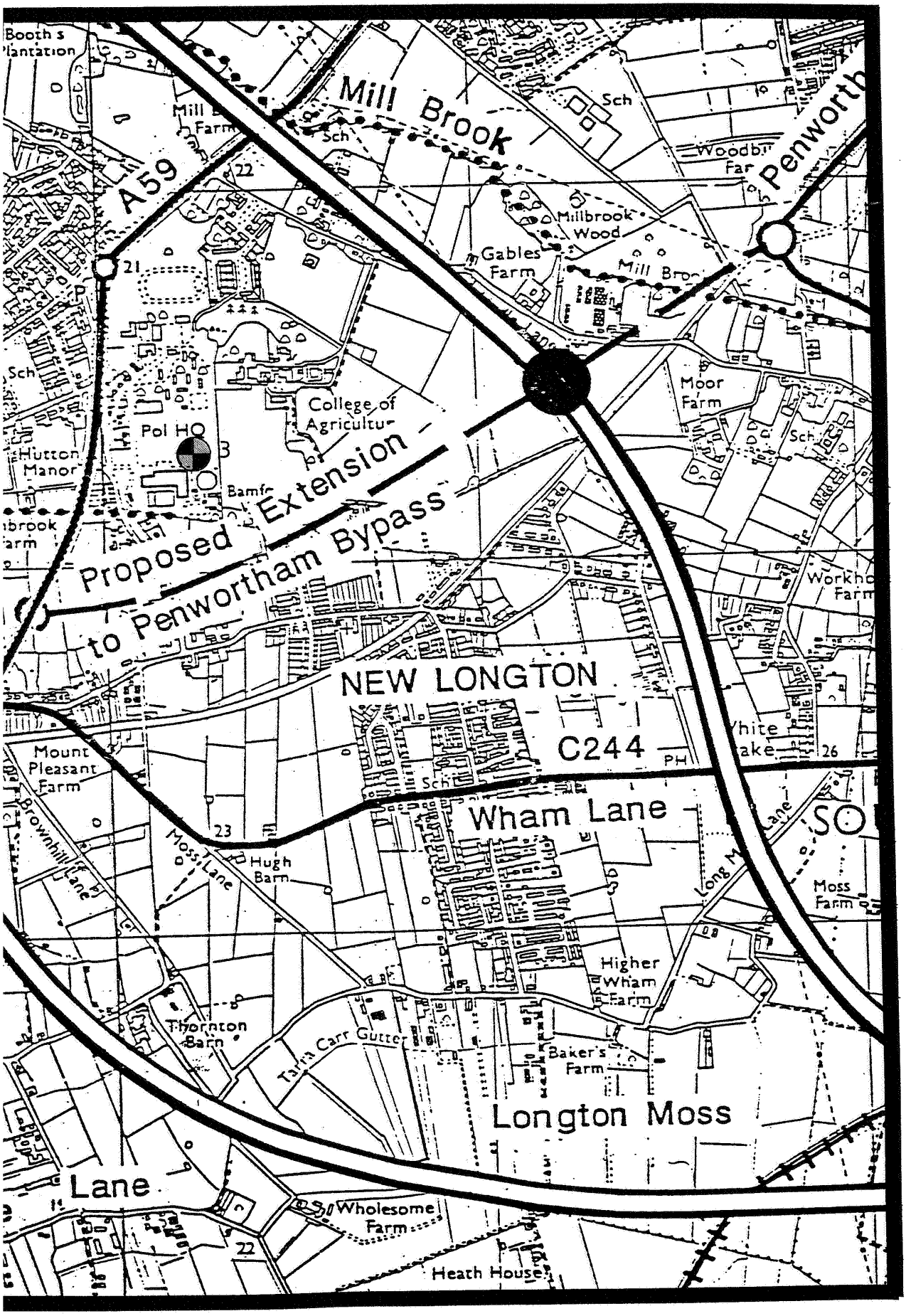
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Moor Farm
College of Agricultur
Pol HQ
Hutton Manor
Proposed Extension to Penwortham Bypass
NEW LONGTON
C244
PH
Mount Pleasant Farm
Wham Lane
Brownhill Lane
Moss Lane
Hugh Barn
Higher Wham Farm
Moss Farm
Thornton Barn
Tarra Carr Gutter
Baker's Farm
Longton Moss
Lane
Wholesome Farm
Heath House
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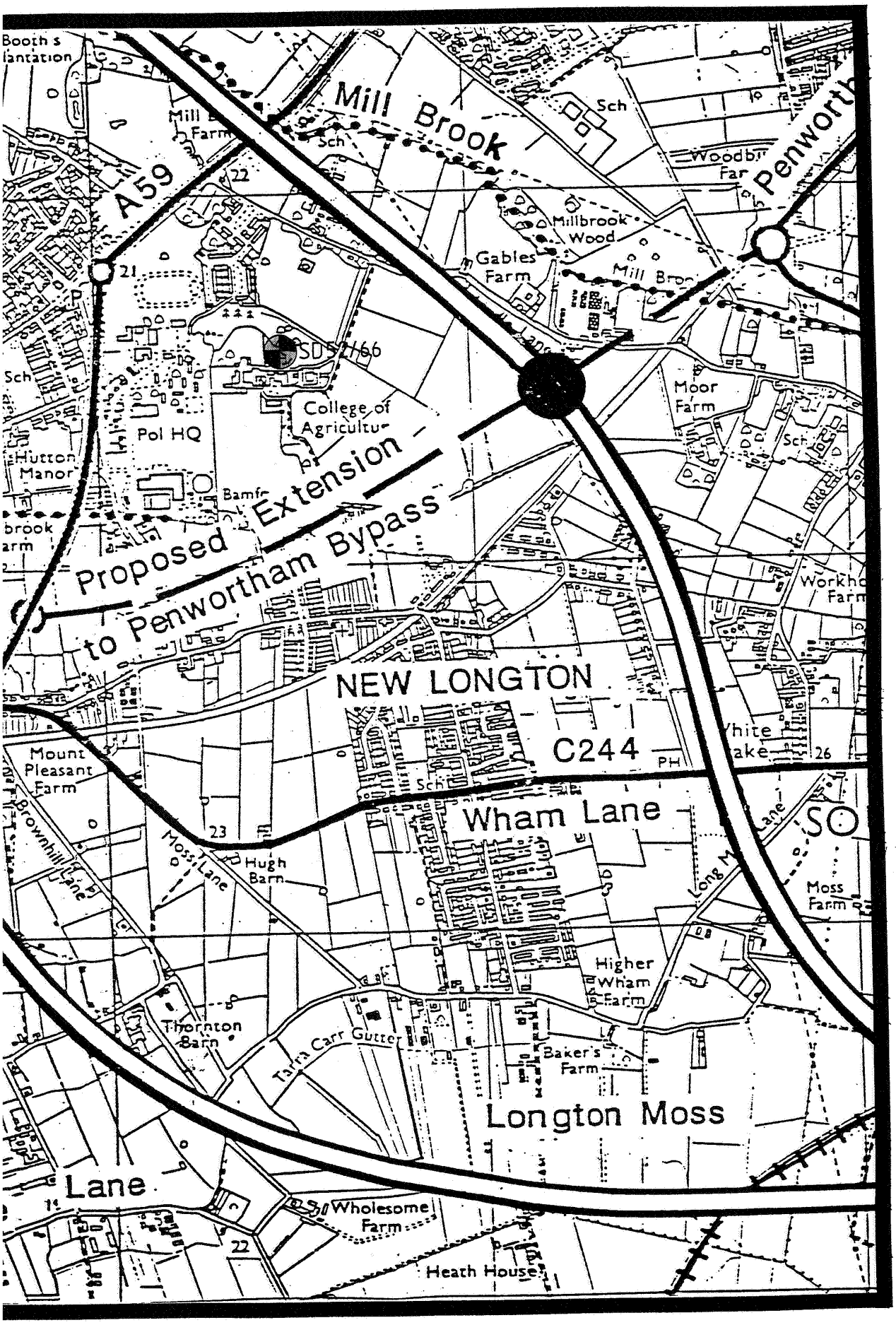
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Proposed Extension to Penwortham Bypass
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Wham Lane
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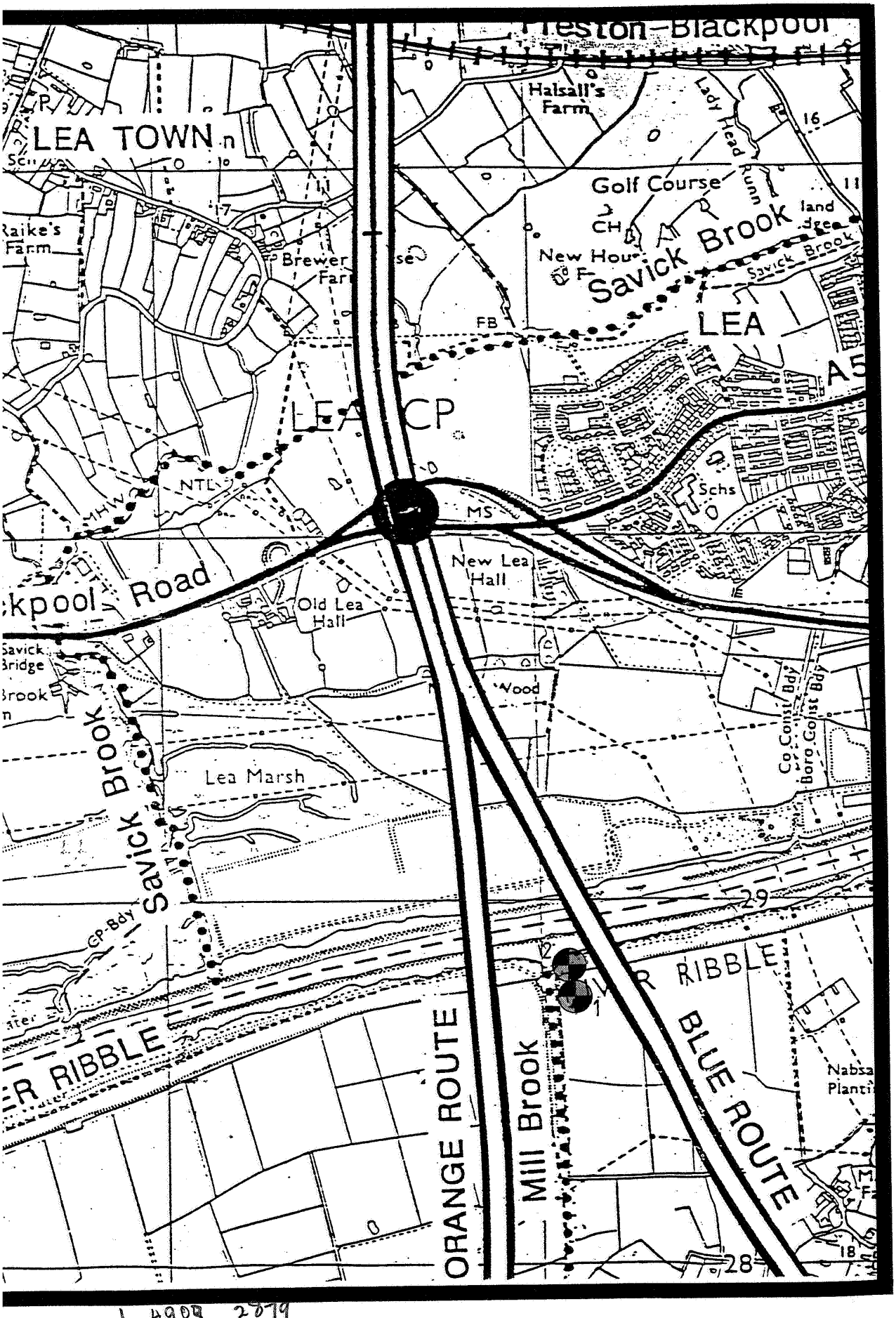
Thornton Barn
Tarra Carr Gutter
Baker's Farm
Longton Moss
Lane
Wholesome Farm
22
Heath House


Preston-Blackpool
LEA TOWN
Halsall's Farm
Lady Head Runn
Golf Course
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Savick Brook
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Old Lea Hall
Wood
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Boro Const Bdy
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ORANGE ROUTE
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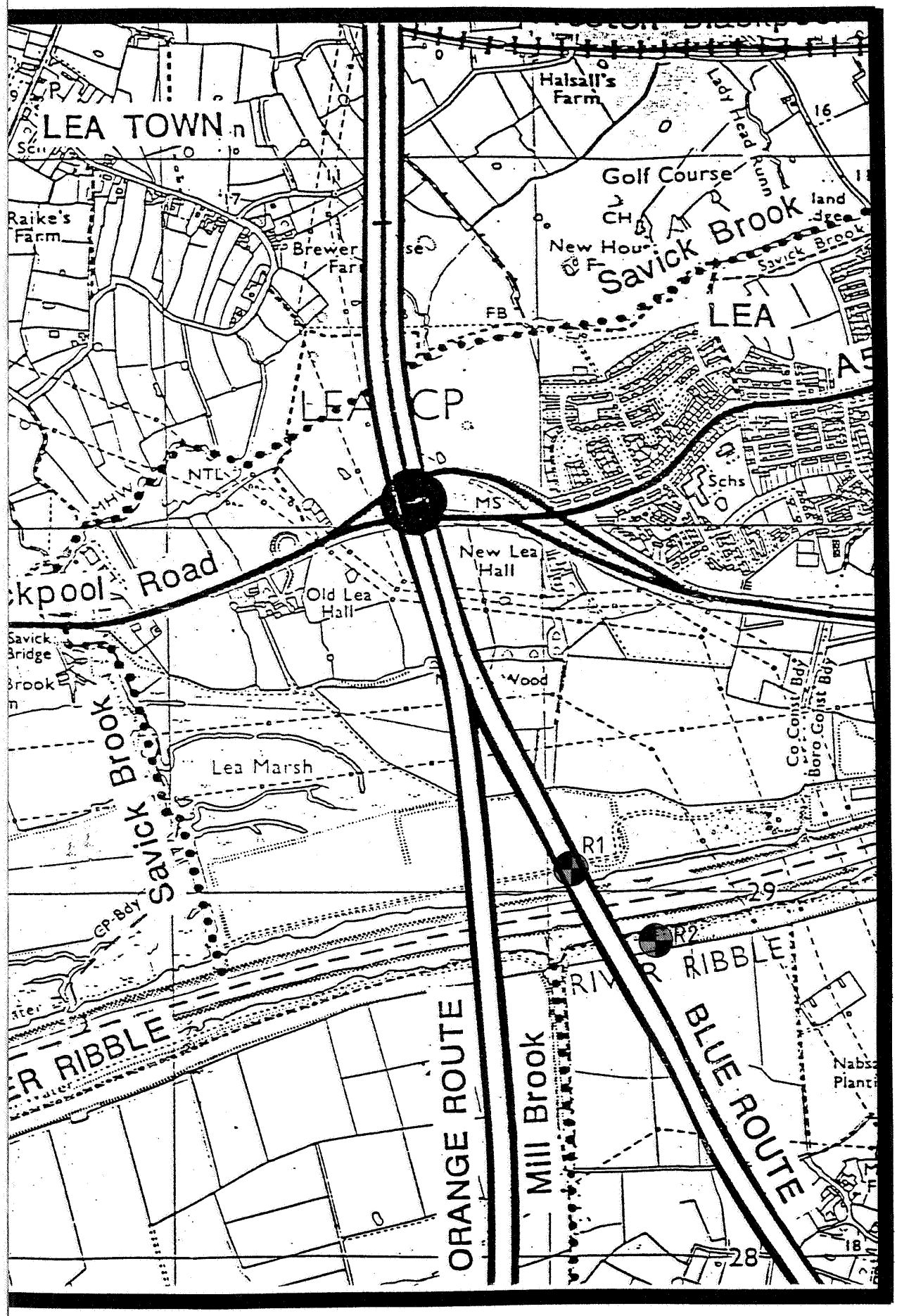
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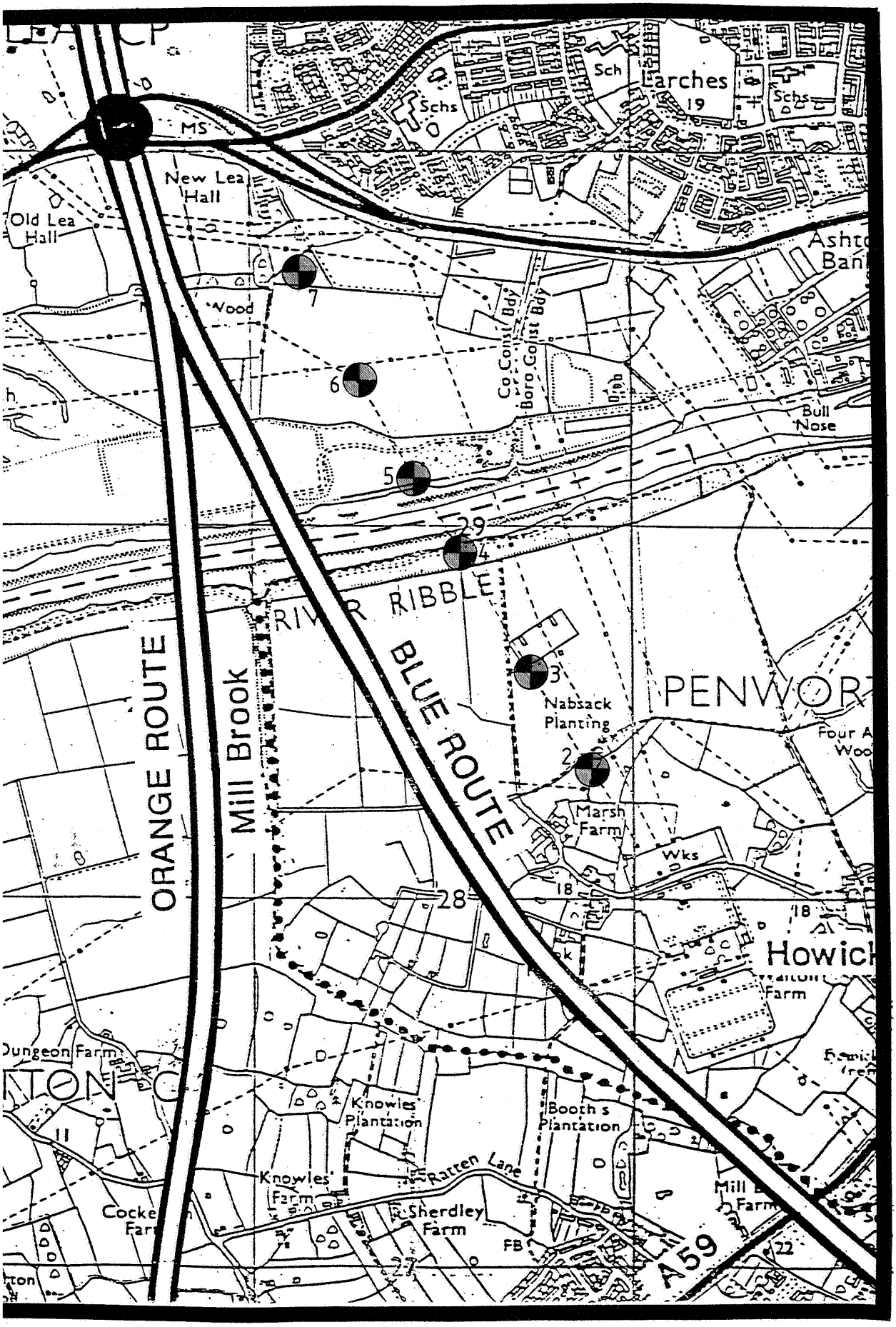
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Old Lea Hall
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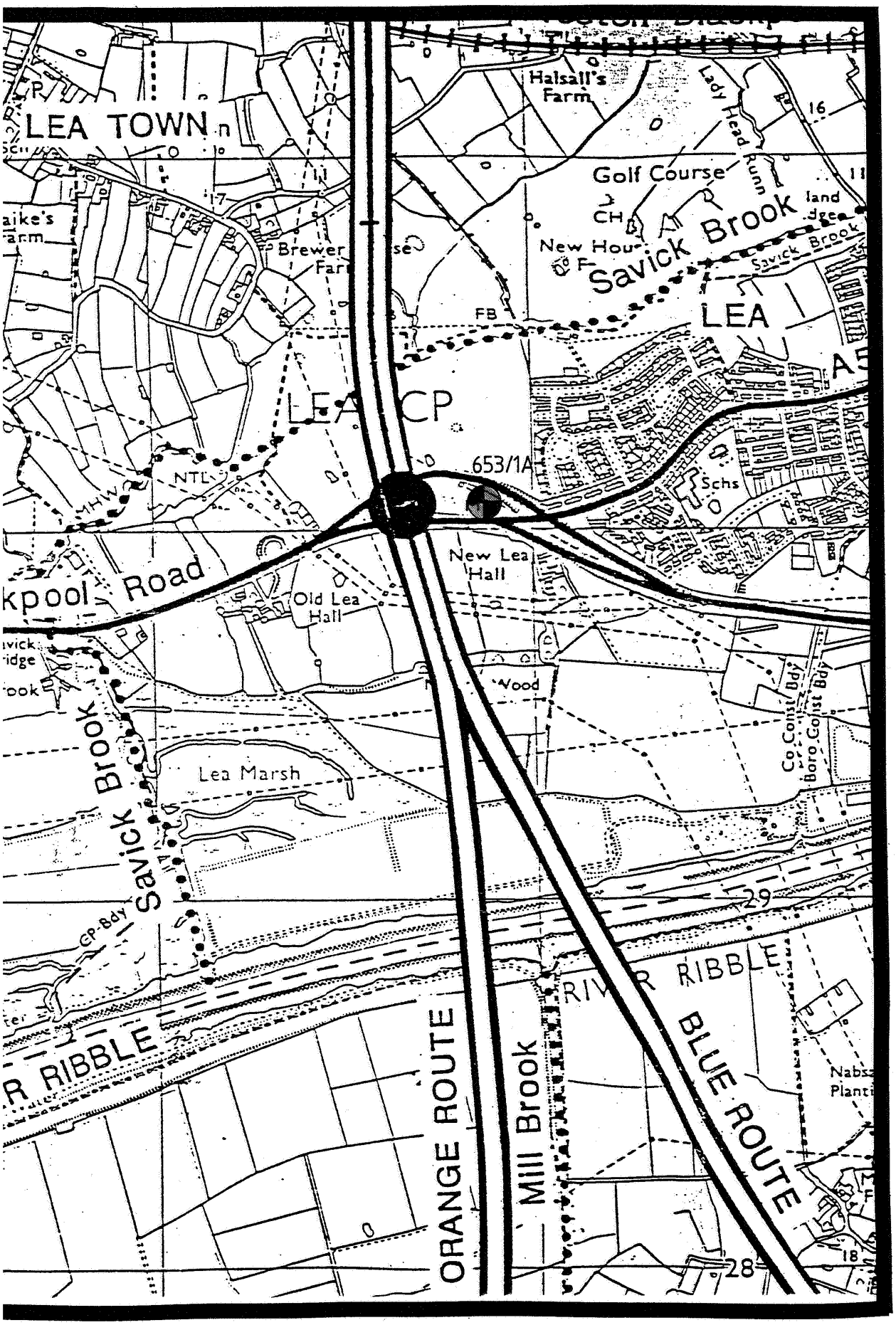
Boro. Const. Bdy
Ditch
Bull Nose
RIBBLE
ORANGE ROUTE
Mill Brook
BLUE ROUTE
Nabsack Planting
PENWORT
Four A
Wood
Marsh Farm
Wks
Howick
Farm
Dungeon Farm
Knowles Plantation
Booth's Plantation
Ratten Lane
Knowles Farm
Sherdley Farm
FB
A59
Mill
Farm


LEA TOWN
Halsall's Farm
Lady Head Runn
Golf Course
CH
Savick Brook
New Hou
Brewer Far
FB
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CP
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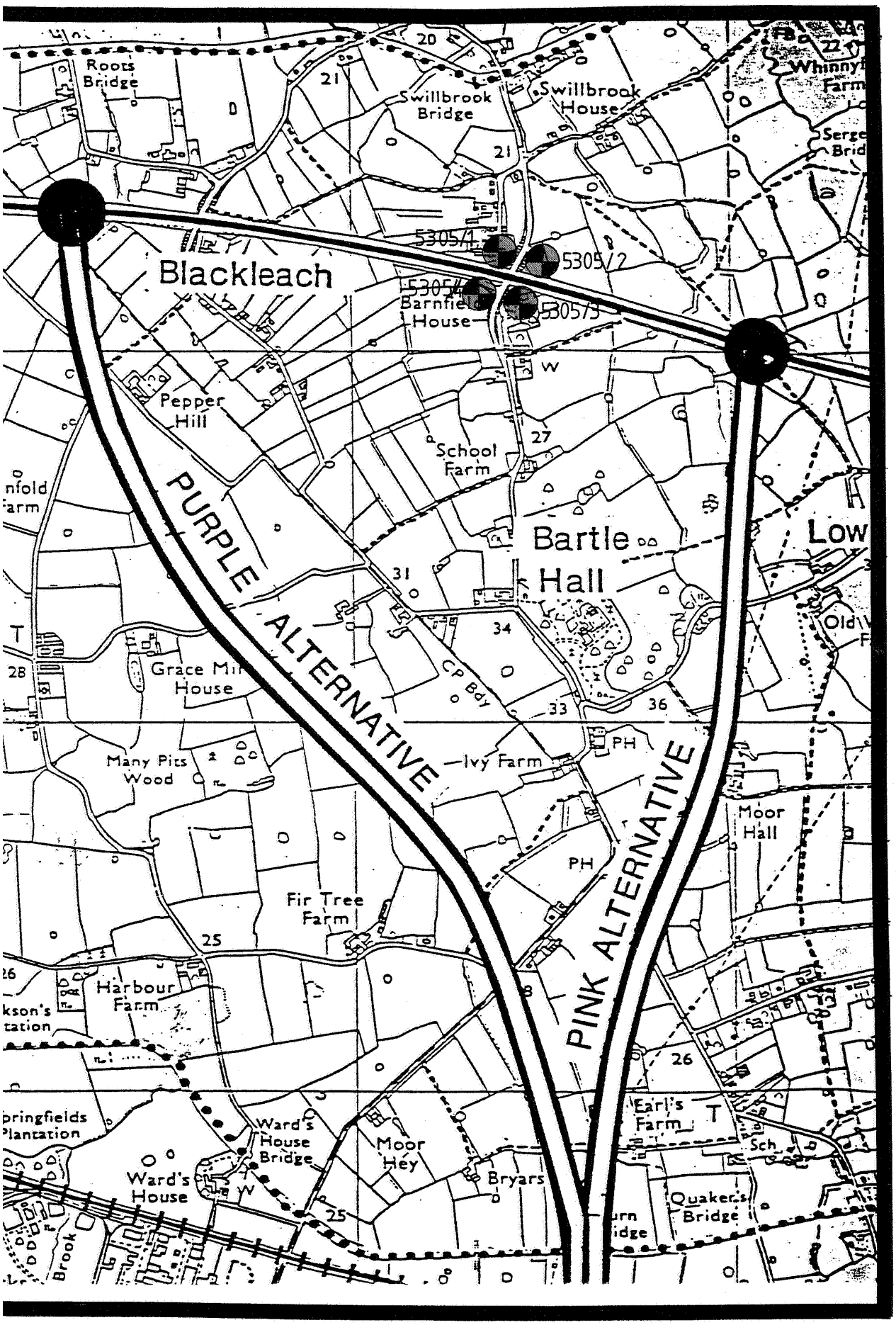
NTL
Schs
New Lea Hall
Old Lea Hall
Wood
Co Const Bdy
Boro Const Bdy
Lea Marsh
Savick Brook
GP-Bdy
R RIBBLE
RIVER RIBBLE
ORANGE ROUTE
Mill Brook
BLUE ROUTE
29
28
18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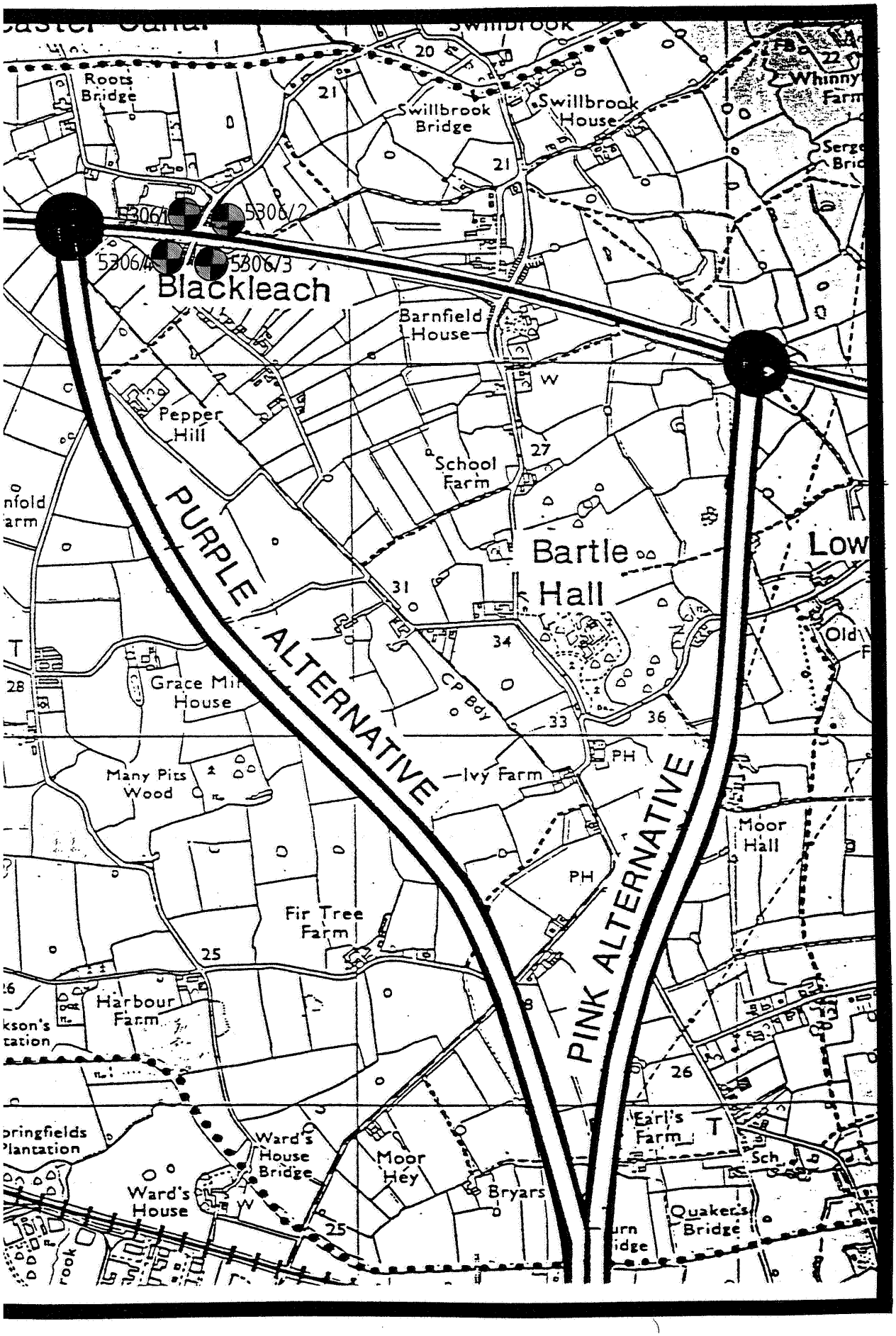
Swillbrook Bridge
Swillbrook House
Whinny Farm
Blackleach
5305/1
5305/2
5305/4
Barnfield House
5305/3
Pepper Hill
School Farm
PURPLE ALTERNATIVE
Bartle Hall
Low
Grace Mill House
CP Boy
Many Pits Wood
Ivy Farm
PH
Moor Hall
Fir Tree Farm
Harbour Farm
PINK ALTERNATIVE
Springfields Plantation
Ward's House Bridge
Ward's House
Moor Hey
Bryars
Earl's Farm
Sch
Quaker's Bridge
Brook


Roots Bridge
Swillbrook Bridge
Swillbrook House
Whinny Farm
5306/1
5306/2
5306/4
5306/3
Blackleach
Barnfield House
Pepper Hill
School Farm
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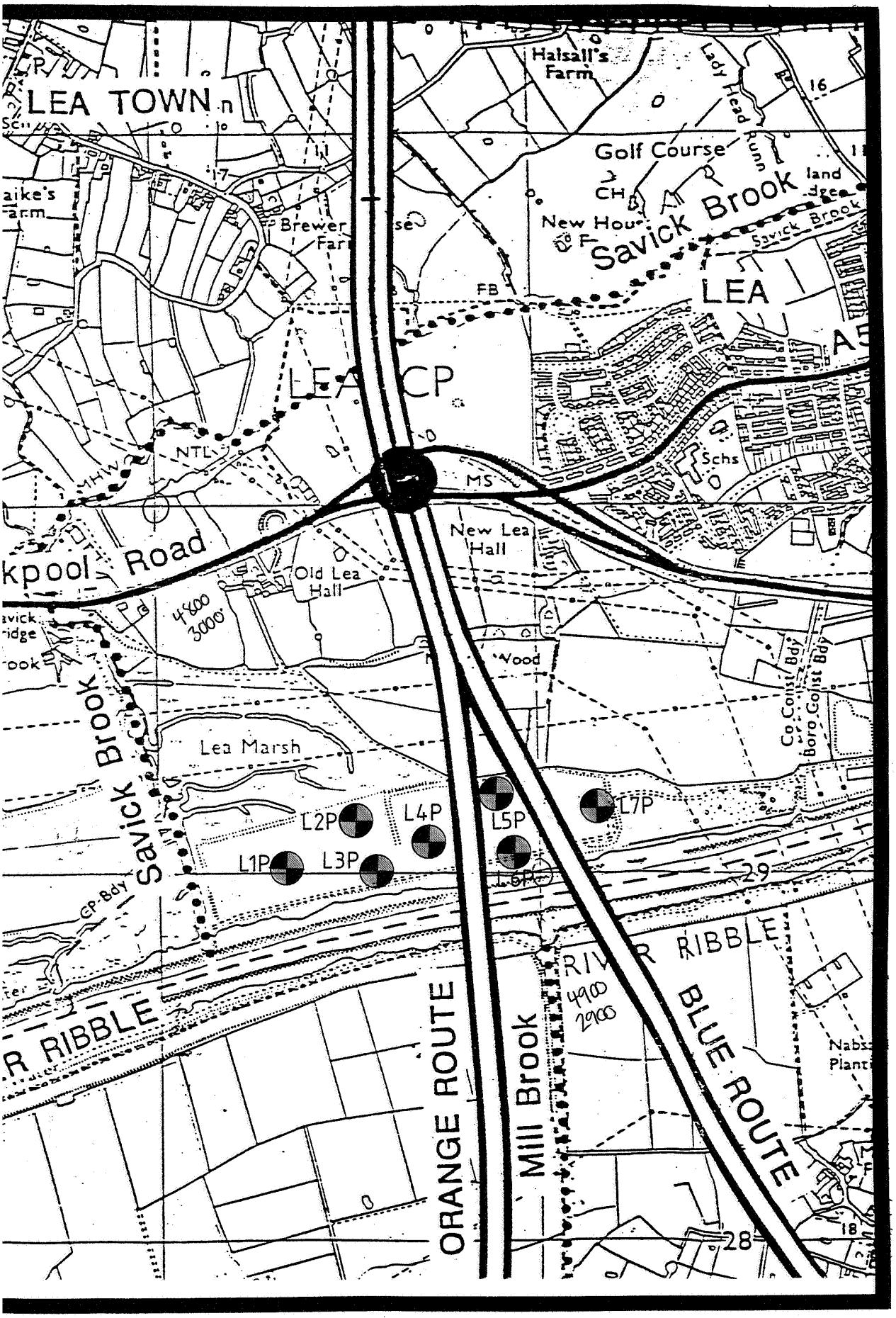
Fir Tree Farm
Harbour Farm
Ward's House Bridge
Ward's House
Moor Hey
Bryars
Earl's Farm
Quaker's Bridge


LEA TOWN
Halsall's Farm
Golf Course
Savick Brook
LEA
CP
Brewer
NTL
MHW
MS
New Lea Hall
Old Lea Hall
Wood
Lea Marsh
Savick Brook
L1P
L2P
L3P
L4P
L5P
L6P
L7P
RIBBLE
ORANGE ROUTE
Mill Brook
BLUE ROUTE
Schs
FB
CH
16
29
28

Name of site

PRESTON WESTERLY BY-PASS

SI BOREHOLE R1

W R B No.

SD 42 / 23

Owner		Licence no. Appn no. Cancelled	
Occupier		IGS ref. no.	
Ground level	m OD	ft. OD	
Level of well top	m OD	ft. OD	
Rest water level	m bwt	ft. bwt	
(Date)	m OD	ft. OD	

Nat. grid ref. SD 4900 2904

Status

Aquifer

Code

Construction: Method Date 1976

Depth bwt	Dia.	Linings (below well top) From	To	Dia.	Type

Summary of geological section	Thickness	Depth
		41.1m
b/h log available enclosed received from N.W Region 5-3-90		

Abstraction rates

gph PWL

gpd

Type of pump

Chem./bact. anal. YES/NO

Well driller

If insufficient space has been allowed, continue in 'Notes' overleaf.

I/5/79/207

Metric

LANCASHIRE COUNTY COUNCIL

BOREHOLE DATA SHEET No. 1 OF 5

SD 4900 2904

JOB No. 473 R1 SD42/23

B.H. No.

SCHEME PRESTON WESTERLY BY-PASS

DEPTH 41.1 m

LOCATION RIBBLE CROSSING (N. SIDE) PRELIMINARY BOREHOLE

GROUND LEVEL 9.5 m

Description of Stratum	Depth	Sample 1 2 3 Key	M.C.	LL/PL/PI Core Rec'y	Class'n	N Value	Water & Casing Details
FILL Loose mid brown fine SAND		SP	10.0			N = 8	Started 23.1.76 200mm Casing.
			20.6		SU/F		
FILL Loose to medium dense dark grey-black organic silty fine SAND	1.5	SP				N = 11	
			33.7		SF/F		
							Slight WE. 3.2m
FILL Loose to medium dense dark grey-black medium SAND with fine to medium gravel and pockets of clay	3.4	SP				N = 10	
					SU/F		
TOPSOIL	4.9	SP	26.8				
Medium dense light brown silty fine SAND (with occasional bands of grey sandy silt)	5.2		29.3			N = 20	23.1.76 pm. 'Dry' Casing to 4.8m 26.1.76 am. 'Wet'
	7.0	SP	17.8	Grading	SF	N = 21	
Medium dense brown fine to medium SAND (with occasional bands of grey sandy silt)					SU		
	8.2						Slight WE. 8.25m
Medium dense brown medium SAND with occasional fine gravel		SP				N = 11	
					SU		26.1.76 pm. SWL 7.7m
							Casing to 8.25m 27.1.76 am. SWL. 7.5m Sand level 7.9m WE. 9.75m rose to 8.1m in 5min/8.0m in 10

STRENGTH TEST RESULTS

Depth of Sample	Bulk Dens'y (kg/m3)	Dry Dens'y (kg/m3)	M.C. (%)	Comp. Stress (kN/m2)	Cohesion (kN/m2)	Ø	Remarks

COMPACTION AND OTHER TEST RESULTS

Depth of Sample	Compaction	Dry Dens'y (kg/m3)	M.C. (%)	S.G.	Air Voids	C.B.R.	SO_3 gm/litre	pH	Remarks or other tests

GENERAL REMARKS

C87A L6272 TayPig

LANCASHIRE COUNTY COUNCIL

BOREHOLE DATA SHEET No. 2 OF 5

JOB No. SW4183

B.H. No. R1

SCHEME PRESTON WESTERLY BY-PASS

DEPTH 41.1 m

GROUND LEVEL 9.5 m

LOCATION RIBBLE CROSSING (N. SIDE) PRELIMINARY BOREHOLE

Description of Stratum	Depth	Sample 1 2 3 Key	M.C.	LL/PL/PI Core Rec'y	Class'n	N Value	Water & Casing Details
	10.5	SP				N = 10	
Medium dense grey silty fine SAND with traces of fine gravel (occasionally more silty or clayey)					SP		
		SP				N = 15	
	13.7						
Dense mid-brown medium SAND with fine to coarse GRAVEL and occasional bands of silt becoming well graded SAND and GRAVEL		SP		Grading	Gp	N = 45	27.1.76 pm. SWL 9.4m Casing to 14.4m 28.1.76 am. SWL 7.5m S. and G. level 12.6m
		SP		Grading	Gw		28.1.76 pm. SWL 8.3m Casing to 16.0m 29.1.76 am. SWL 7.6m S. and G. level 15.8m
	18.0	SP				N = 15	29.1.76 pm. SWL 8.7m Casing to 17.7m 30.1.76 am. SWL 7.6m
Stiff mid-brown sandy silty CLAY with fine to medium gravel sized stones		U4	17.2				
	19.4		21.4				30.1.76 pm. SWL 8.3m Casing to 18.5m 2.2.76 am. SWL 7.9m
See Sheet No. 3							

STRENGTH TEST RESULTS

Depth of Sample	Bulk Dens'y (kg/m3)	Dry Dens'y (kg/m3)	M.C. (%)	Comp. Stress (kN/m2)	Cohesion (kN/m2)	Ø	Remarks
18.5 - 19.0	2180	1860	17.2	168	84	-	100mm U.C.T.

COMPACTION AND OTHER TEST RESULTS

Depth of Sample	Compaction	Dry Dens'y (kg/m3)	M.C. (%)	S.G.	Air Voids	C.B.R.	SO3 gm/litre	pH	Remarks or other tests

GENERAL REMARKS Slow progress driving casing. Sand and gravel rising up casing down to 18m.

C87A L6272 TayPho

Metric

LANCASHIRE COUNTY COUNCIL

BOREHOLE DATA SHEET No. 3 OF 5

JOB No. 473 SD42/23

B.H. No. R1

SCHEME PRESTON WESTERLY BY-PASS

DEPTH 41.1 m

LOCATION RIBBLE CROSSING (N. SIDE) PRELIMINARY BOREHOLE

GROUND LEVEL 9.5 m

Description of Stratum	Depth	Sample 1 2 3 Key	M.C.	LL/PL/PI Core Rec'y	Class'n	N Value	Water & Casing Details
							Change to 150mm Casing
Firm to stiff brown smooth laminated silty CLAY with occasional bands of brown sandy silty boulder clay		U4	24.4				2.2.76 pm. SWL. 8.4m
			26.6				Casing to 19.2m
							3.2.76 am. SWL. 8.3m
			20.9				3.2.76 pm. SWL. 13.7m
							4.2.76 am. SWL. 7.3m
			19.4				4.2.76 pm. SWL. 9.0m
		U4	26.5				5.2.76 am. SWL 7.8m
			25.0	46/22/24	CI		
	23.3	U4	8.7				
Very stiff red brown very sandy CLAY with gravel sized stones and bands of sand and gravel.			9.7				5.2.76 pm. SWL. 9.9m
		SP	10.2		CL/SC	N = 53	Casing to 23.3
							6.2.76 am. SWL. 8.0m
							Sand level to 22.1m
							6.2.76 pm. SWL. 12.8m
							Casing to 24.5
		SP				N = 69	9.2.76 am. SWL 8.2m
							9.2.76 pm. SWL. 11.8m
	27.1						Casing to 26.0m
Soft, very broken, red brown very weathered fine grained SANDSTONE with bands of harder thinly bedded sandstone		SP				N = 97 For 150mm	11.2.76 am. SWL 7.0m Sand level 25.0m
					Sa		11.2.76 pm. SWL. 9.9m BH. to 27.5m
							13.2.76 am. SWL 7.8m Sand level 26.4m
		SP				N = 103 For 75mm	13.2.76 pm. SWL. 9.3
							Casing to 28.6m 16.2.76 am. SWL. 7.0m Sand level 27.1m

STRENGTH TEST RESULTS

Depth of Sample	Bulk Dens'y (kg/m3)	Dry Dens'y (kg/m3)	M.C. (%)	Comp. Stress (kN/m2)	Cohesion (kN/m2)	∅	Remarks
20.2 - 20.6	2040	1640	24.4	168	84	-	100mm U.C.T.
21.8 - 22.2	2030	1600	26.5	144	72	-	100mm U.C.T.
23.3 - 23.8	2370	2180	8.7	118	59	-	100mm U.C.T.

COMPACTION AND OTHER TEST RESULTS

Depth of Sample	Compaction	Dry Dens'y (kg/m3)	M.C. (%)	S.G.	Air Voids	C.B.R.	SO_3 gm/litre	pH	Remarks or other tests

GENERAL REMARKS

Slow progress due to water in borehole, unable to seal off water. Sand and gravel rising up casing. Large boulders at 26.8 to 27.1m

C87A L6272 TsyPtg

Metric

LANCASHIRE COUNTY COUNCIL

BOREHOLE DATA SHEET No. 4 OF 5

JOB No. 473 SD42A23

B.H. No. R1

SCHEME PRESTON WESTERLY BY-PASS

DEPTH 41.1 m

LOCATION RIBBLE CROSSING (N. SIDE) PRELIMINARY BOREHOLE

GROUND LEVEL 9.5 m

Description of Stratum	Depth	Sample 1 2 3 Key	M.C.	LL/PL/PI Core Rec'y	Class'n	CORE RECOVERY	Water & Casing Details
See Sheet No. 3						75%	Air Flush Water not sealed off
	31.3					100%	
Hard, fairly massive, red brown fine to medium grained SANDSTONE with partings up to 150mm and band of soft massive light grey very weakly cemented sandstone at 32.2 - 32.4 Horizontally bedded						100%	
						100%	
						100%	
	36.0					100%	
Soft, very broken, weathered red-brown thinly bedded fine grained SANDSTONE with bands of harder massive sandstone and occasional bands of marl							
	38.0					100%	
Alternate, very soft light grey, uncemented fine to medium SANDSTONE and red brown thinly parted (25mm) weakly cemented fine sandstone with bands of marl							

STRENGTH TEST RESULTS

Depth of Sample	Bulk Dens'y (kg/m3)	Dry Dens'y (kg/m3)	M.C. (%)	Comp. Stress (kN/m2)	Cohesion (kN/m2)	Ø	Remarks

COMPACTION AND OTHER TEST RESULTS

Depth of Sample	Compaction	Dry Dens'y (kg/m3)	M.C. (%)	S.G.	Air Voids	C.B.R.	SO_3 gm/litre	pH	Remarks or other tests

GENERAL REMARKS

C87A L6272 ToyPig

Metric

LANCASHIRE COUNTY COUNCIL

BOREHOLE DATA SHEET No. 5 OF 5

JOB No. 473 SD42/23

B.H. No. R1

SCHEME PRESTON WESTERLY BY-PASS

DEPTH 41.1 m

LOCATION RIBBLE CROSSING (N. SIDE) PRELIMINARY BOREHOLE

GROUND LEVEL 9.5 m

Description of Stratum	Depth	Sample 1 2 3 Key	M.C.	LL/PL/PI Core Rec'y	Class'n	CORE RECOVERY	Water & Casing Details
See Sheet No. 4						100%	
	41.1						B.H. Complete

STRENGTH TEST RESULTS

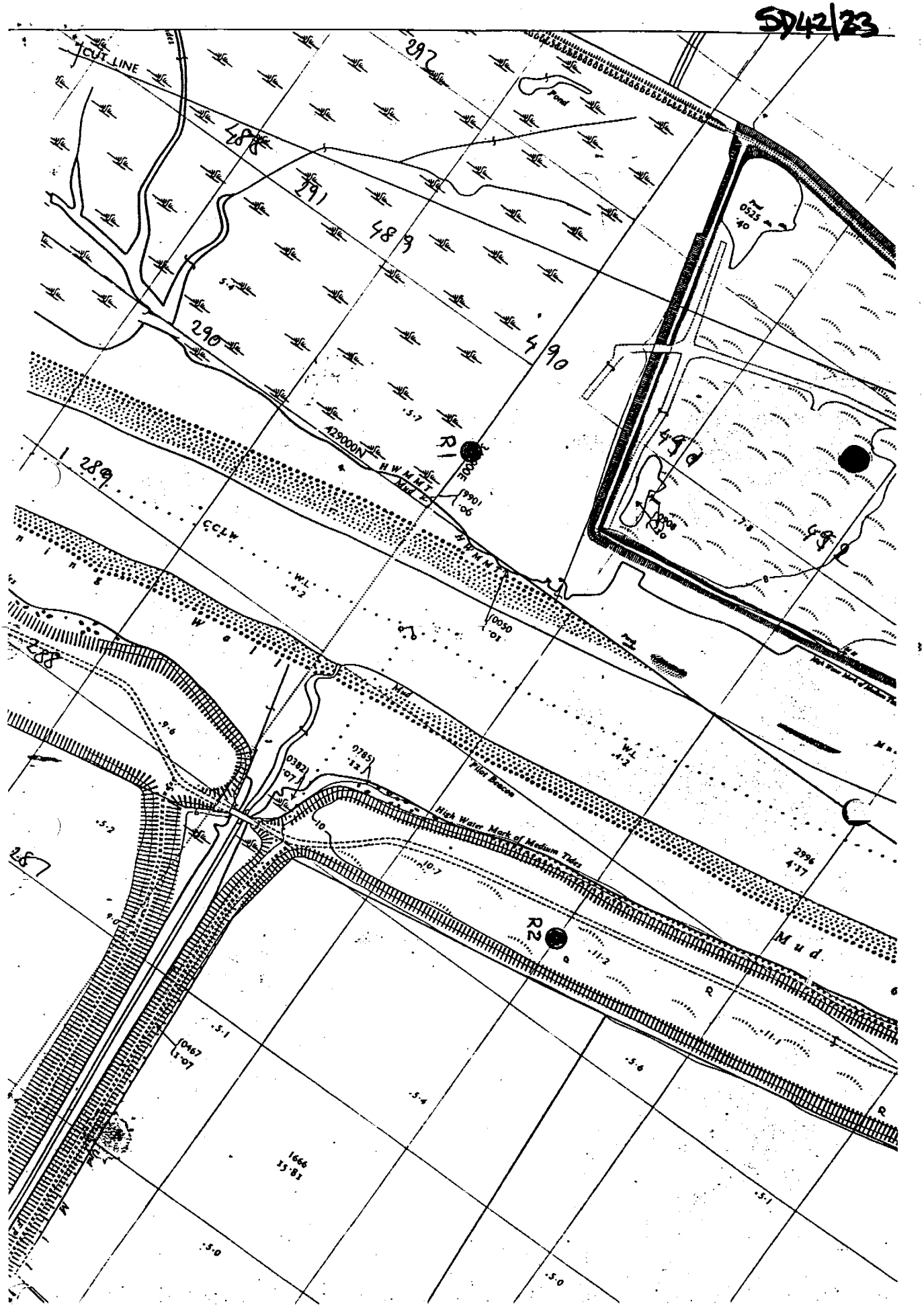
Depth of Sample	Bulk Dens'y (kg/m3)	Dry Dens'y (kg/m3)	M.C. (%)	Comp. Stress (kN/m2)	Cohesion (kN/m2)	Ø	Remarks

COMPACTION AND OTHER TEST RESULTS

Depth of Sample	Compaction	Dry Dens'y (kg/m3)	M.C. (%)	S.G.	Air Voids	C.B.R.	SO_3 gm/litre	pH	Remarks or other tests

GENERAL REMARKS

C87A 16272 Toyfig


SD42/23
CUT LINE
Pond
297
288
291
289
290
490
R1
429000N
H W M M T
Mud
Pilot Beacon
High Water Mark of Medium Tides
R2
Mud
CCLW
WL
Wall
1666
35·81

SD 42 NE/6C

Name of site: CLIFTON MARSH (GRANGE FM) BH 3

WRB No.: SD42/15C

Owner	Licence no. / Appn no. N/A.	Nat. grid ref.	SD 4536 2850
Occupier	IGS ref. no.	Status	Observation & Site Investigation.
Ground level	m OD ft. OD	Aquifer	Superficial Deposits
Level of well top	m OD ft. OD	Code	111
Rest water level 1.155	m bwt ft. bwt		
(Date 10/6/80)	m OD ft. OD		
Construction: Method Cable percussion	Date May 1980		

Depth bwt	Dia.	Linings (below well top) From	To	Dia.	Type
30.70	8" to 13.0	GL	13.50	2"	Plastic
	6" to 30.7	Perforated	10.5 – 13.5		Gravel

Summary of geological section	Thickness	Depth
Sands		9.00
Sands with gravel		12.80
Boulder clay		30.70

Abstraction rates: gph PWL / gpd

Type of pump

Chem./bact. anal. YES/~~NO~~

Well driller Site Soil Surveys

If insufficient space has been allowed, continue in 'Notes' overleaf.

I/5/79/207

Site Plan

SD 42 NE /6 C

Notes

Borehole drilled as part of SI for proposed tipping by NWWA.

Standpipe installed with concrete slabs and steel overcleave with bolted flange with dip plug.

Chemical data available for waters encountered during drilling.

See L40402/01 & Water Quality files + H/R N° 58

SD 42 NE/6c 75/12/c

WATER RESOURCES BOARD

WELL RECORD

SHEET 1

W.R.B. REF. NO. SD 42/15 C

R.A. LICENCE NO.

1. WELL IDENTITY

NATIONAL GRID REFERENCE 4536 2850

Well at Grange Farm No. 3

I.G.S. REF. NO.

RIVER AUTHORITY NWWA

Town

HYDROMETRIC AREA 71

County

SUB-CATCHMENT

Owner of well

Well made by Soil Surveys

Date of sinking 5/1980

Information from [redacted]

Date received 29.7.80

2. WELL DESCRIPTION

Level of ground surface m. If well top is not at above* m

above sea level (O.D.) ft. ground level how far below ft

Shaft m. deep; Diameter at top mm.; at bottom mm

ft. in. in

Bore 30.70 m. deep; Diameter at top 200 mm.; at bottom 150 mm

ft. in. in

Details of headings

DETAILS OF PERMANENT LINING TUBES

Length Plain 13.50 m. ; Diam. 50 mm.; Length Slotted m.; Diam. mm.; Top at m. above/~~below~~ surface

ft. in. ft. in. ft.

Length Plain m. ; Diam. mm.; Length Slotted m.; Diam. mm.; Top m. above* below surface

ft. in. ft. in. ft.

Length Plain m. ; Diam. mm.; Length Slotted m.; Diam. mm.; Top m. above* below surface

ft. in. ft. in. ft.

Details of well screen plastic liner, perforated 10.5 to 13.5 m.

DETAILS OF REST WATER LEVELS DURING CONSTRUCTION

Water struck at depths of below well top

Rest level of water m. above* below* O.D.* well top when bore m. deep. Date

ft. ft.

Rest level of water m. above* below* O.D.* well top when bore m. deep. Date

ft. ft.

Rest level of water on completion of bore 1.155 m. ~~above~~* ~~below~~* well top when bore 30.70 m. deep. Date 10.6.80

ft. ft.

Method of drilling Percussion

SD42NE/6C

75/124C

DETAILS OF PUMPING TEST

Water level depressed from ..... m. / ..... ft. above* / below* well top to ..... m. / ..... ft. below well top, pumping at ..... l/s ..... galls/hr.

Water level depressed from ..... m. / ..... ft. above* / below* well top to ..... m. / ..... ft. below well top, pumping at ..... l/s ..... galls/hr.

Water level depressed from ..... m. / ..... ft. above* / below* well top to ..... m. / ..... ft. below well top, pumping at ..... l/s ..... galls/hr.

Suction at ..... ft. below well top. Capacity of pump ..... l/s / galls/hr. Test from ../../19.. to .. / /19 ..

DETAILS OF PERMANENT PUMPING EQUIPMENT

Make and/or type ..... Motive Power .....

Capacity ..... l/s / galls/hr. Suction at ..... m. / ..... ft. below well top.

Amount pumped ..... m^3/day* / galls/day. Pumping for ..... hrs./day.

Estimated consumption ..... m^3/week* / galls/week ..... m^3/year* / galls/year

3. WELL DATA

WELL USE. Abstraction ☐, Recharge ☐, Observation ☒, Disused ☐, Filled-in ☐

WATER USE. Public Supply ☐, Industrial ☐, Irrigation ☐, Agriculture ☐, Domestic ☐, Unused ☒, Misc. ☐

WATER LEVEL OBSERVATIONS

	Rest Water Level	Pumping Water Level	Depression	Rate of Pumping	Date
(1)	..... m. O.D. / ..... ft.	..... m. O.D. / ..... ft.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....
(2)	..... m. O.D. / ..... ft.	..... m. O.D. / ..... ft.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....
(3)	..... m. O.D. / ..... ft.	..... m. O.D. / ..... ft.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....
(4)	..... m. O.D. / ..... ft.	..... m. O.D. / ..... ft.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....

GEOPHYSICAL DATA AVAILABLE

Resistivity ☐ Conductivity ☐ Temperature ☐ Any other logs .....

PARTIAL ANALYSIS DETAILS In milligrams per litre

Date	TDS	Tot H	Carb H	Non-Carb H	Alk	SO4	Cl	E.C.

SD 42 NE/6C 75/12

WATER RESOURCES BOARD

WELL RECORD

SHEET 2

W.R.B. REF NO. SD 42/15

R.A. LICENCE NO.

4. HYDROGEOLOGY

Topography AT WELL SITE

Local depression ☐, Flat surface ☐, Hill top ☐, Hillside ☐, Valley bottom ☐, Ter

MAJOR AQUIFER Superficial deposits Lithology

Depth to top of aquifer ..... m. ..... ft. Thickness penetrated ..... m. ..... ft.

Top of aquifer ..... m. ..... ft. AOD* BOD Total thickness of aquifer ..... m. ..... ft.

Coefficient of storage ..... Transmissivity ..... $\frac{m^2/day^*}{galls/day/ft.}$

MINOR AQUIFER ..... Lithology

Depth to top of aquifer ..... m. ..... ft. Thickness penetrated ..... m. ..... ft.

Top of aquifer ..... m. ..... ft. AOD* BOD Total thickness of aquifer ..... m. ..... ft.

Coefficient of storage ..... Transmissivity ..... $\frac{m^2/day^*}{galls/day/ft.}$

ADDITIONAL NOTES:

BGS ID: 4266 : BGS Reference: SD42NE6/C
EPSG: 27700 : 345360,428500

5. STRATA

SD 42 NE/6C

75/12

GEOLOGICAL CLASSIFICATION	NATURE OF STRATA	THICKNESS METRES	DEPTH METRES	DEPTH FEET	DEPTH IN
QUATERNARY Est Al.	Sands	9.00	9.00		
Glac. SG	Sands with gravel	3.80	12.80		
" BC	Boulder clay	17.90	30.70		

SD 42/15 C

WATER RESOURCES BOARD

WELL RECORD SD 42 NE/6C SHEET 1

W.R.B. REF. NO. SD 42/15 C

R.A. LICENCE NO.

1. WELL IDENTITY

NATIONAL GRID REFERENCE 4536 2850

Well at Grange Farm No. 3

I.G.S. REF. NO. 75/124 C

RIVER AUTHORITY NWWA

Town

HYDROMETRIC AREA 71

County

SUB-CATCHMENT

Owner of well

Well made by Sub Soil Surveys

Date of sinking 5/1980

Information from [redacted]

Date received 29.7.80

2. WELL DESCRIPTION

Level of ground surface m. If well top is not at above* m.

above sea level (O.D.) ft. ground level how far below ft.

Shaft m. deep; Diameter at top mm. ; at bottom mm.
ft. in. in.

Bore 30.70 m. deep; Diameter at top 200 mm. ; at bottom 150 mm.
ft. in. in.

Details of headings

DETAILS OF PERMANENT LINING TUBES

Length Plain 13.50 m. ; Diam. 50 mm. ; Length Slotted m. ; Diam. mm. ; Top at m. above* / below surface
ft. in. ft. in. ft.

Length Plain m. ; Diam. mm. ; Length Slotted m. ; Diam. mm. ; Top m. above* / below surface
ft. in. ft. in. ft.

Length Plain m. ; Diam. mm. ; Length Slotted m. ; Diam. mm. ; Top m. above* / below surface
ft. in. ft. in. ft.

Details of well screen plastic liner, perforated 10.5 to 13.5 m.

DETAILS OF REST WATER LEVELS DURING CONSTRUCTION

Water struck at depths of below well top

Rest level of water m. above* / below* O.D.* well top when bore m. deep. Date
ft. ft.

Rest level of water m. above* / below* O.D.* well top when bore m. deep. Date
ft. ft.

Rest level of water on completion of bore 1.155 m. ~~above*~~ / below* ~~O.D.*~~ well top when bore 30.70 m. deep. Date 10.6.80
ft. ft.

Method of drilling Percussion.

Brief details of well development e.g. acid treatment etc.

* delete as applicable

(18127/1)

DETAILS OF PUMPING TEST

Water level depressed from ..... m. / ..... ft. above* / below well top to ..... m. / ..... ft. below well top, pumping at ..... l/s / ..... galls/hr.

Water level depressed from ..... m. / ..... ft. above* / below well top to ..... m. / ..... ft. below well top, pumping at ..... l/s / ..... galls/hr.

Water level depressed from ..... m. / ..... ft. above* / below well top to ..... m. / ..... ft. below well top, pumping at ..... l/s / ..... galls/hr.

Suction at ..... ft. below well top. Capacity of pump ..... l/s / galls/hr. Test from ..../..../19.... to ..../..../19....

DETAILS OF PERMANENT PUMPING EQUIPMENT

Make and/or type ..... Motive Power .....

Capacity ..... l/s / galls/hr. Suction at ..... m. / ..... ft. below well top.

Amount pumped ..... m^3/day* / galls/day. Pumping for ..... hrs./day.

Estimated consumption ..... m^3/week* / galls/week ..... m^3/year* / galls/year

3. WELL DATA

WELL USE. Abstraction ☐, Recharge ☐, Observation ☒, Disused ☐, Filled-in ☐

WATER USE. Public Supply ☐, Industrial ☐, Irrigation ☐, Agriculture ☐, Domestic ☐, Unused ☒, Misc. ☐

WATER LEVEL OBSERVATIONS

	Rest Water Level	Pumping Water Level	Depression	Rate of Pumping	Date
(1)	..... m. / ..... ft. O.D.	..... m. / ..... ft. O.D.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....
(2)	..... m. / ..... ft. O.D.	..... m. / ..... ft. O.D.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....
(3)	..... m. / ..... ft. O.D.	..... m. / ..... ft. O.D.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....
(4)	..... m. / ..... ft. O.D.	..... m. / ..... ft. O.D.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....

GEOPHYSICAL DATA AVAILABLE

Resistivity ☐ Conductivity ☐ Temperature ☐ Any other logs .....

PARTIAL ANALYSIS DETAILS in milligrams per litre

Date	TDS	Tot H	Carb H	Non-Carb H	Alk	SO4	Cl	E.C.

Site marked on: 1 inch (print) ....., 1 inch (master) ....., 2½ inch ..... (use symbol and give data)

(18127/1)

SD42/15 C

WATER RESOURCES BOARD

WELL RECORD SD 42 NE/6C

SHEET 2

W.R.B. REF No. SD 42/15 C

R.A. LICENCE No.

4. HYDROGEOLOGY

Topography AT WELL SITE

Local depression ☐, Flat surface ☐, Hill top ☐, Hillside ☐, Valley bottom ☐, Terrace ☐

MAJOR AQUIFER Superficial deposits Lithology .....

Depth to top of aquifer ..... m. / ..... ft. Thickness penetrated ..... m. / ..... ft.

Top of aquifer ..... m. / ..... ft. AOD* / BOD Total thickness of aquifer ..... m. / ..... ft.

Coefficient of storage ..... Transmissivity ..... m²/day* / galls/day/ft.

MINOR AQUIFER ..... Lithology .....

Depth to top of aquifer ..... m. / ..... ft. Thickness penetrated ..... m. / ..... ft.

Top of aquifer ..... m. / ..... ft. AOD* / BOD Total thickness of aquifer ..... m. / ..... ft.

Coefficient of storage ..... Transmissivity ..... m²/day* / galls/day/ft.

ADDITIONAL NOTES:

* delete as applicable

RR 18127/1/2173 5m 5/71 TP

5. STRATA		SD42/15C			
GEOLOGICAL CLASSIFICATION	NATURE OF STRATA	THICKNESS	DEPTH	DEPTH	
		METRES	METRES	FEET	IN
Est. Alluvium	Sands	9.00	9.00		
Glacial Sd & gr.	Sands with gravel	3.80	12.80		
Glacial BCL	Boulder clay	17.90	30.70		

[redacted]

RR 18127/1/2173 5m 5/71 TP

SD 42 NE/6 B

Name of site: CLIFTON MARSH (GRANGE FARM) Bh 2

WRB No.: SD42/15B

Owner	Licence no. / Appn no. N/A	Nat. grid ref.	SD 4551 2884.
Occupier	IGS ref. no.	Status	Observation & Site Investigation
Ground level m OD / ft. OD		Aquifer	Superficial Deposits.
Level of well top m OD / ft. OD		Code	111
Rest water level 1.33 m bwt / ft. bwt		Summary of geological section	Thickness / Depth
(Date 10/6/80) m OD / ft. OD		Sands	15.00
Construction: Method Cable Percussion Date May 1980		Sands and Gravel	16-40
		Boulder Clay	30.50

Depth bwt	Dia.	Linings (below well top) From	To	Dia.	Type
30.50	8" to 10.20	GL	17.0m	2"	Plastic
	6" to 30.50	Perforated 14	-17m.		Grouted

Abstraction rates: gph PWL / gpd

Type of pump

Chem./bact. anal. YES/~~NO~~

Well driller Soil Survey

If insufficient space has been allowed, continue in 'Notes' overleaf.

1/5/79/207

Site Plan

Notes

SD 42 NE/6B

Borehole drilled as part of SI for proposed tipping by NWWA.

Standpipe installed with concrete slab and steel over-sleeve unit bolted flange with dip plug.

Chemical data available for waters encountered during drilling.

See R404/02/01 & Water + H/R N°58

[redacted]

SD 42 NE/6 B 75/124B

WATER RESOURCES BOARD

WELL RECORD SHEET 1

W.R.B. REF. No. SD 42/15 B

R.A. LICENCE NO.

1. WELL IDENTITY

NATIONAL GRID REFERENCE 4551 2884

Well at Grange Farm No. 2

I.G.S. REF. No.

RIVER AUTHORITY NWWA

Town

HYDROMETRIC AREA 71

County

SUB-CATCHMENT

Owner of well

Well made by Soil Survey Date of sinking 5/1980

Information from NWWA Date received 29.7.80

2. WELL DESCRIPTION

Level of ground surface m. If well top is not at above* m.

above sea level (O.D.) ft. ground level now far below ft.

Shaft m. deep; Diameter at top mm.; at bottom mm.
ft. in. in.

Bore 30.50 m. deep; Diameter at top 200 mm.; at bottom 150 mm.
ft. in. in.

Details of headings

DETAILS OF PERMANENT LINING TUBES

Length Plain 17.0 m. ; Diam. 50 mm. Length Slotted m. ; Diam. mm. ; Top at m. above* below* surface
ft. in. ft. in. ft.

Length Plain m. ; Diam. mm. Length Slotted m. ; Diam. mm. ; Top m. above* below* surface
ft. in. ft. in. ft.

Length Plain m. ; Diam. mm. Length Slotted m. ; Diam. mm. ; Top m. above* below* surface
ft. in. ft. in. ft.

Details of well screen plastic tubing perforated 14 - 17 m, gravel packed

DETAILS OF REST WATER LEVELS DURING CONSTRUCTION

Water struck at depths of below well top

Rest level of water m. above* below* O.D.* well top when bore m. deep. Date
ft. ft.

Rest level of water m. above* below* O.D.* well top when bore m. deep. Date
ft. ft.

Rest level of water on completion of bore 1.33 m. ~~above*~~ below* ~~O.D.*~~ well top when bore 30.50 m. deep. Date 10.6.80
ft. ft.

Method of drilling Percussion

SD 42 NE/6B

15/124B

DETAILS OF PUMPING TEST

Water level depressed from ..... m. / ..... ft. above* / below* well top to ..... m. / ..... ft. below well top, pumping at ..... l/s / ..... galls/hr.

Water level depressed from ..... m. / ..... ft. above* / below* well top to ..... m. / ..... ft. below well top, pumping at ..... l/s / ..... galls/hr.

Water level depressed from ..... m. / ..... ft. above* / below* well top to ..... m. / ..... ft. below well top, pumping at ..... l/s / ..... galls/hr.

Suction at ..... ft. below well top. Capacity of pump ..... l/s / galls/hr. Test from ..../..../19.... to .../.../19

DETAILS OF PERMANENT PUMPING EQUIPMENT

Make and/or type ..... Motive Power .....

Capacity ..... l/s / galls/hr. Suction at ..... m. / ..... ft. below well top.

Amount pumped ..... m^3/day* / galls/day. Pumping for ..... hrs./day.

Estimated consumption ..... m^3/week* / galls/week ..... m^3/year* / galls/year

3. WELL DATA

WELL USE. Abstraction ☐, Recharge ☐, Observation ☒, Disused ☐, Filled-in ☐

WATER USE. Public Supply ☐, Industrial ☐, Irrigation ☐, Agriculture ☐, Domestic ☐, Unused ☒, Misc. ☐

WATER LEVEL OBSERVATIONS

	Rest Water Level	Pumping Water Level	Depression	Rate of Pumping	Date
(1)	..... m. O.D. / ..... ft.	..... m. O.D. / ..... ft.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....
(2)	..... m. O.D. / ..... ft.	..... m. O.D. / ..... ft.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....
(3)	..... m. O.D. / ..... ft.	..... m. O.D. / ..... ft.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....
(4)	..... m. O.D. / ..... ft.	..... m. O.D. / ..... ft.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....

GEOPHYSICAL DATA AVAILABLE

Resistivity ☐ Conductivity ☐ Temperature ☐ Any other logs .....

PARTIAL ANALYSIS DETAILS In milligrams per litre

Date	TDS	Tot H	Carb H	Non-Carb H	Alk	SO4	Cl	E.C.

SD 42 NE/6B

75/124

WATER RESOURCES BOARD

WELL RECORD

SHEET 2

W.R.B. REF NO. SD 42/15

R.A. LICENCE NO.

4. HYDROGEOLOGY

Topography AT WELL SITE

Local depression ☐, Flat surface ☐, Hill top ☐, Hillside ☐, Valley bottom ☐, T

MAJOR AQUIFER Superficial deposits Lithology

Depth to top of aquifer ..... m. ..... ft. Thickness penetrated ..... m. ..... ft.

Top of aquifer ..... m. ..... ft. AOD* / BOD Total thickness of aquifer ..... m. ..... ft.

Coefficient of storage ..... Transmissivity ..... m^2/day* / galls/day/ft.

MINOR AQUIFER ..... Lithology .....

Depth to top of aquifer ..... m. ..... ft. Thickness penetrated ..... m. ..... ft.

Top of aquifer ..... m. ..... ft. AOD* / BOD Total thickness of aquifer ..... m. ..... ft.

Coefficient of storage ..... Transmissivity ..... m^2/day* / galls/day/ft.

SD 42 NE/6B

75/124B

5. STRATA

GEOLOGICAL CLASSIFICATION	NATURE OF STRATA	THICKNESS METRES	DEPTH METRES	DEPTH FEET	DEPTH IN
[redacted] StAll	Sands	15·00	15·00		
[redacted] .SaG	Sands with gravel	1·40	16·40		
[redacted] BCl	Boulder clay	14·10	30·50		

SD 42/15 B

WATER RESOURCES BOARD

WELL RECORD SHEET 1

SD 42 NE/6 B

W.R.B. REF. No. SD 42/15 B

R.A. LICENCE No.

1. WELL IDENTITY

NATIONAL GRID REFERENCE 4551 2884

Well at Grange Farm No. 2

I.G.S. REF. No. 75/124 B

RIVER AUTHORITY NWWA

Town

HYDROMETRIC AREA 71

County

SUB-CATCHMENT

Owner of well

Well made by Sub Soil Surveys

Date of sinking 5/1980

Information from NWWA

Date received 29.7.80

2. WELL DESCRIPTION

Level of ground surface m. above sea level (O.D.) ft.

If well top is not at above* ground level how far below m. ft.

Shaft m. ft. deep; Diameter at top mm. in.; at bottom mm. in.

Bore 30.50 m. ft. deep; Diameter at top 200 mm. in.; at bottom 150 mm. in.

Details of headings

DETAILS OF PERMANENT LINING TUBES

Length Plain 17.0 m. ft.; Diam. 50 mm. in.; Length Slotted m. ft.; Diam. mm. in.; Top at m. ft. above* below surface

Length Plain m. ft.; Diam. mm. in.; Length Slotted m. ft.; Diam. mm. in.; Top m. ft. above* below surface

Length Plain m. ft.; Diam. mm. in.; Length Slotted m. ft.; Diam. mm. in.; Top m. ft. above* below surface

Details of well screen plastic 4min perforated 16-17 m, gravel packed.

DETAILS OF REST WATER LEVELS DURING CONSTRUCTION

Water struck at depths of below well top

Rest level of water m. ft. above* below O.D.* well top when bore m. ft. deep. Date

Rest level of water m. ft. above* below O.D.* well top when bore m. ft. deep. Date

Rest level of water on completion of bore 1.33 m. ft. ~~above~~* below ~~O.D.~~* well top when bore 30.50 m. ft. deep. Date 10.6.80

Method of drilling Percussion

Brief details of well development e.g. acid treatment etc.

* delete as applicable

(18127/1)

DETAILS OF PUMPING TEST

Water level depressed from ..... m. / ..... ft. above* / below well top to ..... m. / ..... ft. below well top, pumping at ..... l/s / ..... galls/hr.

Water level depressed from ..... m. / ..... ft. above* / below well top to ..... m. / ..... ft. below well top, pumping at ..... l/s / ..... galls/hr.

Water level depressed from ..... m. / ..... ft. above* / below well top to ..... m. / ..... ft. below well top, pumping at ..... l/s / ..... galls/hr.

Suction at ..... ft. below well top. Capacity of pump ..... l/s / galls/hr. Test from ..../..../19.... to .../../19 ....

DETAILS OF PERMANENT PUMPING EQUIPMENT

Make and/or type ..... Motive Power .....

Capacity ..... l/s / galls/hr. Suction at ..... m. / ..... ft. below well top.

Amount pumped ..... m^3/day* / galls/day. Pumping for ..... hrs./day.

Estimated consumption ..... m^3/week* / galls/week ..... m^3/year* / galls/year

3. WELL DATA

WELL USE. Abstraction ☐, Recharge ☐, Observation ☒, Disused ☐, Filled-in ☐

WATER USE. Public Supply ☐, Industrial ☐, Irrigation ☐, Agriculture ☐, Domestic ☐, Unused ☒, Misc. ☐

WATER LEVEL OBSERVATIONS

	Rest Water Level	Pumping Water Level	Depression	Rate of Pumping	Date
(1)	..... m. O.D. / ..... ft.	..... m. O.D. / ..... ft.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....
(2)	..... m. O.D. / ..... ft.	..... m. O.D. / ..... ft.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....
(3)	..... m. O.D. / ..... ft.	..... m. O.D. / ..... ft.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....
(4)	..... m. O.D. / ..... ft.	..... m. O.D. / ..... ft.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....

GEOPHYSICAL DATA AVAILABLE

Resistivity ☐ Conductivity ☐ Temperature ☐ Any other logs .....

PARTIAL ANALYSIS DETAILS in milligrams per litre

Date	TDS	Tot H	Carb H	Non-Carb H	Alk	SO4	Cl	E.C.

Site marked on: 1 inch (print) ....., 1 inch (master) ....., 2½ inch ..... (use symbol and give data)

(18127/1)

SD 42/15 B

WATER RESOURCES BOARD

WELL RECORD SD 42 NE/6B

SHEET 2

W.R.B. REF NO. SD 42/15 B

R.A. LICENCE No.

4. HYDROGEOLOGY

Topography AT WELL SITE

Local depression ☐, Flat surface ☐, Hill top ☐, Hillside ☐, Valley bottom ☐, Terrace ☐

MAJOR AQUIFER Superficial deposits Lithology .....

Depth to top of aquifer ..... m. / ..... ft. Thickness penetrated ..... m. / ..... ft.

Top of aquifer ..... m. / ..... ft. AOD* / BOD Total thickness of aquifer ..... m. / ..... ft.

Coefficient of storage ..... Transmissivity ..... m²/day* / galls/day/ft.

MINOR AQUIFER ..... Lithology .....

Depth to top of aquifer ..... m. / ..... ft. Thickness penetrated ..... m. / ..... ft.

Top of aquifer ..... m. / ..... ft. AOD* / BOD Total thickness of aquifer ..... m. / ..... ft.

Coefficient of storage ..... Transmissivity ..... m²/day* / galls/day/ft.

ADDITIONAL NOTES:

* delete as applicable

RR 18127/1/2173 5m 5/71 TP

5. STRATA	SD42/15B			
GEOLOGICAL CLASSIFICATION	NATURE OF STRATA	THICKNESS METRES	DEPTH METRES	DEPTH FEET	IN
Est. Alluvium	Sands	15·00	15·00		
Glacial & gv.	Sands with gravel	1·40	16·40		
Glacial BCL	Boulder clay	14·10	30·50		

[redacted]

RR 18127/1/2173 5m 5/71 TP

Name of site: CLIFTON MARSH (GRANGE FARM) BH 1

WRB No.: SD 42 NE/6 a
SD42/15 A

Owner		Licence no. Appn no.	n/a.
Occupier		IGS ref. no.	
Ground level	m OD	ft. OD	
Level of well top	m OD	ft. OD	
Rest water level 2.180	m bwt	ft. bwt	
(Date 10/6/80)	m OD	ft. OD	
Construction: Method Cable Percussion	Date May 1980		

Depth bwt	Dia.	Linings (below well top) From	To	Dia.	Type
25.50	8" to 14.2	GL	25.5	2"	Plastic
	6" to 25.5	Sealed into Sst^n	22.3	- 25.5	

Abstraction rates: gph PWL / gpd

Type of pump

Chem./bact. anal. YES/~~NO~~

Well driller: Soils Soil Surveys.

If insufficient space has been allowed, continue in 'Notes' overleaf.

Nat. grid ref.: SD 4550 2888

Status: Observation & Site Investigation

Aquifer: Permo-Trias Sstn

Code: 118-04

Summary of geological section	Thickness	Depth BGL
Sands		11.00
Sands with gravel		15.10
Boulder clay		
+ sand layers		22.30
Red sand		27.00
Red Sandstone		25.50

1/5/79/207

Site Plan

Notes

SD42NE/6a

Borehole drilled as part of SI for proposed tipping by NWWA.

Standpipe installed with concrete slab and steel overcleave + bolted flange with dip plug.

Chemical data available for waters encountered during drilling

See L404/02/01 a water [redacted]

+ H/R N°58

SD 42 NE/6a 75/124A

WATER RESOURCES BOARD

WELL RECORD SHEET 1

W.R.B. REF. No. SD 42/15 A

R.A. LICENCE No.

1. WELL IDENTITY

NATIONAL GRID REFERENCE 4550 2888

Well at Grange Farm

I.G.S. REF. No.

RIVER AUTHORITY NWWA

Town

HYDROMETRIC AREA 71

County

SUB-CATCHMENT

Owner of well

Well made by Soil Surveys

Date of sinking 5/1980

Information from NWWA

Date received 29.7.80

2. WELL DESCRIPTION

Level of ground surface m. If well top is not at above* m.

above sea level (O.D.) ft. ground level now far below ft.

Shaft m. deep; Diameter at top mm. ; at bottom mm.
ft. in. in.

Bore 25.50 m. deep; Diameter at top 200 mm. ; at bottom 150 mm.
ft. in. in.

Details of headings

DETAILS OF PERMANENT LINING TUBES

Length Plain 15.50 m. ; Diam. 50 mm. ; Length Slotted m. ; Diam. mm. ; Top at m. above* below* surface
ft. in. ft. in. ft.

Length Plain m. ; Diam. mm. ; Length Slotted m. ; Diam. mm. ; Top m. above* below* surface
ft. in. ft. in. ft.

Length Plain m. ; Diam. mm. ; Length Slotted m. ; Diam. mm. ; Top m. above* below* surface
ft. in. ft. in. ft.

Details of well screen plastic louvre

DETAILS OF REST WATER LEVELS DURING CONSTRUCTION

Water struck at depths of below well top

Rest level of water m. above* below* O.D.* well top when bore m. deep. Date
ft. ft.

Rest level of water m. above* below* O.D.* well top when bore m. deep. Date
ft. ft.

Rest level of water on completion of bore 2.18 m. above* below* O.D.* well top when bore 25.50 m. deep. Date 10.6.80
ft. ft.

Method of drilling Percussion

SD 42 NE/6a 75/12A

DETAILS OF PUMPING TEST

Water level ..... m. above* / below* well top to ..... m. below well top, pumping at ..... l/s
depressed from ..... ft. ..... ft. ..... galls/hr.

Water level ..... m. above* / below* well top to ..... m. below well top, pumping at ..... l/s
depressed from ..... ft. ..... ft. ..... galls/hr.

Water level ..... m. above* / below* well top to ..... m. below well top, pumping at ..... l/s
depressed from ..... ft. ..... ft. ..... galls/hr.

Suction at ..... ft. below well top. Capacity of pump ..... l/s / galls/hr. Test from ../../19.. to .. / /19

DETAILS OF PERMANENT PUMPING EQUIPMENT

Make and/or type ..... Motive Power .....

Capacity ..... l/s / galls/hr. Suction at ..... m. / ..... ft. below well top.

Amount pumped ..... m^3/day* / galls/day. Pumping for ..... hrs./day.

Estimated consumption ..... m^3/week* / galls/week ..... m^3/year* / galls/year

3. WELL DATA

WELL USE. Abstraction ☐, Recharge ☐, Observation ☒, Disused ☐, Filled-in ☐

WATER USE. Public Supply ☐, Industrial ☐, Irrigation ☐, Agriculture ☐, Domestic ☐, Unused ☒, Misc. ☐

WATER LEVEL OBSERVATIONS

	Rest Water Level	Pumping Water Level	Depression	Rate of Pumping	Date
1	..... m. / ..... ft. O.D.	..... m. / ..... ft. O.D.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	
2	..... m. / ..... ft. O.D.	..... m. / ..... ft. O.D.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	
3	..... m. / ..... ft. O.D.	..... m. / ..... ft. O.D.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	
4	..... m. / ..... ft. O.D.	..... m. / ..... ft. O.D.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	

GEOPHYSICAL DATA AVAILABLE

Resistivity ☐ Conductivity ☐ Temperature ☐ Any other logs .....

PARTIAL ANALYSIS DETAILS In milligrams per litre

Date	TDS	Tot H	Carb H	Non-Carb H	Alk	SO4	Cl	E.C.

SD 42NE/6a 73/124A

WATER RESOURCES BOARD

WELL RECORD SHEET 2

W.R.B. REF NO. SD 42/15 A

R.A. LICENCE NO.

H. HYDROGEOLOGY

Topography AT WELL SITE

Local depression ☐, Flat surface ☐, Hill top ☐, Hillside ☐, Valley bottom ☐, Terrace ☐

MAJOR AQUIFER Permo-Triassic sandstones Lithology

Depth to top of aquifer 23.0 m. / ft. Thickness penetrated 4.50 m. / ft.

Top of aquifer m. / ft. AOD* / BOD Total thickness of aquifer m. / ft.

Coefficient of storage Transmissivity m²/day* / galls/day/ft.

MINOR AQUIFER Lithology

Depth to top of aquifer m. / ft. Thickness penetrated m. / ft.

Top of aquifer m. / ft. AOD* / BOD Total thickness of aquifer m. / ft.

Coefficient of storage Transmissivity m²/day* / galls/day/ft.

ADDITIONAL NOTES:

Site investigation for proposed tipping.

Boreholes Nos. 8 & 10 were never drilled in this series.

SD 42 NE/6a 75/124A.

5. STRATA

GEOLOGICAL CLASSIFICATION	NATURE OF STRATA	THICKNESS METRES	DEPTH METRES	DEPTH FEET
QUATERNARY Est Al.	Sands	11.00	11.00	
Glac. S&G	Sands with gravel	4.10	15.10	
.. BCl	Boulder clay with sand layers	7.20	22.30	
Weath. Sst	Red sand	0.70	23.00	
Sherwood Sst Group.	Red sandstone	2.50	25.50	

SD42/15 A

WATER RESOURCES BOARD

WELL RECORD SD 42 NE/6 A SHEET 1

W.R.B. REF. No. SD 42/15 A

R.A. LICENCE NO.

1. WELL IDENTITY

NATIONAL GRID REFERENCE 4550 2888

Well at Grange Farm

I.G.S. REF. No. 75/124 A

RIVER AUTHORITY NWWA

Town

HYDROMETRIC AREA 71

County

SUB-CATCHMENT

Owner of well

Well made by Sub Soil Surveys

Date of sinking 5/1980

Information from NWWA

Date received 29.7.80

2. WELL DESCRIPTION

Level of ground surface ..... m. / above sea level (O.D.) ..... ft.

If well top is not at above* ..... m. / ground level how far below ..... ft.

Shaft ..... m. / ..... ft. deep; Diameter at top ..... mm. / ..... in.; at bottom ..... mm. / ..... in.

Bore 25.50 m. / ..... ft. deep; Diameter at top 200 mm. / ..... in.; at bottom 150 mm. / ..... in.

Details of headings

DETAILS OF PERMANENT LINING TUBES

Length Plain 25.50 m. / ..... ft.; Diam. 50 mm. / ..... in.; Length Slotted ..... m. / ..... ft.; Diam. ..... mm. / ..... in.; Top at ..... m. / ..... ft. above* ~~below~~ surface

Length Plain ..... m. / ..... ft.; Diam. ..... mm. / ..... in.; Length Slotted ..... m. / ..... ft.; Diam. ..... mm. / ..... in.; Top ..... m. / ..... ft. above* below surface

Length Plain ..... m. / ..... ft.; Diam. ..... mm. / ..... in.; Length Slotted ..... m. / ..... ft.; Diam. ..... mm. / ..... in.; Top ..... m. / ..... ft. above* below surface

Details of well screen plastic liner

DETAILS OF REST WATER LEVELS DURING CONSTRUCTION

Water struck at depths of ..... below well top

Rest level of water ..... m. / ..... ft. above* below O.D.* well top when bore ..... m. / ..... ft. deep. Date

Rest level of water ..... m. / ..... ft. above* below O.D.* well top when bore ..... m. / ..... ft. deep. Date

Rest level of water on completion of bore 2.18 m. / ..... ft. ~~above~~* below ~~O.D.~~* well top when bore 25.50 m. / ..... ft. deep. Date 10.6.80

Method of drilling Percussion

Brief details of well development e.g. acid treatment etc.

* delete as applicable

(18127/1)

DETAILS OF PUMPING TEST

Water level depressed from ..... m. / ..... ft. above* / below* well top to ..... m. / ..... ft. below well top, pumping at ..... l/s / ..... galls/hr.

Water level depressed from ..... m. / ..... ft. above* / below* well top to ..... m. / ..... ft. below well top, pumping at ..... l/s / ..... galls/hr.

Water level depressed from ..... m. / ..... ft. above* / below* well top to ..... m. / ..... ft. below well top, pumping at ..... l/s / ..... galls/hr.

Suction at ..... ft. below well top. Capacity of pump ..... l/s / galls/hr. Test from ..../..../19.... to ..../..../19....

DETAILS OF PERMANENT PUMPING EQUIPMENT

Make and/or type ..... Motive Power .....

Capacity ..... l/s / galls/hr. Suction at ..... m. / ..... ft. below well top.

Amount pumped ..... m^3/day* / galls/day. Pumping for ..... hrs./day.

Estimated consumption ..... m^3/week* / galls/week ..... m^3/year* / galls/year

3. WELL DATA

WELL USE. Abstraction ☐, Recharge ☐, Observation ☒, Disused ☐, Filled-in ☐

WATER USE. Public Supply ☐, Industrial ☐, Irrigation ☐, Agriculture ☐, Domestic ☐, Unused ☒, Misc. ☐

WATER LEVEL OBSERVATIONS

	Rest Water Level	Pumping Water Level	Depression	Rate of Pumping	Date
(1)	..... m. O.D. / ..... ft.	..... m. O.D. / ..... ft.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....
(2)	..... m. O.D. / ..... ft.	..... m. O.D. / ..... ft.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....
(3)	..... m. O.D. / ..... ft.	..... m. O.D. / ..... ft.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....
(4)	..... m. O.D. / ..... ft.	..... m. O.D. / ..... ft.	..... m. / ..... ft.	..... l/s / ..... galls/hr.	.....

GEOPHYSICAL DATA AVAILABLE

Resistivity ☐ Conductivity ☐ Temperature ☐ Any other logs .....

PARTIAL ANALYSIS DETAILS in milligrams per litre

Date	TDS	Tot H	Carb H	Non-Carb H	Alk	SO4	Cl	E.C.

Site marked on: 1 inch (print) ....., 1 inch (master) ....., 2½ inch ..... (use symbol and give data)

(18127/1)

SD42/15 A

WATER RESOURCES BOARD

WELL RECORD SD 42 NE/6A

SHEET 2

W.R.B. REF NO. SD 42/15 A

R.A. LICENCE NO.

4. HYDROGEOLOGY

Topography AT WELL SITE

Local depression ☐, Flat surface ☐, Hill top ☐, Hillside ☐, Valley bottom ☐, Terrace ☐

MAJOR AQUIFER Permo-Triassic sandstones Lithology

Depth to top of aquifer 23.0 m. / ft. Thickness penetrated 2.50 m. / ft.

Top of aquifer m. / ft. AOD* / BOD Total thickness of aquifer m. / ft.

Coefficient of storage Transmissivity m²/day* / galls/day/ft.

MINOR AQUIFER Lithology

Depth to top of aquifer m. / ft. Thickness penetrated m. / ft.

Top of aquifer m. / ft. AOD* / BOD Total thickness of aquifer m. / ft.

Coefficient of storage Transmissivity m²/day* / galls/day/ft.

ADDITIONAL NOTES:

Site investigation for proposed tipping.

[redacted] 8 & 10 were never drilled in this series.

* delete as applicable

RR 18127/1/2173 5m 5/71 TP

5. STRATA	SD42/15A			
GEOLOGICAL CLASSIFICATION	NATURE OF STRATA	THICKNESS METRES	DEPTH METRES	DEPTH FEET	IN
Ent. Alt.	Sands	11.00	11.00		
Glacial Sa & Gr	Sands with gravel	4.10	15.10		
Glacial BCL	Boulder clay with sand layers	7.20	22.30		
Wreath Sst.	Red sand	0.70	23.00		
[redacted]	Red sandstone	2.50	25.50		

RR 18127/1/2173 5m 5/71 TP

Norwest Holst Soil Engineering Ltd.

Borehole No. 2

BOREHOLE LOG

Contract No. F6805
Location St. Annes on Sea
Client Leonard Laing & Partners
Method of Boring Percussion
Diameter of Borehole 150mm

Sheet 1 of 2
Chainage
Ground Level m.A.O.D.
Date 24/3/86 - 25/3/86

Description of Strata	Legend	Depth Below G.L.(m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"N"/ R.Q.D.%	Daily Progress
TOPSOIL: Dark brown organic silty sand		0.30					
Loose yellow brown fine to medium SAND		3.00			1.25 s 2.50 s	'6' '5'	
Very soft dark brown PEAT with some fibrous vegetation		4.70			3.00 (10) 4.25 (5)		
Light brown fine to medium SAND		5.30			5.30 (20)		
Soft light grey and brown, laminated fine sandy, clayey SILT		7.70			6.50 (20) 7.70	*	
Loose grey silty fine to medium SAND				150mm to 10.00	8.30 9.50	* '9' *	

Type of Sample

Is	S.P.T.	■	Undisturbed
Ic.	C.P.T.	×	Vane
O	Jar	Δ	Water
●	Bulk	P	Piezometer

Remarks (Observations of Ground Water etc.)

24/3/86 1300 hrs Slight inflow at 3.10m
1320 hrs Standing level at 3.00m
Sealed by boring to 3.20m
25/3/86 Standpipe installed to 9.00m

()U100 Blows

*SPT 7.70 Rods sank under their own weight to 8.30m
*SPT 9.50 Rods sank under their own weight to 10.00m.

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

Norwest Holst Soil Engineering Ltd.

Borehole No. 2

BOREHOLE LOG

Contract No. F6805
Location St. Annes on Sea
Client Leonard Laing & Partners
Method of Boring Percussion
Diameter of Borehole 150mm

Sheet 2 of 2
Chainage
Ground Level m.A.O.D.
Date 24/3/86 - 25/3/86

Description of Strata	Legend	Depth Below G.L.(m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"N"/ R.Q.D.%	Daily Progress
Loose brown and grey silty fine SAND		11.70			10.00	'8'	24/3
Stiff red brown and grey fissured sandy silty CLAY with occasional fine to medium gravel		17.00		150mm to 15.00m	12.00 (50) 13.25 (50) 14.50 (60) 16.50 (70)		25/3

Type of Sample

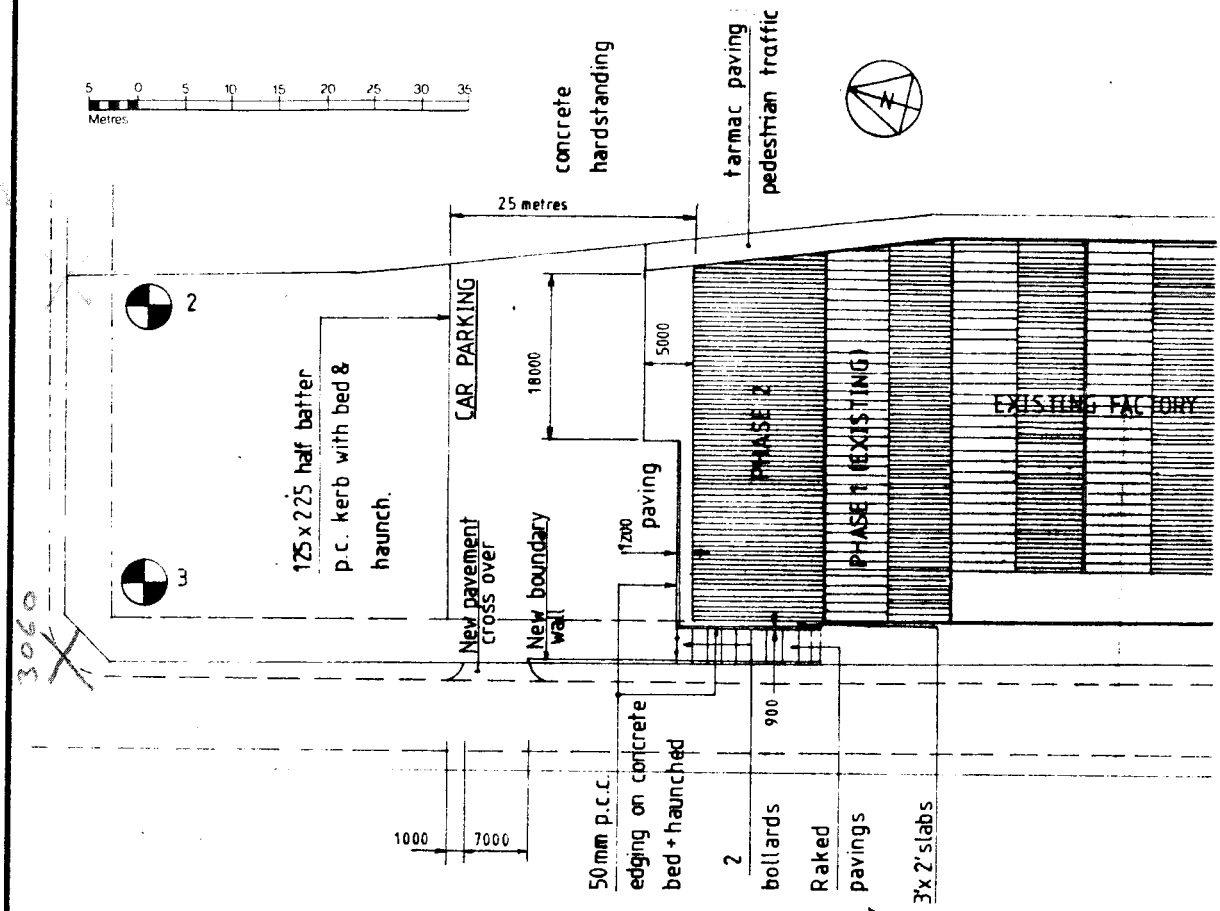
- Is S.P.T. — Undisturbed
- Ic. C.P.T. — Vane
- O Jar — Δ Water
- ● Bulk — Piezometer

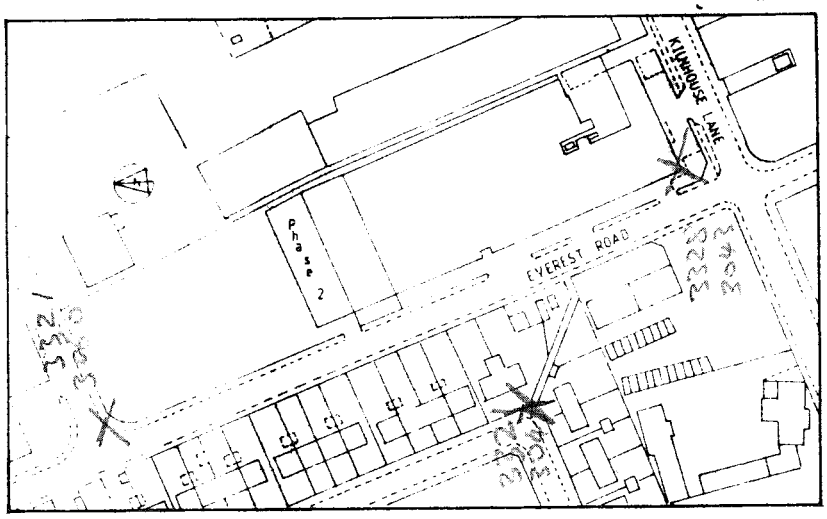
Remarks (Observations of Ground Water etc.) [] U100 Blows
24/3/86 15.30 hrs. Raoid inflow at 3 30m
1550 Standing level at 5.30m
25/3/86 0800hrs Standing level at 3.30m

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

Norwest Holst Soil Engineering Ltd

Client: LEONARD LAING AND PARTNERS **Location:** Sykes Pickavant, St Annes-on-Sea.





BLOCK PLAN

10 0 10 20 30 40 50 60 70 80 90
Metres

Contract Number: F6805	GROUND INVESTIGATION	Fig; 1
Scale: NOTED	**Title:** BOREHOLE LOCATION PLAN	

SD33 SW
123-124
36361

STRATA SURVEYS LIMITED

REPORT NO. 8619

(Contract No. 8D/Q/121)

ST. ANNES REPLACEMENT RADAR

for

CIVIL AVIATION AUTHORITY
Third Floor
Tower Block
CAA House
45-49 Kingsway
LONDON
WC2B 6TE

Compiled by

[redacted]

[redacted]

20th March1998

Strata House, Holmes Chapel Road, Middlewich, Cheshire. CW10 0JB
Tel 01606 834637 Fax 01606 836657

SD33SW 124

STRATA SURVEYS LIMITED

CABLE PERCUSSION RECORD SHEET

Location St Annes Replacement Radar
Client: Civil Aviation Authority Project Ref.:

Borehole No. BH2
Sheet 1 of 3.

Job No.: 8619

Equipment and methods Light Cable Percussion
Casing Diameter (mm) 200
Casing Depth (m)

Drilled by C.B
Ground level m AOD
Co-ordinates E N
Date 16-02-96

CASING DEPTH (m)	WATER DEPTH (m)	Field Records	SAMPLES / TESTS Depth (m) from	to	SAMPLE Type & No	SPT N Value Cu	Description	Depth & Thickness (m)	Reduced Level (m AOD)	Strata Legend
	AM	0.00 19-02					TOPSOIL	(0.30)		
	AM	0.00 20-02						0.30		
NIL	NIL		0.50	0.95	U 1		Soft grey CLAY with a little fine to medium gravel and some organic matter	(0.90)		
	AM	1.00 17-02						1.20		
1.50	WET		1.50	1.95	B 1	2.0	Very loose to loose grey clayey SILT			
			1.50	1.95	S 1					
	PM	2.00 19-02								
	PM	2.00 20-02								
2.50	WET		2.50	2.95	B 2	4.0				
			2.50	2.95	S 2					
	T1	20 mins 3.00 16-02								
	AM	3.00 18-02						(3.90)		
3.50	M1	3.50 16-02	3.50	3.95	B 3	4.0				
	PM	3.50 16-02	3.50	3.95	S 3					
		-(16-02)-								
	PM	4.00 17-02								
	PM	4.50 18-02								
	T2	20 mins 5.00 17-02								
			5.20	5.20	D 1			5.10		
5.30	NIL		5.30	5.75	U 2	25	Brown amorphous PEAT	(0.20)		
								5.30		
							Soft to firm dark brown CLAY with a little fine gravel and occasional shell fragments (Boulder Clay)			
			6.00	6.00	D 2					
6.00	NIL		6.50	6.95	U 3					
								(3.50)		
			7.50	7.50	D 3					
6.00	WET		8.00	8.45	U 4	65				
	M2	8.80 17-02	8.80	8.80	W 1			8.80		
9.00	5.00		9.00	9.45	B 5	17	Medium dense brown clayey very silty fine to medium grained SAND with occasional fine to medium gravel and occasional shell fragments			
			9.00	9.45	S 5					
							(Continued.....)			

Remarks
1) Borehole wet below 1.50m.
2) Groundwater struck at 3.50m rising to 3.00m after 20 mins.
3) Water level 3.50m pm 16-02.
4) Water level 1.00m am 17-02.
5) Borehole dry at 5.30m.
6) Groundwater struck at 8.80m rising to 5.00m after 20 mins.
7) Water level 4.00m pm 17-02.

Scale 1:50

Logged by	Date
G.L.	15/03
Checked by	
Approved by	
FIG No.	

SSL-MRW-cable per -10/93 Rev B

SD33SW 12H

STRATA SURVEYS LIMITED

CABLE PERCUSSION RECORD SHEET

Location St Annes Replacement Radar
Client: Civil Aviation Authority Project Ref.:

Borehole No. BH2
Sheet 2 of 3.

Job No.: 8619

Equipment and methods Light Cable Percussion
Casing Diameter (mm) 200
Casing Depth (m)

Drilled by C.B
Ground level m AOD
Co-ordinates E N
Date 16-02-96

CASING DEPTH (m)	WATER DEPTH (m)	Field Records	SAMPLES / TESTS Depth (m) from	to	SAMPLE Type & No	SPT N Value / Cu	Description	Depth & Thickness (m)	Reduced Level (m AOD)	Strata Legend
			10.50	10.95	B 6		(....cont.)			
			13.00	13.00	D 4					
			15.00	15.00	D 5					
		-(17-02)-						(13.5)		
			17.00	17.00	D 6					
			19.00	19.00	D 7					

Remarks
8) Water level 3.00m am & 4.50m pm 18-02.
9) Sand blowing too much to take SPTs below 17.00m - water added to assist drilling below 17.00m.
10) Water level 0.00m am & 2.00m pm 19-02.
11) Water level 0.00m am & 2.00m pm 20-02.

Scale 1:50

Logged by G.L Date 15/03
Checked by
Approved by
FIG No.

SSL-WWW-cable per - 10/93 Rev a

SD33SW 124

STRATA SURVEYS LIMITED

CABLE PERCUSSION RECORD SHEET

Location St Annes Replacement Radar
Client: Civil Aviation Authority Project Ref.:

Borehole No. BH2
Sheet 3 of 3.

Job No.: 8619

Equipment and methods Light Cable Percussion
Casing Diameter (mm) 200
Casing Depth (m)

Drilled by C.B
Ground level m AOD
Co-ordinates E N
Date 16-02-96

CASING DEPTH (m)	WATER DEPTH (m)	Field Records	SAMPLES / TESTS Depth (m) from	to	SAMPLE Type & No	SPT N Value Cu	Description	Depth & Thickness (m)	Reduced Level (m AOD)	Strata Legend
							Medium dense brown clayey very silty fine to medium grained SAND with occasional fine to medium gravel and occasional shell fragments			
		-(18-02)-	21.00	21.00	D 8					
								22.30		
22.50	0.00		22.50	22.95	U 5	118	Stiff to very stiff dark brown slightly sandy CLAY with a little fine to medium gravel (Boulder Clay)			
22.50	2.00		23.50	23.95	U 6					
			24.20	24.20	D 9					
22.50	2.00		24.50	24.95	U 7	101				
			25.50	25.50	D 10					
23.00	2.00		26.00	26.45	U 8			(7.70)		
		-(19-02)-								
23.00	1.00		27.50	27.95	U 9	176				
23.00	1.50		28.50	28.95	U 10					
23.00	2.00		29.50	29.95	U 11	161				
		-(20-02)-								
							Borehole Complete	30.00		

Remarks

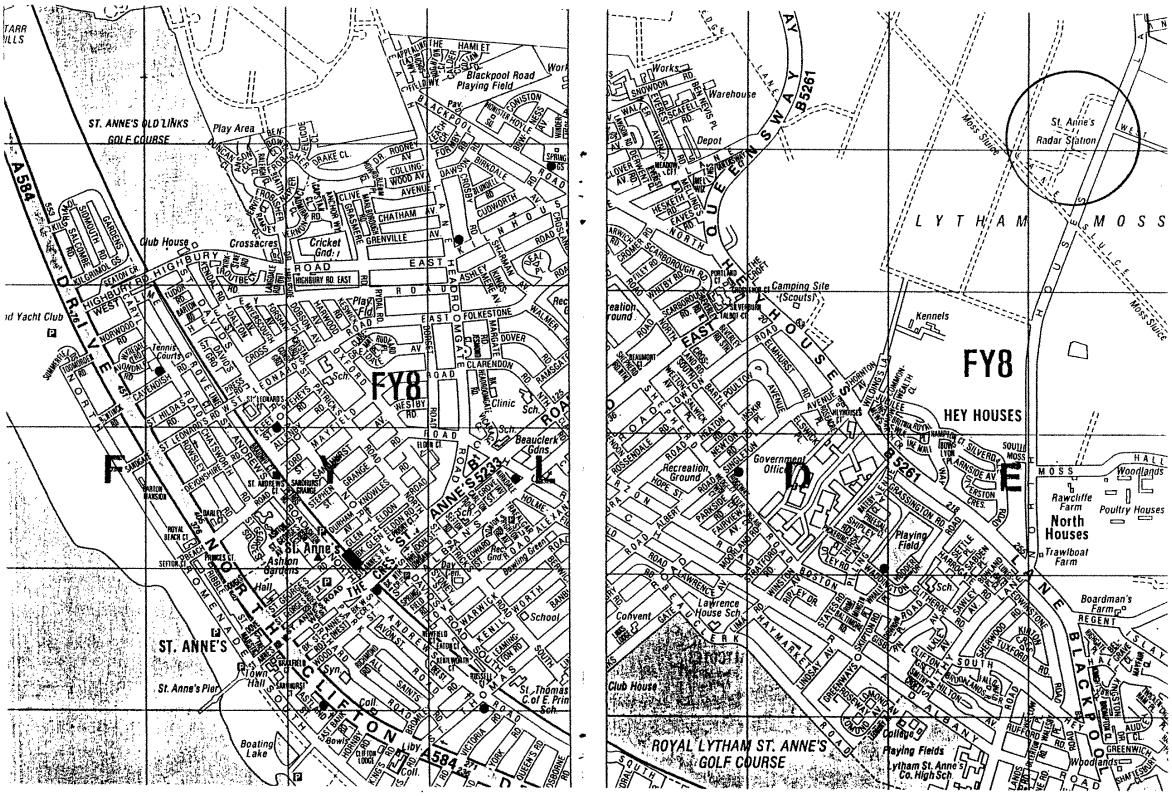
Logged by G.L Date 15/03
Checked by
Approved by

Scale 1:50

FIG No.

SSL-MRW-cable per -10/93 Rev B

SD33SW/F23-124

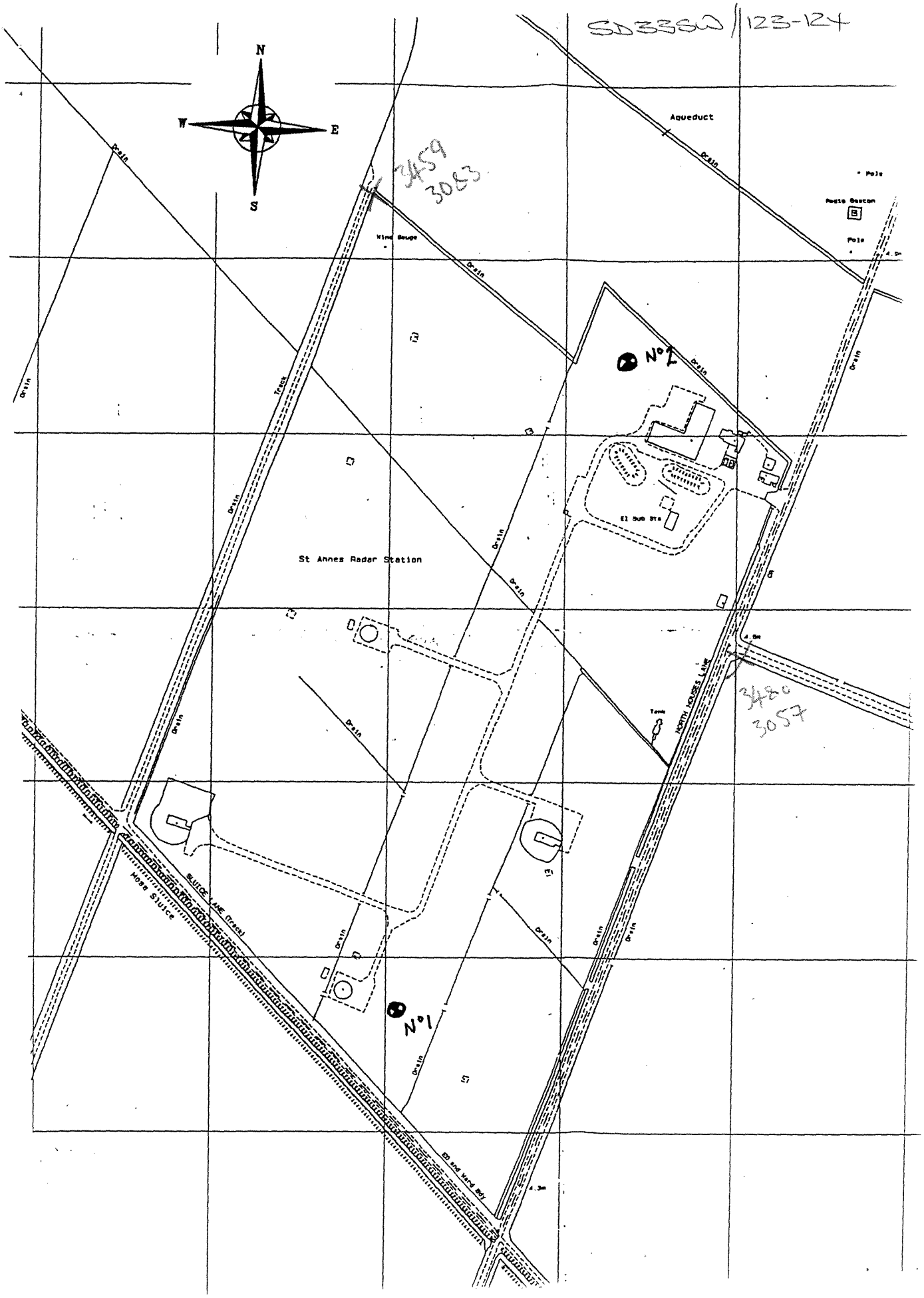


STRATA SURVEYS LTD.
Telephone: 01606 834637 Fax: 01606 836657

Job No : 8619 Location : St Annes Replacement Radar

Client : Civil Aviation Authority

Not to Scale


SD33SW 123-124
N
S
E
W
Aqueduct
Drain
Pole
Radio Beacon
Wind Gauge
Forest
No 2
No 1
El Sub Sta
St Annes Radar Station
NORTH HOUSES LANE
Tank
SLUICE
MOSS Sluice
3459
3083
3458
3057

SD 33 SW 73

FUGRO - McCLELLAND LIMITED

BOREHOLE LOG

Borehole 1

Sheet 1 of 3

Method	Date	Site
Shell & Auger.	23/01/92 - 31/01/92	Blackpool Airport Geotechnical Investigation

Dia mm	Coord	Ground Level m.OD	Client
200/150	2314.0E 1159.0N	8.58	PSA Specialist Services

Soil Samples/Tests		Water & Progress	OD Level m.	Depth m.	Description of Strata	Legend
Type/Test	Depth m.					
B1	0.40	23/01/92	8.43	0.15	MADE GROUND (Topsoil) (0.15)	
J2	0.80		7.98	0.60	MADE GROUND (Very dark brown silty fine to coarse sand with a little gravel (sandstone, brick & black ash)) (0.45)	
S3 (7)	1.00 - 1.45	STRIKE at 1.00m moderate rose to 1.00m sealed out at 3.80m	7.58	1.00	Dark brown with occasional light brown patches, slightly silty fine to coarse SAND with occasional black ash (0.40)	
S4 (5)	2.00 - 2.45				Loose light brown fine to coarse SAND.becoming slightly silty from 2.00m (2.00)	
S5 (4)	3.00 - 3.45		5.58	3.00	Very loose grey slightly silty fine to medium SAND (0.80)	
S6 (10)	4.00 - 4.45		4.78	3.80	Very soft black slightly sandy slightly clayey fibrous PEAT (1.60)	
B7	4.50 - 5.00					
S8 (10)	5.00 - 5.45					
J9	5.60		3.18	5.40	Very soft grey CLAY with pockets of black fibrous peat and abundant fine orange root veins (0.30)	
B10	6.00		2.88	5.70	Loose dark grey very sandy fine to coarse GRAVEL with occasional shells and shell fragments (2.80)	
S11 (7)	6.00 - 6.45					
S 12(10)	7.00 - 7.45					
S13 (10)	8.00 - 8.45					
B14	8.00		0.08	8.50	Dense grey fine to medium SAND (6.90)	
S15 (34)	9.00 - 9.45				becoming very dense from 10.30m	
B16	10.00				becoming medium dense from 13.00m	
S17 (58)	10.00 - 10.45				becoming slightly gravelly at 14.40m	
B18	11.00					
S19 (78)	11.50 - 11.95					
S20 (20)	13.00 - 13.45					
B 21	14.50 - 15.00					
S22 (26)	14.50 - 14.95					
U23	16.00 - 16.45		-6.82	15.40	Firm to stiff reddish brown-grey CLAY with pockets of dark brown fine to medium sand and occasional fine rounded gravel (7.40)	
J24	16.45 - 16.60					
S25 (38)	17.50 - 17.95					
U26	19.00 - 19.45				becoming stiff to very stiff from 19.00m	
J27	19.45 - 19.60					

Remarks

1. S3, rods sank under own weight to 3.30m
2. No recovery for U29.
3. Blowing sand from 8.50 to 15.40

Logged by	Scale	End Casing Depth	Job No.
JJ	1:100	m. 26.00	922531

Sample/Test key:
U () U100 sample (blows)
D Disturbed sample
B Bulk sample
W Water sample
- Progress & Day

Penetration Tests
S () Standard (N value)
C () Cone (N value)
* Blows and penetration when 300mm not achieved

PLATE 2-1

SD 33 SW 73

FUGRO - McCLELLAND LIMITED

BOREHOLE LOG

Borehole 1

Sheet 2 of 3

Method: Shell & Auger.	Date: 23/01/92 - 31/01/92	Site: Blackpool Airport Geotechnical Investigation	
Dia mm: 200/150	Coord: 2314.0E 1159.0N	Ground Level m.OD: 8.58	Client: PSA Specialist Services

Soil Samples/Tests Type/Test	Depth m.	Water & Progress	OD Level m.	Depth m.	Description of Strata	Legend
S28 (30)	20.50 - 20.95				See previous sheet	
U29	22.00 - 22.45				with a slightly gravelly very sandy silt band at 22.00m	
B30	22.00 - 22.50					
			-14.22	22.80		
S31 (38)	23.50 - 23.95				Brown fine to coarse SAND with some fine gravel (0.90)	
			-15.12	23.70		
S32 (42)	24.50 - 24.95				Very stiff reddish brown CLAY with pockets of sand and fine gravel (2.30)	
B33	23.00					
		31/01/92	-17.42	26.00	End of Borehole at 26.00m	

Remarks

1. S3, rods sank under own weight to 3.30m
2. No recovery for U29.
3. Blowing sand from 8.50 to 15.40

Logged by	Scale	End Casing Depth m.	Job No.
JJ	1:100	26.00	922531

Sample/Test key:
U () U100 sample (blows)
D Disturbed sample
B Bulk sample
W Water sample
→ Progress & Day

Penetration Tests
S () Standard (N value)
C () Cone (N value)
* Blows and penetration when 300mm not achieved

PLATE 2-2

SD33SW 73

FUGRO - McCLELLAND LIMITED

BOREHOLE LOG

Borehole 1

Sheet 3 of 3

Method: Shell & Auger.	Date: 23/01/92 - 31/01/92	Site: Blackpool Airport Geotechnical Investigation	
Dia mm: 200/150	Coord: 2314.0E 1159.0N	Ground Level m.OD: 8.58	Client: PSA Specialist Services

Soil Samples/Tests		Water & Progress	OD Level m.	Depth m.	Description of Strata	Legend
Type/Test	Depth m.					
					i. Install piezometer from 5.80 to 6.00 cell size 0.03.	

Remarks

1. S3, rods sank under own weight to 3.30m
2. No recovery for U29.
3. Blowing sand from 8.50 to 15.40

Logged by	Scale	End Casing Depth m.	Job No.
JJ	1:100	26.00	922531

Sample/Test key:
U () U100 sample (blows)
D Disturbed sample
B Bulk sample
W Water sample
– Progress & Day

Penetration Tests
S () Standard (N value)
C () Cone (N value)
* Blows and penetration when 300mm not achieved

PLATE 2-3

23 59NW/9. 13/14 74/3,4,5.

GEOLOGICAL SURVEY AND MUSEUM. BOREHOLES AND SHAFTS.

SD 33 SW 12 - 13

County [redacted]

6-in. Map 59.NW

BORE or ~~SHAFT~~ [redacted]

Bankdale, Ridgeland Rd. Harton. GSM

Surface level about 20 O.D. [redacted]

Communicated 1937 by [redacted]

Date of sinking 1937 Borer [redacted]

Specimens

Description.		THICKNESS. Feet.	THICKNESS. Inches.	DEPTH. Feet.	DEPTH. Inches.
SD33SW/10	No1.				
Upper Boulder Clay	Soil	1		1	
	Boulder clay	43		44	
74/3 Middle Sand	Clay + gravel (no water)	42		86	
Lower Boulder Clay	Clay + stones	18		104	
59NW/9 Kempes	Marl	12		116	
	No2. Test Hole.				
12	Soil	1		1	
Upper B.Cl.	Boulder Clay	36		37	
74/4	Sandy clay	1		38	
Middle Sand	Sand, clay + gravel	3		41	
59 N.W/13	Sand + gravel	10		~~51~~ 44	
Lr Boulder Clay	Boulder clay	7		58.	
	No.3. Test Hole.				
13	Soil				
Upper B.Cl.	Boulder clay	1		1	
74/5	Sandy clay	36		37	
	Sand + gravel	2	6	39	6
59NW/14 Middle Sand		9		~~48~~ 48	6
	Sandy clay		6	49	
	Sand + gravel + boulders	2		51	
Lr Bl Cl	Boulder clay + gravel	7		58.	

(B12268) Wt. 13119—0014 5000 9/27 Gp. 160 O.A.

SD33 | 17, 18, 19. 74/17 A. C

a) SD 3352 3246 SD33SW 10/2/13
b) SD 3351 3241 59NW/ 9.13/14 74/
c) SD 3346 [redacted]

GEOLOGICAL SURVEY AND MUSEUM. BOREHOLES AND SHAFTS.

BORE or SHAFT [redacted]

County Lancs
6-in. Map 59.NW
GSM 74 10

Barkdale, Hedgelands Rd, Morton.

Surface level about 20 O.D. One-inch Map 74

Communicated 1937 by [redacted]

Date of sinking 1937 Borer [redacted]

Specimens A - C

Description.	No.	THICKNESS. Feet.	THICKNESS. Inches.	DEPTH. Feet.	DEPTH. Inches.
A					
PLEISTOCENE BOULDER CLAY Upper Boulder Clay	Soil	1		1	
74/8 GLACIAL GRAVEL Middle and Lower Boulder Clay	Boulder clay	43		44	12
	Clay & gravel (no water)	42		86	
	Clay & stones	18		104	
TRIASSIC 59NW/4 MERCIA MUDSTONE GROUP	Keuper Marl	12		116	
B	No 2. Test Hole.				
	Soil	1		1	
BOULDER Upper B.C. CLAY 74/4	Boulder clay	36		37	
GLACIAL	Sandy clay	1		38	
PLEISTOCENE SAND & GRAVEL Middle and Lower B.C. 59 N.W/13	Sand, clay & gravel	3		41	13
	Sand & gravel	10		51	
BOULDER Lr Boulder Clay CLAY	Boulder clay	7		58.	
	No 3. West Hole.				
C					
	Soil	1		1	
BOULDER Upper B.C. CLAY 74/	Boulder clay	36		37	
	Sandy clay	2	6	39	6
PLEISTOCENE 59NW/14 Middle and Lower B.C. GLACIAL SAND & GRAVEL	Sand & gravel	9		48	6
	Sandy clay		6	49	
	Sand & gravel, boulders	2		51	
BOULDER Lr Bcl CLAY	Boulder clay & gravel	7		58.	

28/6/79.

Sited with ⊙ on 6" Lancs 59 NW/W 16.6.61 RPP.

(B1286) Wt 13119—[illegible] 2" Gp. 180 [illegible]

19 66/6

In file see p in No.10. Rep.N. 13.37.

GEOLOGICAL SURVEY AND MUSEUM. BOREHOLES AND SHAFTS.

SD 33 SW 9

BORE ~~or SHAFT~~ Blackpool Gas Co. Ltd

Marton

Blackpool

County Lancs

6-in. Map 59 NW E/6

GSM

Surface level about 32 O.D. 27' One-inch Map 66

Communicated 1937 b

Date of sinking 1937. R

Specimens

[redacted]

Description. No. 10.	Thickness. Feet.	Thickness. Inches.	Depth. Feet.	Depth. Inches.
Upper B.Co. Sod + soil	1	6	1	6
Grey clay	4	2	5	8
Brown Clay	20	4	26	0
Heavy gravel	7	2	33	2
Fine Brown Sand	27	10	60	
Boulder clay + gravel	7	4	67	4
Cobbles, Sand + Gravel	23	8	91	
Sand + gravel	6		97	
Brown Sandy clay	3	6	100	6
Cobbles, Sand + gravel	18	6	119	
Sand + gravel	7		126	
Brown Sand	2		128	
Sand + gravel	15		143	
do + cobbles	6	6	149	6
Sand + gravel	7		156	6
Sandy clay	3	6	160	
Sand gravel + cobbles	10	11	170	11
Sandy clay + gravel	12	1	183	
? L BCo. POSSIBLE KIRKHAM STAGE. Brown sandy clay	4	3	187	3

Cased as A 4" bored to 5".

Visited + site obtained from plan of Gas Works.
O.D. 27'
Bore made in 1938.
R.W.L. 23'
P.W.L. 72'
Yield 4,200 g.p.h. continuously.
Ram + bucket method of pumping.
Analysis:—

	Parts per million
Temp. hardness	350
Perm. hardness	330
Total Alk.	350
Sulphates	450
Chlorides	1800
Dissolved Oxygen	—
pH	7.3
Dissolved solids	2600.

ULSTER CHLORIDE IS 30 ppm
EURO-LIMIT IS 1,000 for drinking.

M.H.P. 26.4.56

(B12268) Wt. 13119—0014 5000 9/27 Gp. 160 O.A.

SD33/16

66

GEOLOGICAL SURVEY AND MUSEUM. BOREHOLES AND SHAFTS.

SD 3449 3368

BORE ~~or SHAFT~~ Blackpool Gas Co. Ltd

Marton

Blackpool

County Lancs

6-in. Map 59 NW 6

GSM

Surface level about 32 O.D. 27'

Communicated 1937 by [redacted]

Date of sinking 1937 B

Specimens

Description. No. 10.		THICKNESS. Feet.	THICKNESS. Inches.	DEPTH. Feet.	DEPTH. Inches.
QUATERNARY	Soil & clay	1	6	1	6
	Gray clay	4	2	5	8
	Brown Clay	20	4	26	0
	Heavy gravel	7	2	33	2
	Fine brown sand	27	10	60	
	Boulder clay & gravel	7	4	67	4
	Cobbles, sand & gravel	23	8	91	
	Sand & gravel	6		97	
	Brown sandy clay	3	6	100	6
	Cobbles, sand & gravel	18	6	119	
	Sand & gravel	7		126	
	Brown sand	2		128	
	Sand & gravel & cobbles	15		143	
	Sand & gravel	6	6	149	6
	Sandy clay	7		156	6
	Sand gravel & cobbles	3	6	160	
	Sand clay & gravel	10	11	170	11
? KIRKHAM MUDSTONES	Brown sandy clay	12	1	183	
		4	3	187	3

Visited and site obtained from plan of Gas Works.
O.D. 27'
Bore made in 1938.
R.W.L. 23'
P.W.L. 72'.
Yield 4,200 g.p.h. continuously.
Rope & bucket method of pumping.
Analysis. Parts per million

Temp. hardness	350
Perm. hardness	330
Total Alk.	350
Sulphates	450
Chlorides	1800
Dissolved Oxygen	–
pH.	7.3
Dissolved solids	2600.

M.H.P. 26-4-56.

(B12268) Wt. 13119—0014 500) 9/27 Gp. 160 O.A.

Borehole record form

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Environment Agency

Water Resources Act 1991 (as amended by the Water Act 2003)

A Site details

Borehole drilled for: Basline Monitoring Water Borehole 2

Location: Preston New Road Exploration Site, Preston New Road, Flyde, Lancashire, PR4 3PJ

NGR (ten digits): 337322, 432742 Please attach site plan

Ground level (if known): 11.35 metres Above Ordnance Datum

Drilling company: GEOTRON UK

Date drilling commenced: 04/07/2016 (DD/MM/YYYY) Completed: 13/07/2016 (DD/MM/YYYY)

B Construction details

Borehole datum (if not ground level) _____ metres (m). Please tick if this is above ☐ or below ☐ ground level.
(point from which all measurements of depth are taken, for example, flange, edge of chamber)

Borehole drilled diameter

200	mm from	0	to	7 m/depth
150	mm from	7	to	30 m/depth
	mm from		to	m/depth
	mm from		to	m/depth

Casing material _____ diameter _____ mm from _____ to _____ m/depth
and type (for example, if plain steel, plastic slotted). Please record permanent casing details, not temporary casing.

Casing material _____ diameter _____ mm from _____ to _____ m/depth

Casing material _____ diameter _____ mm from _____ to _____ m/depth

Casing material _____ diameter _____ mm from _____ to _____ m/depth

Grouting details _____

Water struck at 1. 6.0 m (depth below datum – mbd) 2. 7.0 m (mbd)

3. _____ m (mbd) 4. _____ m (mbd)

C Test pumping summary (Please supply full details on form WR39)

Test pumping datum _____ m. Please tick if this is above ☐ or below ☐ ground level.
(if different from borehole datum)

Pump suction depth _____ mbd

Water level (start of test) _____ mbd

Water level (end of test) _____ mbd

Type of test (for example, bailer, step, constant rate)
NA

Pumping rate _____ m^3/hour ☐ or litres/second ☐. Please tick as appropriate.

for _____ days, _____ hours, _____ mins

Recovery to _____ mbd in _____ days, _____ hours, _____ mins
(from end of pumping)

Date(s) of measurements Pump started _____ (DD/MM/YYYY)

Pump stopped _____ (DD/MM/YYYY)

Please supply chemical analysis if available. If you have included this please tick this box ☐

D Strata log

Geological classification (BGS only)	Description of strata	Thickness m	Depth (to base of strata) m
	Topsoil	0.4	0.4
	Stiff light brown CLAY with some small cobbles	5.6	6.0
	Coarse brown SAND with fine angular gravel	1	7.0
	Slightly clayey coarse SANDS and GRAVELS (rounded)	1	8.0
	Coarse SAND with occasional cobbles and occasional clay	1.2	9.2
	Sand with fine angular GRAVEL with slightly clayey bands	7.8	17.0
	Soft CLAY lenses within finer sands and small cobbles	0.4	17.4
	Dense coarse brown very gravelly SAND with occasional small to medium cobbles	1.5	18.9
	Dense fine brown SAND with fine coal fragments	7.1	26.0
	Dense very silty red/slightly brown SAND	4	30.0
	(continue on separate page if necessary)		
	Other comments (for example, gas encountered, saline water intercepted)		

E Completing this form

How long did it take you to fill in this form? ⌊_____⌋

For Official use only

Date received (DD/MM/YYYY)	File	Consent number	BGS reference number
Accession number	Wellmaster number	SOBI number	NGR
LIC NO	Purpose		EA reference number
Copy number	Entered by		

OSIRIS - CESCO LTD.

SITE INVESTIGATION DIVISION

BOREHOLE No. 4 SD32NW7/4

REPORT No. D82082

LOCATION WADDINGTON ESTATE, LYTHAM ST. ANNES

Ground/Bed Level N/A

Client FYLDE BOROUGH COUNCIL

Coordinates N/A

Method/Diameter

Rotary Auger 300mm. dia. casing to 5.10m. depth
Shell and Auger 150mm. casing, 5.10-15.95m.

Boring Commenced 14/6/82

Boring Completed 15/6/82

Ground Water observations are given at end of log

Remarks

Penetration force for piston sampler recorded in kN.

Description of Strata	Scale 1:50 Depth (m)	Reduced Level	Legend	Samples/Coring Record Ref. No.	Type	Depth (m) From	Depth (m) To	N blows/0.3m
TOPSOIL.	0.40							
Very loose orange f.m. SAND.				1	S/D	0.80	1.25	4
	2.50							
Soft black sandy amorphous PEAT.				2	P	2.80	3.55	41kN
	4.30							
Soft grey silty CLAY with occasional rotted organic materials, becoming more silty with depth.				3	U	4.60	5.05	(9)
				4	D	5.10		
				5	D	6.00		
				6	D	7.00		
	8.00			7	D	8.00		
Loose grey f. sandy SILT.				8	D	9.00		

Key: **SAMPLES:** U=Undisturbed. B=Bulk Disturbed. D=Disturbed. P=Piston. W=Water.
STANDARD PENETRATION TEST: S=Hollow shoe. C=Cone point. R=Refer to text or explanatory data sheet.
(–) No. of blows to drive U sample.
f = fine. m = medium. c = coarse.

T100

OSIRIS - CESCO LTD.

SITE INVESTIGATION DIVISION

BOREHOLE No. 4

Continuation Sheet No. 1

LOCATION WADDINGTON ESTATE, LYTHAM ST. ANNES

REPORT No. D82082

Scale 1: 50

Description of Strata	Depth (m)	Reduced level	Legend	Ref. No.	Type	Depth (m) From	Depth (m) To	N blows/0.3m
(As above) Loose grey f. sandy SILT.				9	D	10.00		
	10.50			10	D	10.50		
Firm brown silty CLAY, becoming very silty with depth.				11	D	11.50		
				12	D	12.50		
				13	S/D	13.50		0
	14.50			14	D	14.60		
Stiff brown c. sandy slightly silty CLAY with occasional subangular m. gravel.				15	U	15.50	15.95	(250)
	15.95							

GROUND WATER OBSERVATIONS

Inflow observed at (m)	Visual rate of inflow	Water sealed off by casing at (m)
1.20	Seepage	2.50

Date	Time	Hole Depth (m)	Casing Depth (m)	Water Level (m)
14/6/82	1930	5.10	5.10	5.10
15/6/82	0730	5.10	5.10	1.90

Key: **SAMPLES:** U=Undisturbed. B=Bulk Disturbed. D=Disturbed. P=Piston. W=Water.
STANDARD PENETRATION TEST: S=Hollow shoe. C=Cone point. R=Refer to text or explanatory data sheet.
( ) No. of blows to drive U sample.
f = fine. m = medium. c = coarse.

T101

ENGINEERING GEOLOGICAL SYMBOLS

SEDIMENTARY ROCK TYPES


CONGLOMERATE


BRECCIA


SANDSTONE


SILTSTONE


MUDSTONE


SHALE


GYPSUM


CHALK


COAL , LIGNITE


Silty SANDSTONE


Gravelly SANDSTONE


Clayey SANDSTONE


Sandy SILTSTONE


Clayey SILTSTONE


Silty MUDSTONE


Sandy MUDSTONE


LIMESTONE


Argillaceous LIMESTONE

SOIL TYPES


GRAVEL


SAND


SILT


CLAY


BOULDERS, COBBLES


SHELLS


PEAT


Shelly SILT


Bouldery CLAY


Sandy GRAVEL


FILL.


Gravelly


Sandy


Silty


Clayey


Bouldery


Shelly

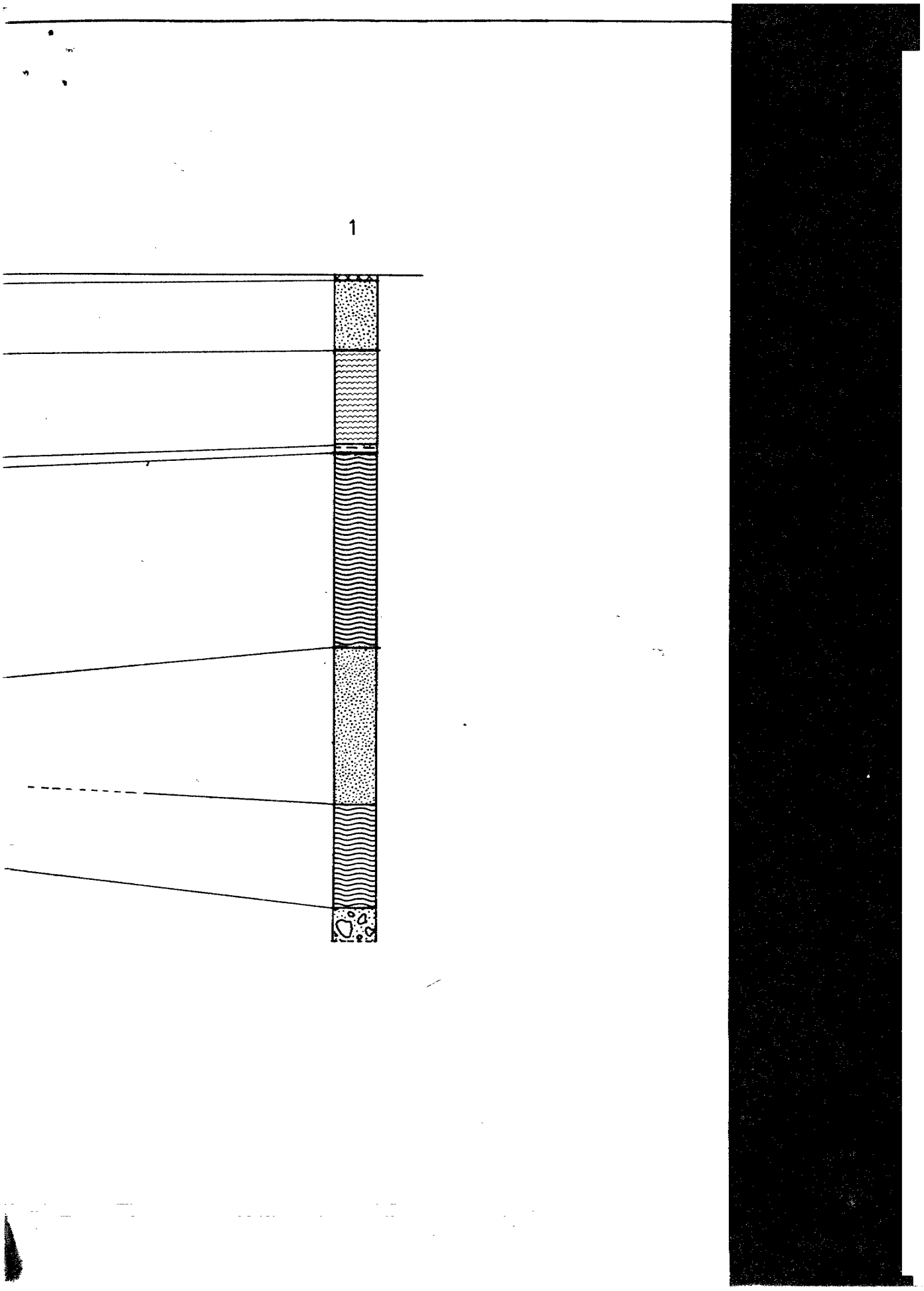

Peaty


Silty SAND


Silty CLAY


Silty PEAT

ref: BS 5930:1981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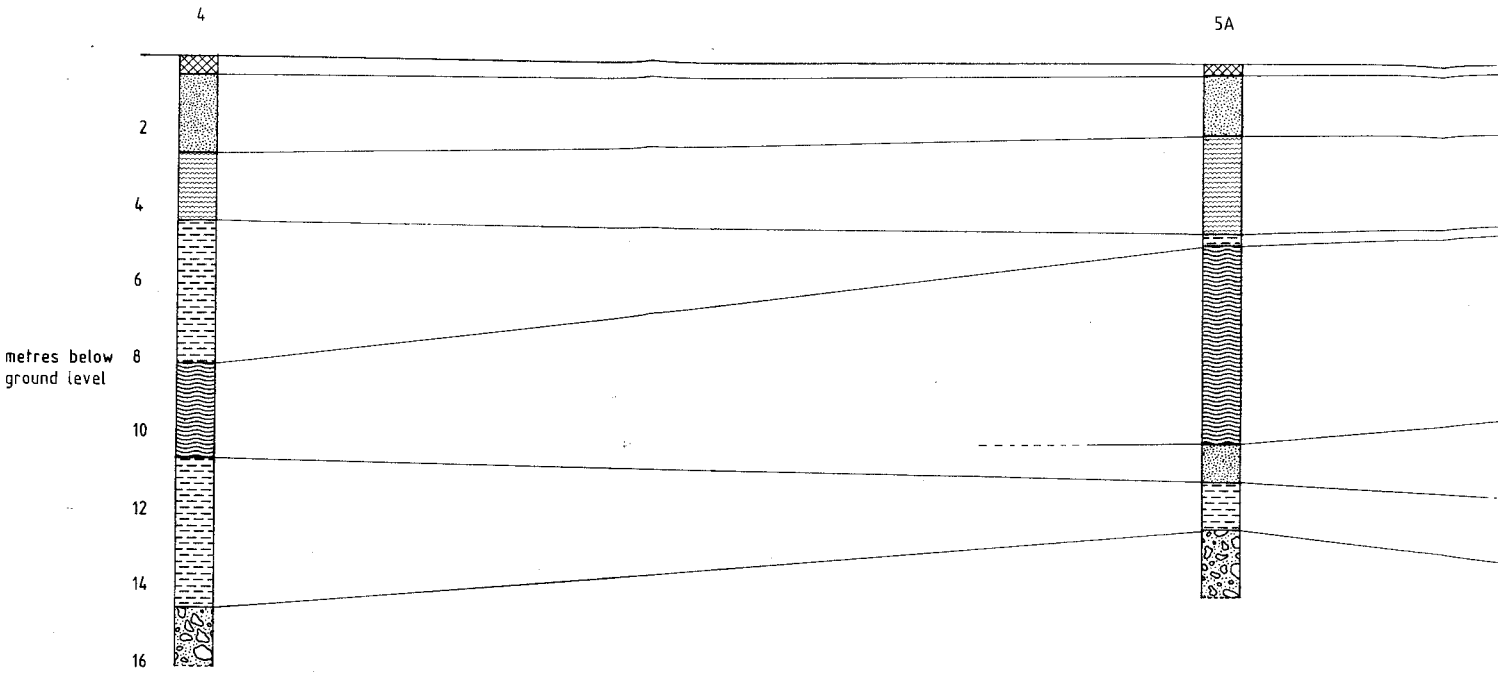
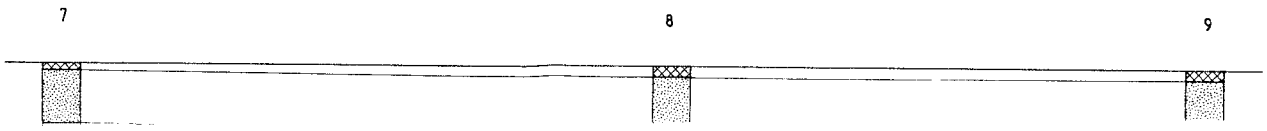


WADDINGTON ESTATE



Name of site Central LS N.WestEA.
LYTHAM GREEN DRIVE GOLF CLUB ABH.

WRB No. SD32NE/34 74/Southport
SD32/14A
74 SD32NE 34

Owner		Licence no. Appn no. C8582. Cancelled	
Occupier		IGS ref. no.	
Ground Level	m OD	ft. OD	
Level of well top	m OD	ft. OD	
Rest water level	m bwt	ft. bwt	
(Date)	m OD	ft. OD	
Construction: Method		Date	

Depth bwt	Dia.	Linings (below well top) From	To	Dia.	Type

Abstraction rates
gph PWL
gpd
Type of pump
Chem./bact. anal. YES/NO
Well driller POWFIT DRILLING LTD

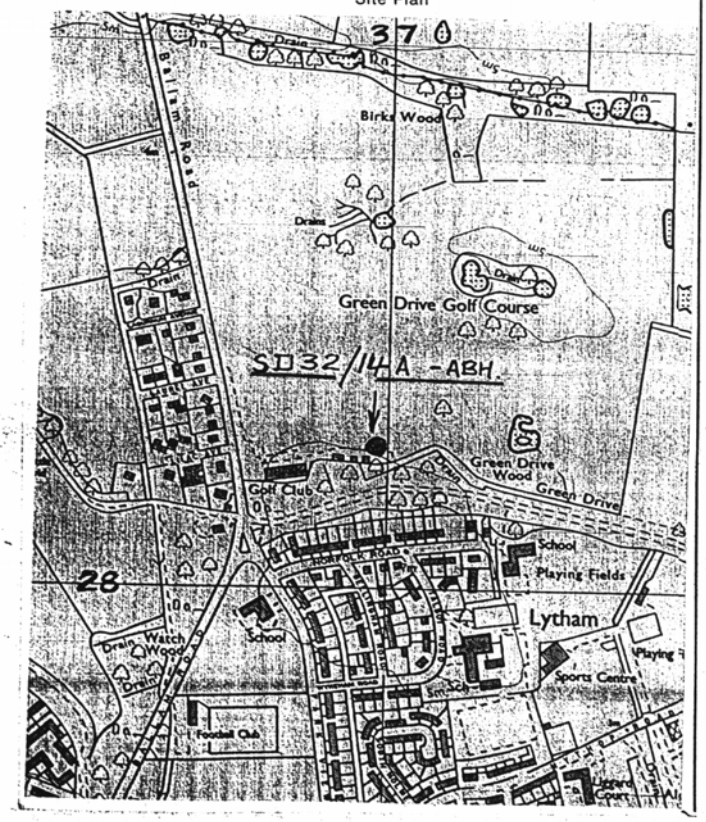
If insufficient space has been allowed, continue in 'Notes' overleaf.

Nat. grid ref. SD 3698 - 2820
Status ABH SPRAY IRRIGATION.
Aquifer SUPERFICIAL DEPOSITS.
Code 111 BD S ZZ

Summary of geological section	Thickness	Depth
BOREHOLE LOG & CASING DETAILS AVAILABLE		

Lockie 162

Site Plan



SD 32/14A LYTHAM GREEN DRIVE GOLF CLUB ABH

Drilled under consent No 920 by Powerfit Drilling Services Ltd.

Register & V.I. completed - DCP.

white card Bh log + P.T. data sent to BGS. Oct 96.

see Report GC.57/96.

[redacted]

SD32NE/34

FORM WR-38

National Rivers Authority
..... Region
BOREHOLE RECORD

NRA No.

(Please type)

A. SITE DETAILS

Borehole drilled for	Green Drive Golf Club ABH SD32/14A.
Location	BALLAM ROAD, LYTHAM, LANCS.
NGR (8 fig.)	SD 370 282 — Please attach site plan
Ground Level (If known) ..	
Drilling Company	Powerfit Drilling Services Ltd
Date of drilling	Commenced: 22. 4.96 Completed: 24. 4.96

B. CONSTRUCTION DETAILS

Borehole datum (If not ground level)..... Ground Level above m below GL
(point from which all measurements of depth are taken eg flange, edge of chamber, etc)

Borehole drilled diameter ..... 254 mm from GL to 25.0 m/depth
_____ mm from _____ to _____ m/depth
_____ mm from _____ to _____ m/depth

Casing material PVC and type (eg plain steel, plastic slotted) diameter 127 mm from GL to 22 m/depth

Casing diameter 127 mm from GL to 7.0 m/depth
Screen diameter 127 mm from 7.0 to 17.0 m/depth
Casing diameter 127 mm from 17.0 to 22.0 m/depth

Grouting details ..... ~~5m B.G.L. to 1m B.G.L~~

Water struck at ..... 3.5m m (depth below datum - mbd)
_____ m (depth below datum - mbd)

Rest water Level on completion ..... 1.25m mbd

C. TEST PUMPING SUMMARY (Please supply full details on Forms WR-39)

Test Pumping Datum (If different from borehole datum) _____ above m below borehole datum (mbd)

Pump Suction Depth ..... _____ mbd

Water Level (Start of Test) ..... _____ mbd

Water Level (End of Test) ..... _____ mbd

Pumping rate ..... _____ m^3/d : l/s

for _____ days/hours

Recovery to ..... mbd in mins : hrs : days
(from end of pumping)

Date(s) of measurements ..... _____

Please Supply Chemical Analysis If Available

GROUNDWATER
DATE RECEIVED 24. 5. 91

SD 32 NE/34

SD32/14A

FORM WR-38 (cont.)

NRA No.

(Please type)

D. STRATA LOG GREEN DRIVE GOLF CLUB ABH LYTHAM.

Geological Classification (BGS only)	Description of strata	Thickness m	Depth m
Man-made deposits	Hardcore	0.1	G.L.
	Grey Sandy Clayand Brick Fill	0.4	0.1
Marine and Estuarine Alluvium	Grey/Brown Sandy Clay	0.5	0.5
	Stiff L/Grey Clay	0.25	1.0
	Peat	0.25	1.25
	Brown/Grey Clay becoming stiff	1.50	1.50
	Soft Brown Sandy Silty Wet Clay	0.5	3.0
	Soft Brown SiltySand	6.5	3.5
	Brown Sand andGravel	4.0	10.0
	Grey Sand and Gravel	4.0	14.0
	Brown Clay (Boulder Clay?)	7.0	18.0

[redacted]

1/12/97.

[continue on separate page if necessary]

Other Comments (eg gas encountered, [illegible] water intercepted, etc)

GROUNDWATER

DATE RECEIVED 24 · 5 · 96

FOR OFFICIAL USE ONLY

FILE ..... CONSENT NO ..... BGS REF NO .....

LICENCE NO ..... USE OF BH .....

Name of site Central hs [redacted]

LYTHAM GREEN DRIVE GOLF CLUB ABH.

W R B No. SD32/14A

74 SD32NE/34

Owner		Licence no. Appn no. C8582. Cancelled	
Occupier		IGS ref. no.	
Ground Level	m OD	ft. OD	
Level of well top	m OD	ft. OD	
Rest water level	m bwt	ft. bwt	
(Date)	m OD	ft. OD	

Nat. grid ref. SD 3698 - 2820

Status ABH SPRAY IRRIGATION.

Aquifer SUPERFICIAL DEPOSITS.

Code 111 BD S ZZ

Construction: Method Date

Depth bwt	Dia.	Linings (below well top) From	To	Dia.	Type

Summary of geological section	Thickness	Depth
BOREHOLE LOG & CASING DETAILS AVAILABLE		

Abstraction rates Type of pump

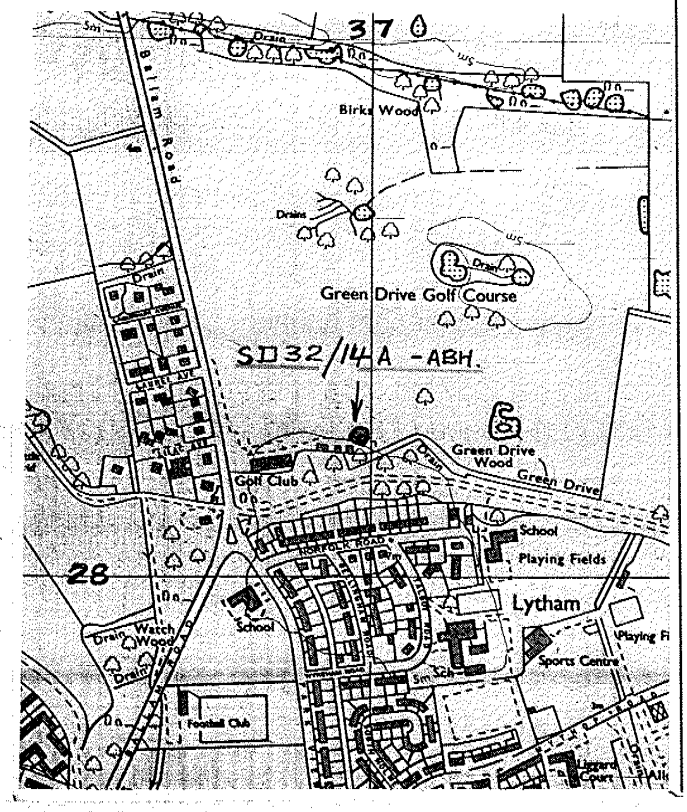
gph PWL Chem./bact. anal. YES/NO

gpd Well driller POWFIT DRILLING LTD

If insufficient space has been allowed, continue in 'Notes' overleaf.

Lockie 162

Site Plan



SD 32/14-A LYTHAM. GREEN DRIVE GOLF CLUB (

Drilled under consent Nº 920 by Powerfit Drilling Services Ltd.

Register & V.I. completed - DCP.

White card Bh log + P.T. data sent to BGS. Oct 96.

See Report GC.57/96.

FORM WR-38

National Rivers Authority

..... Region

(Please type)

BOREHOLE RECORD

NRA No.

A. SITE DETAILS

Borehole drilled for	Green Drive Golf Club ABH SD 32/14A.
Location	Ballam Road, Lytham, Lancs.
NGR (8 fig.)	SD 370 282 — Please attach site plan
Ground Level (If known) ..	
Drilling Company	Powerfit Drilling Services Ltd
Date of drilling	Commenced: 22. 4.96 Completed: 24. 4.96

B. CONSTRUCTION DETAILS

Borehole datum (If not ground level)..... Ground Level above m below GL
(point from which all measurements of depth are taken eg flange, edge of chamber, etc)

Borehole drilled diameter ..... 254 mm from GL to 25.0 m/depth

____ mm from ____ to ____ m/depth

____ mm from ____ to ____ m/depth

Casing material and type (eg plain steel, plastic slotted) PVC diameter 127 mm from GL to 22 m/depth

Casing diameter 127 mm from GL to 7.0 m/depth

Screen diameter 127 mm from 7.0 to 17.0 m/depth

Casing diameter 127 mm from 17.0 to 22.0 m/depth

Grouting details ..... 5m B.G.L. to 1m B.G.L

Water struck at ..... 3.5m m (depth below datum - mbd)

____ m (depth below datum - mbd)

Rest water Level on completion ..... 1.25m mbd

C. TEST PUMPING SUMMARY (Please supply full details on Forms WR-39)

Test Pumping Datum (If different from borehole datum) ____ above m below borehole datum (mbd)

Pump Suction Depth ..... ____ mbd

Water Level (Start of Test) ..... ____ mbd

Water Level (End of Test) ..... ____ mbd

Pumping rate ..... ____ m^3/d : l/s

for ____ days/hours

Recovery to ..... ____ mbd in ____ mins : hrs : days
(from end of pumping)

Date(s) of measurements ..... ____

Please Supply Chemical Analysis If Available

GROUNDWATER
DATE RECEIVED 24 · 5 · 96

Forms/95

SD32/14A

FORM WR-38 (cont.)

NRA No.

(Please type)

D. STRATA LOG GREEN DRIVE GOLF CLUB ABH LYTHAM.

Geological Classification (BGS only)	Description of strata	Thickness m	Depth m
MAN-MADE DEPOSITS	Hardcore	0.1	G.L.
	Grey Sandy Clayand Brick Fill	0.4	0.1
MARINE AND ESTUARINE ALLUVIUM	Grey/Brown Sandy Clay	0.5	0.5
	Stiff L/Grey Clay	0.25	1.0
	Peat	0.25	1.25
	Brown/Grey Clay becoming stiff	1.50	1.50
	Soft Brown Sandy Silty Wet Clay	0.5	3.0
TILL	Soft Brown SiltySand	6.5	3.5
	Brown Sand andGravel	4.0	10.0
	Grey Sand and Gravel	4.0	14.0
[redacted]	Brown Clay (Boulder Clay?)	7.0	18.0
1/12/97			

[continue on separate page if necessary]

Other Comments (eg gas encountered, [illegible] water intercepted, etc)

GROUNDWATER

DATE RECEIVED 24 · 5 · 96

FOR OFFICIAL USE ONLY

FILE ..... CONSENT NO ..... BGS REF NO .....

LICENCE NO ..... USE OF BH ..... NGR .....

Forms/95

FORM WR-39/2

ENVIRONMENT AGENCY

GROUNDWATER

DATE RECEIVED 11 · 6 · 96

PUMPING TEST DATA

CONSTANT RATE PUMPING TEST - RECOVERY

CONSENT NO.	920 SD32/14A
Pumping test at	LYTHAM GREEN DRIVE GOLF CLUB.
NGR	S.D. 3698 2820
Observations from	
NGR	

Description of datum point from which measurements [redacted]. Height above ground level (metres):

Date	Time	Elapsed time Minutes	Elapsed time Hours	Depth of water level below datum (metres)	Drawdown (metres)	FINAL METER READING.	Comments
31/5	10.45	0		8.05		* 2.89 m³/HR.	
		1		4.91			
		2		3.61			
		3		3.24			
		4		3.15			
		5		3.09			
		6		3.05			
		7		3.01			
		8		2.99			
		9		2.96			
		10		2.94			
		15		2.82			
		20		2.73			
		25		2.65			
		30		2.58			
		35		2.51			
		40		2.46			
		45		2.43			
		50		2.40			
		55		2.37			
		60	1	2.33			
		70		2.29			
		80		2.24			
		90		2.19			
		100		2.15			
		120	2	2.10			
		150		2.04			
		180	3	2.00			
		210		1.96			
		240	4	1.95			
31/5		300	5	1.92			

Use continuation sheet (WR-39/4) if necessary

Form 96

FORM WR-39/4

ENVIRONMENT AGENCY

GROUNDWATER
DATE RECEIVED 11 · 6 · 96

PUMPING TEST DATA

CONTINUATION SHEET – Recovery.

CONSENT NO.	920 SD32/14A.
Pumping test at	LYTHAM Green Drive Golf Club.
NGR	
Observations from	
NGR	

Description of datum point from which measurements were made (eg ground level, flange, dip tube/other):

Height above ground level (metres):

Date	Time	Elapsed time Hours	Elapsed time Days	Depth of water level below datum (metres)	Drawdown (metres)		Comments
1/6	06.00			1.72			
	12.00			1.71			
1/6	09.00			1.69			
	16.00			1.66			
3/6	06.00			1.65			
10/6	07.00			1.58			

Use continuation sheet (WR-39/4) if necessary

Forms/96

FORM WR39/1 (A) **PUMPING TEST DATA** ENVIRONMENT AGENCY

WR 39/1 (a) - Nwversion1/Jan'95/DCP

CONSTANT RATE PUMPING TEST

CONSENT NO.	920 SD 32/14A.
Pumping test at	LYTHAM CROSS DRIVE GOLF CLUB
NGR	S.D. 3698 .2820
Observations from	PIEZO 1 (50m WEST) PIEZO 2
NGR	

Description of datum point from which measurements were made (eg ground level, flange, dip tube/other):

Height above ground level (metres):

Date	Time	Elapsed time Minutes	Elapsed time Hours	Depth of water level below datum (metres)	Drawdown (metres)	Meter readings (m^3) or Discharge rate (m^3/hr)	Comments (eg pump started, pumping rate changed, pump stopped)
25/5		DAY (- 3)		1.38		* denotes meter reading/flow measurement required	
26/5		DAY (- 2)		1.38			
27/5		DAY (- 1)		1.39			CALIBRATION TEST.
28/5.	10.45	0		1.50	*		
		1		4.68			
		2		5.74			
		3		6.18			
		4		6.40			
		5		6.53			
		6		6.58			
		7		6.62			
		8		6.65			
		9		6.62			
28/5.	10.55	10		6.60.			
		15		6.60		* 2.97 m^3/hr.	
		20		6.61			
		25		6.83			
		30		6.96		* 2.97 m^3/hr.	
		35		6.99			
		40		7.05			
		45		7.16			
		50		7.24			
		55		7.38			
28/5.	11.45	60		7.44		* 2.89 m^3/hr.	
		70		7.54			
		80		7.60			
		90		7.65		* 2.89 m^3/hr.	
		100		7.69			
28/5.	12.45	120	2	7.72		* 2.89	
		150		7.87		* 2.89	
	13.45	180	3	7.89		* 2.89	
		210		7.91			
	14.45	240	4	7.92		* 2.89	
	15.45.	300	5	7.97		* 2.89	

FORM WR-39/4

ENVIRONMENT AGENCY

GROUNDWATER
DATE RECEIVED 11 · 6 · 96

PUMPING TEST DATA

CONTINUATION SHEET

CONSENT NO.	920. SD32/14A.
Pumping test at	LYTHAM CROSS DRIVE GOLF CLUB.
NGR	SD 3698 2820.
Observations from	
NGR	

Description of datum point from which measurements were made (eg ground level, flange, dip tube/other):

Height above ground level (metres):

Date	Time	Elapsed time Hours	Elapsed time Days	Depth of water level below datum (metres)	Drawdown (metres)		Comments
29/5	06.30			8.12		2.89 m³/hr	
	08.30			8.11		"	
	12.00			8.08		"	
	14.00			8.05		"	
30/5	06.00			7.89		"	
	09.00			7.91		"	
	12.00			7.91		"	
	14.30			7.93		"	
31/5.	08.00			8.03		"	
	10.45			8.05			

Use continuation sheet (WR-39/4) if necessary

Forms/96

SD32/14A

FORM WR-38 (cont.)

NRA No.

(Please type)

D. STRATA LOG GREEN DRIVE GOLF CLUB ABH LYTHAM.

Geological Classification (BGS only)	Description of strata	Thickness m	Depth m
MAN-MADE DEPOSITS	Hardcore	0.1	G.L.
	Grey Sandy Clayand Brick Fill	0.4	0.1
MARINE AND ESTUARINE ALLUVIUM	Grey/Brown Sandy Clay	0.5	0.5
	Stiff L/Grey Clay	0.25	1.0
	Peat	0.25	1.25
	Brown/Grey Clay becoming stiff	1.50	1.50
	Soft Brown Sandy Silty Wet Clay	0.5	3.0
TILL	Soft Brown SiltySand	6.5	3.5
	Brown Sand andGravel	4.0	10.0
	Grey Sand and Gravel	4.0	14.0
	Brown Clay (Boulder Clay?)	7.0	18.0

A Howard 1/12/97

[continue on separate page if necessary]

Other Comments (eg gas encountered, [illegible] water intercepted, etc)

GROUNDWATER

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FILE ..... CONSENT NO ..... BGS REF NO .....

LICENCE NO ..... USE OF BH ..... NGR .....

Forms/85

[SD32NE BJ 34 .]

SD32/14A

FORM WR-38 (cont.)

NRA No.

(Please type)

SD32 NE 5K

D. STRATALOG GREEN DRIVE GOLF CLUB ABH LYTHAM.

Geological Classification (BGS only)	Description of strata	Thickness m	Depth m	Depth m to base
			+ top	
MAN-MADE DEPOSITS	Hardcore	0.1	G.L.	0.1
	Grey Sandy Clayand Brick Fill	0.4	0.1	0.5
MARINE AND ESTUARINE ALLUVIUM	Grey/Brown Sandy Clay	0.5	0.5	1.0
	Stiff L/Grey Clay	0.25	1.0	1.25
	Peat	0.25	1.25	1.5
	Brown/Grey Clay becoming stiff	1.50	1.50	3.0
	Soft Brown Sandy Silty Wet Clay	0.5	3.0	3.5
TILL	Soft Brown SiltySand	6.5	3.5	10.0
	Brown Sand andGravel	4.0	10.0	14.0
	Grey Sand and Gravel	4.0	14.0	18.0
	Brown Clay (Boulder Clay?)	7.0	18.0	25.0

A Navaratnam 1/12/97

[continue on separate page if necessary]

Other Comments (eg gas encountered, drilling water intercepted, etc)

GROUNDWATER

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FILE ..... CONSENT NO ..... BGS REF NO .....

LICENCE NO ..... USE OF BH ..... NGR .....

Forms/85

[SD32NE BJ 34 .]