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# Wylfa Newydd Project

## 6.7.19 ES Volume G - A5025 Off-line Highway Improvements App G7-1 - A5025 Off-line Highway Improvements Baseline Condition Report

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# Wylfa Newydd Project

Horizon Nuclear Power Limited

## Soils and Geology Baseline Conditions Report

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# Executive Summary


This report presents the baseline condition of soils and geology which may potentially be affected by the proposed A5025 Off-line Highway Improvements in section 1 (Valley), section 3 (Llanfachraeth), section 5 (Llanfaethlu), section 7 (Cefn Coch) and the Power Station Access Road Junction. It has been prepared to provide a detailed technical report on soils and geology to support the Environmental Statement.

In accordance with best practice, 250m buffer zones around the four off-line sections and the Power Station Access Road Junction have been defined as the study area. Two soil types have been identified within the study area: East Keswick 1 soils are present in the central parts of sections 3 and 5, at the south of section 7 and across the Power Station Access Road Junction. Brickfield 2 soils are present across all of section 1 and most of section 7 and within the north and south of sections 3 and 5. Agricultural Land Classification (ALC) surveys undertaken in June 2015 and March 2016 identified predominantly good, moderate or poor quality soils, with small areas of very good and very poor quality soils.

The majority of the study area has remained undeveloped and only sporadic made ground deposits were encountered during the Structural Soils Limited (SSL) Ground Investigation undertaken between February and April 2016. In addition, a review of desk-based information has identified the potential for localised made ground associated with land uses such as residential properties, a fuel filling station, garages and cemeteries.

The Ground Investigation identified that superficial deposits across the study area primarily comprise glacial till with thicknesses between 0.20m and 10.47m. In addition, 0.25m–5.80m thick tidal flat deposits were encountered in section 1. Alluvium was encountered up to 3.80m below ground level (mbgl) and thicknesses between 2.20m and 3.00m in section 3. Superficial deposits are absent in isolated areas across the study area.

Geological mapping indicates that the majority of the study area is underlain by bedrock of the New Harbour Group. Section 5 is underlain by the Gwna Group with Church Bay Tuffs and Skerries Grits mapped in the west of the Section. The southern part of section 7 is underlain by the Skerries Group, Gwna Group and Ordovician interbedded mudstone, sandstone and quartzite. Overall, the Ground Investigation confirmed depth to rockhead to range from 0.95m to 10.77mbgl with bedrock outcrops identified in sections 3, 5 and 7.

No sites of geological importance were listed within the study area but the whole of Anglesey has been designated as a United Nations Educational, Scientific and Cultural Organisation (UNESCO) Global GeoPark named ‘GeoMôn GeoPark’, as a result of its complex and unique geological setting.

A number of Category 1 and 2 Aggregates Safeguarding Areas were identified across the study area. However, these are not identified as Mineral Safeguarding Areas.

Preliminary conceptual site models (CSMs) for sections 1, 3, 5 and 7 were developed by RSK in Preliminary Sources Study Reports (PSSRs) prepared for each section (no PSSR was prepared for the Power Station Access Road Junction). Following the Ground Investigation, AECOM assessed the risks from contaminants of potential concern (CoPCs) to human health and controlled waters receptors and provided revised CSMs for sections 1, 3, 5 and 7. This identified chronic risks to human health receptors from contamination in shallow soils, groundwater or leachate within sections 1, 3, 5 and 7 to be low or very low. AECOM identified risks from contamination to surface water receptors to be moderate in sections 1, 3 and 7 and low in section 5. AECOM did not assess risks from acute exposure but recommended that an appropriate health and safety risk assessment should be carried out by the principal contractor prior to any earthworks.

6 Alpha Associates Ltd undertook preliminary Unexploded Ordnance (UXO) risk assessments for a previous alignment of section 1 and for section 7, which concluded that no further action is warranted. Dynasafe BACTEC Ltd undertook assessments for the revised alignment in section 1 and for section 3, which identified negligible UXO risks. The UXO risk for section 5 was considered to be low based on the RSK PSSR.

As the assessments by RSK and AECOM did not include the Power Station Access Road Junction, this report contains a desk-based review of available information to derive a preliminary CSM. This identified potential low or very low risks from soils and groundwater to human health receptors, the Secondary aquifers underlying the site and crops and livestock. The risk of encountering UXO was identified to be low.

# 1. Introduction

## 1.1 Background to Wylfa Newydd Project

Chapter A2 (project overview and introduction to the developments) (Application Reference Number: 6.1.2) provides an overview of the Wylfa Newydd Project (the Project), with more detailed information on the A5025 Off-line Highway Improvements in chapter G1 (proposed development) (Application Reference Number: 6.7.1).

## 1.2 A5025 Off-line Highway Improvements

The main route to the Wylfa Newydd Development Area from the mainland and the port of Holyhead is along the A55, the A5 and the A5025. The existing road infrastructure along the A5025 does not meet current design standards and is not suitable to cope with the predicted traffic flows associated with the construction and operation of the proposed Wylfa Newydd Power Station.

A variety of highway improvement works along the A5025 will be needed to address existing safety and environmental concerns and mitigate the impacts of the construction and operation of the Wylfa Newydd Project.

The proposed A5025 Off-line Highway Improvements form an important component of the Wylfa Newydd Project, and are required as part of the wider transport strategy. The proposed On-line Highway Improvements include the replacement of the existing carriageway and minor widening within or adjacent to the highway boundary, and are the subject of a separate planning application. The A5025 Off-line Highway Improvements involve the construction of new sections of road such as bypasses and road realignment works, and form part of the Development Consent Order application.

The A5025 Off-line Highway Improvements seek to address potential environmental effects on communities, including noise from increased road traffic and severance.

## 1.3 Study area

The A5025 between Valley and the Power Station Site is approximately 16.5km in length and can be broadly described geographically in 8 sections. Sections 2, 4, 6 and 8 relate to the A5025 On-line Highway Improvements. Sections 1, 3, 5 and 7 and the Power Station Access Road Junction relate to the A5025 Off-line Highway Improvements and can be described as follows:

- Section 1 – A5 east of Valley Junction to north of Valley Junction – proposed four arm roundabout and bypass connecting the A5 with the A5025 to the east of the existing A5/A5025 signalised junction;
- Section 3 – north of Llanynghenedl to north of Llanfachraeth – proposed 2km highway to provide a bypass to the east of Llanfachraeth village;
- Section 5 – south of Llanfaethlu to north of Llanfaethlu – proposed bypass to provide a straighter section of road, where there are two existing substandard bends near the Black Lion pub and through Llanfaethlu;
- Section 7 – north of Llanrhyddlad to north of Cefn Coch – proposed bypass to eliminate two existing substandard bends in Llanrhwydrus; and
- Power Station Access Road Junction.

The A5025 Off-line Highway Improvements are proposed to be completed in time for the start of major construction activities at the Wylfa Newydd Development Area. It is anticipated that carrying out the A5025 Off-line Highway Improvements would last for approximately 18 months.

This report presents the soils and geology baseline conditions within the proposed A5025 Off-line Highway Improvements sections (1, 3, 5 and 7 and Power Station Access Road Junction) outlined above.

As the design progressed, the proposed alignment of the road in section 1 was moved approximately 60m to the east and a flood compensation area was added. Some of the earlier survey and assessment work, including the Ground Investigation by SSL, the land quality risk assessment by AECOM, the Agricultural Land Classification (ALC) survey by Reading Agricultural Consultants and the preliminary UXO risk assessment by 6 Alpha

Associates were for the previous alignment. The change of the alignment and the addition of the flood compensation area have been taken into consideration during reporting of the findings of these assessments in this report.

Similarly, the Power Station Access Road Junction has been added to the scope of the A5025 Off-line Highway Improvements following the initial phases of work. The assessment of potential land contamination risks associated with the Power Station Access Road Junction is primarily based on a desk-based review of information as the area was not included within the study area of the RSK Preliminary Source Study Reports (PSSR), SSL Ground Investigation or AECOM interpretive reports. However, where data such as ALC survey results (obtained for the Wylfa Newydd Development Area) are available, these have been used to inform the baseline and assessment of this section.

The potential effects on receptors from the A5025 Off-line Highway Improvements relevant to soils and geology are likely to be associated with direct disturbance of ground conditions or the migration of contaminants to/from areas immediately adjacent to the site. As a result, 250m buffer zones around the A5025 Off-line Sections, shown as green dashed lines on Figures 1–3, have been taken as the study area for the purposes of this report.

## 1.4 Report purpose

This report has been prepared to provide a detailed technical report on soils and geology to support the Environmental Statement for the A5025 Off-line Highway Improvements. Although the Environmental Statement is aimed at a wide audience, this report is primarily aimed at stakeholders requiring a detailed, technical understanding of the baseline conditions for soils and geology.

## 1.5 Report scope

This report considers the baseline conditions relating to soils and geology within the study area and comprises the structure set out below.

- Section 2: Information sources. This section provides details of the information sources used in preparation of this report, including previous surveys and investigations, publicly and commercially available literature and technical consultations.
- Section 3: Soil types and quality. The soil types and soil quality present across the study area are introduced, as these represent receptors for soil and geology effects.
- Section 4-6: These sections describe the geological strata present across the study area, including details of made ground Section 4), superficial geology (Section 5) and bedrock geology (Section 6), based on geological mapping and information gained from Ground Investigation.
- Section7: Sites of geological importance. This section provides the baseline with regard to statutory and non-statutory sites of geological importance across the study area.
- Section 8: Geological resources. This section provides information on Aggregates Safeguarding Areas present beneath the study area. No Minerals Safeguarding Areas are present across the study area.
- Section 9: Land contamination. This section reviews potential sources of contamination within the study area that could affect receptors in the form of humans, controlled waters or property, based on a review of historical mapping, consultation responses and findings of previous investigations and assessments.

It is recognised that soils and geology are closely related to other Environmental Impact Assessment topics (e.g. hydrogeology, hydrology, geomorphology, ecology, and land-use) and such interfaces are identified (where relevant) within this report.

For the purpose of this report, ‘soils’ should be taken to mean Holocene/recent unconsolidated deposits and artificial geology (e.g. made ground, filled ground and worked ground). ‘Geology’ should be taken to mean both superficial deposits and bedrock geology which may be affected by the A5025 Off-line Highway Improvements, including both listed and notified sites of geological importance and mineral resources/reserves.

# 2. Information sources

## 2.1 Previous surveys and investigations

A number of surveys and assessments have been undertaken within the study area that are relevant to defining the soils and geology baseline, including:

- *Stage 1 Scheme Assessment report* (Mott MacDonald, 2011);
- Preliminary Sources Study Reports (Off-line Sections) (RSK, 2014 a–d);
- *Stage 2 Scheme Assessment report* (URS, 2014);
- *Environmental Impact Assessment Scoping Report* (Horizon, 2015);
- ALC reports for the Power Station Main Site and A5025 Off-line Highway Improvements (Reading Agricultural Consultants Limited, 2015 and 2017 respectively);
- Off-line Highways Improvements Ground Investigation factual reports (Structural Soils Ltd. (SSL), 2016a–d);
- A5025 Wylfa, Ground Investigation reports (AECOM, 2016a–d); and
- *Wylfa New Build Power Station - Contaminated Land Desk Study and Initial Risk Assessment* (Halcrow, 2012).

## 2.2 Publicly and commercially available literature

The following sources of publicly available information have been consulted during the preparation of this report:

- British Geological Survey (BGS) *GeoIndex* (BGS, 2017a);
- *1:50,000 Scale 'Solid and Drift Geology' Geological Map of Anglesey (Special Sheet 092)* (British Geological Survey (BGS), 1974);
- *North West Wales Aggregates Safeguarding Map* (BGS and Welsh Assembly Government, 2012);
- Soils site reports (National Soil Resources Institute (NSRI), 2015a–d); and
- *MapInsight: All Scales GS-1797586* (Groundsure, 2014).

## 2.3 Technical consultations

Table 2.1 sets out the technical consultations that have been undertaken for soils and geology. Consultations specific to waste and materials use are summarised in Chapter B16 (waste and materials management) (Application Reference Number: 6.2.16).

**Table 2.1 Stakeholder consultations relating to soils and geology**

| Stakeholder | Format and date | Description |
|---|---|---|
| The Isle of Anglesey (IACC) Contamination Team | Written enquiry, 2014 | Request for environmental information in relation to potentially contaminated sites, pollution incidents or permitted activities; response provided in Appendix C1. |
| North Wales Minerals and Waste Planning Team | Written enquiry, 2015 | Request for information in relation to mineral resources and aggregates safeguarding plans. |
| Animal and Plant Health Agency | Written enquiry, 2014 | Request for information on the location of any animal burial pits within the study area; response provided in Appendix C2. |

| Stakeholder | Format and date | Description |
| --- | --- | --- |
| Natural Resources Wales (NRW) | Written enquiry, 2014 | Request for environmental information in relation to potentially contaminated sites, pollution incidents or permitted activities; response provided in Appendix C3. |

# 3. Soil types and quality

Information on soil types and quality within the study area obtained from published sources and baseline surveys is presented below.

## 3.1 Soil types

The information presented below has been obtained from the NSRI (2015a–d) reports presented in Appendices A1–A4. The alignment of the Power Station Access Road Junction falls within the extents of NSRI (2015d).

Two different soil associations are found within the study area; their characteristics and spatial occurrences within the scheme are outlined in Table 3.1.

**Table 3.1 Soil associations potentially affected and their spatial occurrence within the study area**

| | Soil association | |
|---|---|---|
| **Characteristic** | **East Keswick 1 Soils** | **Brickfield 2 Soils** |
| Source | Drift material derived from Palaeozoic sandstone and shale. | Drift from Palaeozoic and Mesozoic sandstone and shale. |
| Composition | Deep, well-drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging. Low/negligible storage capacity and low natural soil fertility. | Slowly permeable seasonally waterlogged fine loamy soil with low natural soil fertility. |
| Hydrology of soil type (HOST) | HOST Class 6 – free-draining permeable soils in unconsolidated loams or clays with low permeability and storage capacity. Minor risk of flooding. | HOST Class 24 – Slowly permeable, seasonally waterlogged soils over slowly permeable substrates with negligible storage capacity; minor risk of flooding. |
| Pollutant leaching potential | Soils of intermediate leaching potential which have a moderate ability to attenuate a wide range of diffuse source pollutants but in which it is possible that some non-absorbed diffuse source pollutants and liquid discharges could penetrate the soil layer. | Soils in which pollutants are unlikely to penetrate the soil layer either because water movement is largely horizontal or because they have a large ability to attenuate diffuse source pollutants. |
| Land use | Neutral and acid pastures and deciduous woodlands; acid communities such as bracken and gorse in the uplands supporting stock rearing on permanent grassland. | Seasonally wet pastures and woodlands. Dairying and stock rearing on permanent or short-term grassland; some cereals in drier areas. |
| Spatial occurrence | **Section 1:** not present<br>**Section 3:** central (from where the A5025 crosses the Afon Alaw to the Pen Y Graig junction)<br>**Section 5:** central (around Llanfaethlu)<br>**Section 7:** on southern border<br>**Power Station Access Road Junction:** whole section | **Section 1:** whole section<br>**Section 3:** north and south<br>**Section 5:** north and south<br>**Section 7:** predominant soil<br>**Power Station Access Road Junction:** not present |

## 3.2 Soil quality

The economic resource value of soil is primarily measured by its ability to support agricultural uses. This is quantified by its ALC, which is determined through climatic, topographical and interactive soil limitations.

Best and Most Versatile (BMV) agricultural land equates to Grades 1 and 2 and Subgrade 3a of the ALC system and is the most flexible land in terms of the range of crops that can be grown, the level and consistency of yield and the cost of obtaining yield. *Planning Policy Wales* (Edition 9) states that BMV land should be conserved as a finite resource for future use wherever possible, and considerable weight should be given to protecting it because of its special importance (Welsh Government, 2016).

### 3.2.1 Methodology

An ALC survey was undertaken for the A5025 Off-line Highway Improvement sections 1 (previous alignment), 3, 5 and 7 in March 2016. The survey comprised soil augering at 63 locations to obtain soil profiles for assessment and four observation pits to examine the subsoil structure (Reading Agricultural Consultants Ltd., 2017 – Appendix B). Local agro-climatic conditions were interpreted from one Meteorological Office data point for each of the four sections and the survey area was found to be wet and moderately warm, with moderately small to moderate crop moisture deficits and a relatively high number of field capacity days. Reading Agricultural Consultants Ltd. reviewed the findings of the ALC survey within section 1 to extrapolate the existing data and provide information on the ALC Grade of soils within the new alignment. The revised survey report (Reading Agricultural Consultants Ltd, 2017) is provided in Appendix B.

The area of the Power Station access road junction was included within the extents of an ALC survey undertaken across the majority of the Wylfa Newydd Development Area in June 2015 (Reading Agricultural Consultants Ltd., 2015). One auger point was located within the alignment of the Power Station Access Road Junction and a further four auger points and one pit were located within 250m of the alignment.

The assessments of ALC were completed in accordance with the guidance presented in the *Revised guidelines and criteria for grading the quality of agricultural land* (Ministry of Agriculture, Fisheries and Food, 1988). At each observation point, soil texture, significant stoniness, colour, consistency, structural condition, free carbonate and depth were assessed. Soil wetness class was also inferred from matrix colour, mottling and low permeability layers and soil droughtiness calculated through moisture balance equations.

### 3.2.2 Off-line Highway Improvements section 1: Valley

The land use for this section was mainly grass with sheep grazing. Sandy loam is the dominant topsoil texture, with the occasional presence of clay loam and sandy clay loams; the subsoil is of a loamy sand or sand texture. Mottling is present through the soil profile, indicating periods of prolonged saturation. Soils within low-lying land were found to be limited to Grade 4 by flooding. The remainder of section 1 is limited to Grade 3b due to the presence of irregular slopes which would pose access restrictions for some machinery (Reading Agricultural Consultants Ltd, 2017). This is identified on figure G7-1 of Volume G of the Environmental Statement.

### 3.2.3 Off-line Highway Improvements section 3: Llanfachraeth

This section mostly comprised pasture land, although two fields were cultivated in the north. The topsoil is mainly of a medium clay loam or medium silty clay loam texture, with sandy clay loam occasionally present. The subsoil is of a similar texture but with less clay, whilst the stone content is moderate to high; most of the subsoil was gleyed (evidenced by mottling). Most of the assessment points were limited by wetness and workability, in conjunction with climatic factors and topsoil textures, to either Grade 2, Subgrade 3a or Subgrade 3b. A small area in the middle of the section is limited to Grade 4 due to flood risk (Reading Agricultural Consultants Ltd, 2017). This is identified on figure G7-1 of Volume G of the Environmental Statement.

### 3.2.4 Off-line Highway Improvements section 5: Llanfaethlu

The land use was grass for this section, mostly with sheep grazing, but also cattle and ponies in the north. The soil profiles investigated generally comprised medium clay topsoils and clay or clay loam subsoils. The subsoil was gleyed, with frequent mottling. Wetness and workability were the most limiting factors for the majority of the assessment points, either to Grade 2, Subgrade 3a, or Subgrade 3b. Areas of Grade 5 were mapped due to microrelief limitations (Reading Agricultural Consultants, 2017). This is identified on figure G7-2 of Volume G of the Environmental Statement.

### 3.2.5 Off-line Highway Improvements section 7: Cefn Coch

This area predominantly comprised improved grassland for grazing, although more scrub-like areas of reeds and wetland vegetation were present in the north.

The March 2016 ALC survey for the section identified the topsoil texture as medium clay loam, with a variable subsoil texture of medium and heavy clay loam, sandy clay loam, and occasional sandy loam and clay; gleying is common in the subsoil. Most of this section is of Subgrades 3a and 3b, with wetness and workability the main limiting factor, although slope is limiting in the north. Small areas of Grade 4 are mapped due to flood risk (in the northwest) and droughtiness resulting from severe compaction (in the northeast). Grade 5 is mapped in the south due to microrelief (Reading Agricultural Consultants, 2017). This is identified on figure G7-2 of Volume G of the Environmental Statement.

### 3.2.6 Power Station Access Road Junction

The June 2015 ALC survey (Reading Agricultural Consultants, 2015) identified topsoil as comprising mainly medium clay loam, although heavy clay loam and sandy clay loam are also present; the average depth of the topsoil is 0.32m. The subsoil is mostly of a clay texture, although heavy clay loam was also encountered in the south and sandy clay in the east. Gleying is ubiquitous, as evidenced by frequent mottles. The profiles are all limited to Subgrade 3b due to a wetness and workability limitation. This is identified on figure G7-3 of this Environmental Statement.

### 3.2.7 Quantification of ALC Grade Areas for all Off-line Sections

Table 3.2presents a summary of ALC grade, area and relative percentage of the encountered grades across the study area. For comparison, Table 3.3 presents a summary of the provisional ALC grades across the entire Isle of Anglesey, where the total area of Anglesey has been taken as 71,361 hectares. The ALC data for Wales (Ministry of Agriculture, Fisheries and Food, 1977) provide no differentiation between Subgrade 3a and 3b, as they are provisional data intended for strategic planning purposes.

**Table 3.2 ALC Grades – spatial coverage[1]**

| Grade | Description | Section 1 | | Section 3 | | Section 5 | | Section 7 | | Power Station Access Road Junction | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Area (ha) | % land[2] | Area (ha) | % land[2] | Area (ha) | % land[2] | Area (ha) | % land[2] | Area (ha) | % land[2] |
| 1 | Excellent quality | - | - | - | - | - | - | - | - | - | - |
| 2 | Very good quality | - | - | 1.3 | 10 | 1.1 | 15 | - | - | - | - |
| 3a | Good | - | - | 7.9 | 59 | 1.0 | 13 | 2.1 | 26 | - | - |
| 3b | Moderate quality | 4.6 | 38 | 3.5 | 26 | 3.9 | 53 | 3.3 | 40 | 2.7 | 100 |
| 4 | Poor quality | 7.5 | 62 | 0.7 | 5 | - | - | 0.7 | 8 | - | - |

[1] Areas based on Reading Agricultural Ltd survey mapping and section areas available at the time of the surveys
[2] % agricultural land, excluding woodland and urban land.

| Grade | Description | Section 1 | | Section 3 | | Section 5 | | Section 7 | | Power Station Access Road Junction | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Area (ha) | % land[2] | Area (ha) | % land[2] | Area (ha) | % land[2] | Area (ha) | % land[2] | Area (ha) | % land[2] |
| 5 | Very poor quality | - | - | - | - | 1.4 | 19 | 2.1 | 26 | - | - |
| | Total agricultural | 12.1 | 100 | 13.4 | 100 | 7.4 | 100 | 8.2 | 100 | - | - |

**Table 3.3 Provisional ALC Grades for Anglesey**

| Grade | Description | Area (ha) | Percentage (%) |
|---|---|---|---|
| 1 | Excellent quality (BMV) | 0.0 | 0.0 |
| 2 | Very good quality (BMV) | 1,116.9 | 1.6 |
| 3a | Good quality (BMV) | 27,559.3 | 38.6 |
| 3b | Moderate quality | | |
| 4 | Poor quality | 27,213.8 | 38.1 |
| 5 | Very poor quality | 10,398.4 | 14.6 |
| - | Non-agricultural* | 5,072.6 | 7.1 |

* Non-agricultural land includes areas such as woodland and urban land.

# 4. Made ground

The summary of known and potential areas of made ground (artificial geology) presented below is based upon a review of the information sources outlined in section 2 and a site walkover undertaken by Jacobs on 30 and 31 March 2015. No formal walkovers were undertaken to update the observations after this date. However, site visits were undertaken which did not identify significant changes to the observations made during the 2015 walkover.

Following a review of desk-based information, made ground was not anticipated to be present across the majority of the A5025 Off-line Highway Improvement sections or the Power Station Access Road Junction due to the agricultural nature of the land. However, made ground will be present beneath the existing A5025 (including potentially coal tar containing tarmac and sub-base) and adjoining roads. Made ground may also generally be present in field entrances where farmers have used hardcore to improve access (RSK, 2014b; RSK, 2014c; RSK, 2014d).

## 4.1 Off-line Highway Improvements section 1: Valley

The presence of made ground was not identified within this section and site observations did not provide any indication of significant ground disturbance across the area. The Ground Investigation undertaken in section 1 by SSL did not encounter made ground in any of the locations (SSL, 2016a, provided in Appendix E1). However, the SSL Ground Investigation followed a previously proposed alignment to the west of the currently proposed course. The proposed alignment has since shifted approximately 60m to the east and a flood compensation area has been added to the west of the alignment. Notwithstanding, the findings of the SSL Ground Investigation are still considered relevant due to the short distance the alignment has been moved. Furthermore, land use in both the previous and revised alignments is agricultural and no presence of made ground or potentially contaminative historical or present land uses has been identified. Made ground may be present beneath and around the neighbouring residential properties, fuel filling station and garage site. Localised made ground is also anticipated to be present within the cemetery to the southeast of the section which is associated with burials, infrastructure and parking areas.

## 4.2 Off-line Highway Improvements section 3: Llanfachraeth

A potential for the localised presence of made ground, including several former quarries located within the study area, was identified associated with a number of man-made features recorded on historical mapping, and identified during consultation with the IACC, (refer to Appendix C1).

A covered tank is located to the north of the Afon Alaw, in close proximity to the proposed route. Jacobs was not able to undertake a walkover of this area due to land access restrictions but RSK were able to visit this location on their walkover. RSK observed that it comprised ‘a potentially operational above-ground filter bed constructed of brick’ (RSK, 2014b). Further details are provided in Section 9.4.1.

The SSL Ground Investigation identified the presence of made ground in six out of 45 exploratory locations, with a maximum thickness of 0.80m recorded at BHB7 (SSL, 2016b, provided in Appendix E2). The made ground was typically described as firm light brown slightly sandy gravelly clay including gravels of ceramic, rare brick and coal. The spatial distribution of made ground within the area subject to Ground Investigation appears to be sporadic, rather than being confined to any particular area (AECOM, 2016b).

## 4.3 Off-line Highway Improvements section 5: Llanfaethlu

A number of historical man-made features including former lime kilns and quarries have been identified in proximity to the proposed scheme which may have resulted in discrete areas of made ground.

A former landfill (Bryn Maethlu) was identified by NRW and the IACC approximately 60m to the northwest of the section. This landfill had a waste license granted in 1995 which was surrendered in 2010. The facility contained less than 25,000 tonnes and only accepted inert waste.

Only a limited site walkover in the northern part of the section was possible due to land access constraints. At the northern end of the section, a former garage and existing bus depot is present directly east of the existing A5025. The Off-Site Power Station Facilities are proposed to be constructed in this area; refer to Chapter E7 (soils and geology) (Application Reference Number: 6.5.7) for further details. Observations indicate that ground surface in this area is either concrete/tarmac or hardcore. The site walkover undertaken for the Off-Site Power Station Facilities (refer to Appendix E7-1, Soils and Geology Baseline Conditions Report, Application Reference Number: 6.5.15) identified evidence of small fuel/oil spills and localised presence of waste materials in this area, which are discussed and assessed in more detail in Appendix E7-1 (Application Reference Number: 6.5.15) and Chapter E7 (Application Reference Number: 6.5.7).

A small sewage works is located to the east of the A5025, to the south of the bus depot. This contains several tanks and is surfaced with hardcore. A cemetery and car park are also located within the southern part of the section. These land uses may represent localised areas of made ground.

The SSL Ground Investigation recorded the presence of made ground in seven out of 27 exploratory locations, with a maximum thickness of 0.40m recorded in trial pits TPC15 and TPC18 (SSL, 2016c, provided in Appendix E3). The made ground was typically described as soft brown slightly gravelly slightly sandy clay topsoil with occasional rootlets and fragments of glass, metal, nails, ceramics and brick. The made ground was primarily encountered within the northern section of the proposed alignment, to the east and northeast of Llanfaethlu (AECOM, 2016c).

## 4.4 Off-line Highway Improvements section 7: Cefn Coch

There is the potential for made ground along the historical A5025 road alignment, which ran to the west of the current route within this section.

In addition, two former mill ponds were located adjacent to the proposed scheme in this section; one located in the central part of the section to the west of the A5025 and one located at the northern extent of the section, also to the west of the existing road. The locations of both ponds were observed during the Jacobs site walkover. The location of the central mill pond comprised an area of steeply sloping land adjacent to a watercourse with a small area of relatively flat surface where sparse soils and broken bedrock was observed. No made ground/fill material was observed in this area. The northern pond comprised an area of marshy ground, which appeared to be located in a shallow depression. The surface was vegetated and no obvious signs of made ground were evident. Due to land access restrictions, the site walkover was restricted to the northern part of the section.

A former sand/gravel pit is identified on historical mapping and by the IACC in their consultation response (Appendix C1). Although no access to this area was possible during the Jacobs walkover, observations of the area from a vantage point did not indicate any obvious signs of surface workings.

The SSL Ground Investigation confirmed the presence of made ground in two out of 25 exploratory locations, with a maximum thickness of 0.52m recorded at BHD5 (SSL, 2016d, provided in Appendix E4). The made ground encountered comprised cohesive material, described as soft to firm brown slightly sandy slightly gravelly clay with rare brick fragments, and less frequently, granular material described as dark brown to black and red slightly clayey sand and gravel of brick, sandstone and phyllite (AECOM, 2016d).

## 4.5 Power Station Access Road Junction

Based on a desk-based review of geological mapping, made ground is not anticipated to be present across the majority of the proposed roundabout alignment. Made ground will be present beneath the existing A5025 (including potentially coal tar containing tarmac and sub-base) and may be present in field entrances. The area was not subject to Ground Investigation; therefore, this assumption has not been confirmed.

# 5. Superficial geology

A summary of known areas of superficial geology is presented below. This is based upon a review of the information sources outlined in Section 2. In general, superficial deposits within the study area comprise one or more of the three types of deposits identified in Table 5.1 below.

**Table 5.1 Superficial geology potentially affected within the study area**

| Superficial deposit | Detail |
|---|---|
| Glacial till | Comprises sandy gravelly clay, with subordinate sand and gravel pockets and lenses. |
| Tidal flat deposits | Comprises clay and silt |
| Alluvium | Comprises clay, silt, sand, gravel and potentially organic components (peat). |

## 5.1 Off-line Highway Improvements section 1: Valley

Tidal flat deposits are mapped across much of the western and southwestern parts of section 1, including a narrow spur of deposits close to a stream trending northeast to southwest across the central part of the study area, which exits the site parallel to the eastern boundary of the cemetery (BGS, 1974).

The remaining central and eastern parts of section 1 comprise Diamicton glacial till (BGS, 1974), as identified on figure G7-4 of this Environmental Statement. Whilst no alluvium is shown, it is likely that localised shallow thicknesses of alluvium will be present along existing streams and former stream alignments, where periodic clearance and de-silting may have occurred.

There are several isolated areas where no superficial deposits are mapped either side of the A5025 in the north of the study area (BGS, 1974).

The SSL Ground Investigation confirmed the presence of tidal flat deposits, comprising either fine or coarse-grained material, at all the exploratory locations within the study area, which followed a previously proposed alignment to the west of the current proposal (refer Section 4.1 above).

The fine-grained materials were encountered at 11 of the 13 borehole locations with thicknesses ranging between 0.25m and 3.30m. The materials were typically described as very soft to firm locally stiff dark grey mottled orange brown silty sandy gravelly clay. The fine-grained tidal flat deposits were also locally found to be interbedded with silt (AECOM, 2016a).

Coarse-grained tidal flat deposits were recorded at all exploratory locations, typically described as loose to medium dense, orange brown, mottled grey, slightly clayey, slightly gravelly, fine to coarse sand with rare shell fragments. These deposits ranged in thickness from 0.90m to 5.80m and were occasionally found to be interbedded with fine-grained deposits (AECOM, 2016a).

Glacial till was encountered at the borehole locations within the central and eastern parts of section 1, with thicknesses ranging between 1.55m and 6.69m. The glacial till was typically described as firm to stiff, dark grey slightly sandy to sandy locally very sandy slightly gravelly silty clay with medium cobble content (AECOM, 2016a).

## 5.2 Off-line Highway Improvements section 3: Llanfachraeth

Superficial deposits are mapped across the majority of section 3 but appear to be absent from a few isolated areas immediately south of the A5025 bridge over the Afon Alaw and a large area surrounding Llanfachraeth (BGS, 1974).

Deposits of glacial till cover the majority of section 3, with the exception of alluvium which is recorded along the route of the Afon Alaw, its tributaries and drainage areas (BGS, 1974), as identified on figure G7-4 of Volume G of the Environmental Statement.

Materials described as alluvium were recorded at four exploratory locations during the SSL Ground Investigation. The materials were described as soft to firm occasionally stiff, greyish brown slightly sandy slightly gravelly clay, sandy clayey silt, or dense dark grey clayey sandy gravel, and recorded to a maximum depth of 3.80mbgl, with strata thicknesses ranging between 2.20m and 3.00m. The deposits were primarily encountered within the corridor of the Afon Alaw watercourse (AECOM, 2016b).

Glacial till, comprising both fine-grained (cohesive) and coarse-grained (granular) materials were confirmed at the majority of exploratory locations, with thicknesses ranging between 0.70m and 10.47m. The fine-grained materials were described as firm to stiff, occasionally very soft and soft or very stiff, locally friable, yellowish brown, mottled grey, slightly sandy, slightly gravelly, occasionally silty clay with low occasionally medium cobble content and/or firm grey, light grey and light brown slightly sandy silt (AECOM, 2016b).

The coarse-grained materials were described as dense to very dense, occasionally loose grey/greenish grey, orange and purple, locally slightly clayey, sandy, occasionally very sandy gravel or slightly gravelly clayey, occasionally silty sand with low to medium cobble content, some boulders and occasional beds of firm clay. The coarse-grained materials were generally found to be interbedded with the cohesive materials, with strata thicknesses ranging between 0.20m and 4.70m (AECOM, 2016b).

## 5.3 Off-line Highway Improvements section 5: Llanfaethlu

Geological mapping (BGS, 1974) indicates that superficial deposits are absent in areas surrounding Llanfaethlu. The remainder of section 5 is indicated to comprise glacial till, as identified on figure G7-5 of Volume G of the Environmental Statement. Alluvium is recorded outside the study area to the southeast.

The SSL Ground Investigation recorded glacial till at all exploratory locations, up to 9.65m in thickness. The material was found to comprise both cohesive and granular deposits. The fine cohesive material was typically described as firm, becoming stiff, locally hard, high strength, locally friable, yellowish brown and grey mottled, slightly sandy, slightly gravelly, locally very gravelly clay, with low cobble content, locally high cobble content. Silt was also locally encountered, described as very stiff to hard light brownish red slightly sandy slightly gravelly clayey silt (AECOM, 2016c).

Granular glacial till was less frequently encountered and where recorded was typically described as occasionally clayey, sandy gravel or gravelly sand. The granular glacial till was generally found to be interbedded with cohesive, fine-grained material (AECOM, 2016c).

## 5.4 Off-line Highway Improvements section 7: Cefn Coch

As identified on figure G7-5 of Volume G of the Environmental Statement, deposits of glacial till are mapped across the majority of the section, with the exception of isolated areas within the western and southern parts, where bedrock outcrops (BGS, 1974).

The SSL Ground Investigation encountered glacial till overlying bedrock at all exploratory locations, with the exception of TPD2 in the southern part of the section, where superficial deposits were absent. Strata thicknesses of between 0.20m and 10.15m were recorded and, as with the other sections, the glacial till was found to comprise fine-grained material, interbedded with coarse-grained deposits (AECOM, 2016d).

The fine-grained materials were typically described as firm to stiff, locally soft to firm and very stiff to hard (medium to high strength, locally very high strength) thinly laminated, brown, mottled grey, slightly gravelly, slightly sandy, silty clay with rare decaying rootlets and low cobble and boulder content. It was locally recovered as soft, becoming firm, light brown and grey, slightly sandy, slightly gravelly silt (AECOM, 2016d).

The coarse-grained glacial till stratum ranged between 0.10m and 3.60m thickness and was typically described as either dense dark greyish, green, slightly clayey, very gravelly sand or medium dense to dense, greyish brown, clayey to very clayey, sandy to very sandy gravel with low cobble content or very dense, light greyish green, sandy, gravelly cobbles or dark purplish green, gravelly boulders (AECOM, 2016d).

## 5.5 Power Station Access Road Junction

A desk-based review of information indicated that deposits of glacial till are mapped across the section (BGS, 1974), as identified on figure G7-6 of this Environmental Statement. The area was not subject to Ground Investigation, thus the presence and description of the glacial till has not been confirmed.

# 6. Bedrock geology

The summary of known areas of bedrock geology presented below is based upon a review of the information sources outlined in section 2. The unit name, formation and general description of each bedrock unit present within the study area is presented within Table 6.1 below, primarily based on a review of *Footsteps Though Time* (Campbell *et al.*, 2014).

**Table 6.1 Summary of bedrock geology**

| Unit | Detail |
|---|---|
| Gwna Group<br>Approximately 635–508 million years ago (Mya) | Main unit of the Monian Supergroup.<br>Originated from a mélange, the product of a major undersea debris slide. The mixing of rocks in a deep sea trench occurred where seafloor sediments were scraped off the descending oceanic plate at a destructive margin and accreted onto the trench walls. The mélange formed in an accretionary prism, where the youngest sediments were underthrust beneath older sediments already underplated. As subduction continued, the oldest rocks became inverted at the top and youngest forced to the bottom.<br>The strata comprise alternating silty and sandy layers, with green schist, mica schist, blue schist, psammite, quartzite and pillow lava. |
| New Harbour Group<br>Approximately 530–520 Mya | The New Harbour Group was derived from a volcanic arc and deposited as sand and mud turbidites. It was thrust under the older Gwna Group as an accretionary prism and weakly metamorphosed. Sands and muds underwent low-grade metamorphism to psammites and pelites.<br>Strata often show evidence of intense multi-generational folding deformation which may have occurred during plate margin collisions, underplating accretionary processes, and later the Caledonian Orogeny.<br>Strata comprises fissile green mica schist, gritty green mica schist with bedded jasper, jaspery phyllite, psammite and alternating with pelites. |
| Skerries Group<br>(Church Bay Tuffs and Skerries Grits)<br>Age under discussion | Recently became part of the New Harbour Group.<br>Derived from sub-volcanic granite/felsic volcanic source, potentially from an island arc.<br>Comprises widely deformed, bedded succession of pebbly sandstones, tuffs, conglomerates, basalts and metamorphosed volcanic sandstones. |
| South Stack Group<br>Approximately 501–515 Mya | Deposited in a shallow water shelf at a continental margin, before also being thrust under Gwna Group accretionary prism and New Harbour Group.<br>Comprise interbedded sandstone, shales and pelites, with mica schist and quartzite. |

A detailed description of the bedrock conditions, including relevant observations from the site walkover and Ground Investigation findings within each of the sections is provided below.

## 6.1 Off-line Highway Improvements section 1: Valley

The New Harbour Group underlies section 1 (BGS, 1974), as identified on figure G7-7 of this Environmental Statement. No geological bedrock faults were recorded beneath the section or within the immediate surrounding area (RSK, 2014a).

With the exception of one location, the SSL Ground Investigation to the west of the currently proposed alignment (refer Section 1.2 above) did not encounter bedrock. Possible bedrock was recorded at a single exploratory location at a depth of 3.25mbgl, although this was not confirmed as competent rockhead.

## 6.2 Off-line Highway Improvements section 3: Llanfachraeth

The New Harbour Group underlies section 3 and the surrounding area (BGS, 1974), as identified on figure G7-7 of this Environmental Statement. Bedrock was noted to outcrop close to surface along parts of the alignment. Published sources do not record faults beneath the section or within the immediate surrounding area (RSK, 2014b).

The SSL Ground Investigation recorded bedrock in 18 of the 20 exploratory boreholes drilled and five of the 22 trial pits dug. Depth to bedrock ranged from 0.95m to 10.77mbgl and generally consisted of psammite and phyllite, with breccia encountered in two boreholes (BHB7 and BHB10). In BH7, two bands of metabreccia were logged at 7.83–8.04mbgl and 8.18–9.00mbgl. In BH10, weak to medium-strong breccia was encountered at 4.00–4.58mbgl, 6.00–6.65mbgl and 11.10–11.36mbgl. For a detailed description of the encountered bedrock, refer to SSL (2016b).

## 6.3 Off-line Highway Improvements section 5: Llanfaethlu

Geological mapping (BGS, 1974) identified Gwna Group underlying section 5, as identified on figure G7-8 of this Environmental Statement. There is an outcrop of quartzite to the northeast of section 5 and an outcrop of jasper along the eastern boundary. There are several other locations of exposed bedrock in proximity to the proposed highway alignments (RSK, 2014c), including isolated patches of bedrock exposed at ground level, which were also identified during the site walkover, approximately 100m west of the existing northeast sewage works.

Metabasaltic intrusions within the Gwna Group are indicated to be present to the west of the section north and south of Llanfaethlu. Isolated deposits of the Central Anglesey Shear Zone and Berw Shear Zone (undifferentiated) Glaucophane Schist are located to the northwest of section 5, west of the A5025. A further small isolated deposit is present along the southwest boundary (RSK, 2014c).

Published mapping shows the Church Bay Tuffs and Skerries Grits extending from the coastline to 30m within the study area at the southwest of the section.

The SSL Ground Investigation recorded bedrock in six of the seven exploratory boreholes drilled, and two of the 11 trial pits dug. Depth to bedrock ranged from 0.38m to 9.95mbgl and typically consisted of phyllite, psammite and schist of the Gwna Group, with sandstone and tuff of the Church Bay Tuffs and Skerries Grits encountered in the north of the section. The upper contact of the bedrock was often highly weathered and extremely weak to very weak, with strength increasing with depth. For a detailed description of the encountered bedrock, refer to SSL (2016c).

## 6.4 Off-line Highway Improvements section 7: Cefn Coch

The majority of the northern parts of section 7 are underlain by the New Harbour Group (BGS, 1974), as identified on figure G7-8 of this Environmental Statement. Mapping indicates gabbro, microgabbro and diorite igneous intrusions within the New Harbour Group which trend northwest to southeast. There are also serpentinite outcrop intrusions of unknown ages (RSK, 2014d).

The southern part of section 7 is underlain by the Skerries Group, Gwna Group and Ordovician interbedded mudstone, sandstone and quartzite. Bedrock outcrops at the surface in several locations, particularly towards the central western part of the section (RSK, 2014d).

Bedrock (potentially Gwna Group) was noted to outcrop at ground level during the site walkover, at an area adjacent to the watercourse orientated north-south, immediately to the west of the crossroads at the central part of the section.

The SSL Ground Investigation encountered bedrock in five of nine exploratory boreholes drilled and one of the six trial pits dug. The New Harbour Group was recorded in the northern and central areas of the section, with the Gwna Group encountered in the south.

The Gwna Group was recorded in BHD1 and consisted of quartzite, schist and psammite. TPD2 at the far south of the section exposed the top surface of the bedrock, which was described as psammite and assigned to the New Harbour Group. However, as a very small section of the unit was logged (<5cm), this assignation may be inaccurate and the psammite may be part of the Gwna Group. The New Harbour Group consisted of psammite and phyllite, often interbedded.

## 6.5 Power Station Access Road Junction

The north of the section is mapped to be underlain by mica schist and psammite of the New Harbour Group (BGS, 1974), as identified on figure G7-9 of this Environmental Statement. The south of the section is mapped to be underlain by tuff and sandstone of the Church Bay Tuffs and Skerries Grits. The area was not subject to Ground Investigation to confirm the bedrock geology.

# 7. Sites of geological importance

## 7.1 The GeoMôn Geopark

The Isle of Anglesey was included in the European Geopark Network in 2009 as a result of its outstanding geodiversity and geological heritage. The Anglesey Geopark (called the 'GeoMôn Geopark') covers the 720km$^2$ of the Isle of Anglesey and has approximately 200km of coastline.

The European Geopark Network aims to protect geodiversity, promote geological heritage to the general public and support sustainable economic development of Geopark territories through the development of geological tourism. As a member of the European Geopark Network, it is also included in the Global Geopark Network.

In November 2015, the GeoMôn Geopark was designated as a UNESCO Global Geopark at UNESCO's 38th General Conference (UNESCO, 2015). The new designation is intended to raise awareness and promote respect for the environment and integrity of the landscape. The status also expresses governmental recognition of the importance of holistic management of the Geoparks. The designation is not legislative, but the key heritage sites within the Geoparks should be protected under local, regional or national legislation as appropriate. The UNESCO Global Geopark designation is not permanent. A revalidation process exists whereby a thorough re-examination of the Geopark is undertaken every four years, after which the status is either renewed for a further four years, or the management body will be allowed two years to fulfil certain criteria. Should these still not be met after the prescribed period, the park would lose the UNESCO Global Geopark status (UNESCO, 2015).

Both NRW and GeoMôn have responsibilities for protecting geosites. NRW has a statutory responsibility to protect areas notified as geological Sites of Special Scientific Interest and GeoMôn leads on the conservation of Regionally Important Geodiversity Sites (RIGS) within the GeoMôn Geopark. Both organisations work together to protect and promote the sustainable use of Anglesey's geoheritage.

## 7.2 Statutory sites of geological importance

The Geological Conservation Review (GCR) initiative aims to identify sites of national and international importance that demonstrate the key elements of Great Britain's earth heritage. GCR sites are either already notified or being considered for notification as Sites of Special Scientific Interest and, as such, form the basis of statutory geological and geomorphological site conservation in Great Britain. The Joint Nature Conservation Committee is responsible for the administration of GCR data and, in Wales, NRW are responsible for advising the Joint Nature Conservation Committee of the links between GCR sites and Sites of Special Scientific Interest (Joint Nature Conservation Committee, 2016).

There are currently no listed or notified GCR sites or Sites of Special Scientific Interest within the study area and no sites have been identified that are likely to be affected by the A5025 Off-line Highway Improvements (Natural England, 2017).

## 7.3 Non-statutory sites of geological importance

RIGS are non-statutory listed sites of local, regional or national importance for their geodiversity. They are conserved and protected from development by local authorities, and are designated for their scientific/research, educational, historical and/or aesthetic importance.

There are no RIGS within the study area and no sites have been identified that are likely to be affected by the A5025 Off-line Highway Improvements (Wood, 2007).

# 8. Geological resources

## 8.1 Introduction

Following consultation with the North West Wales Minerals & Waste Planning Service, the following sources of information have been used to assess the potential impacts of the A5025 Off-line Highway Improvements on identified mineral resources:

- *North West Wales Aggregates Safeguarding Map* (BGS and Welsh Assembly Government, 2012);
- *Hard Rock and Sand & Gravel Safeguarding Areas in Ynys Môn* (Capita Symonds, 2010); and
- Extract from *BritPits* (BGS, 2017b), provided by the North Wales Minerals and Waste Planning Service.

None of the Mineral Safeguarding Areas identified within the *Hard Rock and Sand & Gravel Safeguarding Areas in Ynys Môn* report (Capita Symonds, 2010) or the quarries identified within the *Britpits* extract are located within the study area.

A number of Aggregates Safeguarding Areas have been identified on the *North West Wales Aggregates Safeguarding Map* located beneath the proposed alignment or directly adjacent to the route. These are identified on figures G7-10 (sections 1 and 3), G7-11 (sections 5 and 7) and G7-12 (Power Station Access Road Junction) of Volume G of the Environmental Statement. The Aggregates Safeguarding Areas categories are as follows:

- Category 1 Aggregate Safeguarding Areas, which contain resources considered to be of national importance; and
- Category 2 Aggregate Safeguarding Areas, which contain resources considered to be of local or regional importance.

## 8.2 Off-line Highway Improvements section 1: Valley

A Category 2 Aggregates Safeguarding Area, associated with sands and gravels, is identified beyond the northeastern corner of the section to the west of Cleifiog Isaf.

## 8.3 Off-line Highway Improvements section 3: Llanfachraeth

Glacio-fluvial deposits located at Pen-yr-orsedd are designated as a Category 1 Aggregates Safeguarding Area. The deposits are located within the study area but outside the section alignment.

Alluvial deposits located on site surrounding the Afon Alaw are classed as a Category 2 Aggregates Safeguarding Area.

## 8.4 Off-line Highway Improvements section 5: Llanfaethlu

The route crosses two Category 2 Aggregates Safeguarding Areas; one associated with igneous rocks (Skerries Group) and the other sandstone with silica potential (Gwna Group).

## 8.5 Off-line Highway Improvements section 7: Cefn Coch

Category 2 Aggregates Safeguarding Areas associated with sandstone with silica potential (Gwna Group) and igneous rocks (Church Bay Tuffs and Skerries Grits) are located beneath the alignment of section 7.

## 8.6 Power Station Access Road Junction

A Category 2 Aggregates Safeguarding Area associated with igneous rocks is located beneath this area.

# 9. Land contamination

## 9.1 Introduction

This report section includes a desk-based review by Jacobs to identify the potential for land contamination using data obtained from consultation responses and the following sources of information:

- *MapInsight: All Scales GS-1797586* (Groundsure, 2014);
- *MapInsight: All Scales GS-2319990* (Groundsure, 2015); and
- Groundsure reports associated with the RSK PSSRs (RSK, 2014a-d).

The assessment of risks associated with potential land contamination and the development of the site conceptual models (CSM) is based on previous work by RSK and AECOM as outlined below.

RSK produced PSSRs for the four Off-line Highway Improvements sections 1, 3, 5 and 7 that summarised the findings of a desk-based review of available information (RSK, 2014a–d). Furthermore, the reports identified preliminary conceptual site models (CSMs) outlining potential pollutant linkages for the site requiring further investigation and assessment. The PSSR reports for the four sections are provided in Appendices D1–D4. The study area of the PSSR for section 1 included both the previously proposed and the revised alignment of the A5025.

Following the Ground Investigation and soil and groundwater sampling and testing, AECOM provided geotechnical interpretive reports for sections 1, 3, 5 and 7 (AECOM, 2016a-d). These included the assessment of risks from CoPCs to human health and controlled waters receptors and the provision of revised CSMs. The SSL factual and AECOM interpretive reports for the four sections are provided in Appendices E1–E4 and F1–F4 respectively.

Contrary to the above, the assessment of potential land contamination risks associated with the Power Station Access Road Junction was undertaken by Jacobs and is based on a desk-based review of the above information sources as the area was not included within the study area of the RSK PSSRs, SSL Ground Investigation or AECOM interpretive reports (refer to Section 1.2 above).

## 9.2 Off-line Highway Improvements: all sections

A review of the historical and present day Ordnance Survey mapping (Groundsure, 2014) identified that the majority of the A5025 corridor has remained relatively unchanged from the earliest available historical mapping (approximately 1880) to the present day, with fields and agricultural land dominating the area. A number of small settlements are present along the route, associated with historical or more recent industrial/commercial activities.

The Animal and Plant Health Agency confirmed that they do not hold any records of animal burial pits within the study area of any of the sections.

## 9.3 Off-line Highway Improvements section 1: Valley

### 9.3.1 Jacobs review of historical maps and consultation responses

#### (a) Historical map review

Historical mapping indicates that a petrol filling station has been located to the southwest of the proposed route since approximately 1968. Observations from the site walkover indicate that the adjacent buildings are used as a garage/vehicle testing centre. A cemetery is located to the southeast of the proposed route, first identified on historical mapping in 1991. A freight yard (railways sidings) located south of the A5 has been identified on mapping since approximately 1968. A filled stream is recorded in the west of the site from approximately 1901. Two filled ponds are recorded in the north of the study area since approximately 1962 and one west of the A5025 from approximately 1890.

**(b) Pollution incidents/NRW information**

NRW records one pollution incident to have occurred in section 1. This incident (no. 752502, dated 10/02/2010) was associated with burning of waste to the rear of Minffordd Road and was recorded as having caused a minor impact to land. Given that the incident was classified as minor and occurred to the south of the A5, it is not considered likely to present a risk to the proposed scheme.

**(c) IACC information**

The consultation response from the IACC is provided in Appendix C1. The IACC identified several potentially filled pond and stream areas. One of these is located in the west of the section, others are identified to the northwest and southeast of the section. The type of fill material within this area, and any potential contamination associated with it, is unknown.

The IACC also identified the dismantled railway land as a potential source of contaminants, however given the presence of the A5 between the site and the former railway sidings and the likely direction of groundwater flow to the east towards the surface water course, this site is considered unlikely to pose a risk to the scheme.

### 9.3.2 RSK and AECOM CSM and risk assessment

The preliminary CSM was developed by RSK and is presented in the PSSR report provided in Appendix D1. This was revised by AECOM based on the findings of the SSL Ground Investigation and presented in the interpretive Ground Investigation report (AECOM, 2016a, provided in Appendix F1). Whilst the study area for the RSK PSSR included both the previously proposed and the revised alignments of the A5025 in section 1, the SSL Ground Investigation and the AECOM Ground Investigation report only comprised the previously proposed route. However, the findings of the AECOM Ground Investigation report have been reviewed and are considered to be still relevant due to the predominantly agricultural land use in the area and the limited potential for contamination sources. However, the potential for encountering unexpected ground conditions and/or contamination exists.

With regard to chronic risks to human health receptors from CoPCs within shallow soils and made ground or within ground water and leachate, the assessment AECOM identified risks to be low or very low. The report did not include an assessment of risks from acute exposure of human health receptors such as construction workers to CoPCs but recommended that an appropriate health and safety risk assessment should be carried out by the principal contractor prior to any earthworks.

With regard to controlled waters, AECOM (2016a) concluded that there is a moderate risk from CoPCs in soils and leachate to surface water receptors, namely the Afon Alaw and its tributaries and other unnamed streams, field drains and ponds. Based on the findings of the PSSR, groundwater was not considered a sensitive receptor within the risk assessment due to the absence of registered groundwater abstractions and the classification of the bedrock as a Secondary B aquifer. Risks with respect to groundwater and surface water contamination are considered in Chapter G8 (surface water and groundwater) (Application Reference Number: 6.7.8).

The RSK PSSR (RSK, 2014a) included consideration of risks associated with encountering Unexploded Ordnance (UXO). The report notes that the area around Valley within Off-line Highway Improvements section 1 has been identified to be at moderate risk of encountering UXO due to its proximity to the docks at Holyhead and associated wartime infrastructure.

A preliminary UXO risk assessment was undertaken for section 1 by 6 Alpha Associates Ltd. (2015a), which concluded that the probability of encountering UXO at the site is low/medium and that no further action is warranted. Following change of the alignment in section 1, a further preliminary UXO risk assessment was undertaken by Dynasafe BACTEC Ltd (2017a). This identified the UXO risk for the section to be negligible and recommended no further action. UXO risks have therefore not been considered further for section 1. The preliminary UXO risk assessment reports are included in Appendices H1 and H2 respectively.

## 9.4 Off-line Highway Improvements section 3: Llanfachraeth

### 9.4.1 Jacobs review of historical maps and consultation responses

#### (a) Historical map review

Historical mapping indicates that a woollen mill was formerly located to the north of the Afon Alaw, as recorded from the earliest available mapping (1887) to approximately 1959.

Filter beds and an associated covered tank are identified directly on the proposed route to the north of the Afon Alaw. These features were first identified on the 1974 historical mapping and were marked as 'disused' at that point; however, the RSK walkover (RSK, 2014b) recorded that the filter bed was potentially still in use. The Groundsure report attached to the RSK report identified the activity associated with the filter beds as 'waste storage, processing and disposal'. RSK considered the tank to have been used for industrial purposes and the filter bed as part of an associated reprocessing plant. However, no further information was available regarding the nature of the waste.

The presence of a smithy was recorded within the current route of the A5025 near the centre of the section from the earliest available mapping (1887) till approximately 1900. A graveyard is present at the current route of the A5025 in the north of the section and a burial ground was indicated to be present north of the Afon Alaw in the 1889 map edition.

In addition, five former ground workings/quarries are present within the study area. The IACC consultation response (Appendix C1) indicate that one of these features located to the west of the route in the central part of the section is likely to have been infilled. The nature and origin of the fill is unknown. The former quarry located at the northern end of the section to the east of the route is marked as a pond and is therefore unlikely to have been infilled. As it was not possible to undertake a site walkover (due to access restrictions) it is not clear whether the other quarries have been infilled.

#### (b) Pollution incidents/NRW information

According to NRW records, seven pollution incidents have occurred in the study area of section 3. However, all of these were recorded as minor impacts between 2001 and 2013 and were not located within a distance that was considered likely to have impacted on the scheme. Therefore, they were not considered further.

#### (c) IACC information

The IACC identified two filled quarries within 250m of the proposed alignment, one of which is believed to have been infilled. The nature and origin of the infill material is unknown.

### 9.4.2 RSK and AECOM CSM and risk assessment

The preliminary CSM was developed by RSK and is presented in the PSSR report provided in Appendix D2. This was revised by AECOM based on the findings of the Ground Investigation and presented in the interpretive Ground Investigation report (AECOM, 2016b, provided in Appendix F2).

With regard to chronic risks to human health receptors from CoPCs within shallow soils and made ground or within ground water and leachate, the assessment identified risks to be low or very low. The report did not include an assessment of risks from acute exposure of human health receptors such as construction workers to CoPCs but recommends that an appropriate health and safety risk assessment should be carried out by the principal contractor prior to any earthworks.

The PSSR included consideration of groundwater vulnerability and soil leaching potential and identified low vulnerability to contamination due to low productivity superficial geology and the Secondary B aquifer classification of the bedrock. The report notes further that, although classified as a Secondary A aquifer, superficial alluvial deposits are shallow and not considered a potential potable water receptor. Based on this, AECOM (2016b) did not identify groundwater as a sensitive controlled waters receptor. The primary controlled waters receptors considered by AECOM (2016b) are the surface water courses of the Afon Alaw and tributaries, other unnamed streams, field drains and ponds. AECOM (2016b) identified risks to these receptors from migration of CoPCs in shallow groundwater to be moderate. Risks with respect to groundwater and surface water contamination are considered in Chapter G8 (Application Reference Number: 6.7.8).

The RSK PSSR (RSK, 2014b) included consideration of risks associated with encountering UXO. The report notes that section 3 is within an area considered to be at low to moderate risk of encountering UXO. A preliminary UXO risk assessment was undertaken by Dynasafe BACTEC Ltd. (2017b), which identified the UXO risk for section 3 to be negligible and recommended no further action. UXO risks have therefore not been considered further for section 3. The preliminary UXO risk assessment report is included in Appendix H3.

## 9.5 Off-line Highway Improvements section 5: Llanfaethlu

### 9.5.1 Jacobs review of historical maps and consultation responses

#### (a) Historical map review

A review of historical mapping has identified a number of features within the study area. At the southern end of the route a burial ground has been identified on historical maps since approximately 1889 (the first available maps) to the east of the route adjacent to the Black Lion pub. An ‘old lime kiln’ was identified to the west of the route on the historical maps from approximately 1900.

At the northern end of the section to the east of the proposed route, a sewage works has been present since approximately 1974. A garage has been present adjacent to the A5025 since approximately 1974. The site walkover indicated that this site is currently used as a bus depot with a small (possibly disused) commercial facility in the area formerly marked as a garage, close to the route.

To the west of the route, opposite the garage, an old quarry was identified on the first available mapping (1889), with an old lime kiln marked adjacent to the quarry.

#### (b) Pollution incidents/NRW information

According to NRW records, four pollution incidents have occurred within section 5. However, all of these were recorded as minor impacts between 2001 and 2005 and were not considered likely to have impacted on the scheme. Therefore, they were not considered further.

NRW records identify one historical inert landfill site (now closed), licence number EAWML37136 at Bryn Maethlu, which received inert waste. The permit was surrendered on 16 March 2010.

#### (c) IACC information

The IACC identified a garage, sewage works and disturbed ground associated with the ceramics industry (associated with the old lime kiln to the south of the section) which could be associated with a number of CoPCs.

### 9.5.2 CSM and risk assessment

The preliminary CSM was developed by RSK and is presented in the PSSR report provided in Appendix D3. This was revised by AECOM based on the findings of the Ground Investigation and presented in the interpretive Ground Investigation report (provided in Appendix F3).

With regard to chronic risks to human health receptors from CoPCs within the made ground or within groundwater and leachate, the assessment of the findings of the Ground Investigation by AECOM identified risks to be low or very low. The report did not include an assessment of risks from acute exposure of human health receptors such as construction workers to CoPCs but recommends that an appropriate health and safety risk assessment should be carried out by the principal contractor prior to any earthworks.

With regard to risks to controlled waters, AECOM (2016c) did not identify significant linkages to groundwater based on the site being underlain by glacial till and a Secondary B aquifer within the bedrock without recorded groundwater abstractions. The risks from site soils and leachate to the bedrock Secondary B aquifer were therefore assessed as being very low. With regard to risks to surface water receptors in the form of adjacent drainage channels, ditches and streams, these were assessed as low. Risks with respect to groundwater and surface water contamination are considered in Chapter G8 (Application Reference Number: 6.7.8).

Risks associated with the garage and bus depot area in the north of the study area are discussed in Appendix E7-1 (Application Reference Number: 6.5.15).

The RSK PSSR (RSK, 2014c) includes consideration of risks associated with encountering UXO. The report notes that section 5 is within an area considered to be at low risk of encountering UXO.

## 9.6 Off-line Highway Improvements section 7: Cefn Coch

### 9.6.1 Jacobs review of historical maps and consultation responses

#### (a) Historical map review

A review of historical mapping identified the presence of a former mill pond beneath the footprint of the route at the northern extent of the section. The mill pond was present on the first available historical map (1889) associated with the woollen mill located north of section 7. Although the buildings were still present, the woollen mill was not identified from the 1899 map, and the mill pond was not identified from the 1924 map. During the site walkover on 30 March 2015, the location of the former pond was observed to be a low-lying marshy area, with no visible signs of man-made structures. A selection of photographs is presented in Appendix G.

Another mill was formerly located west of the A5025, to the north of the crossroads. The mill was identified as disused on the earliest available historical mapping (1889). A site visit on 30 March 2015 identified an area of broken bedrock, although due to steeply sloping ground and vegetation, a full walkover of the area was not possible. A selection of photographs is presented in Appendix G.

A disused pit was identified on the historical map from approximately 1973 located to the east of the A5025 in the centre of the section. RSK identified a quarry from available satellite imagery located directly to the southwest of the crossroads in the centre of the section (RSK, 2014d). Whilst the satellite imagery indicates some form of surface disturbance in the location, there is no indication that this area was used as a quarry and no records indicate mineral extraction within this area. A complete walkover during 30 March 2015 was not possible due to land access restrictions. However, the feature location was viewed from an adjacent road, and proved no evidence of ground workings within the location. The feature can be seen in Photograph 12 in Appendix G.

#### (b) Pollution incidents/NRW information

According to NRW records, one pollution incident has occurred within this section. This incident (No. 696259, dated 08/07/2009) was recorded as a minor impact to land from fly tipping.

Given the age and minor nature of the incident, it is not considered likely to pose an impact to the proposed scheme.

#### (c) IACC information

The IACC identified two potentially contaminative historical land uses within section 7, relating to a textile mill at the northern extent of the section (the woollen mill identified within this historical map review) and quarrying associated with the disused pit located to the east of the route.

#### 9.6.2 CSM and risk assessment

The preliminary CSM was developed by RSK and is presented in the PSSR report provided in Appendix D4. This was revised by AECOM based on the findings of the Ground Investigation and presented in the interpretive Ground Investigation report (provided in Appendix F4).

Based on the findings of the Ground Investigation, AECOM assessed chronic risks to human health receptors from CoPCs within shallow soils and made ground or within groundwater and leachate to be low or very low. The report did not include an assessment of risks from acute exposure of human health receptors such as construction workers to CoPCs but recommends that an appropriate health and safety risk assessment should be carried out by the principal contractor prior to any earthworks.

Based on the findings of the PSSR, groundwater was not considered a sensitive receptor within the risk assessment by AECOM (2016d), due to the absence of registered groundwater abstractions and the classification of the bedrock as a Secondary B aquifer. However, AECOM (2016d) identified moderate risks to surface water receptors, namely the Afon Alaw and its tributaries, other unnamed streams, field drains and ponds, from lateral migration of contamination in shallow ground waters from soils and leachate. Risks with respect to groundwater and surface water contamination are considered in Chapter G8 (Application Reference Number: 6.7.8).

The RSK PSSR (RSK, 2014d) includes consideration of risks associated with encountering UXO. The report notes that section 7 is within an area considered to be at low to moderate risk of encountering unexploded ordnance. A preliminary UXO risk assessment was subsequently undertaken for section 7 by 6 Alpha Associates Ltd. (2015b) which concluded that the probability of encountering UXO at the site is low/medium and that no further action is warranted. This report is included in Appendix H4.

### 9.7 Power Station Access Road Junction

#### 9.7.1 Historical map review

Historical mapping indicates that the area has been used as agricultural land. The A5025 has been present since the earliest available map from 1888. Northwest of the junction alignment, quarries were indicated on the 1899 map but were inactive in 1924 and may have been infilled.

#### 9.7.2 Regulatory and archive information

No formal consultation was undertaken for this section. However, the location of the Power Station Access Road Junction was included in the study area of the Groundsure report that was appended to the Power Station site contaminated land desk study and initial risk assessment (Halcrow, 2012). Information included in the Groundsure report did not record presence of discharge consents, pollution incidents, environmental permits, landfill or waste sites or current industrial land uses within the study area of the Power Station Access Road Junction.

The Zetica Regional Unexploded Bomb Risk map for Anglesey (Zetica, 2016) notes presence of a military target south of Cemaes, approximately 2km east of the Power Station Access Road. However, the study area of the Power Station Access Road Junction itself is located within a region indicated as being at low risk of encountering UXO (Zetica, 2016). UXO risk has therefore not been considered further.

#### 9.7.3 Contaminants of potential concern

Based upon the above, potential sources of contamination have been identified in the form of the potentially infilled former quarries. CoPCs associated with these may include heavy metals, hydrocarbons and asbestos.

#### 9.7.4 Receptors

The human health receptors relevant to the Power Station Access Road Junction are summarised in Table 9.1 below. Table 9.2 identifies the relevant controlled waters receptors. These comprise both groundwater and surface water receptors. The superficial deposits underlying the study area are classed as a secondary undifferentiated aquifer by NRW and the bedrock is classed as a Secondary B aquifer. However, NRW consider both aquifers to be single groundwater unit, hereafter referred to referred to as the 'Secondary aquifers', and this this is considered to be a receptor for the purpose of this assessment. A small stream is present on the western boundary of the study area which leads into the Caerdegog Isaf stream. This is considered the primary surface water receptor for contamination from the site. The property receptors relevant to the site are identified in Table 9.3.

**Table 9.1 Human health receptors**

| Receptor | Typical activity |
|---|---|
| Construction workers | All activities involved with the construction of the road. High likelihood of contact with site soils and likely contact with groundwater during drainage works. |
| Maintenance workers | Routine maintenance work. Likely contact with site soils and low likelihood of contact with groundwater. |
| Future site users | Future users of the site. Low likelihood of contact with site soils. |
| Adjacent land users | Primarily agricultural land use and dwelling Groes-fechan. Low likelihood of inhalation of contaminated wind-blown dusts and vapours. |

**Table 9.2 Controlled waters receptors**

| Receptor | Description |
|---|---|
| Groundwater | Secondary aquifers. |
| Surface water | Drains/stream leading into Caerdegog Isaf stream to west. |

**Table 9.3 Property receptors**

| Receptor | Description |
|---|---|
| Structures | Power Station Access Road Junction (future use); buildings and structures associated with Groes-fechan. |
| Crops and livestock | Agricultural land use adjacent to highways junction. |

### 9.7.5 Pathways

Potential pathways by which the on-site contaminants may affect human health receptors or crops and livestock at the site are:

- inhalation;
- ingestion; and
- direct contact (including dermal contact and ingestion).

The pathway relevant to controlled waters receptors is leaching of contaminants to groundwater.

There is no direct pathway for contamination from the site to enter the surface water receptor. However, migration of contamination through shallow groundwater could be possible. Pathways relevant to contaminants once they have entered groundwater/surface water are considered within Chapter G8 (Application Reference Number: 6.7.8) and will not be discussed further here.

The pathway through which contamination could affect buildings and services is considered to be migration of ground gases and accumulation within enclosed spaces leading to potential risk of asphyxiation and/or explosion. However, no enclosed spaces would be constructed associated with the Power Station Access Road Junction and thus this pathway and potential pollutant linkage are not considered relevant and have not been considered further. A potential pathway exists for ground gas from the potentially infilled quarry to affect Groes-fechan.

However, evaluation of this is outside the scope of this assessment, as the proposed construction of the Power Station Access Road has no potential to affect or be affected by this potential pollutant linkage. It has therefore not been considered further for the purpose of this assessment.

### 9.7.6 Potential pollutant linkages and risk assessment

Based on the contaminant sources, receptors and pathways outlined above, a small number of potential pollutant linkages have been identified and a CSM has been developed. Using guidance within *Model Procedures for the Management of Land Contamination: Contaminated Land Report 11* (CLR11) (Department for Environment, Food and Rural Affairs and Environment Agency, 2004) and *Contaminated Land Risk Assessment: A Guide to Good Practice* (C552) (Rudland *et al*., 2001) a qualitative risk assessment has been undertaken to assess the significance of each pollutant linkage using Table 9.4 **Consequence of occurrence (severity)**

through Table 9.7 **Risk definition**

.

**Table 9.4 Consequence of occurrence (severity)**

| Classification | Human health | Controlled waters | Crops/livestock |
|---|---|---|---|
| **Severe** | Short-term (acute) risk to human health. Concentrations present likely to result in "significant harm" as defined by Part 2A of the *Environmental Protection Act 1990*. | Substantial pollution of water resources such that "significant pollution" or "significant possibility of pollution" of controlled waters as defined by Part 2A of the *Environmental Protection Act 1990* is being caused. | Major damage or harm to crops/livestock, which is likely to result in irreversible or substantial adverse change. |
| **Medium** | Chronic damage to human health. Concentrations present that could result in significant harm. | Pollution of water resources such that there is a measurable (but not significant) reduction in water quality compared to the water quality standards. | Significant damage or harm to crops/livestock that could endanger the long-term functioning of the asset. |
| **Mild** | Slight short-term health effects to humans. Exposure to human health unlikely to lead to significant harm. | Measurable reduction in water resources compared to baseline. | Minor or short-lived damage or harm to crops/livestock. |
| **Minor** | Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc.). | Insubstantial pollution to water resources compared to baseline. | Insignificant damage or harm to crops/scheme. |

**Table 9.5 Estimation of probability (likelihood)**

| Classification | Definition |
|---|---|
| **High likelihood** | There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution. |

| | |
|---|---|
| **Likely** | There is a pollutant linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term. |
| **Low likelihood** | There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain even over a longer period that such an event would take place, and it is even less likely in the shorter term. |
| **Unlikely** | There is a pollutant linkage but circumstances are such that it is improbable that an event would occur even in the very long term. |

**Table 9.6 Risk rating**

| **Risk matrix** | | **Consequence of occurrence (severity)** | | | |
|---|---|---|---|---|---|
| | | Severe | Medium | Mild | Minor |
| **Probability (likelihood)** | **High likelihood** | Very high | High | Moderate | Moderate/low |
| | **Likely** | High | Moderate | Moderate/low | Low |
| | **Low likelihood** | Moderate | Moderate/low | Low | Very low |
| | **Unlikely** | Moderate/low | Low | Very low | Very low |

**Table 9.7 Risk definition**

| Risk | Risk description |
|---|---|
| Very high | There is a high likelihood of the event occurring and having severe consequences. If the risk is realised it is likely to result in a substantial liability. |
| High | It is likely that an event with medium or even severe consequences could arise. If the risk is realised it may result in a substantial liability. |
| Moderate | It is possible that an event could occur; it is either unlikely, but with severe consequences, or it is more likely to occur, but the consequences would be relatively mild. Investigation would normally be required to clarify the risk and determine the potential liability. |
| Low risk | It is possible that an event could occur but it is likely that the consequences would be mild at worst. |
| Very low | It is unlikely that an event could occur, and if it happened the consequences are likely to be mild at worst. |

The CSM and risk assessment is presented in Table 9.8 Potential Pollutant Linkages

. The findings of the assessment of desk-based studies and environmental databases, indicate the relative risks associated with the identified CoPCs to be low. For pollutant linkages relevant to contaminants once they have entered groundwater/surface waters, refer to Chapter G8 (Application Reference Number: 6.7.8).

It needs to be recognised that the above assessment was undertaken based on a desk-based review that has not been informed by the findings of a Ground Investigation and soils sampling and testing. When such data become available, the above risk assessment should be reviewed and the preliminary CSM revised accordingly.

**Table 9.8 Potential Pollutant Linkages**

| Source | Potential Contaminants | Pathway | Receptor | Consequence of occurrence | Likelihood of occurrence | Potential risk | Comments |
|---|---|---|---|---|---|---|---|
| Soils and groundwater associated with potential presence of made ground (potentially infilled quarry) | - Heavy metals<br>- Hydrocarbons<br>- Asbestos | Migration of contaminants to on-site and ingestion, inhalation, dermal contact with contaminated soil/groundwater | Construction workers<br>Maintenance workers | Medium | Unlikely | Low | The quarry is considered unlikely to present a contamination risk to the site due to its age (approximately 1887), size and distance from the site. |
| | | Migration of contaminants to on-site and ingestion, inhalation, dermal contact with contaminated soil | Future site users | Medium | Unlikely | Low | |
| | | Migration of contaminants to aquifer beneath site | Secondary aquifers | Medium | Unlikely | Low | |
| | | Inhalation of wind-blown dust | Adjacent land users | Minor | Unlikely | Very low | |
| | | Migration of contaminants to on-site and ingestion, inhalation, dermal contact with contaminated soil | Crops and livestock | Minor | Unlikely | Very low | |

# 10. Glossary

| Acronym | Definition |
|---|---|
| ALC | Agricultural Land Classification |
| BGS | British Geological Survey |
| BMV | Best and Most Versatile (Agricultural Land Classification) |
| Britpits | British Pits: database of surface and underground mineral workings produced by the BGS |
| CoPC | Contaminant of potential concern |
| CSM | Conceptual site model |
| GCR | Geological Conservation Review |
| HOST | Hydrology of soil type |
| IACC | Isle of Anglesey County Council |
| Mya | Million years ago |
| NRW | Natural Resources Wales |
| NSRI | National Soil Resources Institute |
| PSSR | Preliminary Sources Study Report |
| RIGS | Regionally Important Geodiversity Site |
| SSL | Structural Soils Ltd. |
| UNESCO | United Nations Educational, Scientific and Cultural Organisation |
| UXO | Unexploded Ordnance |

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# 12. Limitations

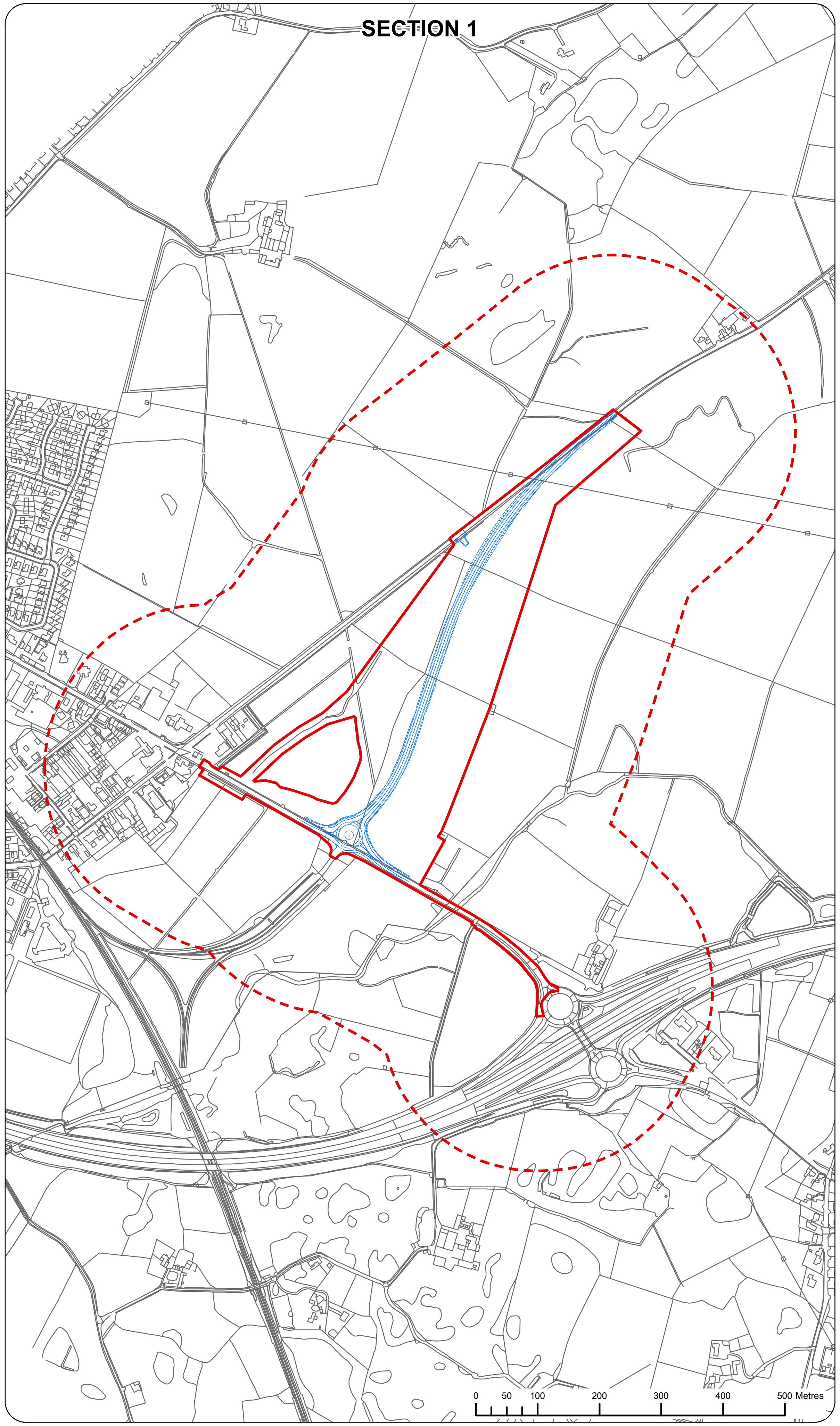
The potential remains for the presence of unknown, unidentified, or unforeseen surface and sub-surface contamination. Any additional evidence of such potential site contamination would require appropriate surface and sub-surface exploration and testing. The findings of this report were developed in a manner consistent with a level of care and skill normally exercised by members of the environmental science and engineering profession currently practising under similar conditions.

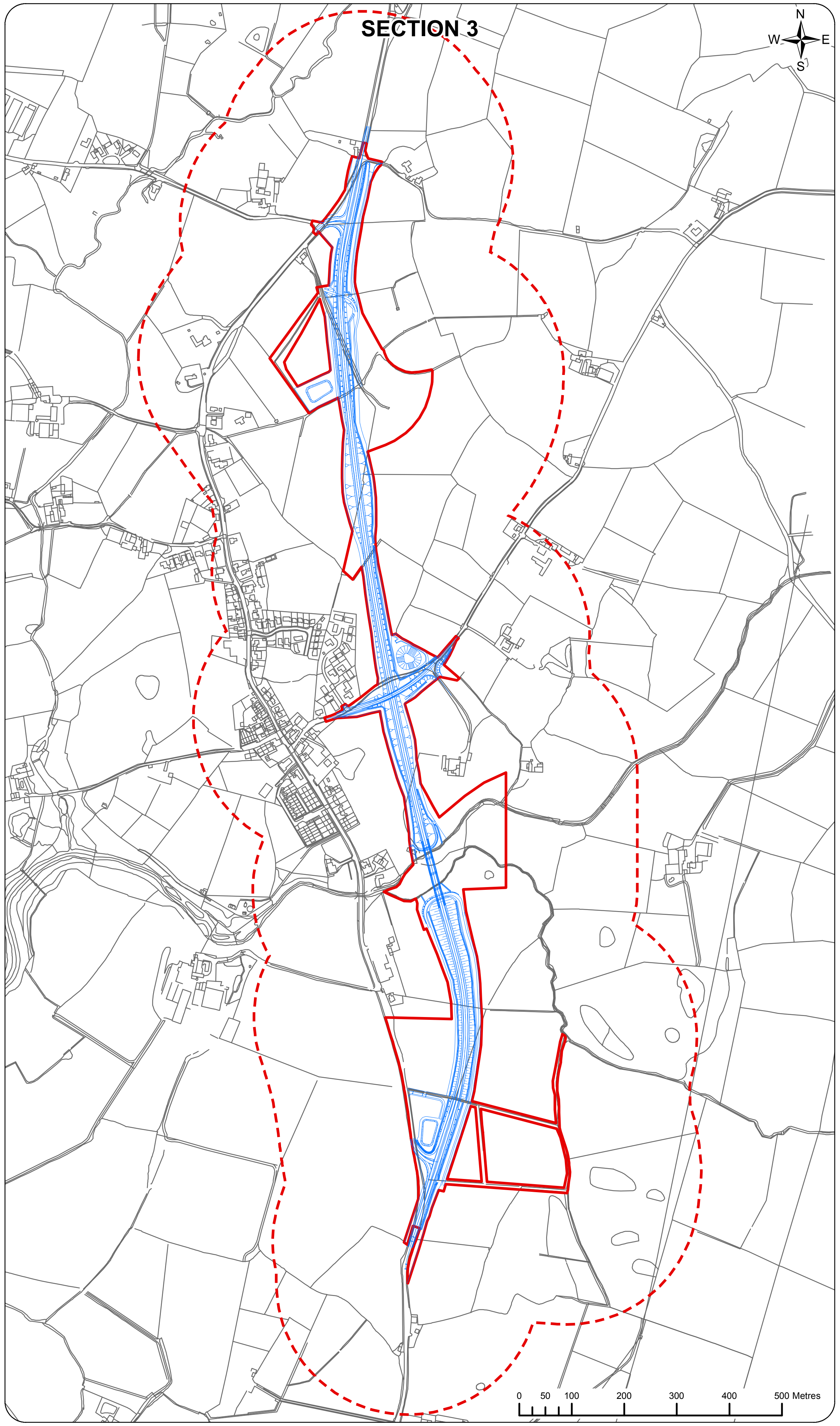
A number of the findings and conclusions presented in this report are based on information provided by third parties and/or historical records, which Horizon Nuclear Power Wylfa Limited has relied on in good faith. Jacobs accepts no responsibility for any deficiency, misstatements, or inaccuracy contained in this report as a result of errors, omissions or misstatements of said third parties or from information obtained from these.

If new information is obtained or developed during future work (which may include excavations, borings or other studies), Jacobs should be requested to re-evaluate the conclusions of this report, and to provide amendments as required.

# Figures

# FIGURE 1



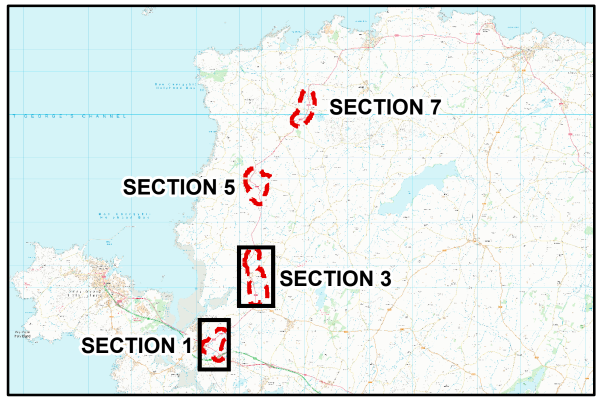




Legend

A5025 Off-line Highway Improvements

Extent of land take

Study area

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|---|---|---|---|---|---|---|
| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |

Client

HORIZON NUCLEAR POWER

Project

WYLFA NEWYDD PROJECT
ENVIRONMENTAL STATEMENT

Drawing Title

APPENDIX G7-2
SOILS AND GEOLOGY STUDY AREA -
SECTIONS 1 AND 3

| | | |
|---|---|---|
| Scale @ A3 | 1:8,500 (Section 1) and 1:10,000 (Section 3) | DO NOT SCALE |
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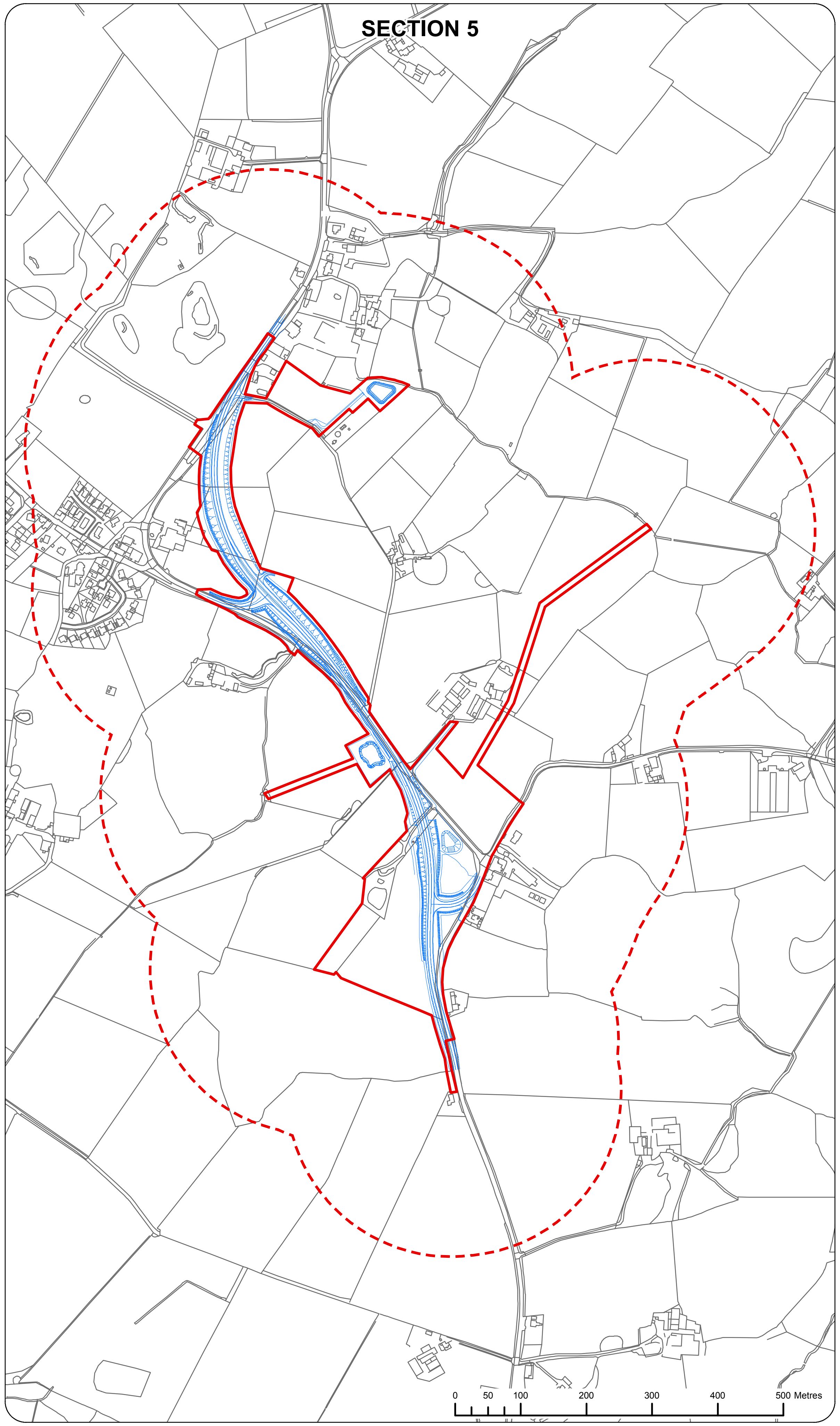
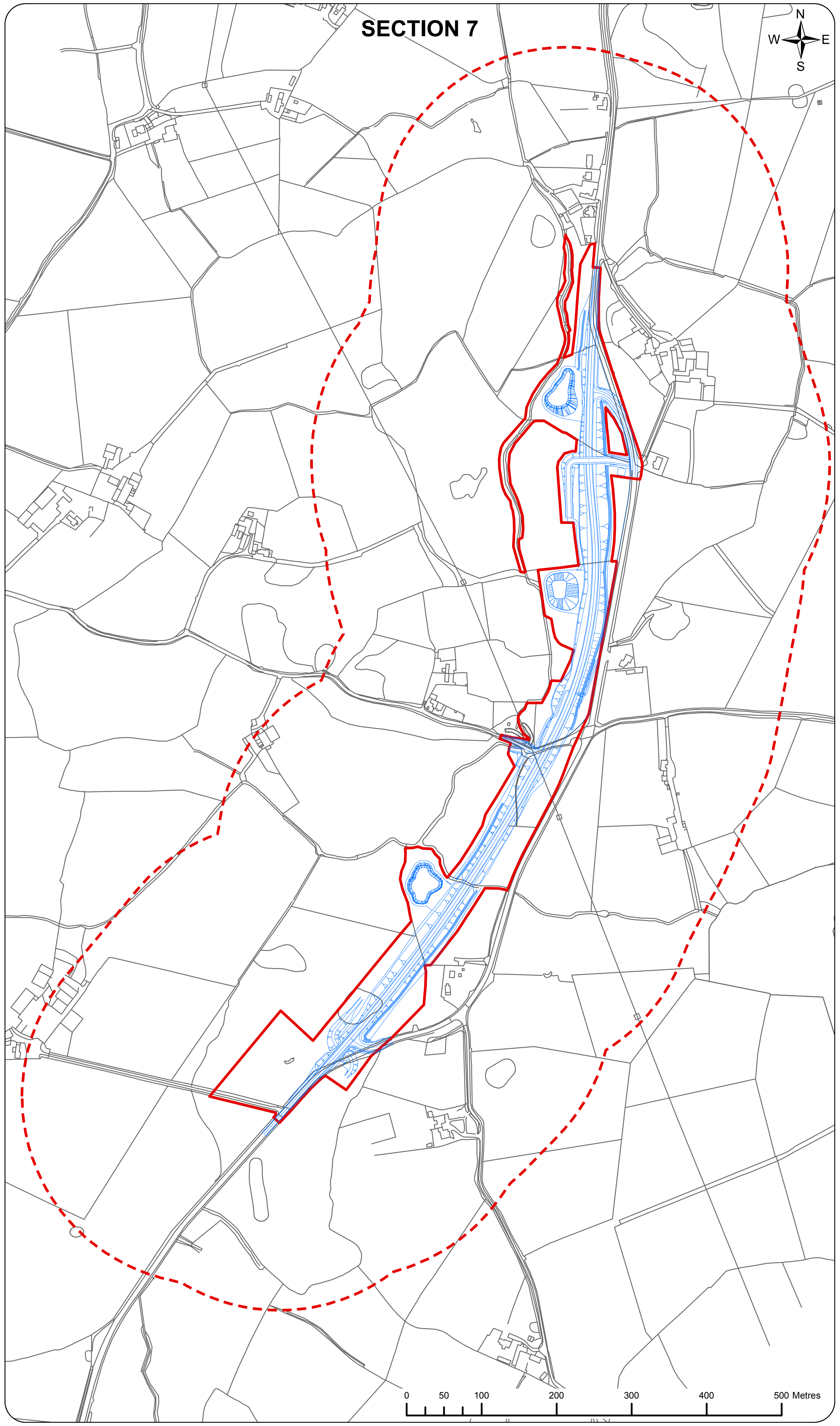
| Client No. | | |
| Drawing No. | 60PO8077_DCO_VOL_G_APP_07_02_01 | |



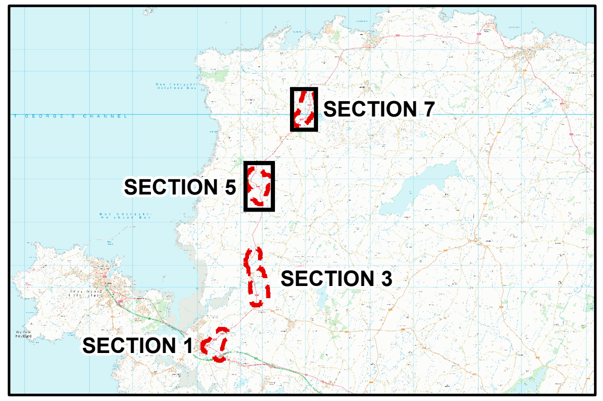






# FIGURE 2

Legend

- A5025 Off-line Highway Improvements
- Extent of land take
- Study area




| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 0 | AUG 17 | Initial Issue | SP | AOD | KY | RB |

Client

HORIZON
NUCLEAR POWER

Project

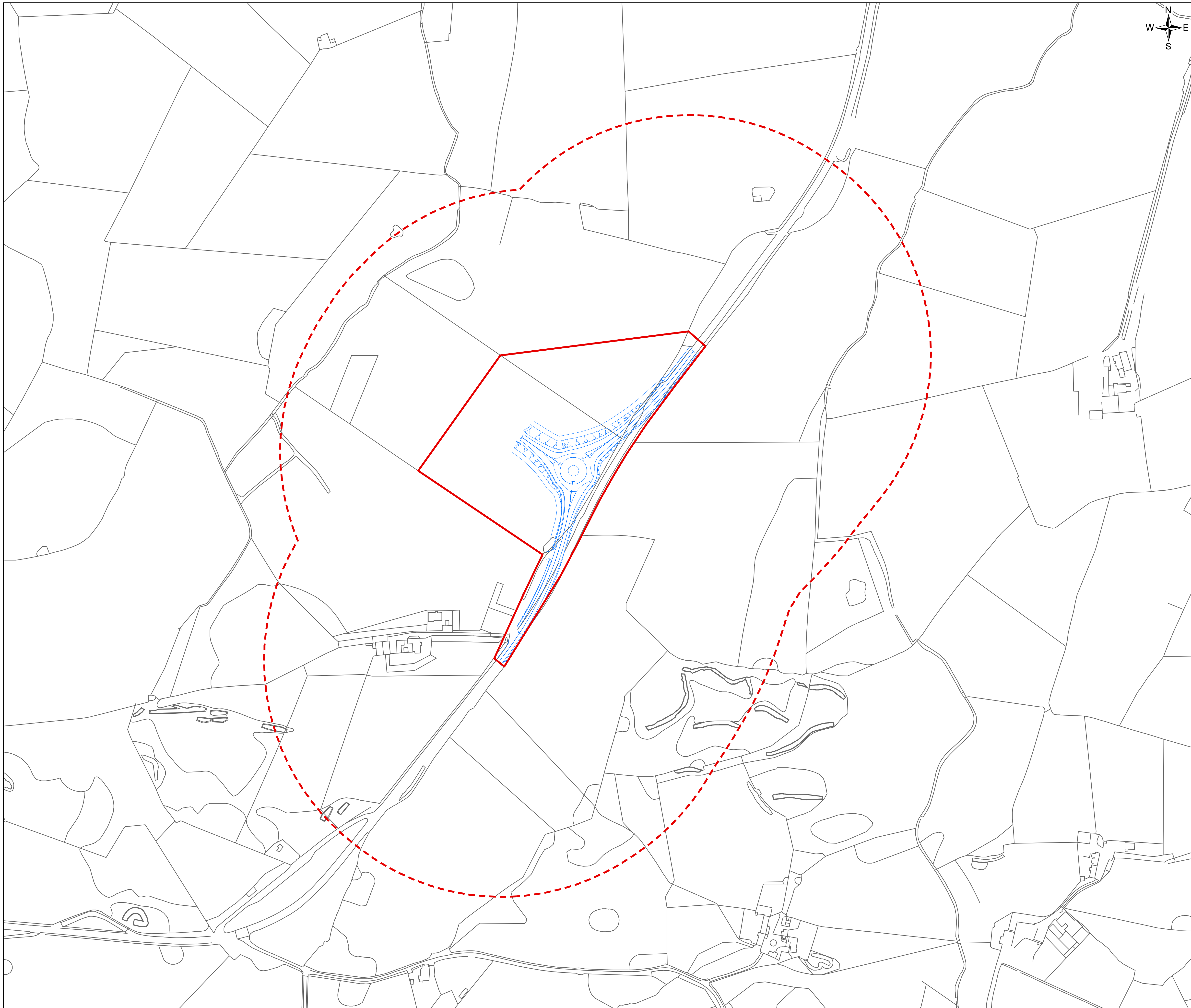
WYLFA NEWYDD PROJECT
ENVIRONMENTAL STATEMENT

Drawing Title

APPENDIX G7-2
SOILS AND GEOLOGY STUDY AREA -
SECTION 5 AND 7

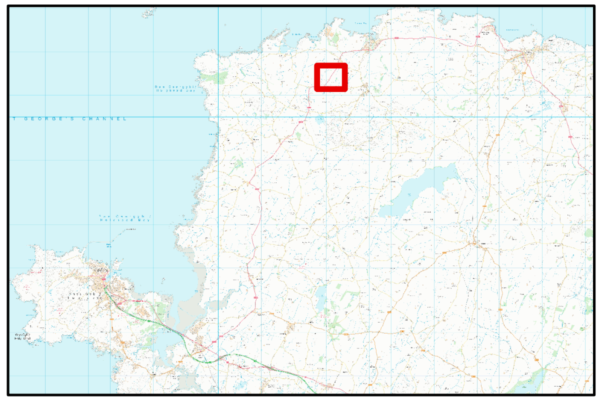
| | | |
|---|---|---|
| Scale @ A3 | 1:8,000 (Section 5) and 1:7,000 (Section 7) | DO NOT SCALE |
| Jacobs No. | 60PO8077 | |
| Client No. | | |
| Drawing No. | 60PO8077_DCO_VOL_G_APP_07_02_02 | |

# FIGURE 3




Legend

- A5025 Off-line Highway Improvements
- Extent of land take
- Study area



| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 0 | AUG 17 | Initial Issue | AD | AOD | KY | RB |

Client

HORIZON NUCLEAR POWER

Project

WYLFA NEWYDD PROJECT
ENVIRONMENTAL STATEMENT

Drawing Title

APPENDIX G7-2
SOILS AND GEOLOGY STUDY AREA -
POWER STATION ACCESS ROAD JUNCTION

| | | |
|---|---|---|
| Scale @ A3 | 1:4,000 | DO NOT SCALE |
| Jacobs No. | 60PO8077 | |
| Client No. | | |

Drawing No.

60PO8077_DCO_VOL_G_APP_07_02_03

0 25 50 100 150 200 250 metres

# Appendices

## Appendix A1 NSRI Soil Report – Section 1

# National Soil Resources Institute

## Soils Site Report

Full Soil Report

National Grid Reference: SH3057680287

Easting: 230576

Northing: 380287

Site Area: 5km x 5km

Prepared by
authorised user:
**Joanne Jeffreys**
Jacobs

2 March 2015

# Citations

Citations to this report should be made as follows:

National Soil Resources Institute (2015) Full Soils Site Report for location 230576E, 380287N, 5km x 5km, National Soil Resources Institute, Cranfield University. Accessed via https://www.landis.org.uk/sitereporter/.

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# About this report

This Soils Site Report identifies and describes the properties and capacities of the soil at your specified location as recorded in the 1:250,000 scale National Soil Map for England and Wales. It has been produced by Cranfield University's National Soil Resources Institute.

The National Soil Map represents the most accurate comprehensive source of information about the soil at the national coverage in England and Wales. It maps the distribution of soil mapping units (termed soil associations) which are defined in terms of the main soil types (or soil series) that were recorded for each soil association during field soil survey. Each soil association is named after its principal soil series and these bear the location name from where they were first described (e.g. Windsor). Each of these soil associations have differing environmental characteristics (physical, chemical and biological) and it is by mapping these properties that the range of thematic maps in this report have been produced.

Soil types and properties vary locally, as well as at the landscape scale. It is not possible to identify precisely the soil conditions at a specific location without first making a site visit. We have therefore provided you with information about the range of soil types we have identified at and around your selected location. Schematic diagrams are also provided to aid accurate identification of the soil series at your site.

Whilst an eight-figure national grid reference should be accurate to within 100m, a single rural Postcode can cover a relatively large geographical area. Postcodes can therefore be a less precise basis for specifying a location. The maps indicate the bounded area the reports relate to.

Your Soils Site Report will enable you to:

- identify the soils most likely to be present at and immediately around your specified location;
- understand the patterns of soil variation around your location and how these correlate with changes in landscape;
- identify the nature and properties of each soil type present within the area;
- understand the relevant capacities and limitations of each of the soils and how these might impact on a range of factors such as surface water quality.

Provided that this Soils Site Report is not modified in any way, you may reproduce it for a third-party.

For more information visit www.landis.org.uk/reports

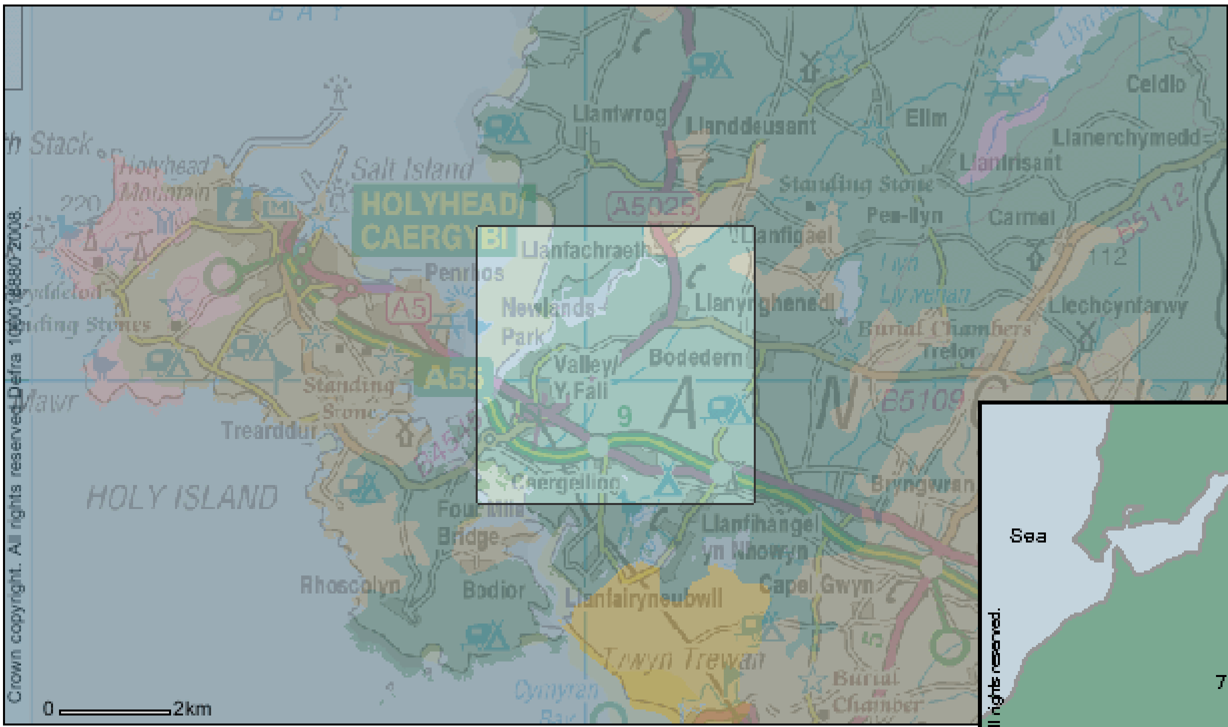
# Table of Contents

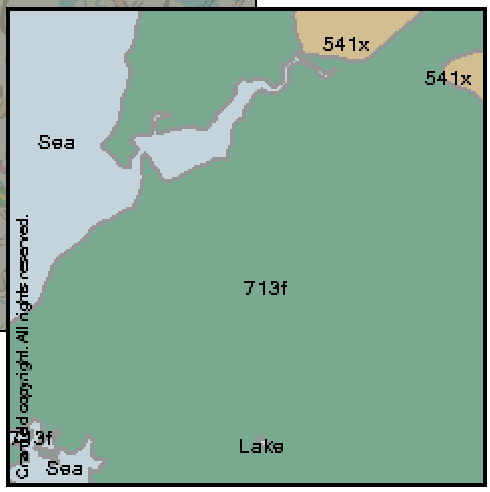
# 1. SOIL THEMATIC MAPS

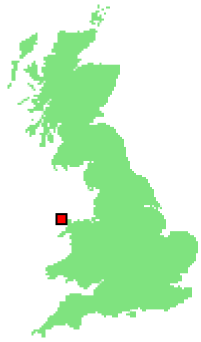
This section contains a series of maps of the area surrounding your selected location, based on the 1:250,000 scale National Soil Map, presenting a number of thematic maps relating to the characteristics of the soils. These provide an overview of the nature and condition of the local soil conditions. It is these conditions that may be used to infer the response of an area to certain events (with the soil as a receptor), such as pollution contamination from a chemical spill, or an inappropriate pesticide application and the likelihood of these materials passing though the soil to groundwater. Other assessments provide an insight into the way a location may impact, by corrosive attack or ground movement, upon structures or assets within the ground, for example building or engineering foundations or pipes and street furniture.

Soil is a dynamic environment with many intersecting processes, chemical, physical and biological at play. Even soils 'sealed' over by concrete and bitumen are not completely dormant. The way soils respond to events and actions can vary considerably according to the properties of the soil as well as other related factors such as land-use, vegetation, topography and climate. There are many threats facing our national soil resource today and forthcoming legislation such as the proposed Soil Framework Directive (SFD) (COM(2006) 232) will seek to identify measures aimed towards soil protection and ensuring the usage of soils in the most sustainable way. This report is therefore a useful snapshot of the soil properties for your given area, providing a summary of a broad range of ground conditions.

## 1a. SOILS - SPATIAL DISTRIBUTION



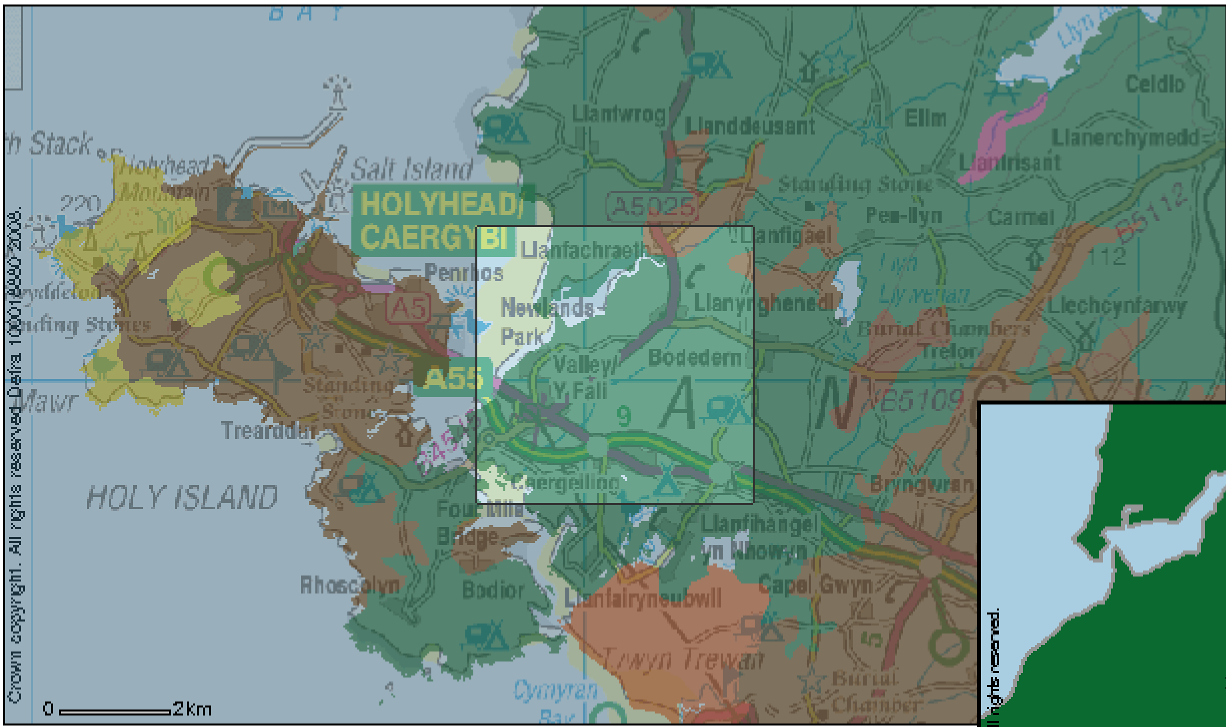
## SOIL ASSOCIATION MAP UNIT KEY

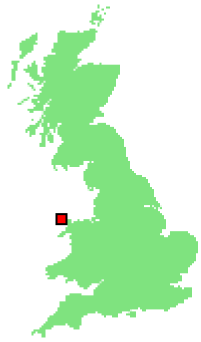
**EAST KESWICK 1** 541x
*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

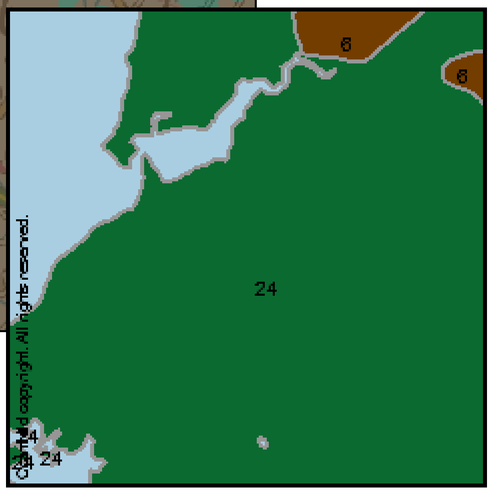
**BRICKFIELD 2** 713f
*Slowly permeable seasonally waterlogged fine loamy soils.*

Soil associations represent a group of soil series (soil types) which are typically found occurring together, associated in the landscape (Avery, 1973; 1980; Clayden and Hollis, 1984). Soil associations may occur in many geographical locations around the country where the environmental conditions are comparable. For each of these soil associations, a collection of soil types (or soil series) are recorded together with their approximate proportions within the association. Soil associations have codes as well as textual names, thus code '554a' refers to the 'Frilford' association. Where a code is prefixed with 'U', the area is predominantly urbanised (e.g. 'U571v'). The soil associations for your location, as mapped above, are described in more detail in Section 2: Soil Association Descriptions.

# 1b. HYDROLOGY OF SOIL TYPE (HOST)






## HYDROLOGY OF SOIL TYPE KEY

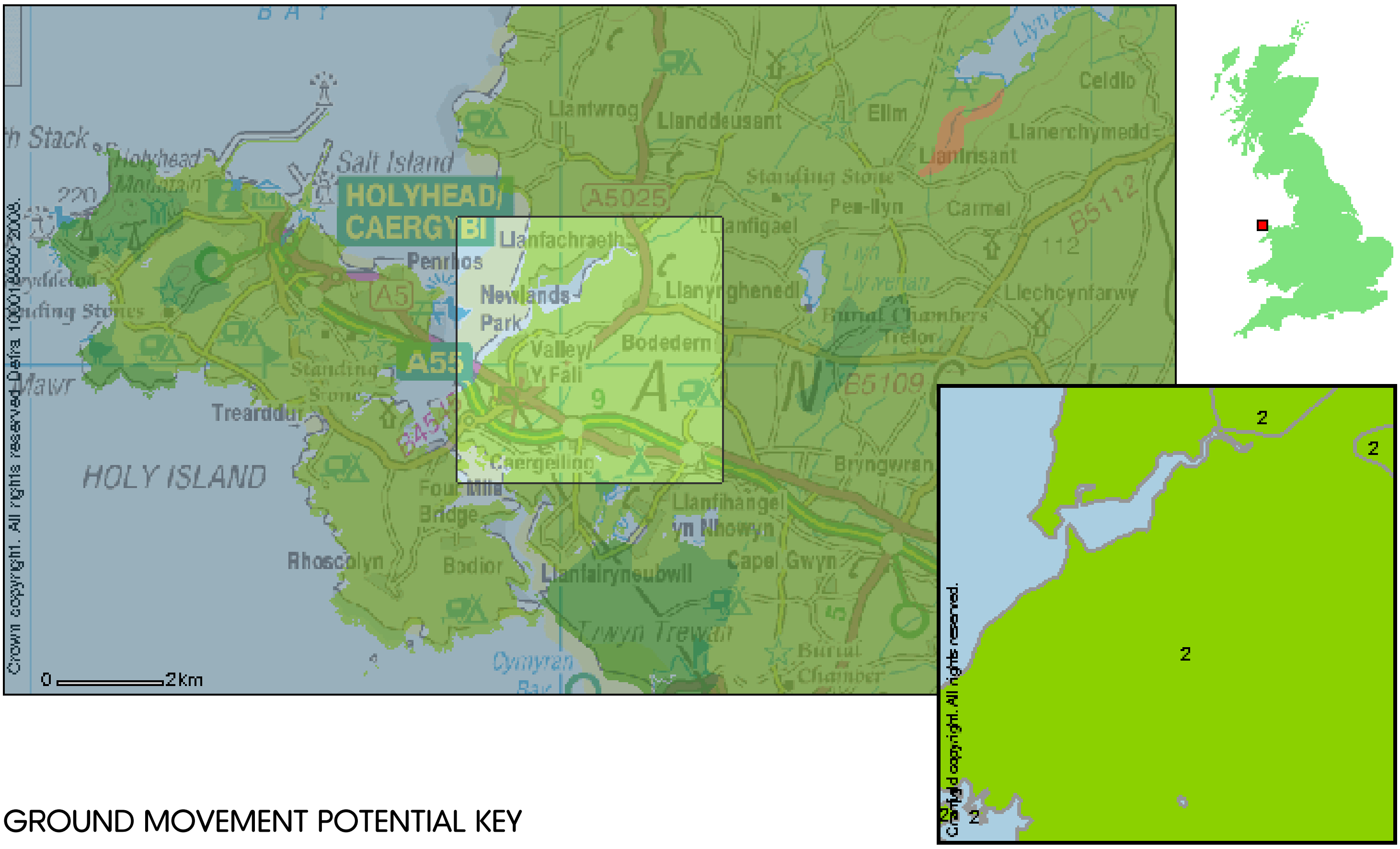
24 - *Slowly permeable, seasonally waterlogged soils over slowly permeable substrates with negligible storage capacity*

6 - *Free draining permeable soils in unconsolidated loams or clays with low permeability and storage capacity*

HOST CLASS DESCRIPTION

The Hydrology of Soil Types (HOST) classification describes the dominant pathways of water movement through the soil and, where appropriate, the underlying substrate. Eleven drainage models are defined according to the permeability of the soil and its substrate and the depth to a groundwater table, where one is present (Boorman et al,1995). These are further subdivided into 29 HOST classes to which all soil series have been assigned. These classes identify the way soil water flows are partitioned, with water passing over, laterally through, or vertically down the soil column. Analysis of the river hydrograph and the extent of soil series for several hundred gauged catchments allowed mean values for catchment hydrological variables to be identified for each HOST class, The HOST classification is widely used to predict river flows and the frequency and severity of flood events and also to model the behaviour of diffuse pollutants (Hollis et al, 1995).

## 1c. GROUND MOVEMENT POTENTIAL




## GROUND MOVEMENT POTENTIAL KEY

- 1 - *Very low*
- 2 - *Low*
- 3 - *Moderate*
- 4 - *High*
- 5 - *Very high*

* If a High class is starred, a 'Very High' ground movement potential is likely to be achieved if these soils are drained to an effective depth of at least two metres.

### GROUND MOVEMENT POTENTIAL DESCRIPTION

Clay-related ground movement is the most widespread cause of foundation failure in the UK and is linked to seasonal swelling and shrinkage of the clay. The content of clay within the soils of your selected area has therefore a direct bearing upon the likelihood of ground movement.

Among the inorganic particles that constitute the solid component of any soil, clay particles are the smallest and defined as being <0.002 mm - equivalent spherical diameter (esd) in size. Clay particles occur in most kinds of soil but they only begin to exert a predominant influence on the behaviour of the whole soil where there is more than 35 per cent (by weight) of clay-sized material present.

Because clay particles are very small and commonly platy in shape they have an immense surface area onto which water can be attracted, relative to the total volume of the soil material. In addition to surface attraction or inter-crystalline absorption of water, some clay minerals, those with three layers of atoms (most other kinds of clay have only two layers of atoms) are able to absorb and hold additional water between these layers. It is these types of clay mineral, which are widespread in British soils and commonly known as *smectites* that have the greatest capacity to shrink and swell.

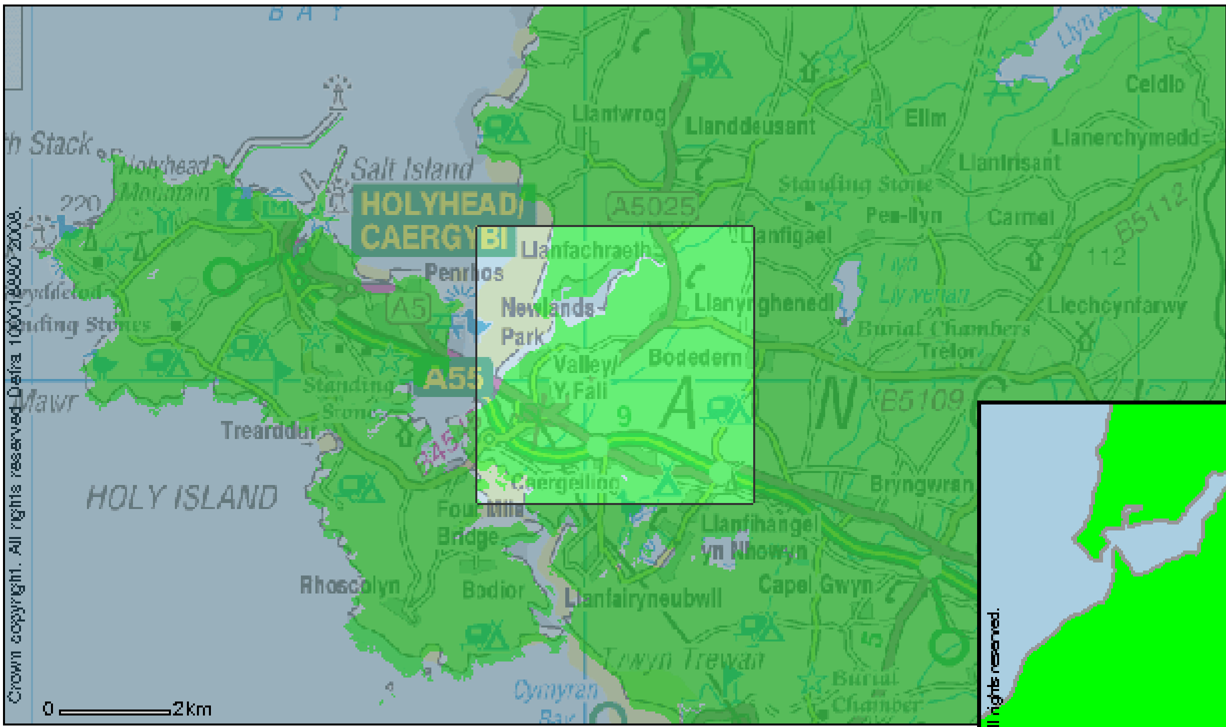
In a natural undisturbed condition, the moisture content of deep subsoil clay does not change greatly through the year and consequently there are no changes in volume leading to shrinkage and swelling. However, when clays are exposed at or near the ground surface and especially when vegetation is rooting in them seasonal moisture and volume changes can be dramatic. Plants and trees transpire moisture from the soil to support their growth and transfer necessary nutrients into their structures. Surface evaporation

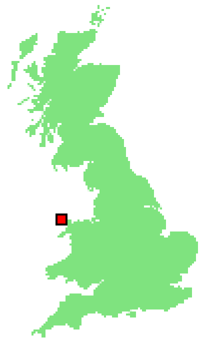
also takes place from soil and plant structures, and the combination of evaporation from surfaces and transpiration by plants and trees is termed *evapotranspiration*. Thus, the layer of soil material down to 2m depth into which plants will root is critical when assessing the vulnerability of land to subsidence.

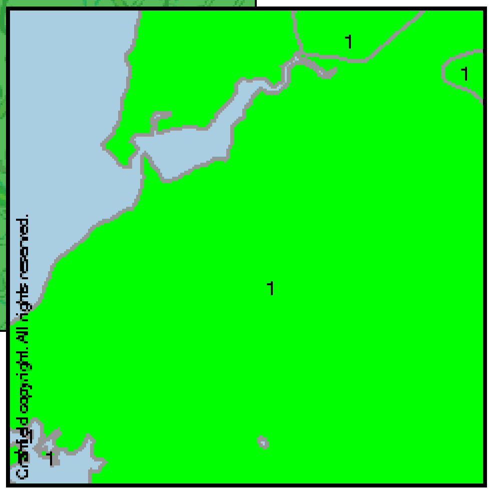
Whenever soil moisture is continuously being replenished by rainfall, the soil moisture reserves will be unaffected by the removal of moisture by plants as there is no net loss. However, in many parts of Britain, particularly in the south and east, summer rainfall is small and is exceeded by evapotranspiration. Water reserves are then not sufficiently replenished by rainfall and so a soil moisture deficit develops. The water removed from a clayey soil by evapotranspiration leads to a reduction in soil volume and the consequent shrinkage causes stress in the soil materials leading in turn to stress on building foundations that are resting in the soil (Hallett, et al, 1994).

The foundations themselves may then move and thus cause damage to building structures. This problem can be exacerbated by the fact that the soil beneath the structure may not dry out uniformly, so that any lateral pressure exerted on the building foundation is made effectively greater. This assessment identifies the likelihood of soil conditions being prone to ground movement given these other factors.

## 1d. FLOOD VULNERABILITY






### FLOOD VULNERABILITY CLASS KEY

0 - *Major risk*

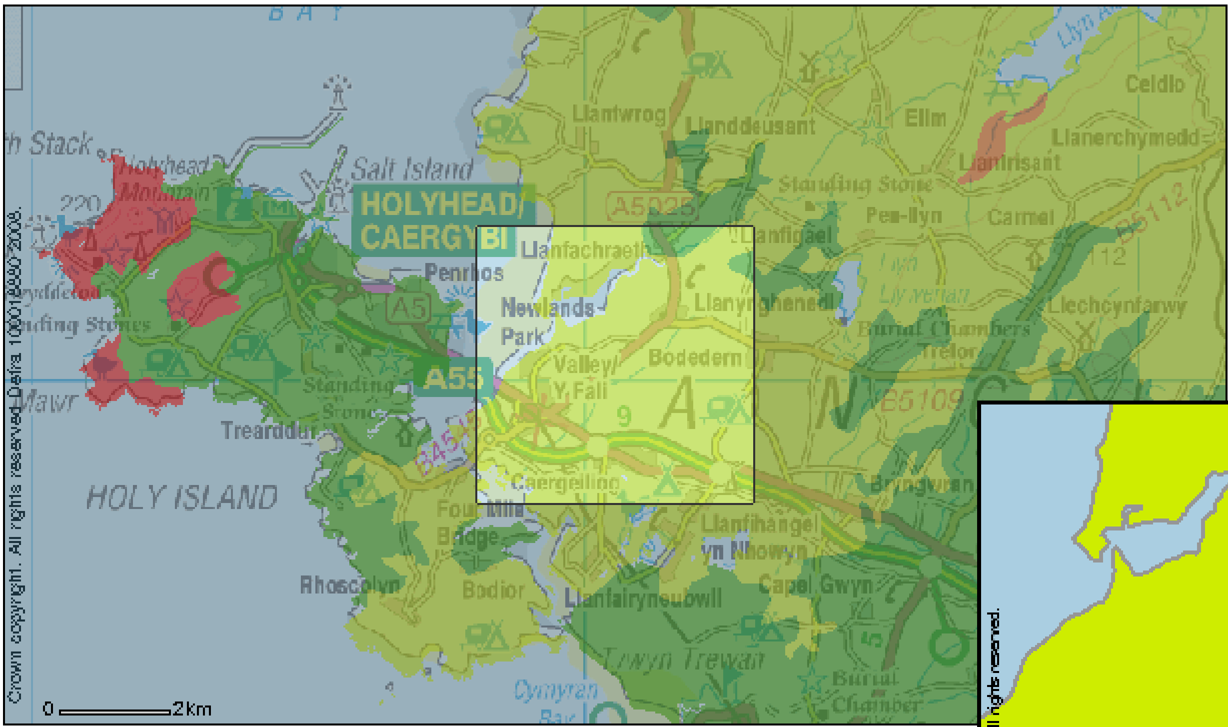
1 - *Minor risk*

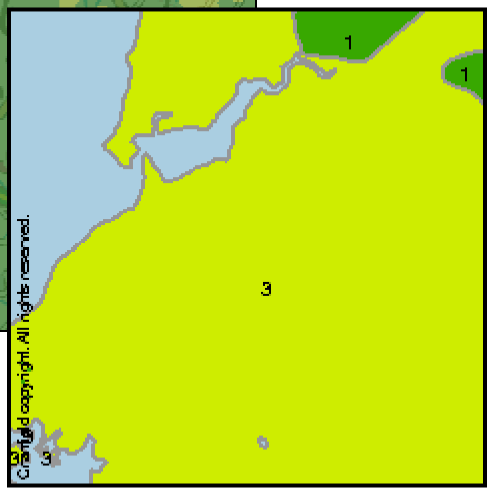
FLOOD VULNERABILITY DESCRIPTION

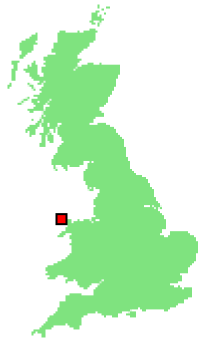
The inundation of properties by flood water can occur in a number of circumstances. Surface run-off can collect on low-lying land from upslope following heavy rainfall. More commonly rivers, lakes and/or the sea extend beyond their normal limits as a result of prolonged or intense rainfall, unusually high tides and/or extreme wind events. Water damage to properties and their contents is compounded by the deposition of sediment suspended in the flood waters. The spatial distribution of such waterborne sediment (or alluvium as defined in soil science) is one basis upon which land that has been subject to historical flooding can be mapped, and this forms a basis for present-day flooding risk assessment.

Both riverine and marine alluvium are identified as distinct soil parent materials within the British soil classifications. Combining soil map units that are dominated by soil series developed in alluvium across Great Britain identifies most of the land that is vulnerable to flooding. This assessment does not account for man-made flood defence measures, showing instead the areas where once water has stood.

# 1e. RISK OF CORROSION TO FERROUS IRON



## RISK OF CORROSION TO FERROUS IRON KEY

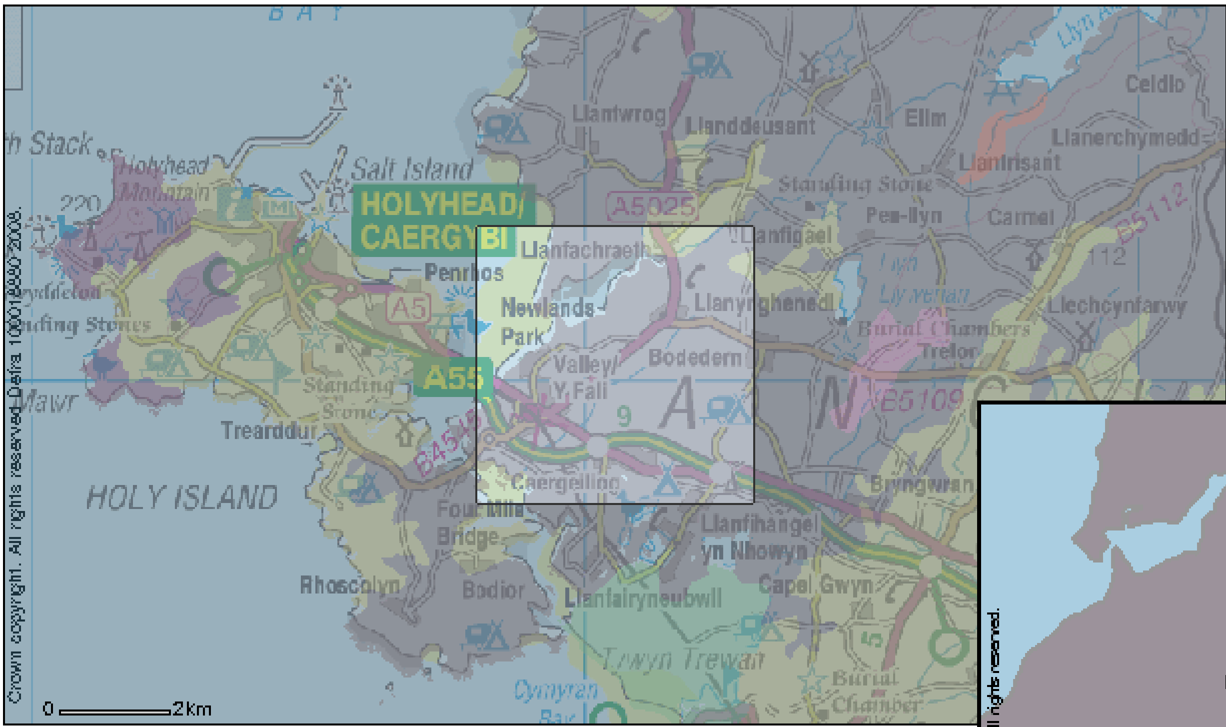
- 1 - *Non-aggressive*
- 2 - *Slightly Aggressive*
- 3 - *Moderately Aggressive*
- 4 - *Highly Aggressive*
- 5 - *Very highly Aggressive*
- 6 - *Impermeable Rock*

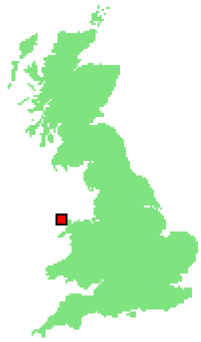
* If a class is starred, it is assumed that there are moderate amounts of sulphate in the soil. If there is abundant sulphate present, the soil may be one class more aggressive. Conversely, if there is very little sulphate, the soil may be one class less aggressive to buried ferrous iron.

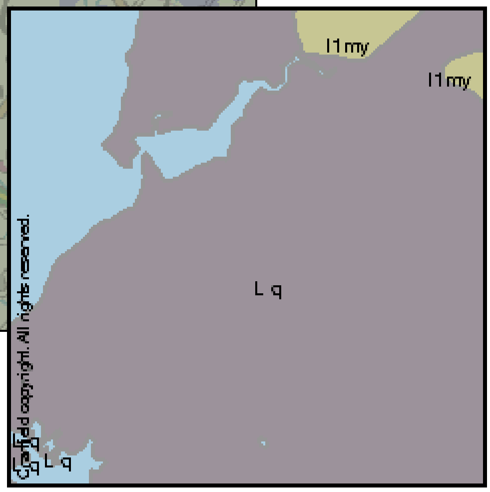
RISK OF CORROSION TO FERROUS IRON DESCRIPTION

Buried iron pipes and other infrastructure corrode at rates that are influenced by soil conditions (Jarvis and Hedges, 1994). Soil acidity, sulphide content, aeration and wetness all influence the corrosivity of the soil. These factors are used to map 5 major classes of relative corrosivity.

## 1f. PESTICIDE LEACHING RISK






### PESTICIDE LEACHING CLASS KEY

- **I1my** - *Deep loamy soil; groundwater at moderate depth*
- **L q** - *Impermeable soils over soft substrates of low or negligible storage capacity that sometimes conceal groundwater bearing rocks at depth*

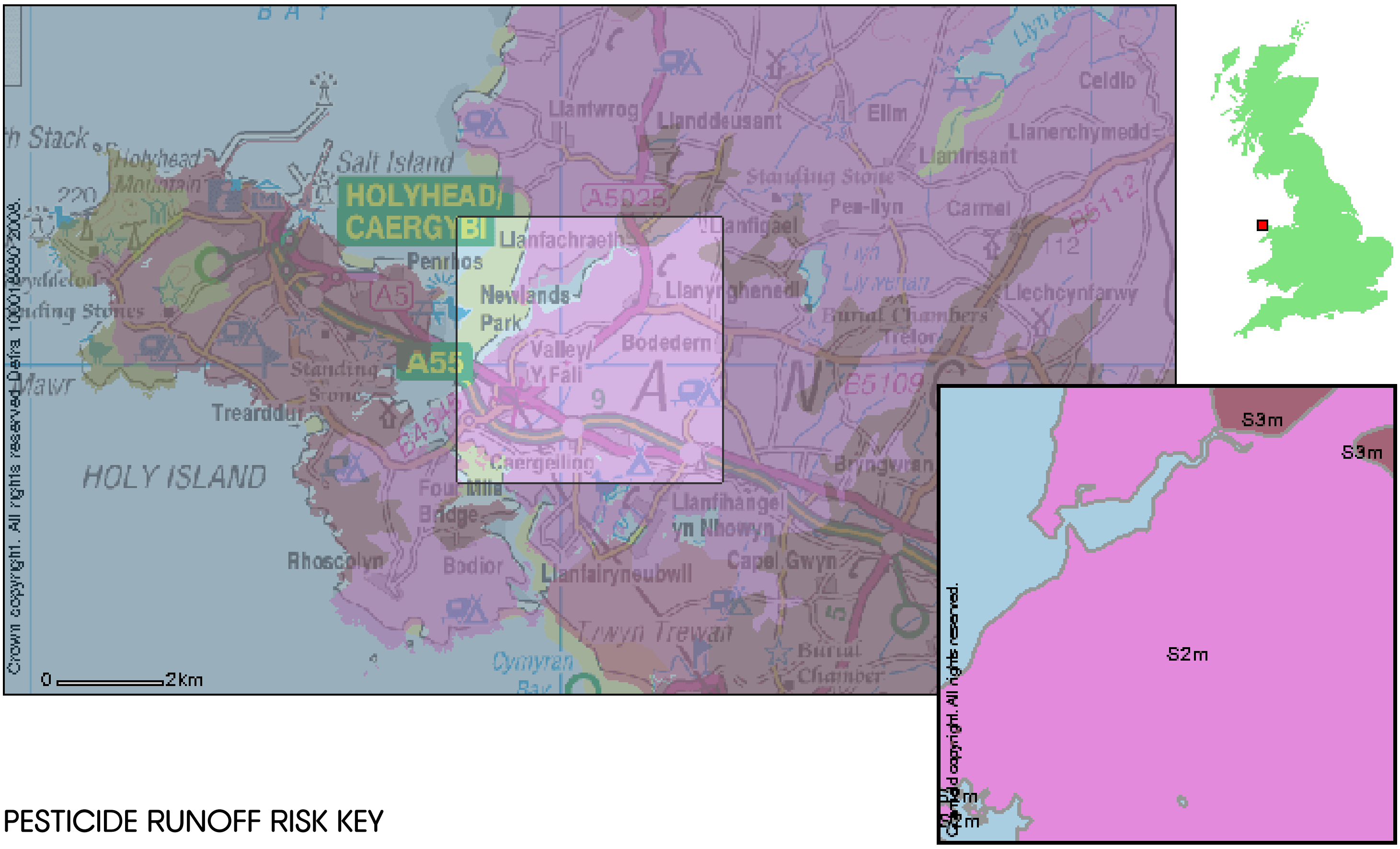
PESTICIDE LEACHING CLASS DESCRIPTION

The natural permeability and water regime of soils are influential in determining the fate and behaviour of pesticides applied to the crop and soil surface (Hollis et al, 1995). A system of vulnerability assessment was devised as part of the national system for Policy and Practice for the Protection of Groundwater. This divided soils into three primary vulnerability classes.

H - Soils of high leaching capacity with little ability to attenuate non-adsorbed pesticide leaching which leave underlying groundwater vulnerable to pesticide contamination.
I – Soils of intermediate leaching capacity with a moderate ability to attenuate pesticide leaching.
L - Soils of low leaching capacity through which pesticides are unlikely to leach.

The primary classes have been further subdivided into nearly forty subclasses. These subclasses, with their descriptions, are mapped above. These classes do not account for differences in land cultivation, which can also have a significant impact on pesticide behaviour.

# 1g. PESTICIDE RUNOFF RISK



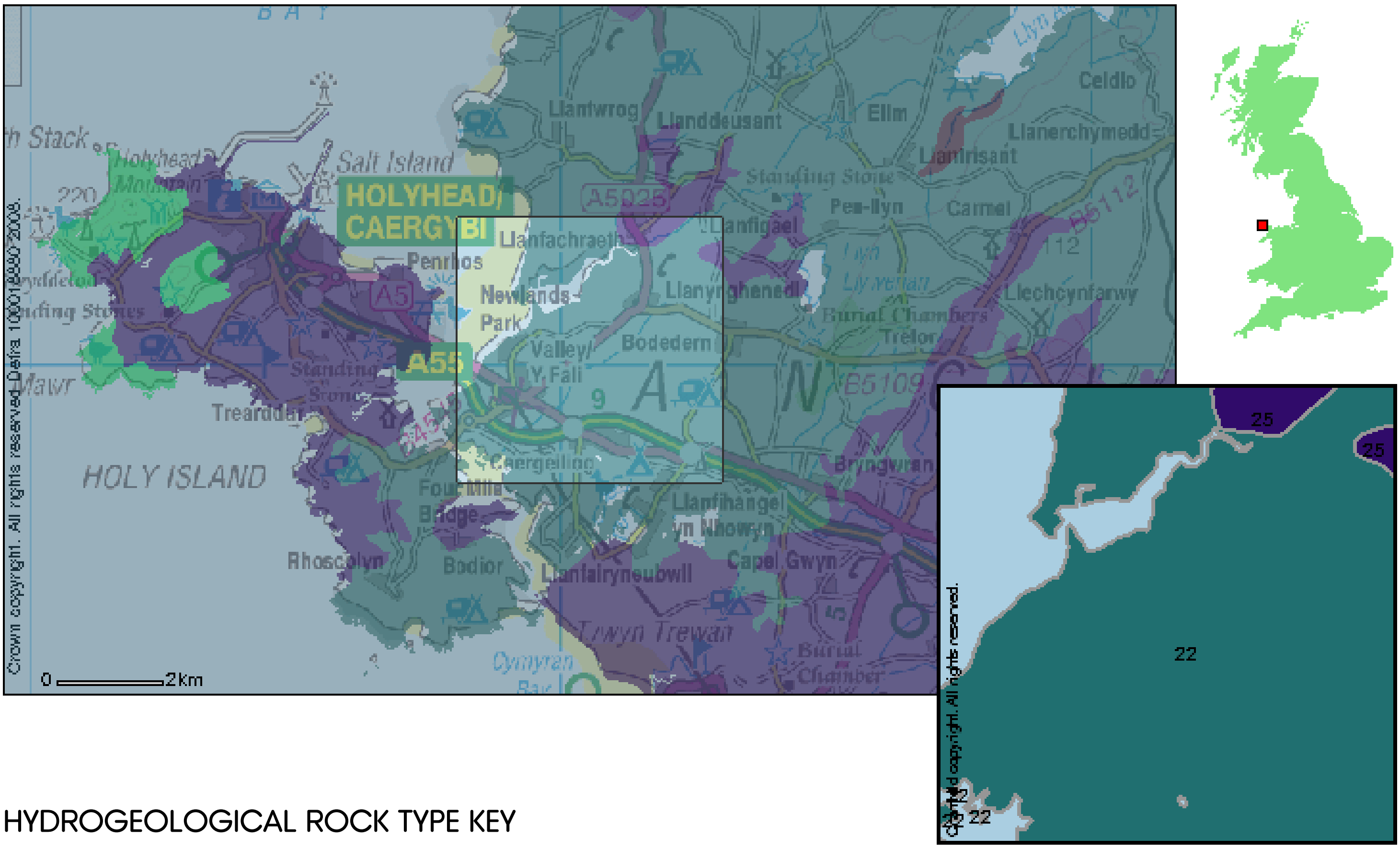

## PESTICIDE RUNOFF RISK KEY

- **S2m** - *Soils with high run-off potential but moderate adsorption potential*
- **S3m** - *Soils with moderate run-off potential and moderate adsorption potential*

PESTICIDE RUNOFF RISK DESCRIPTION

The physical properties and natural water regime of soils influence the speed and extent of lateral water movement over and through the soil at different depths (Hollis et al, 1995). At as result, soils can be classed according to the potential for pesticide run-off. Five runoff potential classes are identified for mineral soils and a further two for peat soils. The mineral soil classes are further subdivided according to the potential for pesticide adsorption.

## 1h. HYDROGEOLOGICAL ROCK TYPE



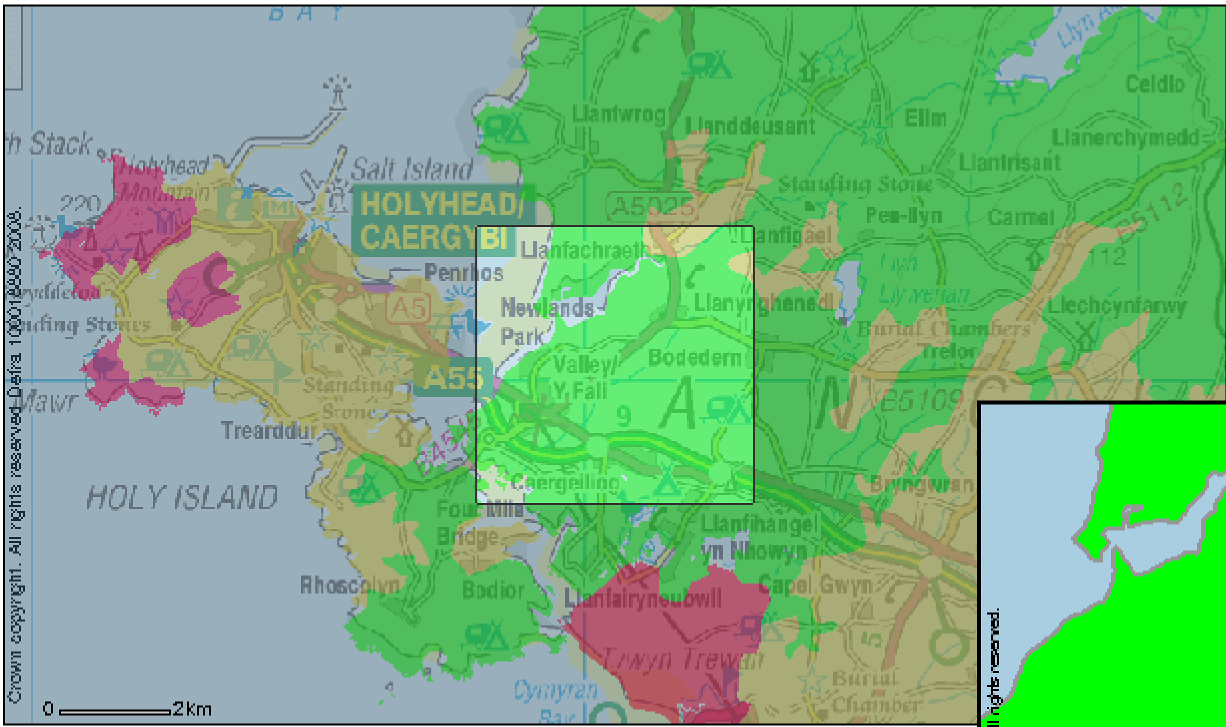

### HYDROGEOLOGICAL ROCK TYPE KEY

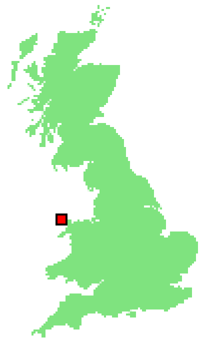
- 22 - *till and compact Head*
- 25 - *loamy drift*

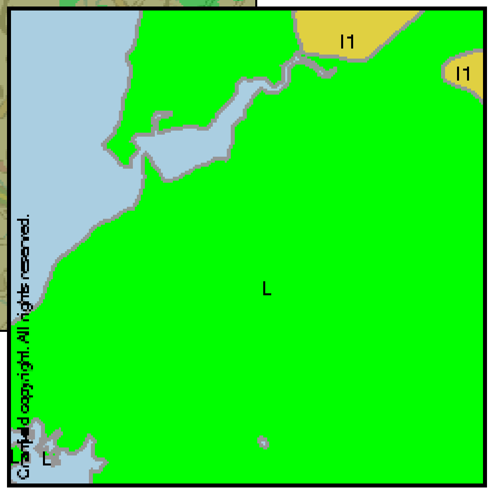
HYDROGEOLOGICAL ROCK TYPE DESCRIPTION

The hydrogeological classification of the soil parent materials provides a framework for distinguishing between soil substrates according to their general permeability and whether they are likely to overlie an aquifer. Every soil series has been assigned one of the 32 substrate classes and each of these is characterised according to its permeability (being characterised as permeable, slowly permeable or impermeable). For further information, see Boorman et al (1995).

## 1i. GROUND WATER PROTECTION POLICY (GWPP) LEACHING





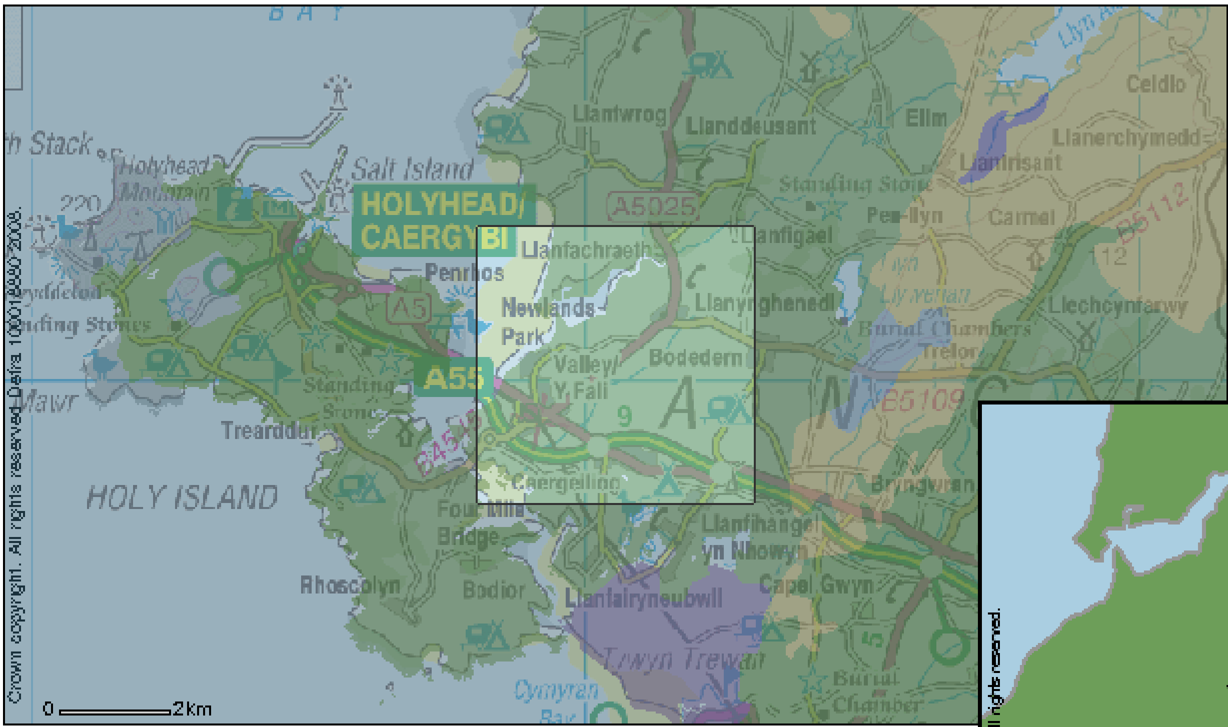

### GWPP LEACHING CLASS KEY

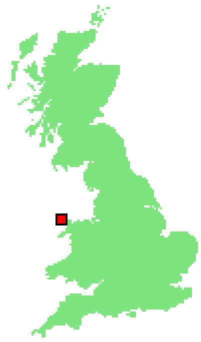
- I1 - *Soils of intermediate leaching potential which have a moderate ability to attenuate a wide range of diffuse source pollutants but in which it is possible that some non-adsorbed diffuse source pollutants and liquid discharges could penetrate the soil layer*
- L - *Soils in which pollutants are unlikely to penetrate the soil layer either because water movement is largely horizontal or because they have a large ability to attenuate diffuse source pollutants*

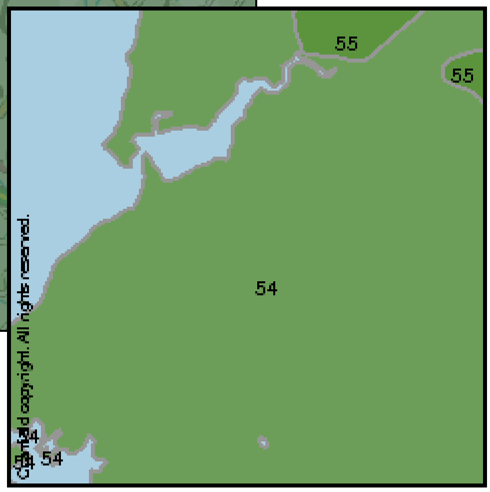
GWPP LEACHING CLASS DESCRIPTION

The Ground Water Protection Policy classes describe the leaching potential of pollutants through the soil (Hollis, 1991; Palmer et al, 1995). The likelihood of pollutants reaching ground water is described. Different classes of pollutants are described, including liquid discharges adsorbed and non-adsorbed pollutants.

## 1j. SOIL PARENT MATERIAL





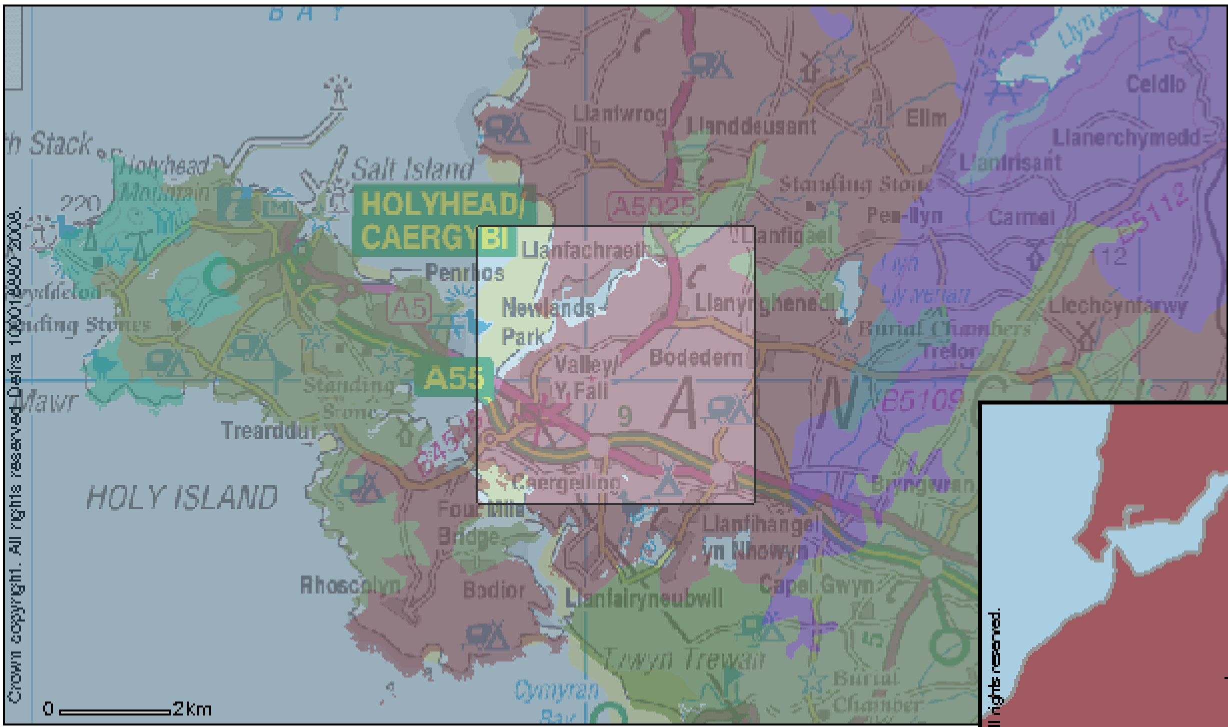

### SOIL PARENT MATERIAL KEY

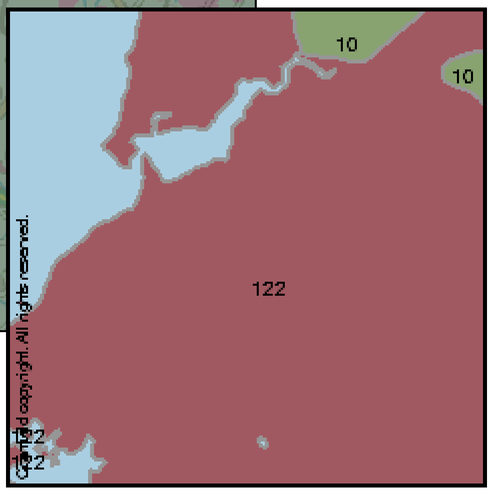
- 54 - *Drift from Palaeozoic and Mesozoic sandstone and shale*
- 55 - *Drift from Palaeozoic sandstone and shale*

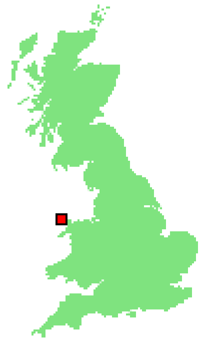
SOIL PARENT MATERIAL DESCRIPTION

Along with the effects of climate, relief, organisms and time, the underlying geology or 'parent material' has a very strong influence on the development of the soils of England and Wales. Through weathering, rocks contribute inorganic mineral grains to the soils and thus exhibit control on the soil texture. During the course of the creation of the national soil map, soil surveyors noted the parent material underlying each soil in England and Wales. It is these general descriptions of the regional geology which is provided in this map.

## 1k. EXPECTED CROPS AND LAND USE



### EXPECTED CROPS AND LAND USE KEY

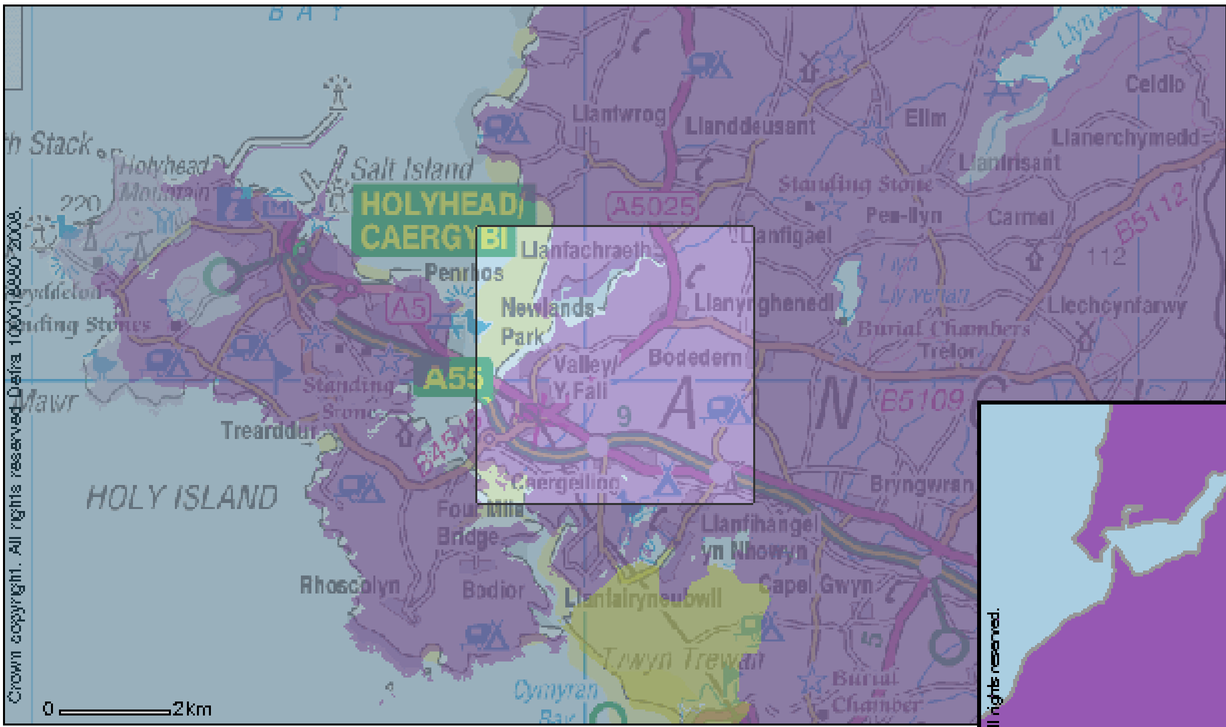
10 - *Cereals and grassland in the Northern Region; stock rearing on permanent grassland in Wales.*

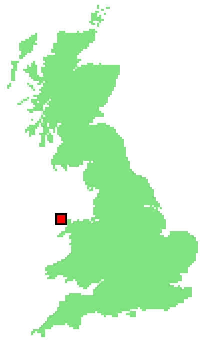
122 - *Dairying and stock rearing on permanent or short term grassland; some cereals in drier areas.*

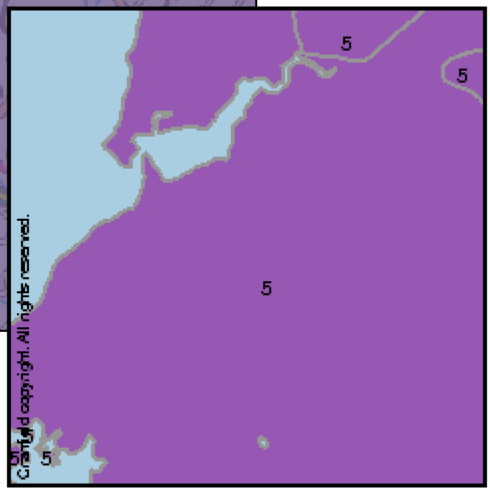
EXPECTED CROPS AND LAND USE DESCRIPTION

Individual soils are commonly associated with particular forms of land cover and land use. Whilst the soil surveyors were mapping the whole of England and Wales, they took careful note of the range of use to which the land was being put. This map shows the most common forms of land use found on each soil unit.

## 11. NATURAL SOIL FERTILITY





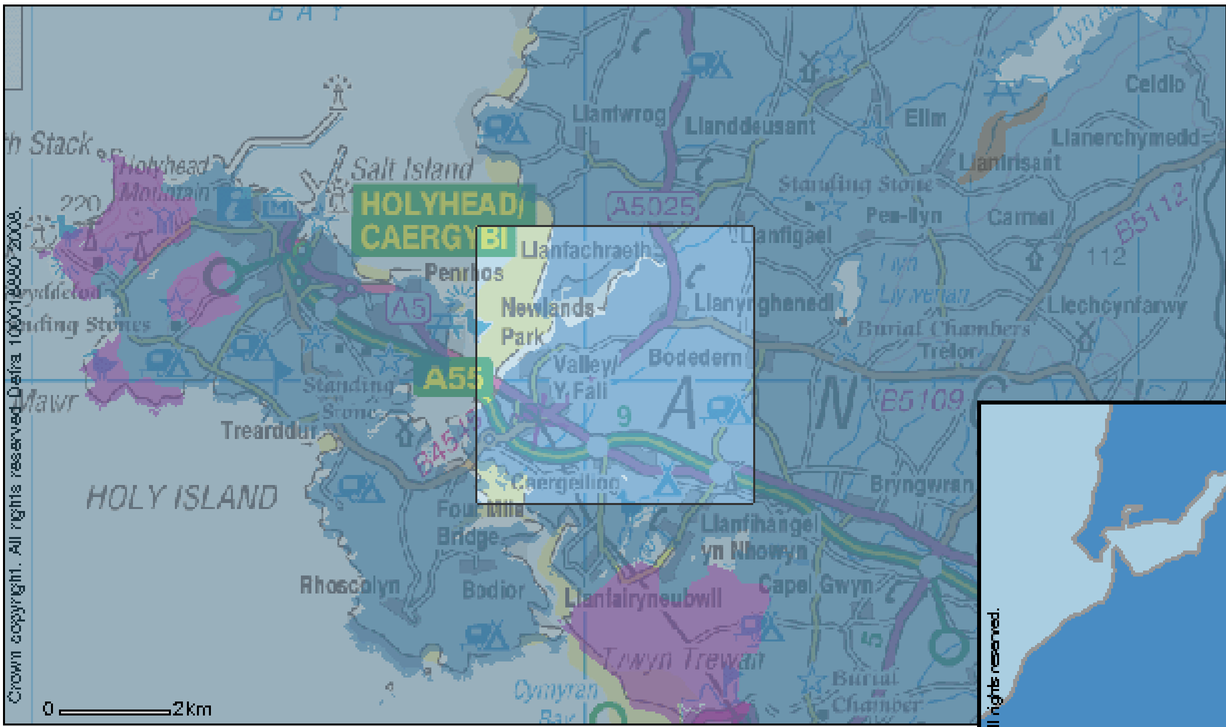

### NATURAL SOIL FERTILITY KEY

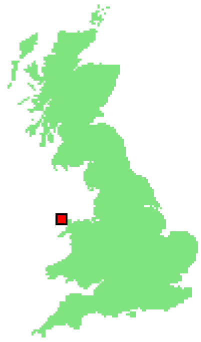
5 - *Low*

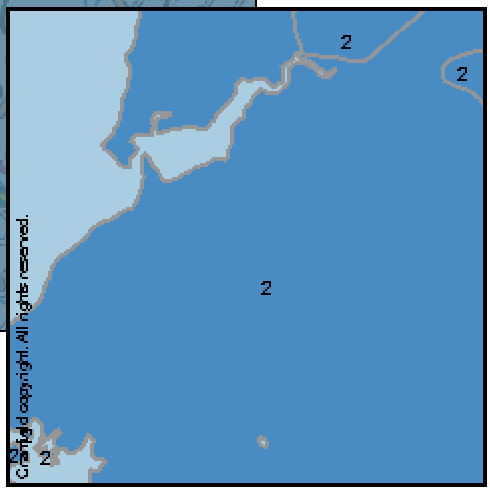
NATURAL SOIL FERTILITY DESCRIPTION

Soil fertility can be greatly altered by land management especially through the application of manures, lime and mineral fertilisers. What is shown in this map, however, is the likely natural fertility of each soil type. Soils that are very acid have low numbers of soil-living organisms and support heathland and acid woodland habitats. These are shown as of very low natural fertility. Soils identified as of low natural fertility are usually acid in reaction and are associated with a wide range of habitat types. The moderate class contains neutral to slightly acid soils, again with a wide range of potential habitats. Soil of high natural fertility are both naturally productive and able to support the base-rich pastures and woodlands that are now rarely encountered. Lime-rich soils contain chalk and limestone in excess, and are associated with downland, herb-rich pastures and chalk and limestone woodlands.

## 1m. SIMPLE TOPSOIL TEXTURE





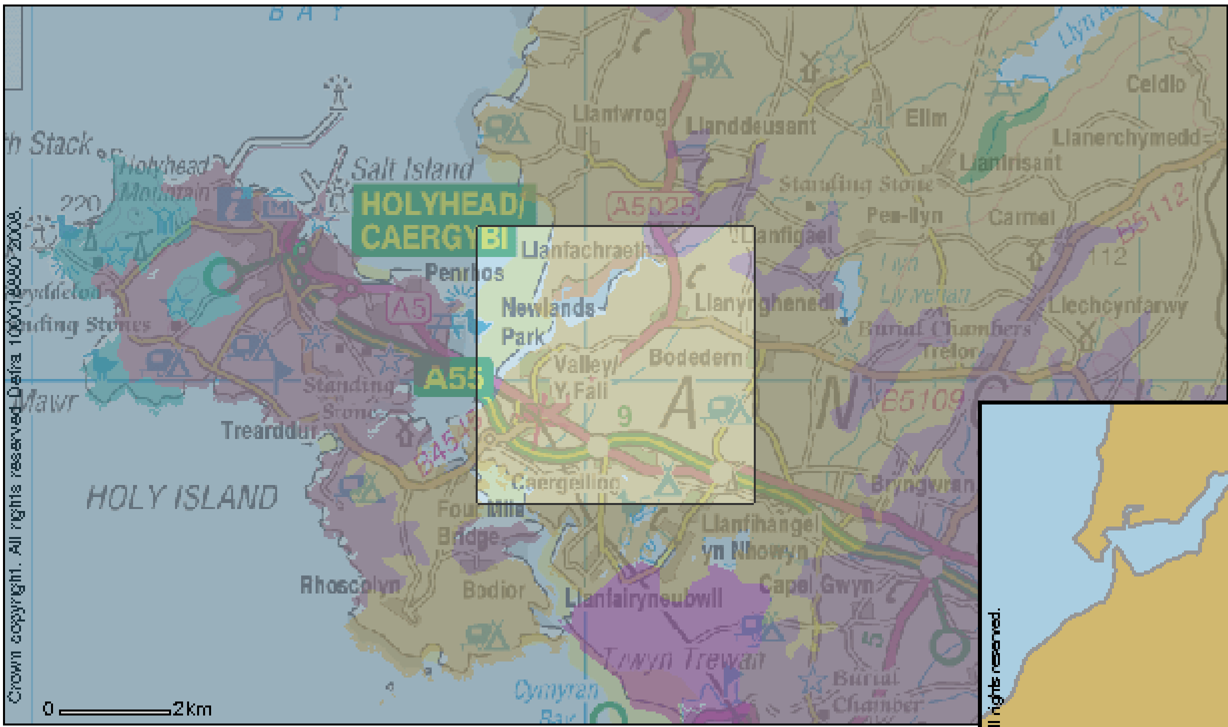

### SIMPLE TOPSOIL TEXTURE KEY

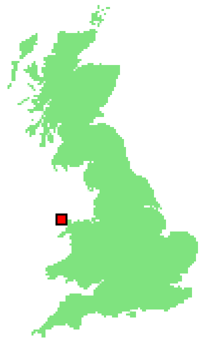
- 1 - *Clayey*
- 2 - *Loamy*
- 3 - *Peaty*
- 4 - *Sandy*

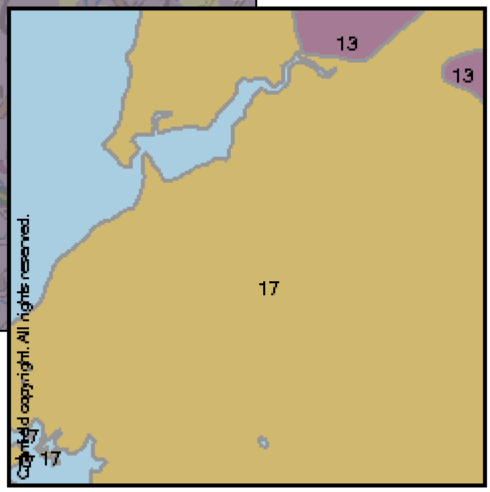
SIMPLE TOPSOIL TEXTURE DESCRIPTION

Soil texture is a term used in soil science to describe the physical composition of the soil in terms of the size of mineral particles in the soil. Specifically, we are concerned with the relative proportions of sand, silt and clay. Soil texture can vary between each soil layer or horizon as one moves down the profile. This map indicates the soil texture group of the upper 30 cm of the soil. 'Light' soils have more sand grains and are described as sandy, while 'heavy' soils have few sand grains but a lot of extremely small particles and are described as clayey. Loamy soils have a mix of sand, silt and clay-sized particles and are intermediate in character. Soils with a surface layer that is dominantly organic are described as Peaty. A good understanding of soil texture can enable better land management.

## 1n. TYPICAL HABITATS






### TYPICAL HABITATS KEY

- 13 - *Neutral and acid pastures and deciduous woodlands; acid communities such as bracken and gorse in the uplands*
- 17 - *Seasonally wet pastures and woodlands*

TYPICAL HABITATS DESCRIPTION

There is a close relationship between vegetation and the underlying soil. Information about the types of broad habitat associated with each soil type is provided in this map. Soil fertility, pH, drainage and texture are important factors in determining the types of habitats which can be established. Elevation above sea level and sometimes even the aspect - the orientation of a hillslope - can affect the species present. This map does not take into account the recent land management or any urban development, but provides the likely natural habitats assuming good management has been carried out.

## 2. SOIL ASSOCIATION DESCRIPTIONS

The following pages describe the following soil map units, (soil associations), in more detail.

**EAST KESWICK 1** 541x
*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

**BRICKFIELD 2** 713f
*Slowly permeable seasonally waterlogged fine loamy soils.*

The soil associations are described in terms of their texture and drainage properties and potential risks may be identified. The distribution of the soils across England and Wales are provided. Further to this, properties of each association's component soil series are described in relation to each other. Lastly, schematic diagrams of each component series are provided for greater understanding and in-field verification purposes.

# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

**a. General Description**

Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging. Some coarse loamy soils affected by groundwater.
The major landuse on this association is defined as cereals and grassland in the northern region; stock rearing on permanent grassland in wales.

**b. Distribution (England & Wales)**

The EAST KESWICK 1 association covers 804km² of England and Wales which accounts for 0.53% of the landmass. The distribution of this association is shown in Figure 1. Note that the yellow shading represents a buffer to highlight the location of very small areas of the association.

**c. Comprising Soil Series**

Multiple soil series comprise a soil association. The soil series of the EAST KESWICK 1 association are outlined in Table 1 below. In some cases other minor soil series are present at a particular site, and these have been grouped together under the heading 'OTHER'. We have endevoured to present the likelihood of a minor, unnamed soil series occuring in your site in Table 1.

Schematic diagrams of the vertical soil profile of the major constituent soil series are provided in Section D to allow easier identification of the particular soil series at your site.

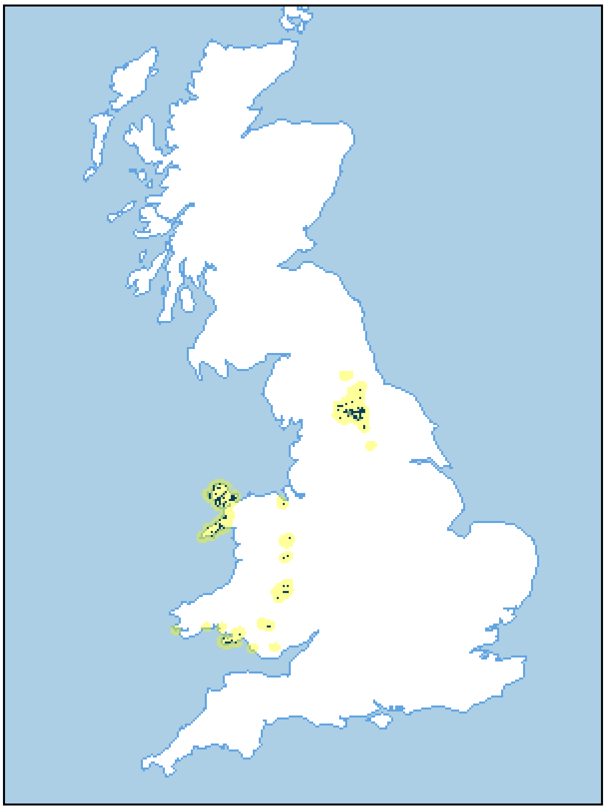


Figure 1. Association Distribution

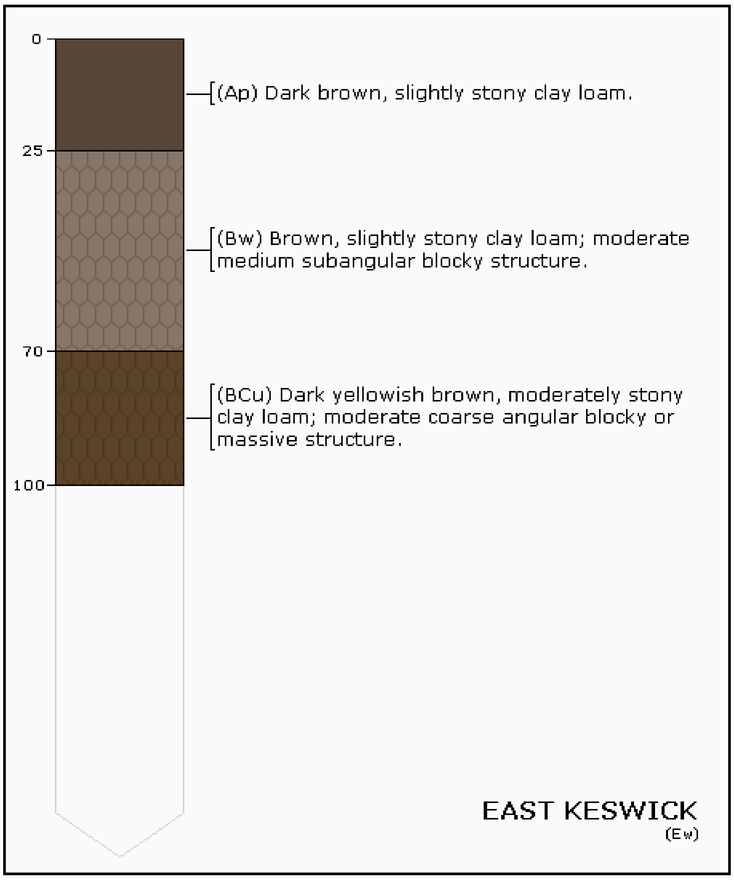
| Soil Series | Description | Area % |
|---|---|---|
| EAST KESWICK (Ew) | medium loamy drift with siliceous stones | 45% |
| NERCWYS (Nc) | medium loamy drift with siliceous stones | 30% |
| ARROW (aO) | light loamy drift with siliceous stones | 10% |
| OTHER | other minor soils | 15% |

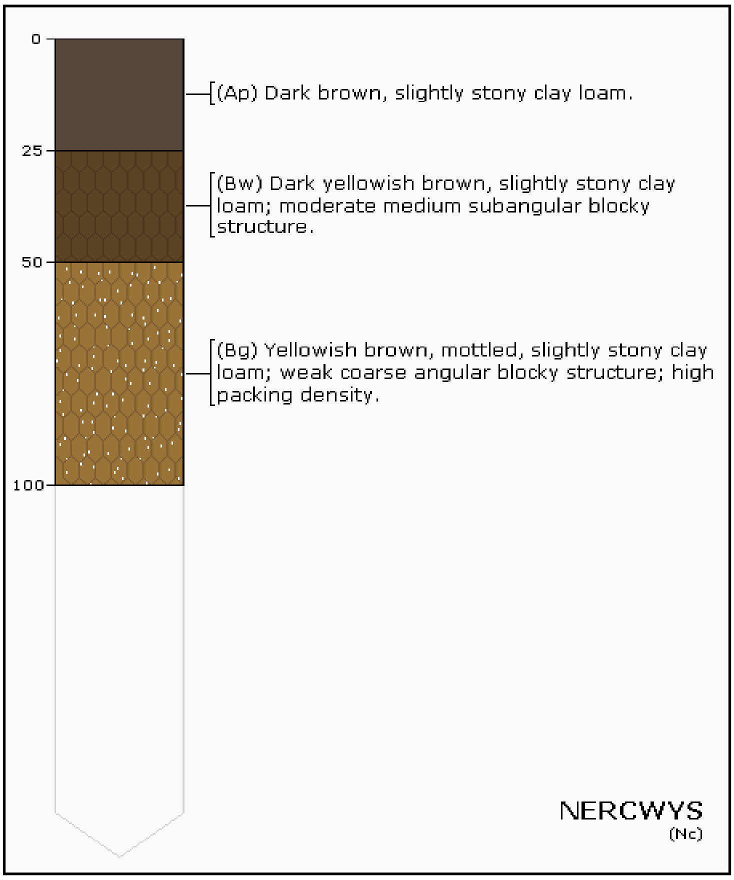
Table 1. The component soil series of the EAST KESWICK 1 soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

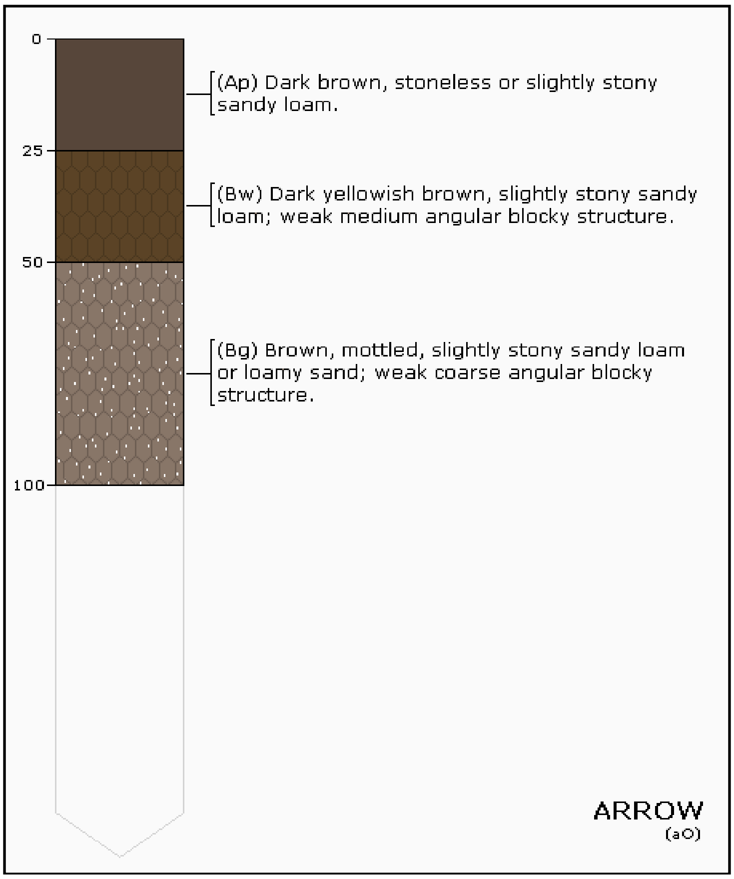
# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

## d. EAST KESWICK 1 Component Series Profiles



# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

## e. Soil Properties

This section provides graphical summaries of selected attribute data available for the component series in this association. The blue bars of the graphs presented in this section describe the range of property values for all soils across England and Wales. Superimposed on these graphs are the values for the component soil series in this association. This has been done to provide the reader with an understanding of where each property for each series sits within the national context.

| Soil Series | Description | Area % |
|---|---|---|
| EAST KESWICK (Ew) | medium loamy drift with siliceous stones | 45% |
| NERCWYS (Nc) | medium loamy drift with siliceous stones | 30% |
| ARROW (aO) | light loamy drift with siliceous stones | 10% |
| OTHER | other minor soils | 15% |

Table 1. The component soil series of the EAST KESWICK 1 soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

## e(i). Soil Depth Information and Depths to Important Layers

*Depth to rock* A mean depth to bedrock or very stony rubble which has been assigned to each soil series based on observed and recorded soil profiles.

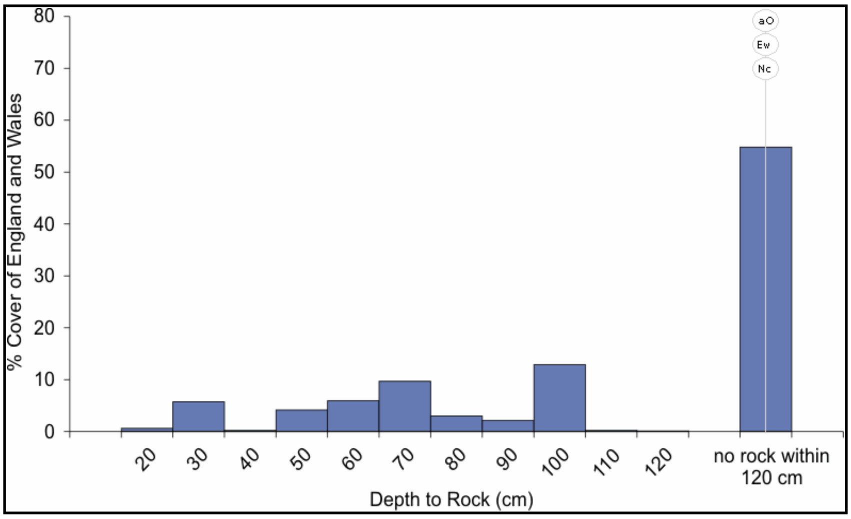



Figure 2. Depth of soil to Rock

*Depth to gleying*, the presence of grey and ochreous mottles within the soil, is caused by intermittent waterlogging. A mean depth to gleying has been assigned to each soil series based on observed and recorded soil profiles. The definition of a gleyed layer is designed to equate with saturation for at least 30 days in each year or the presence of artificial drainage.

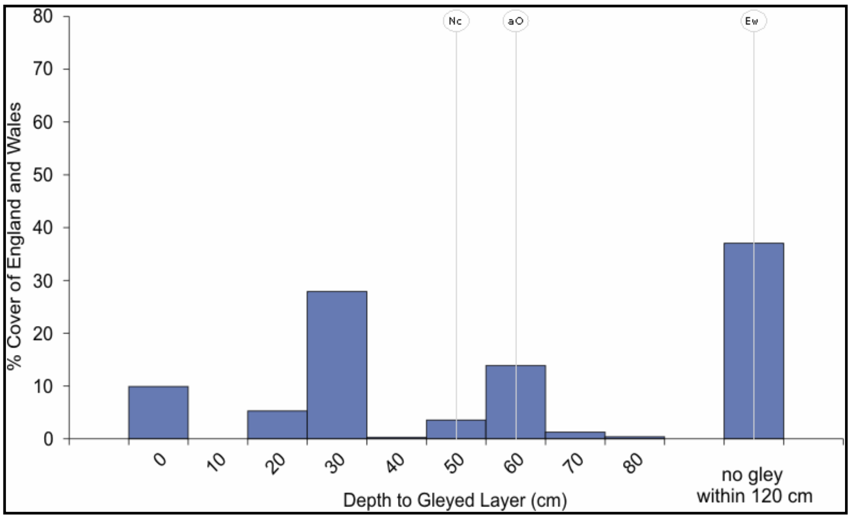



Figure 3. Depth of Soil to Gleying

# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

## e(i). Soil Depth Information and Depths to Important Layers continued

*Depth to slowly permeable layer (downward percolation)* A mean depth to a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede downward percolation of excess soil water. This causes periodic saturation in the overlying soil, reduced storage capacity and therefore increased hydrological response to rainfall events.

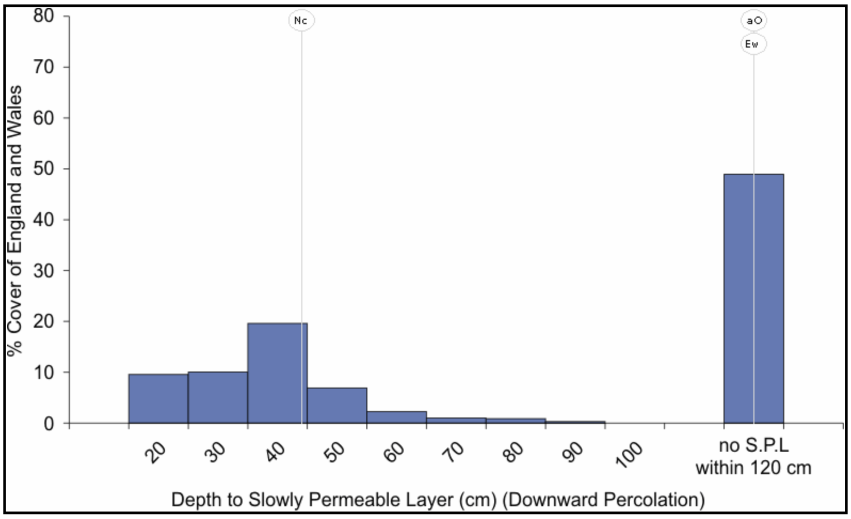



Figure 4. Depth to slowly permeable layer (downward percolation)

*Depth to Slowly Permeable Layer (upward diffusion)* A mean depth to the bottom of a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede upward diffusion of water and gasses.

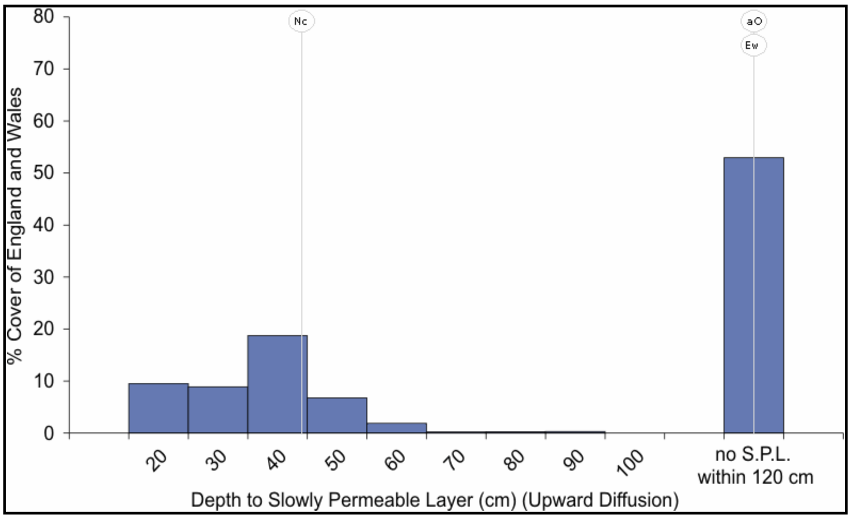



Figure 5. Depth to Slowly Permeable Layer (upward diffusion)

# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

## e(ii). Soil Hydrological Information

*Integrated air capacity (IAC)* is the total coarse pore space (>60 $\mu$m diameter) to 1 m depth. This size of pore would normally be air-filled when the soil is fully moist but not waterlogged. A large IAC means that the soil is well aerated. This will encourage root development and, provided near surface soil structure is well developed, will allow rainfall to percolate into the ground thus mitigating against localised flooding.

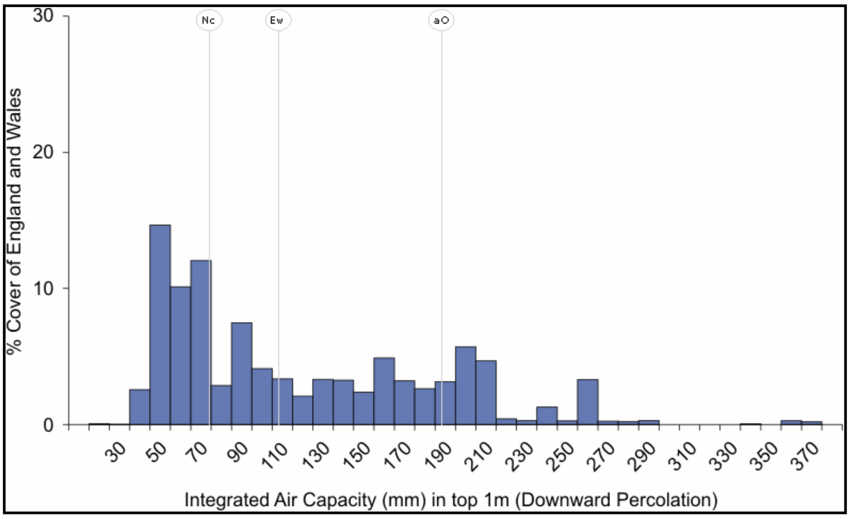



Figure 6. Integrated Air Capacity

*Standard Percentage Runoff (SPR)* is the percentage of rainfall that causes the short-term increase in flow seen at a catchment outlet following a storm event. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

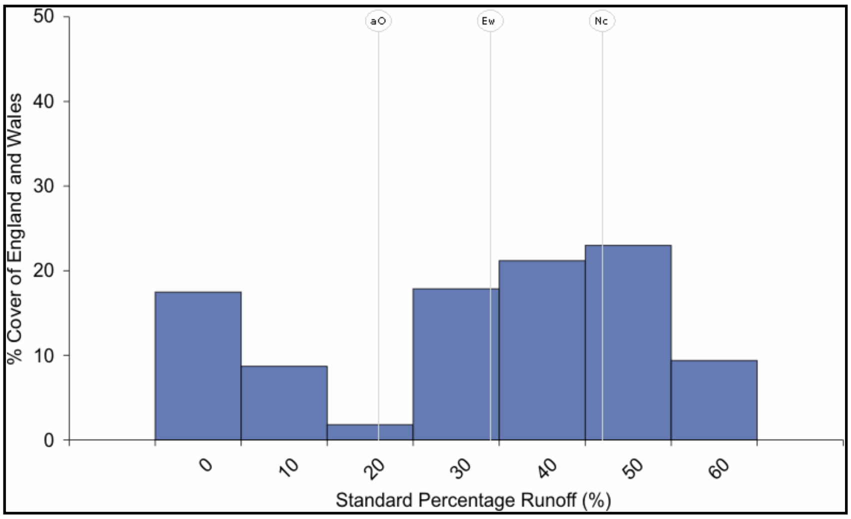



Figure 7. Standard Percentage Runoff

*Base flow index* is calculated from daily river flow data and expresses the volume of base flow of a river as a fraction of the total flow volume. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

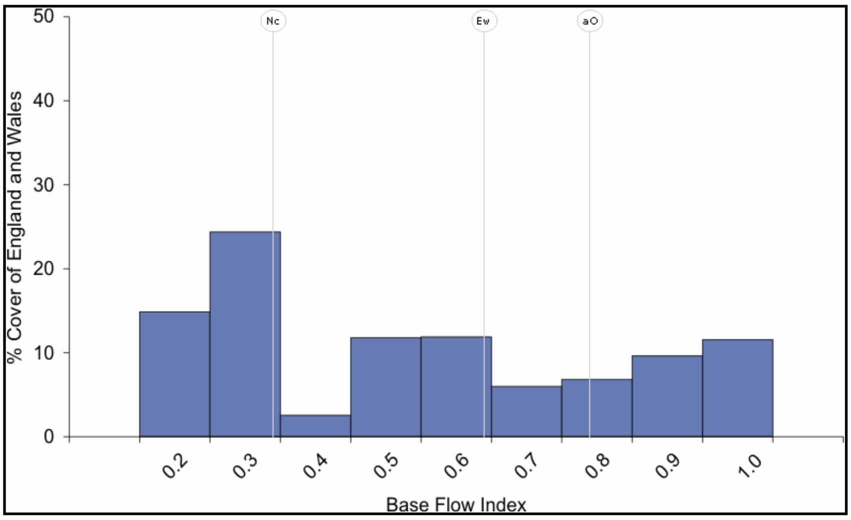



Figure 8. Base Flow Index

# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

## e(iii). Available Water Content

*Available water content* for plants varies depending on a number of factors, including the rooting depth of the plants. Described below are differing available water contents for cereals, sugar beet, grass and potato crops, as well as a generic available water value to 1 m depth.

*Available water (by crop)* Available water content to 1 m for the specified soil series between suctions of 5 and 1500kPa.

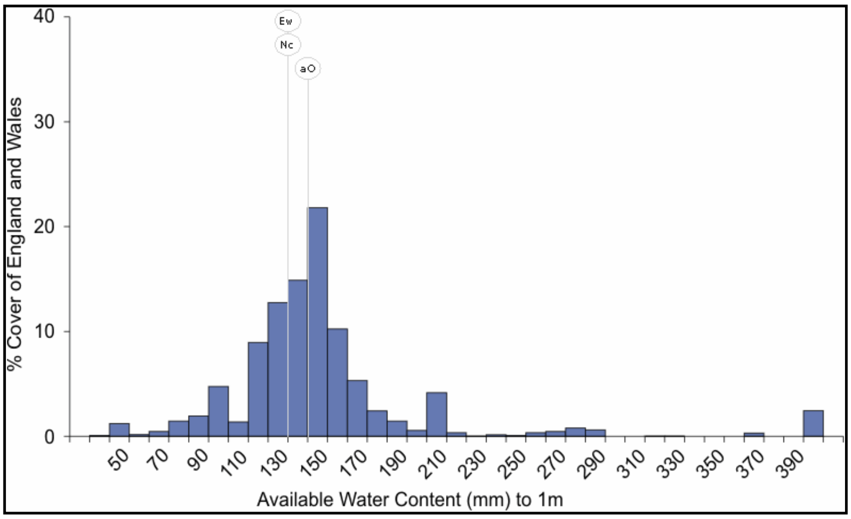



Figure 9. Available Water (by crop)

*Available water for grass* represents the water that is available to a permanent grass sward that is able to root to 100cm depth.

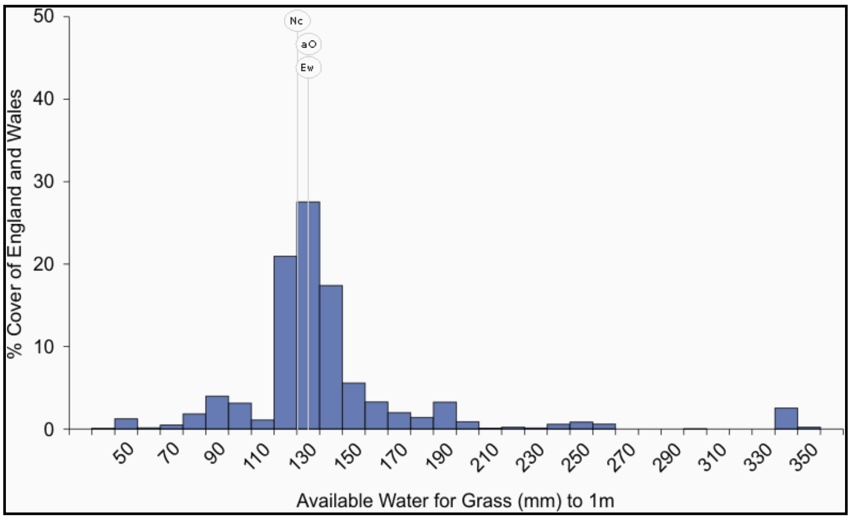



Figure 10. Available Water for Grass

# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

**e(iii). Available Water Content** continued

*Available water for cereal* represents the water that is available to a cereal crop that is able to root to 120cm depth.

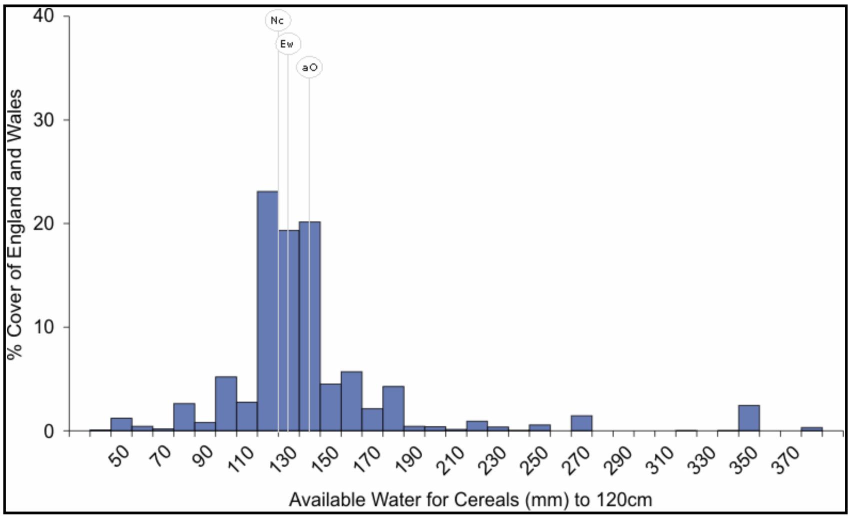



Figure 11. Available Water for Cereal

*Available water for Sugar Beet* represents the water that is available to a sugar beet crop that is able to root to 140cm depth.

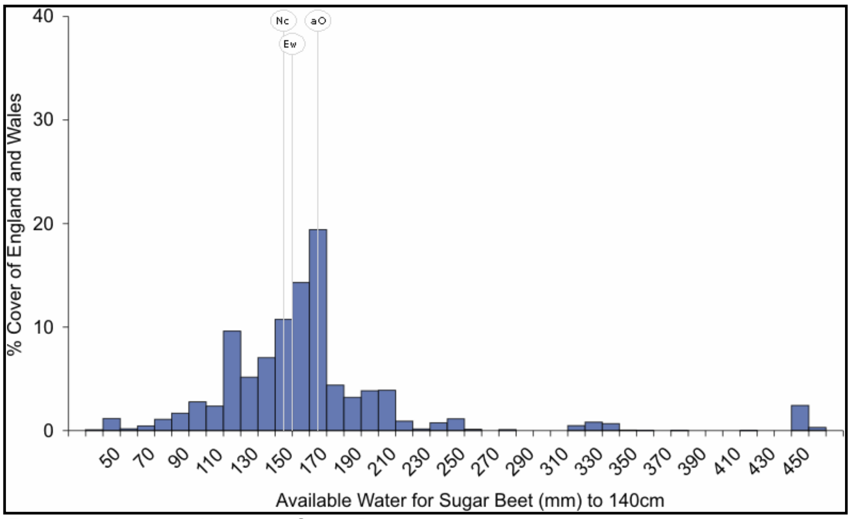



Figure 12. Available Water for Sugar Beet

*Available water for Potatoes* represents the water that is available to a potato crop that is able to root to 70cm depth.

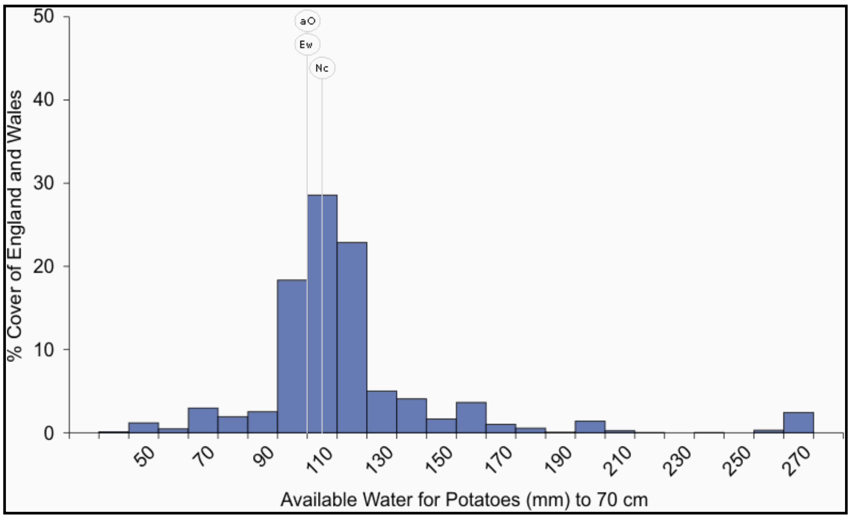



Figure 13. Available Water for Potatoes

# BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

**a. General Description**

Slowly permeable seasonally waterlogged fine loamy soils. Associated with fine loamy soils with only slight waterlogging and some deep well drained fine loamy soils.

The major landuse on this association is defined as dairying and stock rearing on permanent or short term grassland; some cereals in drier areas.

**b. Distribution (England & Wales)**

The BRICKFIELD 2 association covers 1596km² of England and Wales which accounts for 1.06% of the landmass. The distribution of this association is shown in Figure 14. Note that the yellow shading represents a buffer to highlight the location of very small areas of the association.

**c. Comprising Soil Series**

Multiple soil series comprise a soil association. The soil series of the BRICKFIELD 2 association are outlined in Table 2 below. In some cases other minor soil series are present at a particular site, and these have been grouped together under the heading 'OTHER'. We have endevoured to present the likelihood of a minor, unnamed soil series occuring in your site in Table 2.

Schematic diagrams of the vertical soil profile of the major constituent soil series are provided in Section D to allow easier identification of the particular soil series at your site.

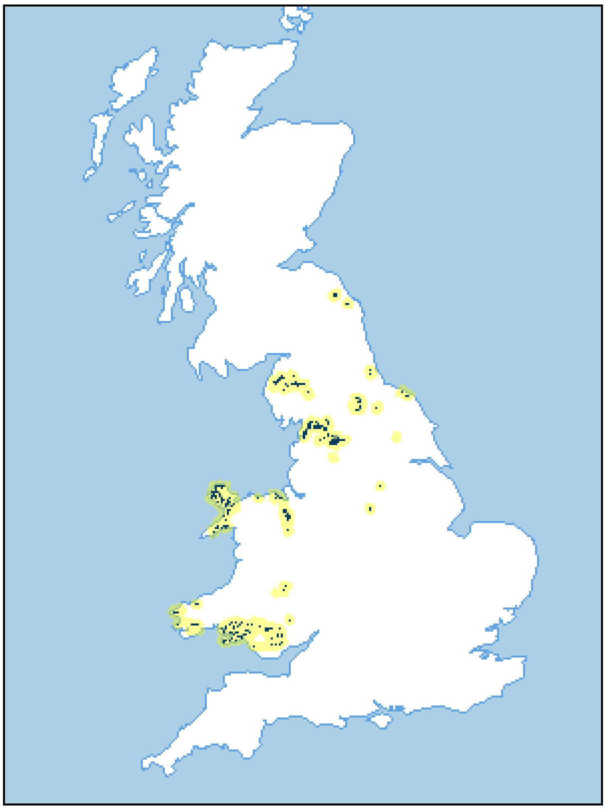


Figure 14. Association Distribution

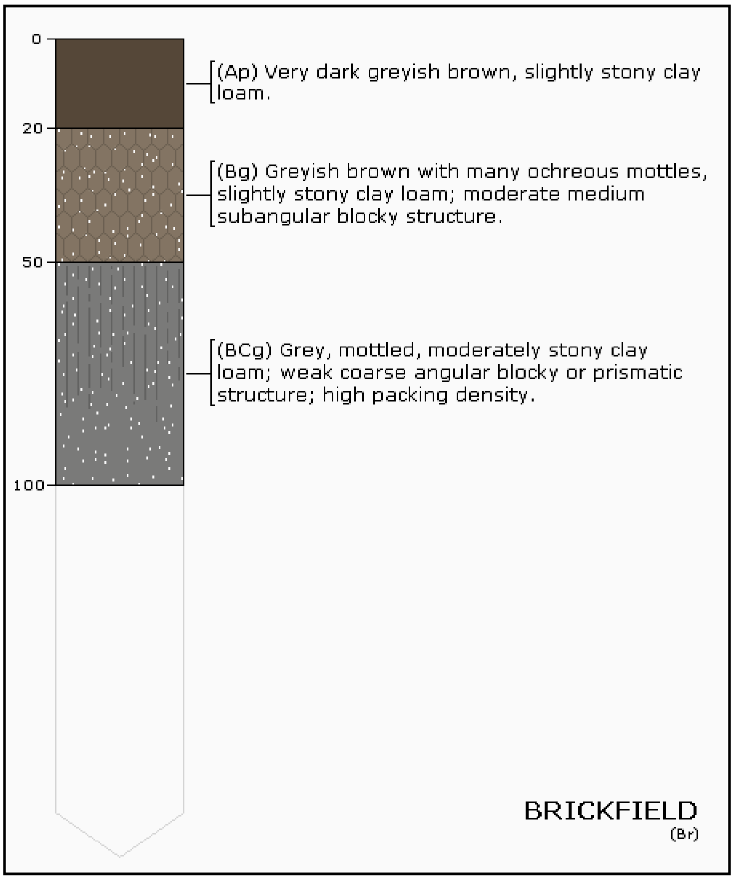
| Soil Series | Description | Area % |
| --- | --- | --- |
| BRICKFIELD (Br) | medium loamy drift with siliceous stones | 40% |
| NERCWYS (Nc) | medium loamy drift with siliceous stones | 20% |
| EAST KESWICK (Ew) | medium loamy drift with siliceous stones | 15% |
| OTHER | other minor soils | 25% |

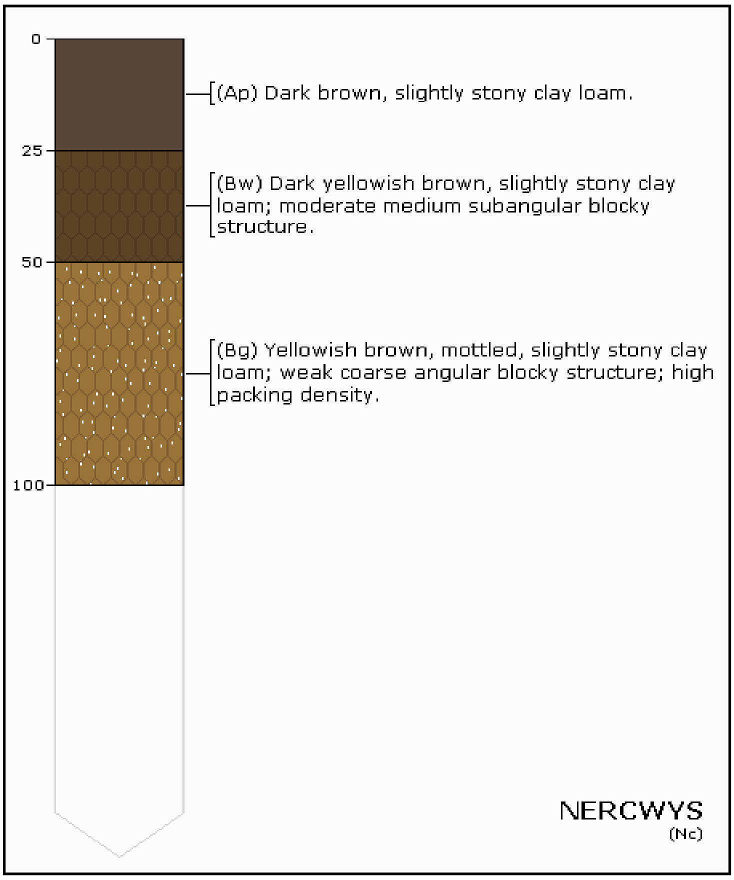
Table 2. The component soil series of the BRICKFIELD 2 soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

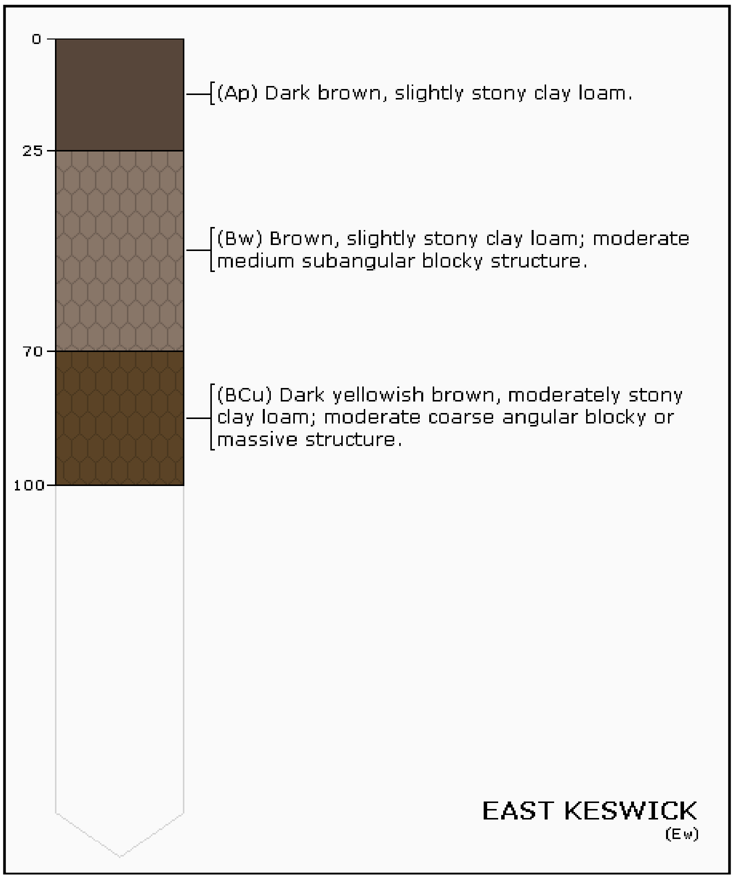
# BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

## d. BRICKFIELD 2 Component Series Profiles



## BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

### e. Soil Properties

This section provides graphical summaries of selected attribute data available for the component series in this association. The blue bars of the graphs presented in this section describe the range of property values for all soils across England and Wales. Superimposed on these graphs are the values for the component soil series in this association. This has been done to provide the reader with an understanding of where each property for each series sits within the national context.

| Soil Series | Description | Area % |
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| EAST KESWICK (Ew) | medium loamy drift with siliceous stones | 15% |
| OTHER | other minor soils | 25% |

Table 2. The component soil series of the BRICKFIELD 2 soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

### e(i). Soil Depth Information and Depths to Important Layers

*Depth to rock* A mean depth to bedrock or very stony rubble which has been assigned to each soil series based on observed and recorded soil profiles.

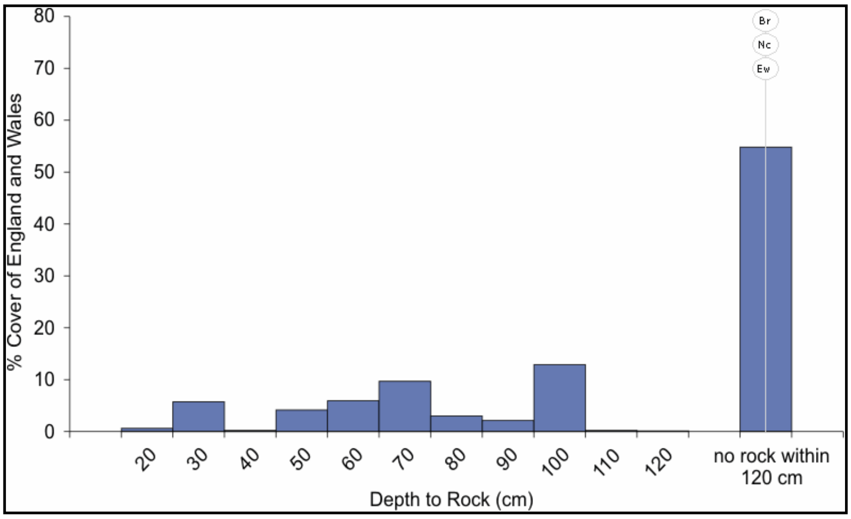



Figure 15. Depth of soil to Rock

*Depth to gleying*, the presence of grey and ochreous mottles within the soil, is caused by intermittent waterlogging. A mean depth to gleying has been assigned to each soil series based on observed and recorded soil profiles. The definition of a gleyed layer is designed to equate with saturation for at least 30 days in each year or the presence of artificial drainage.

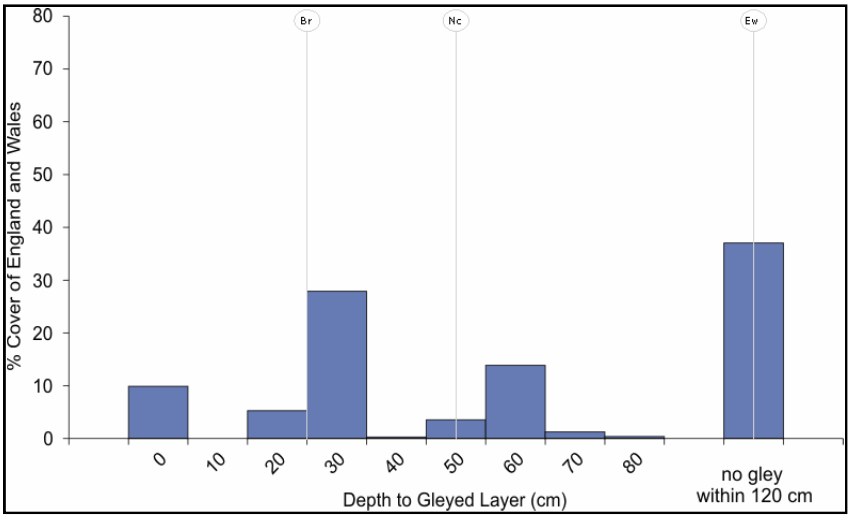



Figure 16. Depth of Soil to Gleying

## BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

### e(i). Soil Depth Information and Depths to Important Layers continued

*Depth to slowly permeable layer (downward percolation)* A mean depth to a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede downward percolation of excess soil water. This causes periodic saturation in the overlying soil, reduced storage capacity and therefore increased hydrological response to rainfall events.

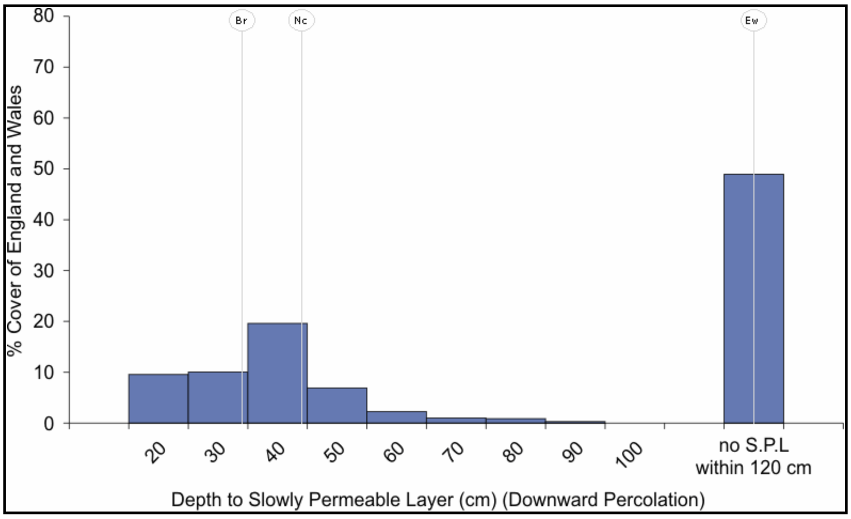



Figure 17. Depth to slowly permeable layer (downward percolation)

*Depth to Slowly Permeable Layer (upward diffusion)* A mean depth to the bottom of a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede upward diffusion of water and gasses.

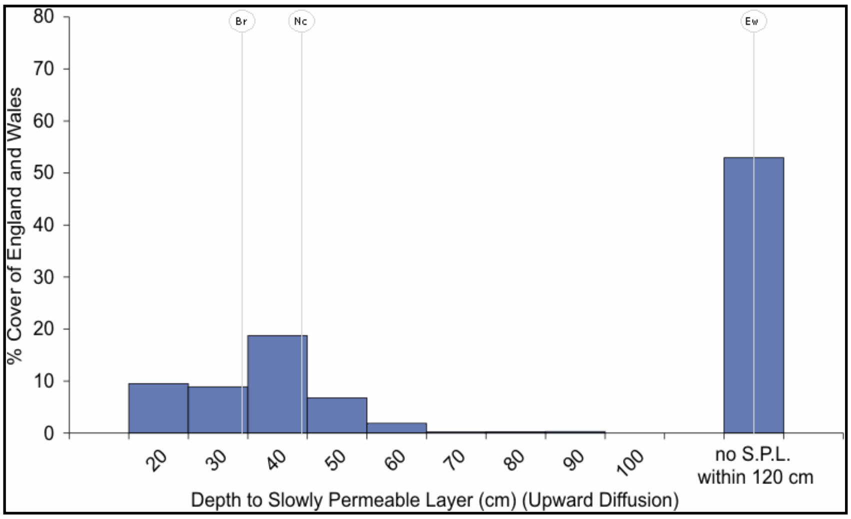



Figure 18. Depth to Slowly Permeable Layer (upward diffusion)

## BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

### e(ii). Soil Hydrological Information

*Integrated air capacity (IAC)* is the total coarse pore space (>60 $\mu$m diameter) to 1 m depth. This size of pore would normally be air-filled when the soil is fully moist but not waterlogged. A large IAC means that the soil is well aerated. This will encourage root development and, provided near surface soil structure is well developed, will allow rainfall to percolate into the ground thus mitigating against localised flooding.

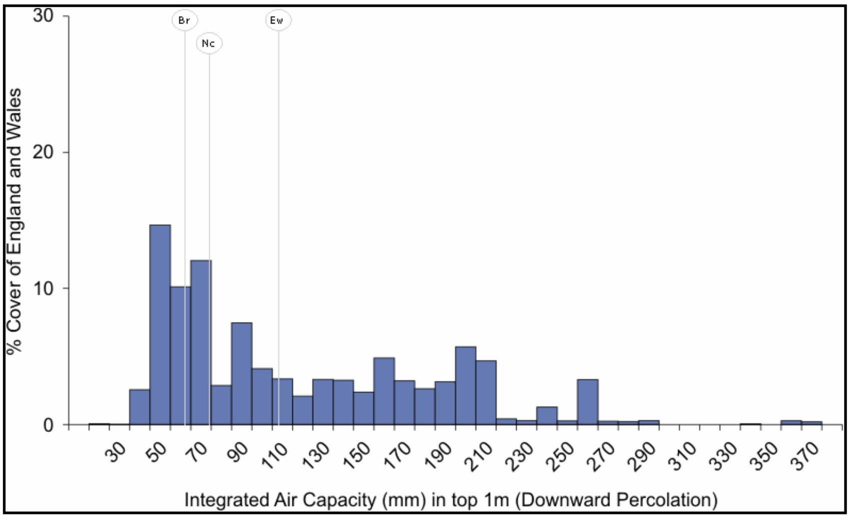



Figure 19. Integrated Air Capacity

*Standard Percentage Runoff (SPR)* is the percentage of rainfall that causes the short-term increase in flow seen at a catchment outlet following a storm event. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

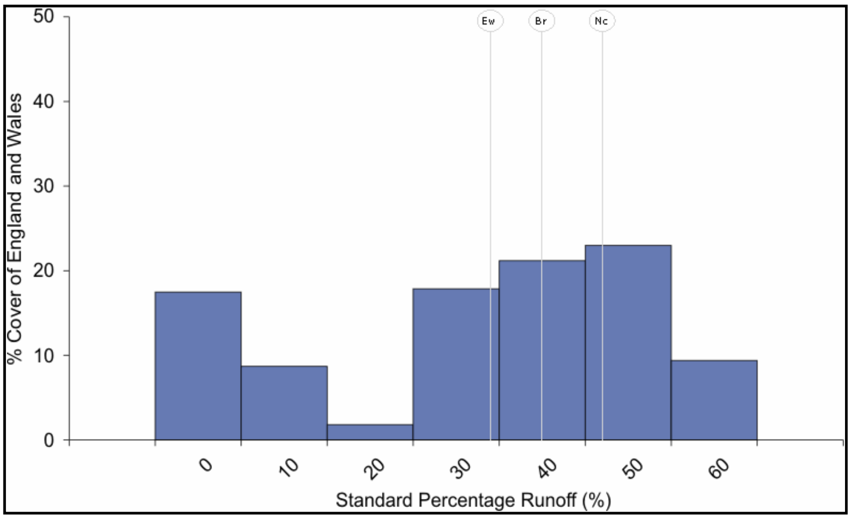



Figure 20. Standard Percentage Runoff

*Base flow index* is calculated from daily river flow data and expresses the volume of base flow of a river as a fraction of the total flow volume. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

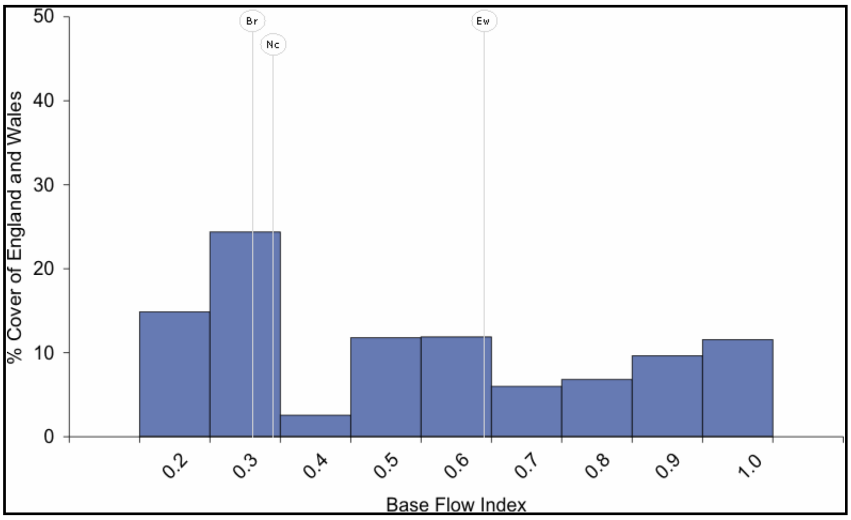



Figure 21. Base Flow Index

# BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

## e(iii). Available Water Content

*Available water content* for plants varies depending on a number of factors, including the rooting depth of the plants. Described below are differing available water contents for cereals, sugar beet, grass and potato crops, as well as a generic available water value to 1 m depth.

*Available water (by crop)* Available water content to 1 m for the specified soil series between suctions of 5 and 1500kPa.

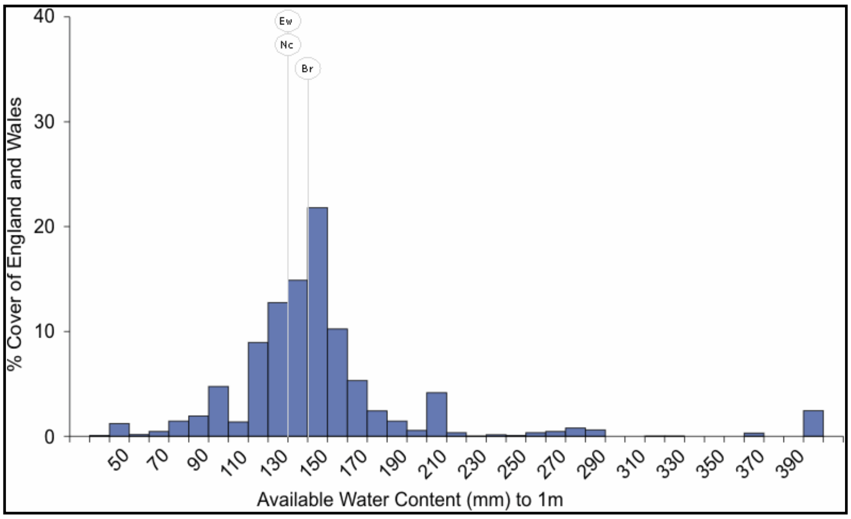



Figure 22. Available Water (by crop)

*Available water for grass* represents the water that is available to a permanent grass sward that is able to root to 100cm depth.

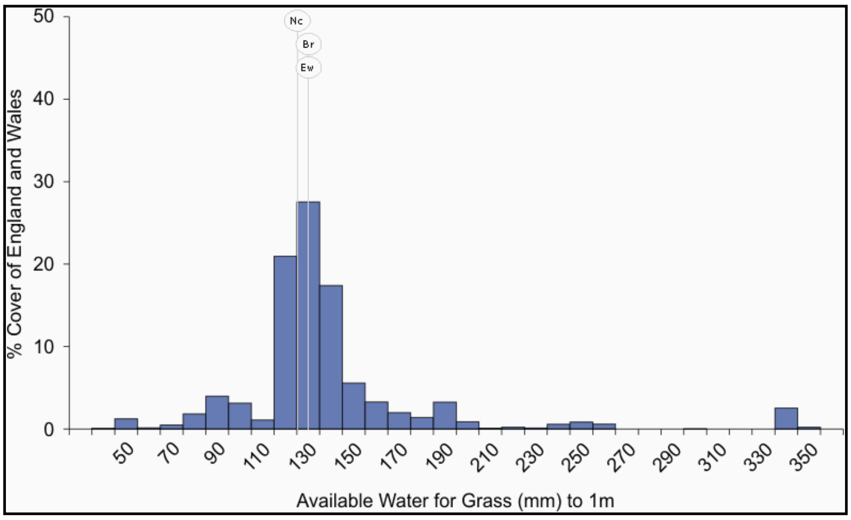



Figure 23. Available Water for Grass

## BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

### e(iii). Available Water Content continued

*Available water for cereal* represents the water that is available to a cereal crop that is able to root to 120cm depth.

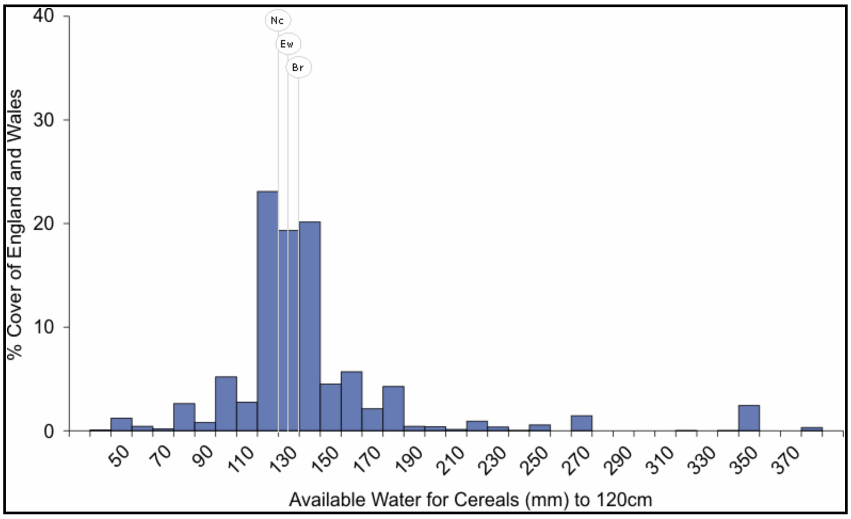



Figure 24. Available Water for Cereal

*Available water for Sugar Beet* represents the water that is available to a sugar beet crop that is able to root to 140cm depth.

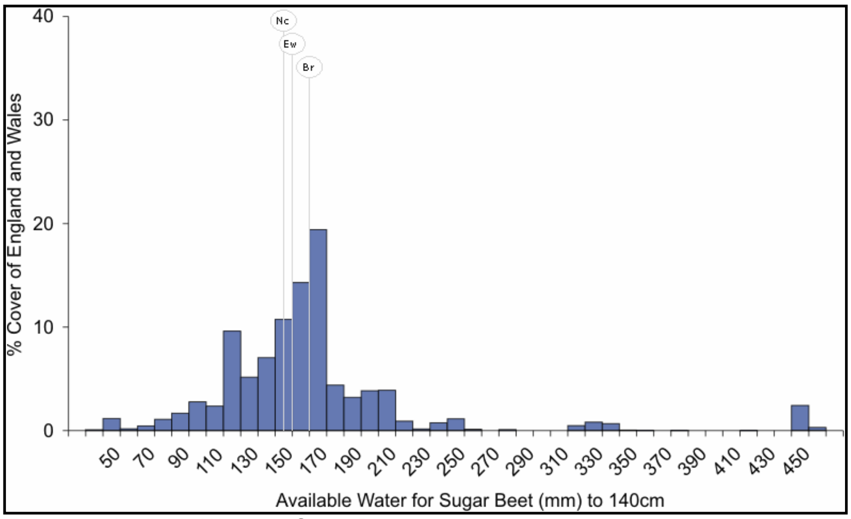



Figure 25. Available Water for Sugar Beet

*Available water for Potatoes* represents the water that is available to a potato crop that is able to root to 70cm depth.

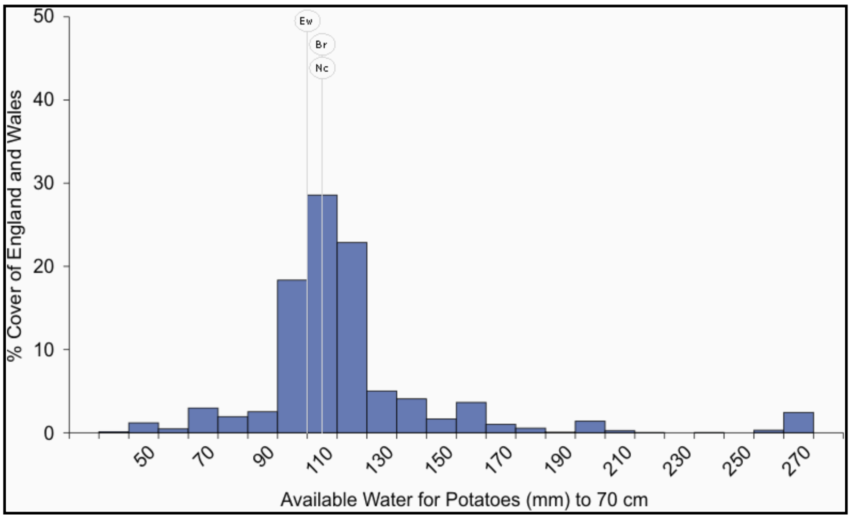
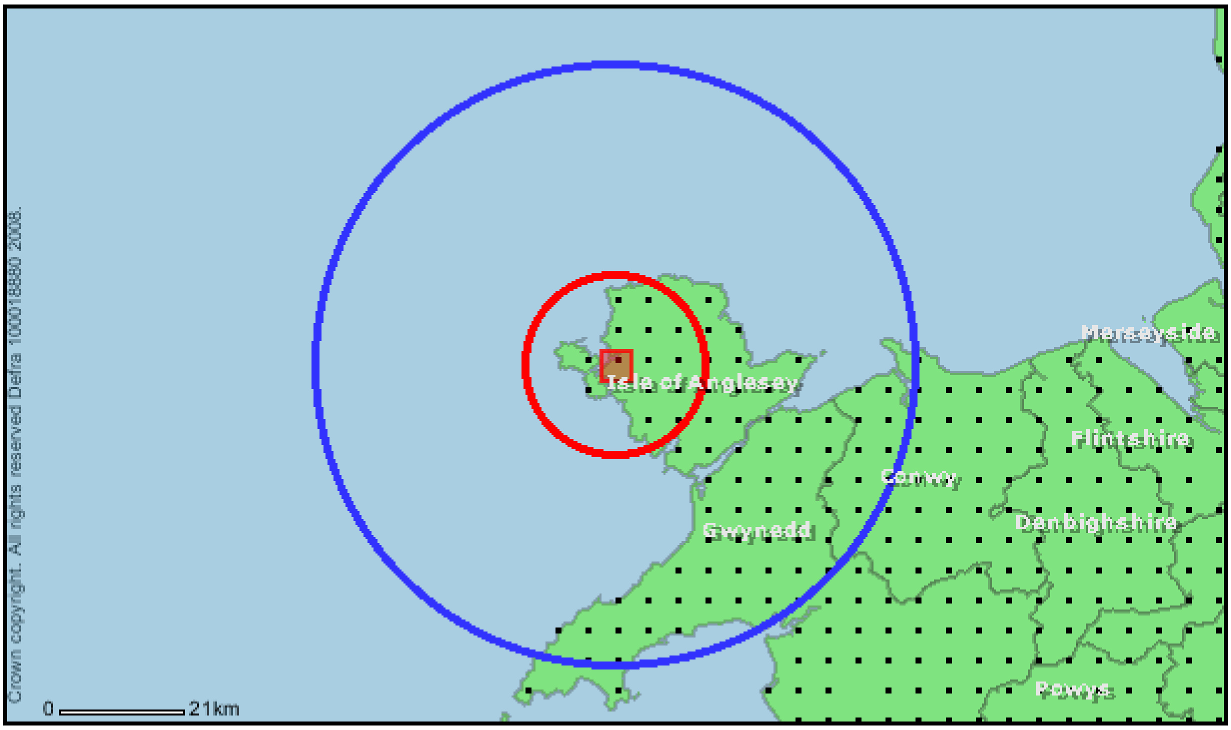
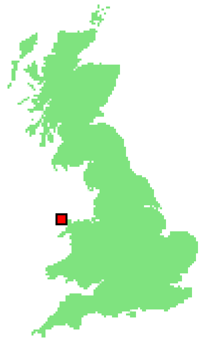



Figure 26. Available Water for Potatoes

## 3. TOPSOIL ELEMENT BACKGROUND LEVELS



### TOPSOIL ELEMENT BACKGROUND LEVELS KEY

- NSI sample points
- Report area
- 15 km radius - local area
- 50 km radius - regional area

TOPSOIL ELEMENT BACKGROUND LEVELS DESCRIPTION

The National Soil Inventory (NSI) covers England and Wales on a 5 km grid and provides detailed information for each intersect of the grid. Collectively NSI data are statistically representative of England and Wales soils. The original sampling was undertaken around 1980 and there were partial resamplings in the mid-1990s. The most up-to-date data is presented here.

Analysis of the NSI samples provides detailed measurements of over 20 elements from the soils, in addition to pH. This data is summarised over three areas to provide you with an understanding of how your site, and your data for it, sits within the local, regional and national context.

Where available, the soil element levels are compared with the Soil Guideline Values and where a soil sample we have analysed has been found in excess of the SGV guidelines for "residential with plant uptake" land, this is displayed in red in the tables which follow.

SGV levels are provided for the following elements: lead, selenium, nickel, mercury, chromium, cadmium and arsenic.

In the following pages, a number of analyses of the topsoil are provided. The majority of analyses have been performed on the full compliment of sample points, however, in some areas, for some elements, only a few samples were analysed as part of subsequent programmes. In order to present the full suite of possible datasets, and accurately convey the validity of the data, the number of actual measured samples is stated for each analysis. Care should be taken where the number of samples is disproportionately low.

## 3a. Analyses Within a 15 km Radius (15 Sample Points)

| ANALYSES | SAMPLES | MEAN | MIN | MAX | ST. DEV |
|---|---|---|---|---|---|
| pH (PH) | 15 | 5.1 | 4.5 | 5.7 | 0.4 |
| Carbon (CARBON) | 15 | 4.6 | 2.2 | 13.5 | 2.8 |
| Aluminium (AL_ACID) | 15 | 30,575.5 | 13,802.0 | 53,950.0 | 9,952.5 |
| Arsenic (AS_ACID) | 13 | 3.6 | 2.0 | 9.6 | 1.9 |
| Barium (BA_ACID) | 15 | 200.7 | 76.0 | 372.0 | 96.0 |
| Calcium (CA_ACID) | 15 | 2,600.8 | 353.0 | 4,696.0 | 1,590.4 |
| Cadmium (CD_ACID) | 15 | 0.5 | 0.1 | 1.3 | 0.4 |
| Cadmium (Extractable) (CD_EDTA) | 15 | 0.2 | 0.1 | 0.4 | 0.1 |
| Cobalt (CO_ACID) | 15 | 10.8 | 3.6 | 25.5 | 5.5 |
| Cobalt (Extractable) (CO_EDTA) | 15 | 0.6 | 0.1 | 1.9 | 0.5 |
| Chromium (CR_ACID) | 15 | 50.0 | 34.3 | 88.4 | 16.1 |
| Copper (CU_ACID) | 15 | 21.7 | 5.8 | 49.1 | 10.5 |
| Copper (Extractable) (CU_EDTA) | 15 | 5.6 | 1.2 | 9.8 | 2.3 |
| Flouride (F_ACID) | 14 | 41.5 | 0.0 | 137.0 | 38.6 |
| Iron (FE_ACID) | 15 | 33,156.5 | 17,114.0 | 53,860.0 | 10,557.0 |
| Mercury (HG_ACID) | 13 | 0.0 | 0.0 | 0.1 | 0.0 |
| Potassium (K_ACID) | 15 | 4,637.1 | 1,717.0 | 8,269.0 | 2,005.7 |
| Potassium (Extractable) (K_NITRATE) | 15 | 104.3 | 25.0 | 247.0 | 58.7 |
| Magnesium (MG_ACID) | 15 | 3,778.7 | 2,133.0 | 5,459.0 | 1,093.7 |
| Magnesium (Extractable) (MG_NITRATE) | 15 | 135.0 | 66.0 | 307.0 | 59.8 |
| Manganese (MN_ACID) | 15 | 1,020.9 | 231.0 | 2,707.0 | 756.9 |
| Manganese (Extractable) (MN_EDTA) | 15 | 136.8 | 9.0 | 337.0 | 112.6 |
| Molybdenum (MO_ACID) | 14 | 1.1 | 0.0 | 2.9 | 0.8 |
| Sodium (NA_ACID) | 15 | 553.5 | 193.0 | 1,176.0 | 332.2 |
| Nickel (NI_ACID) | 15 | 21.7 | 13.5 | 32.7 | 6.7 |
| Nickel (Extractable) (NI_EDTA) | 15 | 0.7 | 0.3 | 2.9 | 0.6 |
| Phosphorus (P_ACID) | 15 | 920.0 | 358.0 | 2,016.0 | 443.3 |
| Phosphorus (Extractable) (P_OLSEN) | 15 | 22.5 | 6.0 | 58.0 | 13.4 |
| Lead (PB_ACID) | 15 | 36.8 | 15.0 | 69.0 | 15.2 |
| Lead (Extractable) (PB_EDTA) | 15 | 9.4 | 3.6 | 31.1 | 6.9 |
| Selenium (SE_ACID) | 13 | 0.5 | 0.2 | 0.7 | 0.1 |
| Strontium (SR_ACID) | 15 | 24.7 | 1.0 | 45.0 | 13.9 |
| Vanadium (V_ACID) | 14 | 44.8 | 6.7 | 84.3 | 19.4 |
| Zinc (ZN_ACID) | 15 | 71.4 | 25.0 | 158.0 | 31.0 |
| Zinc (Extractable) (ZN_EDTA) | 15 | 3.2 | 1.1 | 10.2 | 2.1 |

for units, see Analyses Definitions (p41)

## 3b. Analyses Within a 50 km Radius (80 Sample Points)

| ANALYSES | SAMPLES | MEAN | MIN | MAX | ST. DEV |
|---|---|---|---|---|---|
| pH (PH) | 80 | 4.8 | 3.5 | 6.2 | 0.6 |
| Carbon (CARBON) | 80 | 10.7 | 0.2 | 44.1 | 11.2 |
| Aluminium (AL_ACID) | 80 | 24,470.5 | 3,269.0 | 53,950.0 | 10,998.1 |
| Arsenic (AS_ACID) | 50 | 5.4 | 0.4 | 25.2 | 4.0 |
| Barium (BA_ACID) | 80 | 136.5 | 11.0 | 372.0 | 78.8 |
| Calcium (CA_ACID) | 80 | 1,897.8 | 100.0 | 5,800.0 | 1,480.9 |
| Cadmium (CD_ACID) | 80 | 0.6 | 0.0 | 4.5 | 0.6 |
| Cadmium (Extractable) (CD_EDTA) | 79 | 1.1 | 0.0 | 75.0 | 8.4 |
| Cobalt (CO_ACID) | 80 | 15.4 | 0.7 | 321.8 | 39.3 |
| Cobalt (Extractable) (CO_EDTA) | 79 | 0.9 | 0.0 | 10.8 | 1.6 |
| Chromium (CR_ACID) | 80 | 38.2 | 3.8 | 200.4 | 27.6 |
| Copper (CU_ACID) | 80 | 21.7 | 2.4 | 103.7 | 16.3 |
| Copper (Extractable) (CU_EDTA) | 79 | 5.3 | 1.2 | 39.2 | 4.7 |
| Flouride (F_ACID) | 69 | 52.9 | 0.0 | 554.8 | 87.5 |
| Iron (FE_ACID) | 80 | 27,840.4 | 3,538.0 | 83,515.0 | 14,684.2 |
| Mercury (HG_ACID) | 50 | 0.1 | 0.0 | 1.2 | 0.2 |
| Potassium (K_ACID) | 80 | 3,743.0 | 581.0 | 8,269.0 | 1,751.0 |
| Potassium (Extractable) (K_NITRATE) | 80 | 109.6 | 13.0 | 256.0 | 47.9 |
| Magnesium (MG_ACID) | 80 | 3,051.6 | 322.0 | 9,598.0 | 1,949.0 |
| Magnesium (Extractable) (MG_NITRATE) | 80 | 104.6 | 24.0 | 307.0 | 50.6 |
| Manganese (MN_ACID) | 80 | 1,297.4 | 26.0 | 13,613.0 | 1,723.0 |
| Manganese (Extractable) (MN_EDTA) | 79 | 165.4 | 1.0 | 2,347.0 | 277.3 |
| Molybdenum (MO_ACID) | 68 | 1.3 | 0.0 | 5.9 | 1.2 |
| Sodium (NA_ACID) | 80 | 460.7 | 137.0 | 2,209.0 | 341.4 |
| Nickel (NI_ACID) | 80 | 16.8 | 2.9 | 46.8 | 9.9 |
| Nickel (Extractable) (NI_EDTA) | 79 | 0.7 | 0.1 | 2.9 | 0.5 |
| Phosphorus (P_ACID) | 80 | 949.1 | 175.0 | 2,214.0 | 404.6 |
| Phosphorus (Extractable) (P_OLSEN) | 80 | 20.8 | 3.0 | 88.0 | 14.7 |
| Lead (PB_ACID) | 80 | 75.9 | 6.0 | 795.0 | 92.2 |
| Lead (Extractable) (PB_EDTA) | 79 | 18.7 | 3.6 | 108.0 | 17.6 |
| Selenium (SE_ACID) | 50 | 1.3 | 0.0 | 6.4 | 1.3 |
| Strontium (SR_ACID) | 80 | 18.9 | 0.0 | 54.0 | 11.2 |
| Vanadium (V_ACID) | 69 | 36.8 | 0.0 | 165.4 | 30.6 |
| Zinc (ZN_ACID) | 80 | 72.7 | 21.0 | 318.0 | 48.6 |
| Zinc (Extractable) (ZN_EDTA) | 79 | 5.8 | 1.1 | 35.9 | 5.8 |

for units, see Analyses Definitions (p41)

## 3c. National Analyses (5686 Sample Points)

| ANALYSES | SAMPLES | MEAN | MIN | MAX | ST. DEV |
|---|---|---|---|---|---|
| pH (PH) | 5,630 | 6.0 | 3.1 | 9.2 | 1.3 |
| Carbon (CARBON) | 5,672 | 6.1 | 0.1 | 61.5 | 8.9 |
| Aluminium (AL_ACID) | 5,677 | 26,775.3 | 491.0 | 79,355.0 | 12,772.2 |
| Arsenic (AS_ACID) | 2,729 | 4.6 | 0.0 | 110.0 | 5.7 |
| Barium (BA_ACID) | 5,677 | 150.0 | 7.0 | 3,840.0 | 159.5 |
| Calcium (CA_ACID) | 5,677 | 13,768.7 | 0.0 | 339,630.0 | 37,785.0 |
| Cadmium (CD_ACID) | 5,677 | 0.7 | 0.0 | 40.9 | 1.0 |
| Cadmium (Extractable) (CD_EDTA) | 5,655 | 0.5 | 0.0 | 85.0 | 3.0 |
| Cobalt (CO_ACID) | 5,677 | 10.6 | 0.0 | 567.0 | 13.7 |
| Cobalt (Extractable) (CO_EDTA) | 5,655 | 1.1 | 0.0 | 26.5 | 1.2 |
| Chromium (CR_ACID) | 5,677 | 38.9 | 0.0 | 2,339.8 | 43.7 |
| Copper (CU_ACID) | 5,677 | 22.6 | 0.0 | 1,507.7 | 36.8 |
| Copper (Extractable) (CU_EDTA) | 5,655 | 6.4 | 0.3 | 431.4 | 11.1 |
| Flouride (F_ACID) | 3,320 | 58.5 | 0.0 | 6,307.9 | 186.2 |
| Iron (FE_ACID) | 5,677 | 28,147.8 | 395.0 | 264,405.0 | 16,510.5 |
| Mercury (HG_ACID) | 2,159 | 0.1 | 0.0 | 2.4 | 0.2 |
| Potassium (K_ACID) | 5,677 | 4,727.7 | 60.0 | 23,905.0 | 2,700.2 |
| Potassium (Extractable) (K_NITRATE) | 5,609 | 182.0 | 6.0 | 2,776.0 | 151.6 |
| Magnesium (MG_ACID) | 5,677 | 3,648.1 | 0.0 | 62,690.0 | 3,284.1 |
| Magnesium (Extractable) (MG_NITRATE) | 5,609 | 146.0 | 1.0 | 1,601.0 | 147.5 |
| Manganese (MN_ACID) | 5,677 | 777.0 | 3.0 | 42,603.0 | 1,068.8 |
| Manganese (Extractable) (MN_EDTA) | 5,654 | 159.4 | 0.0 | 3,108.0 | 188.6 |
| Molybdenum (MO_ACID) | 4,417 | 0.9 | 0.0 | 56.3 | 2.0 |
| Sodium (NA_ACID) | 5,677 | 323.3 | 17.0 | 25,152.0 | 572.3 |
| Nickel (NI_ACID) | 5,677 | 25.4 | 0.0 | 1,350.2 | 29.2 |
| Nickel (Extractable) (NI_EDTA) | 5,655 | 1.6 | 0.1 | 73.2 | 2.0 |
| Phosphorus (P_ACID) | 5,677 | 792.1 | 41.0 | 6,273.0 | 433.9 |
| Phosphorus (Extractable) (P_OLSEN) | 5,604 | 27.4 | 0.0 | 534.0 | 25.5 |
| Lead (PB_ACID) | 5,677 | 73.3 | 0.0 | 17,365.0 | 280.6 |
| Lead (Extractable) (PB_EDTA) | 5,655 | 27.8 | 1.2 | 6,056.5 | 119.7 |
| Selenium (SE_ACID) | 2,729 | 0.6 | 0.0 | 22.8 | 0.8 |
| Strontium (SR_ACID) | 5,677 | 42.3 | 0.0 | 1,445.0 | 67.8 |
| Vanadium (V_ACID) | 4,428 | 41.0 | 0.0 | 854.4 | 33.9 |
| Zinc (ZN_ACID) | 5,677 | 90.2 | 0.0 | 3,648.0 | 104.4 |
| Zinc (Extractable) (ZN_EDTA) | 5,655 | 9.6 | 0.5 | 712.0 | 24.6 |

for units, see Analyses Definitions (p41)

## SOIL GUIDELINE VALUES (SGV)

Defra and the Environment Agency have produced soil guideline values (SGVs) as an aid to preliminary assessment of potential risk to human health from land that may be contaminated. SGVs represent ‘intervention values’, which, if exceeded, act as indicators of potential unacceptable risk to humans, so that more detailed risk assessment is needed.

The SGVs were derived using the Contaminated Land Exposure Assessment (CLEA) model for four land uses:

1. residential (with plant uptake / vegetable growing)
2. residential (without vegetable growing)
3. allotments
4. commercial / industrial

SGVs are only designed to indicate whether further site-specific investigation is needed. Where a soil guideline value is exceeded, it does not mean that there is necessarily a chronic or acute risk to human health.

The values presented in this report represent those from a number of sample points ( given in the "Samples" column in each table) providing local, regional and national background levels. Figures which appear in red indicate that a bulked sample from 20m surrounding a sample point, has at a past date, exceeded the SGV for the ‘residential with plant uptake’ land use.

It is always advisable to perform site specific investigations.

More details on all the SGVs can be found on the Environment Agency Website.

All units are mg/kg which is equivalent to parts per million (ppm)

| SUBSTANCE | RESIDENTIAL WITH PLANT UPTAKE | RESIDENTIAL WITHOUT PLANT UPTAKE | ALLOTMENTS | COMMERCIAL / INDUSTRIAL |
|---|---|---|---|---|
| LEAD | 450 | 450 | 450 | 750 |
| SELENIUM | 35 | 260 | 35 | 8000 |
| NICKEL | 50 | 75 | 50 | 5000 |
| MERCURY | 8 | 15 | 8 | 480 |
| CHROMIUM | 130 | 200 | 130 | 5000 |
| CADMIUM (pH 6) | 1 | 30 | 1 | 1400 |
| CADMIUM (pH 7) | 2 | 30 | 2 | 1400 |
| CADMIUM (pH 8) | 8 | 30 | 8 | 1400 |
| ARSENIC | 20 | 20 | 20 | 500 |

# ANALYSES DEFINITIONS

### PH (pH)
pH of soil measure after shaking 10ml of soil for 15 minutes with 25ml of water

### CARBON (Carbon)
Organic Carbon (% by wt) measured either by loss-on-ignition for soils estimated to contain more than about 20% organic carbon or by dichromate digestion.

### AL_ACID (Aluminium)
Total Aluminium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### AS_ACID (Arsenic)
Total Arsenic concentration (mg/kg) determined by Hydride Atomic Absorption Spectrometry (AAS), extracted into hydrochloric acid after digestion with nitric acid and ashing with magnesium nitrate

### BA_ACID (Barium)
Total Barium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### CA_ACID (Calcium)
Total Calcium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### CD_ACID (Cadmium)
Total Cadmium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### CD_EDTA (Cadmium Extractable)
Extractable Cadmium concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### CO_ACID (Cobalt)
Total Cobalt concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### CO_EDTA (Cobalt Extractable)
Extractable Cobalt concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### CR_ACID (Chromium)
Total Chromium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### CU_ACID (Copper)
Total Copper concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### CU_EDTA (Copper Extractable)
Extractable Copper concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### F_ACID (Flouride)
Flouride extracted with 1mol / l sulphuric acid and determined by Ion Selective Electrode (ISE)

### FE_ACID (Iron)
Total Iron concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### HG_ACID (Mercury)
Total Mercury concentration (mg/kg) determined by Hydride Atomic Absorption Spectrometry (AAS), digested in a nitric/sulphuric acid mixture

### K_ACID (Potassium)
Total Potassium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### K_NITRATE (Potassium Extractable)
Extractable Potassium concentration (mg/l) determined by shaking 10ml of air dry soil with 50ml of 1.0M ammonium nitrate for 30mins, filtering and then measuring the concentration by flame photometry

## ANALYSES DEFINITIONS continued

### MG_ACID (Magnesium)
Total Magnesium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### MG_NITRATE (Magnesium Extractable)
Extractable Magnesium concentration (mg/l) determined by shaking 10ml of air dry soil with 50ml of 1.0M ammonium nitrate for 30mins, filtering and then measuring the concentration by flame photometry

### MN_ACID (Manganese)
Total Manganese concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### MN_EDTA (Manganese Extractable)
Extractable Manganese concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### MO_ACID (Molybdenum)
Total Molybdenum concentration (mg/kg) determined by Atomic Adsorption Spectrometyr (AAS) in an aqua regia digest

### MO_EDTA (Molybdenum Extractable)
Extractable Molybdenum concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### NA_ACID (Sodium)
Total Sodium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### NI_ACID (Nickel)
Total Nickel concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### NI_EDTA (Nickel Extractable)
Extractable Nickel concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### P_ACID (Phosphorus)
Total Phosphorus concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### P_OLSON (Phosphorous Extractable)
Extractable Phosphorus concentration (mg/l) determined by shaking 5ml of air dry soil with 100ml of 0.5M sodium bicarbonate for 30mins at 20 deg.C, filtering and then measuring the absorbance at 880 nm colorimetrically with acid ammonium molybdate solution

### PB_ACID (Lead)
Total Lead concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### PB_EDTA (Lead Extractable)
Extractable Lead concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### SE_ACID (Selenium)
Total Selenium concentration (mg/kg) determined by Hydride Atomic Absorption Spectrometry (AAS), extracted into hydrochloric acid after digestion with nitric acid and ashing with magnesium nitrate

### SR_ACID (Strontium)
Total Strontium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### V_ACID (Vanadium)
Total Vanadium concentration (mg/kg) determined by Atomic Adsorption Spectrometyr (AAS) in an aqua regia digest

### ZN_ACID (Zinc)
Total Zinc concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### ZN_EDTA (Zinc Extractable)
Extractable Zinc concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

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To view the glossary visit: www.landis.org.uk/sitereporter/GLOSSARY.pdf

For a list of further reading visit: www.landis.org.uk/sitereporter/FURTHER_READING.pdf

For more information visit: www.landis.org.uk/reports

**GIS DATASETS:**
The GIS data used in the creation of this report is available to lease for use in projects.
To learn more about, or acquire the GIS datasets used in the creation of this report, please contact the National Soil Resources Institute:

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# Appendix A2 NSRI Soil Report – Section 3

# National Soil Resources Institute

## Soils Site Report

Full Soil Report

National Grid Reference: SH3267088793
Easting: 232670
Northing: 388793
Site Area: 5km x 5km

Prepared by
authorised user:
**Joanne Jeffreys**
Jacobs

2 March 2015

# Citations

Citations to this report should be made as follows:

National Soil Resources Institute (2015) Full Soils Site Report for location 232670E, 388793N, 5km x 5km, National Soil Resources Institute, Cranfield University. Accessed via https://www.landis.org.uk/sitereporter/.

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# About this report

This Soils Site Report identifies and describes the properties and capacities of the soil at your specified location as recorded in the 1:250,000 scale National Soil Map for England and Wales. It has been produced by Cranfield University's National Soil Resources Institute.

The National Soil Map represents the most accurate comprehensive source of information about the soil at the national coverage in England and Wales. It maps the distribution of soil mapping units (termed soil associations) which are defined in terms of the main soil types (or soil series) that were recorded for each soil association during field soil survey. Each soil association is named after its principal soil series and these bear the location name from where they were first described (e.g. Windsor). Each of these soil associations have differing environmental characteristics (physical, chemical and biological) and it is by mapping these properties that the range of thematic maps in this report have been produced.

Soil types and properties vary locally, as well as at the landscape scale. It is not possible to identify precisely the soil conditions at a specific location without first making a site visit. We have therefore provided you with information about the range of soil types we have identified at and around your selected location. Schematic diagrams are also provided to aid accurate identification of the soil series at your site.

Whilst an eight-figure national grid reference should be accurate to within 100m, a single rural Postcode can cover a relatively large geographical area. Postcodes can therefore be a less precise basis for specifying a location. The maps indicate the bounded area the reports relate to.

Your Soils Site Report will enable you to:

- identify the soils most likely to be present at and immediately around your specified location;
- understand the patterns of soil variation around your location and how these correlate with changes in landscape;
- identify the nature and properties of each soil type present within the area;
- understand the relevant capacities and limitations of each of the soils and how these might impact on a range of factors such as surface water quality.



For more information visit www.landis.org.uk/reports

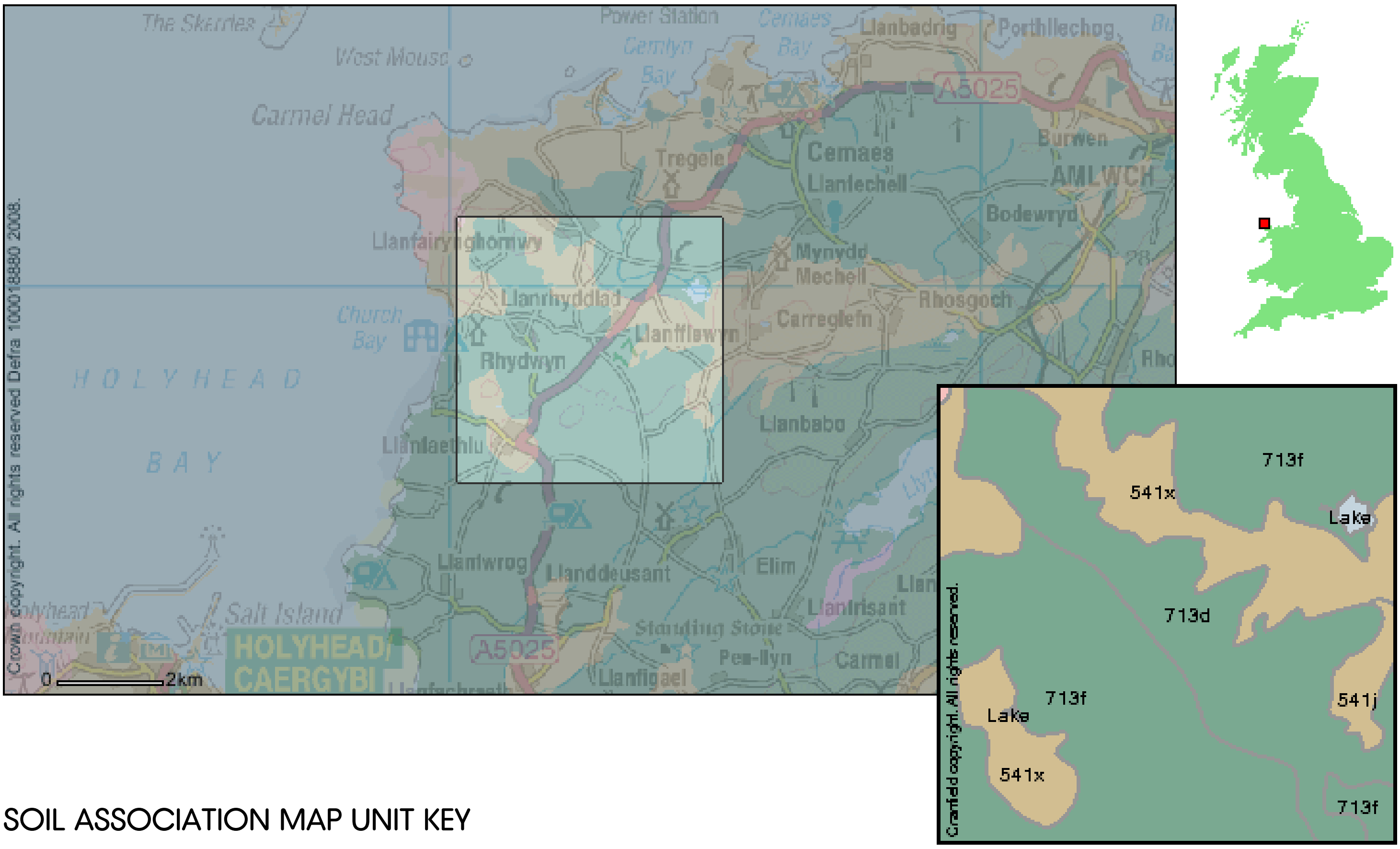
# Table of Contents

# 1. SOIL THEMATIC MAPS

This section contains a series of maps of the area surrounding your selected location, based on the 1:250,000 scale National Soil Map, presenting a number of thematic maps relating to the characteristics of the soils. These provide an overview of the nature and condition of the local soil conditions. It is these conditions that may be used to infer the response of an area to certain events (with the soil as a receptor), such as pollution contamination from a chemical spill, or an inappropriate pesticide application and the likelihood of these materials passing though the soil to groundwater. Other assessments provide an insight into the way a location may impact, by corrosive attack or ground movement, upon structures or assets within the ground, for example building or engineering foundations or pipes and street furniture.

Soil is a dynamic environment with many intersecting processes, chemical, physical and biological at play. Even soils ‘sealed’ over by concrete and bitumen are not completely dormant. The way soils respond to events and actions can vary considerably according to the properties of the soil as well as other related factors such as land-use, vegetation, topography and climate. There are many threats facing our national soil resource today and forthcoming legislation such as the proposed Soil Framework Directive (SFD) (COM(2006) 232) will seek to identify measures aimed towards soil protection and ensuring the usage of soils in the most sustainable way. This report is therefore a useful snapshot of the soil properties for your given area, providing a summary of a broad range of ground conditions.

# 1a. SOILS - SPATIAL DISTRIBUTION




## SOIL ASSOCIATION MAP UNIT KEY

**DENBIGH 1** 541j
*Well drained fine loamy and fine silty soils over rock.*

**EAST KESWICK 1** 541x
*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

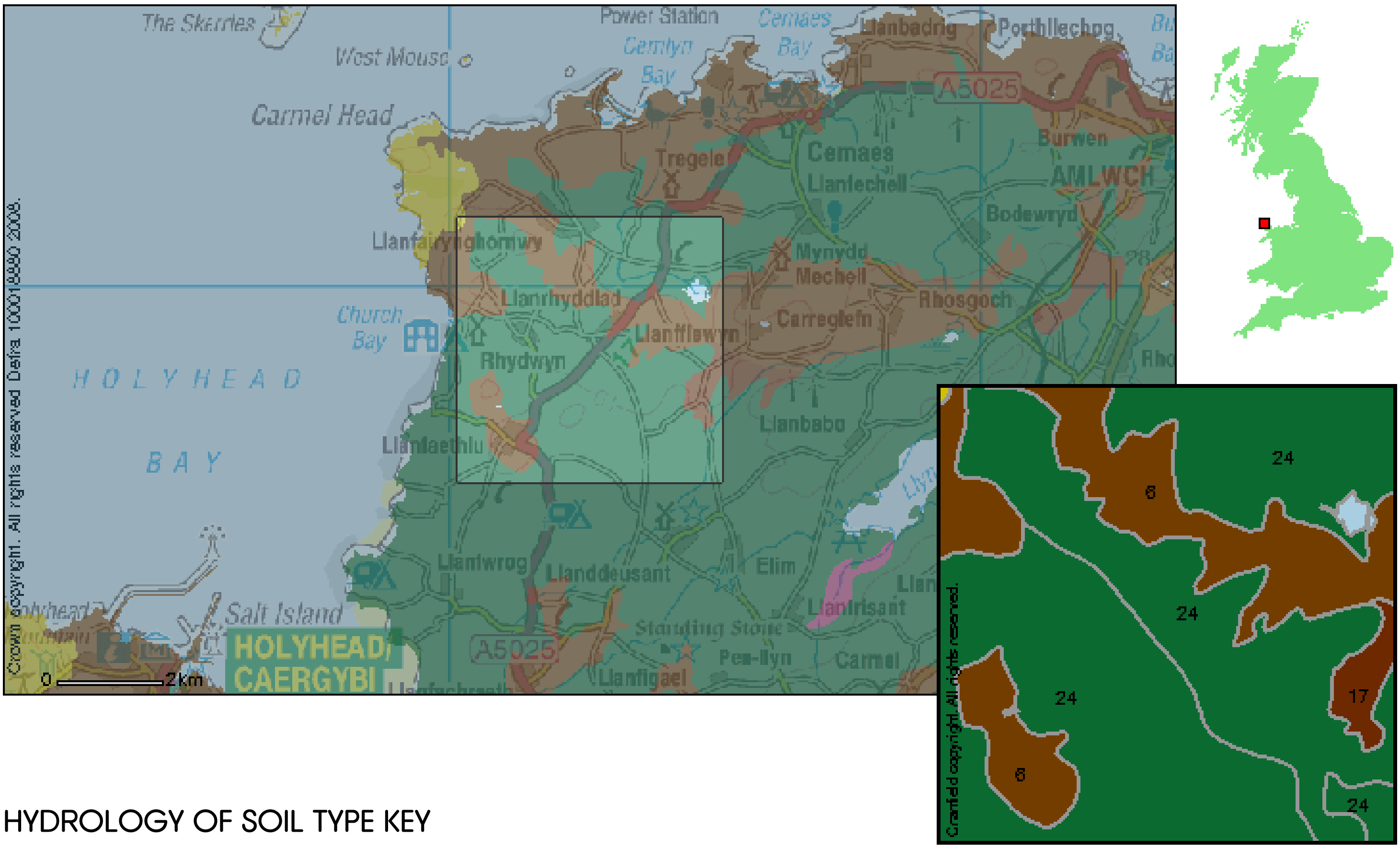
**ANGLEZARKE** 631a
*Well drained very acid coarse loamy soils over sandstone with a bleached subsurface horizon.*

**CEGIN** 713d
*Slowly permeable seasonally waterlogged fine silty and clayey soils.*

**BRICKFIELD 2** 713f
*Slowly permeable seasonally waterlogged fine loamy soils.*

Soil associations represent a group of soil series (soil types) which are typically found occurring together, associated in the landscape (Avery, 1973; 1980; Clayden and Hollis, 1984). Soil associations may occur in many geographical locations around the country where the environmental conditions are comparable. For each of these soil associations, a collection of soil types (or soil series) are recorded together with their approximate proportions within the association. Soil associations have codes as well as textual names, thus code '554a' refers to the 'Frilford' association. Where a code is prefixed with 'U', the area is predominantly urbanised (e.g. 'U571v'). The soil associations for your location, as mapped above, are described in more detail in Section 2: Soil Association Descriptions.

# 1b. HYDROLOGY OF SOIL TYPE (HOST)



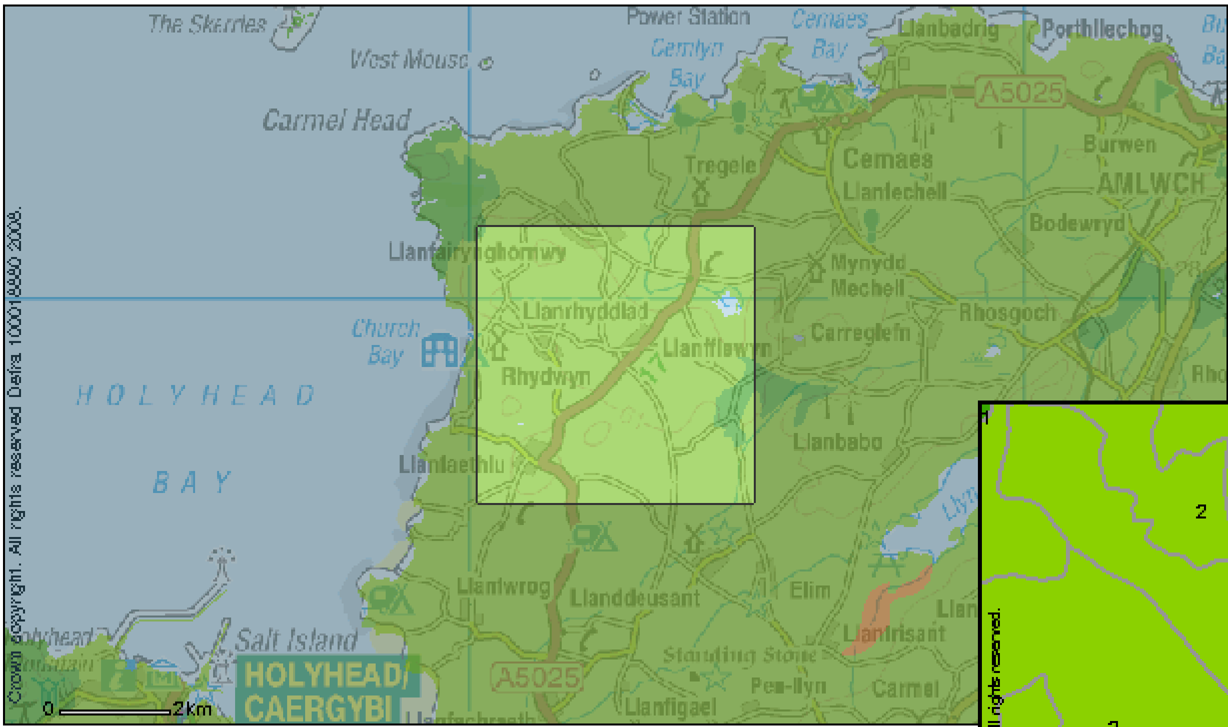

## HYDROLOGY OF SOIL TYPE KEY

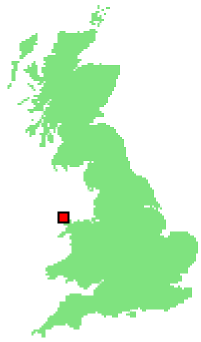
- 17 - *Relatively free draining soils with a large storage capacity over hard impermeable rocks with no storage capacity*
- 24 - *Slowly permeable, seasonally waterlogged soils over slowly permeable substrates with negligible storage capacity*
- 4 - *Free draining permeable soils on hard but fissured rocks with high permeability but low to moderate storage capacity*
- 6 - *Free draining permeable soils in unconsolidated loams or clays with low permeability and storage capacity*

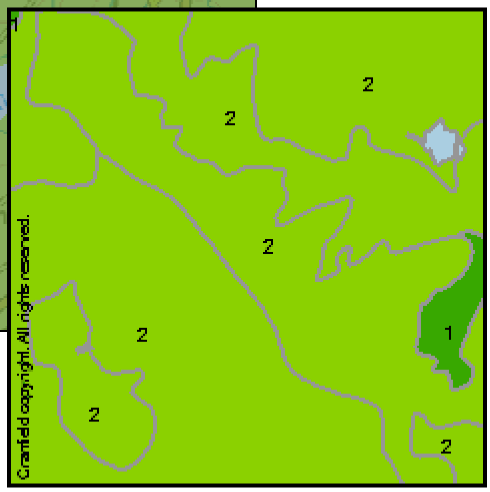
HOST CLASS DESCRIPTION

The Hydrology of Soil Types (HOST) classification describes the dominant pathways of water movement through the soil and, where appropriate, the underlying substrate. Eleven drainage models are defined according to the permeability of the soil and its substrate and the depth to a groundwater table, where one is present (Boorman et al,1995). These are further subdivided into 29 HOST classes to which all soil series have been assigned. These classes identify the way soil water flows are partitioned, with water passing over, laterally through, or vertically down the soil column. Analysis of the river hydrograph and the extent of soil series for several hundred gauged catchments allowed mean values for catchment hydrological variables to be identified for each HOST class, The HOST classification is widely used to predict river flows and the frequency and severity of flood events and also to model the behaviour of diffuse pollutants (Hollis et al, 1995).

# 1c. GROUND MOVEMENT POTENTIAL






## GROUND MOVEMENT POTENTIAL KEY

- 1 - *Very low*
- 2 - *Low*
- 3 - *Moderate*
- 4 - *High*
- 5 - *Very high*

* If a High class is starred, a 'Very High' ground movement potential is likely to be achieved if these soils are drained to an effective depth of at least two metres.

GROUND MOVEMENT POTENTIAL DESCRIPTION

Clay-related ground movement is the most widespread cause of foundation failure in the UK and is linked to seasonal swelling and shrinkage of the clay. The content of clay within the soils of your selected area has therefore a direct bearing upon the likelihood of ground movement.

Among the inorganic particles that constitute the solid component of any soil, clay particles are the smallest and defined as being <0.002 mm - equivalent spherical diameter (esd) in size. Clay particles occur in most kinds of soil but they only begin to exert a predominant influence on the behaviour of the whole soil where there is more than 35 per cent (by weight) of clay-sized material present.

Because clay particles are very small and commonly platy in shape they have an immense surface area onto which water can be attracted, relative to the total volume of the soil material. In addition to surface attraction or inter-crystalline absorption of water, some clay minerals, those with three layers of atoms (most other kinds of clay have only two layers of atoms) are able to absorb and hold additional water between these layers. It is these types of clay mineral, which are widespread in British soils and commonly known as *smectites* that have the greatest capacity to shrink and swell.

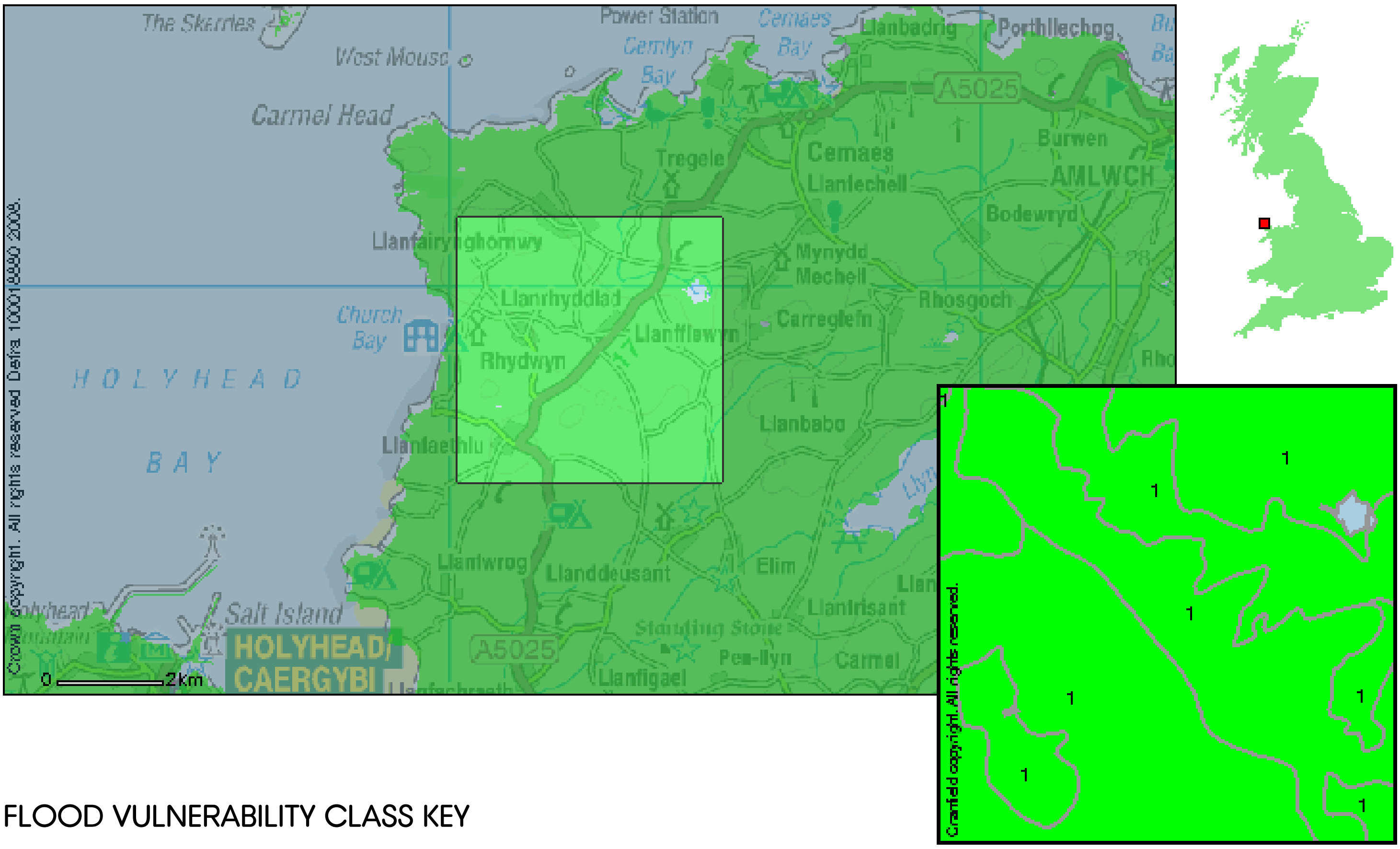
In a natural undisturbed condition, the moisture content of deep subsoil clay does not change greatly through the year and consequently there are no changes in volume leading to shrinkage and swelling. However, when clays are exposed at or near the ground surface and especially when vegetation is rooting in them seasonal moisture and volume changes can be dramatic. Plants and trees transpire moisture from the soil to support their growth and transfer necessary nutrients into their structures. Surface evaporation

also takes place from soil and plant structures, and the combination of evaporation from surfaces and transpiration by plants and trees is termed *evapotranspiration*. Thus, the layer of soil material down to 2m depth into which plants will root is critical when assessing the vulnerability of land to subsidence.

Whenever soil moisture is continuously being replenished by rainfall, the soil moisture reserves will be unaffected by the removal of moisture by plants as there is no net loss. However, in many parts of Britain, particularly in the south and east, summer rainfall is small and is exceeded by evapotranspiration. Water reserves are then not sufficiently replenished by rainfall and so a soil moisture deficit develops. The water removed from a clayey soil by evapotranspiration leads to a reduction in soil volume and the consequent shrinkage causes stress in the soil materials leading in turn to stress on building foundations that are resting in the soil (Hallett, et al, 1994).

The foundations themselves may then move and thus cause damage to building structures. This problem can be exacerbated by the fact that the soil beneath the structure may not dry out uniformly, so that any lateral pressure exerted on the building foundation is made effectively greater. This assessment identifies the likelihood of soil conditions being prone to ground movement given these other factors.

# 1d. FLOOD VULNERABILITY




## FLOOD VULNERABILITY CLASS KEY

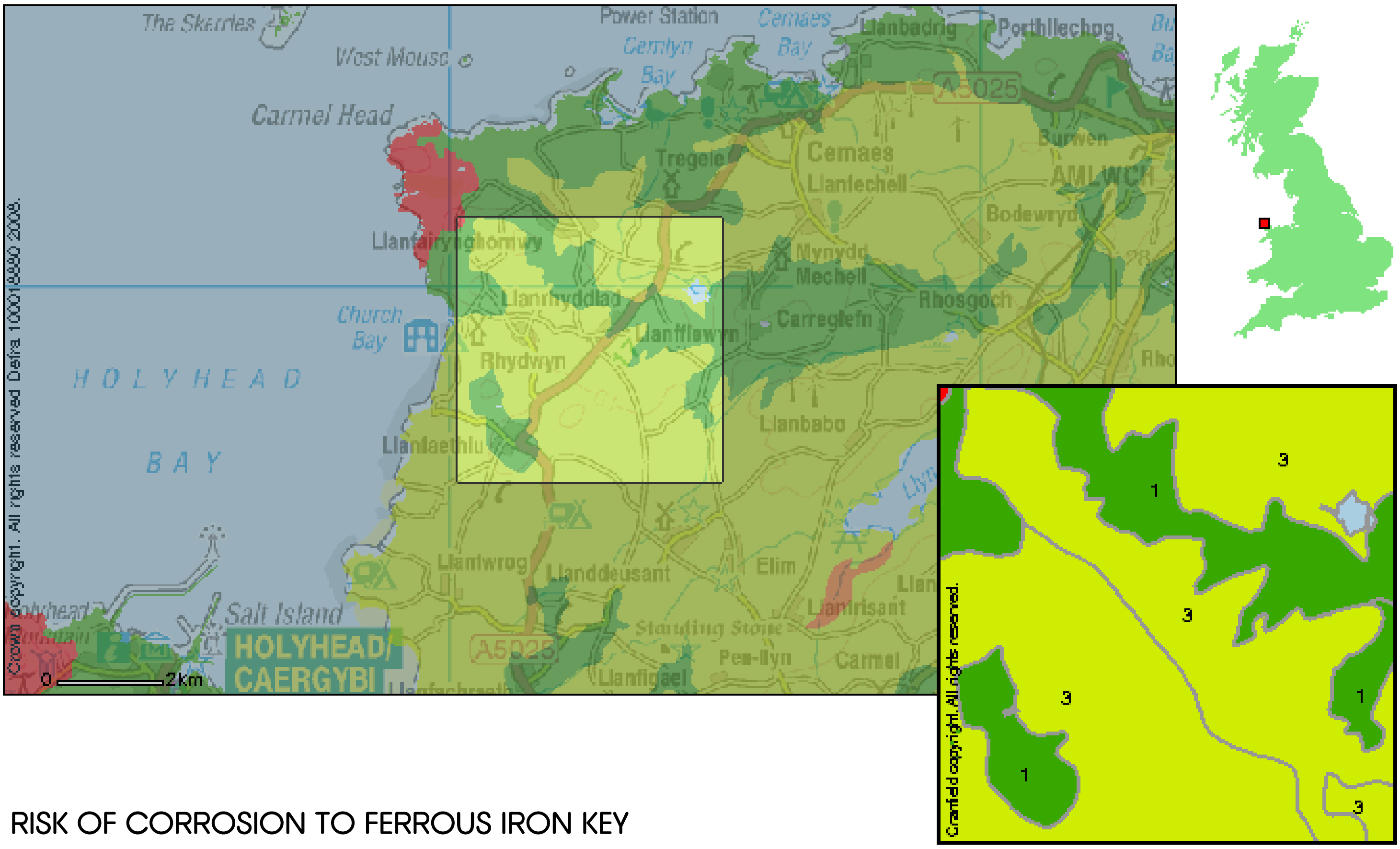
- 0 - *Major risk*
- 1 - *Minor risk*

FLOOD VULNERABILITY DESCRIPTION

The inundation of properties by flood water can occur in a number of circumstances. Surface run-off can collect on low-lying land from upslope following heavy rainfall. More commonly rivers, lakes and/or the sea extend beyond their normal limits as a result of prolonged or intense rainfall, unusually high tides and/or extreme wind events. Water damage to properties and their contents is compounded by the deposition of sediment suspended in the flood waters. The spatial distribution of such waterborne sediment (or alluvium as defined in soil science) is one basis upon which land that has been subject to historical flooding can be mapped, and this forms a basis for present-day flooding risk assessment.

Both riverine and marine alluvium are identified as distinct soil parent materials within the British soil classifications. Combining soil map units that are dominated by soil series developed in alluvium across Great Britain identifies most of the land that is vulnerable to flooding. This assessment does not account for man-made flood defence measures, showing instead the areas where once water has stood.

## 1e. RISK OF CORROSION TO FERROUS IRON




### RISK OF CORROSION TO FERROUS IRON KEY

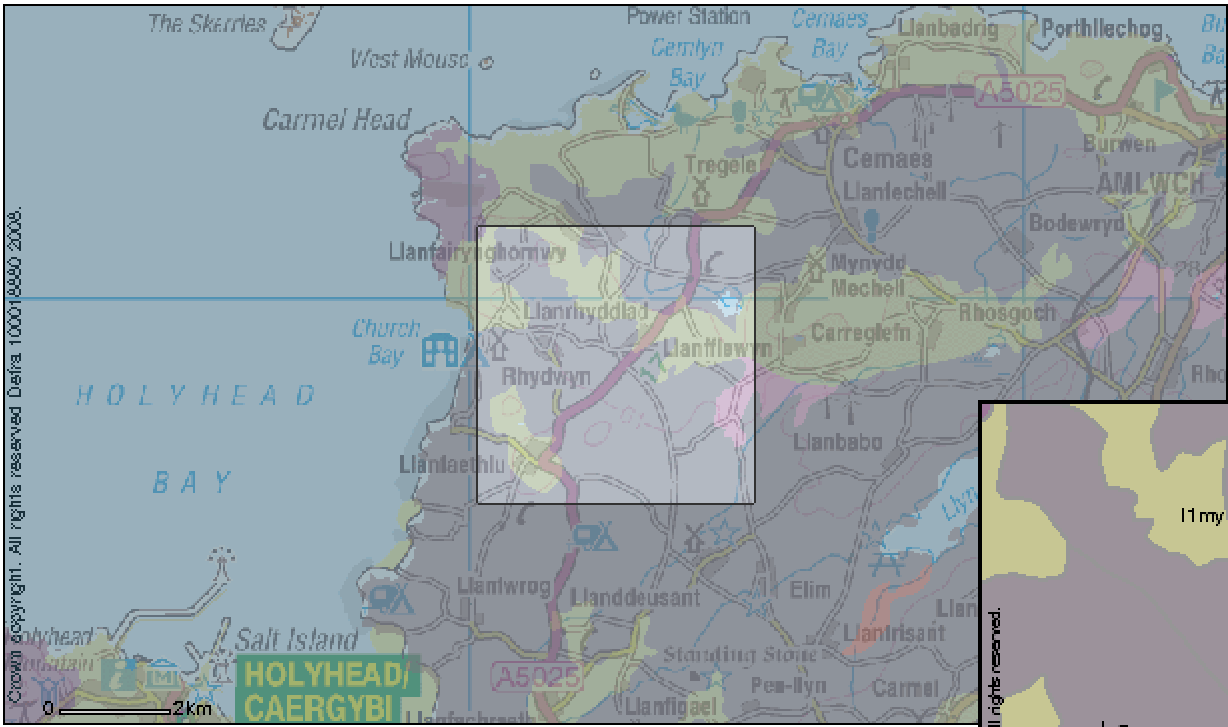
- 1 - *Non-aggressive*
- 2 - *Slightly Aggressive*
- 3 - *Moderately Aggressive*
- 4 - *Highly Aggressive*
- 5 - *Very highly Aggressive*
- 6 - *Impermeable Rock*

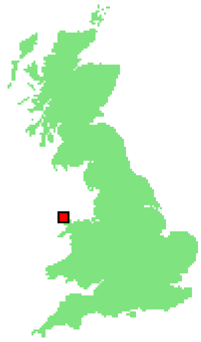
* If a class is starred, it is assumed that there are moderate amounts of sulphate in the soil. If there is abundant sulphate present, the soil may be one class more aggressive. Conversely, if there is very little sulphate, the soil may be one class less aggressive to buried ferrous iron.

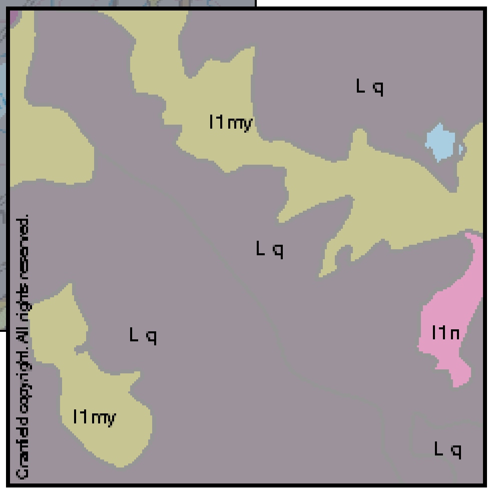
RISK OF CORROSION TO FERROUS IRON DESCRIPTION

Buried iron pipes and other infrastructure corrode at rates that are influenced by soil conditions (Jarvis and Hedges, 1994). Soil acidity, sulphide content, aeration and wetness all influence the corrosivity of the soil. These factors are used to map 5 major classes of relative corrosivity.

## 1f. PESTICIDE LEACHING RISK






## PESTICIDE LEACHING CLASS KEY

- H3df - *Moderately shallow soil over fissured hard rock with deep groundwater*
- I1my - *Deep loamy soil; groundwater at moderate depth*
- I1n - *Deep loamy soils over hard non-porous rocks - no groundwater present*
- L q - *Impermeable soils over soft substrates of low or negligible storage capacity that sometimes conceal groundwater bearing rocks at depth*

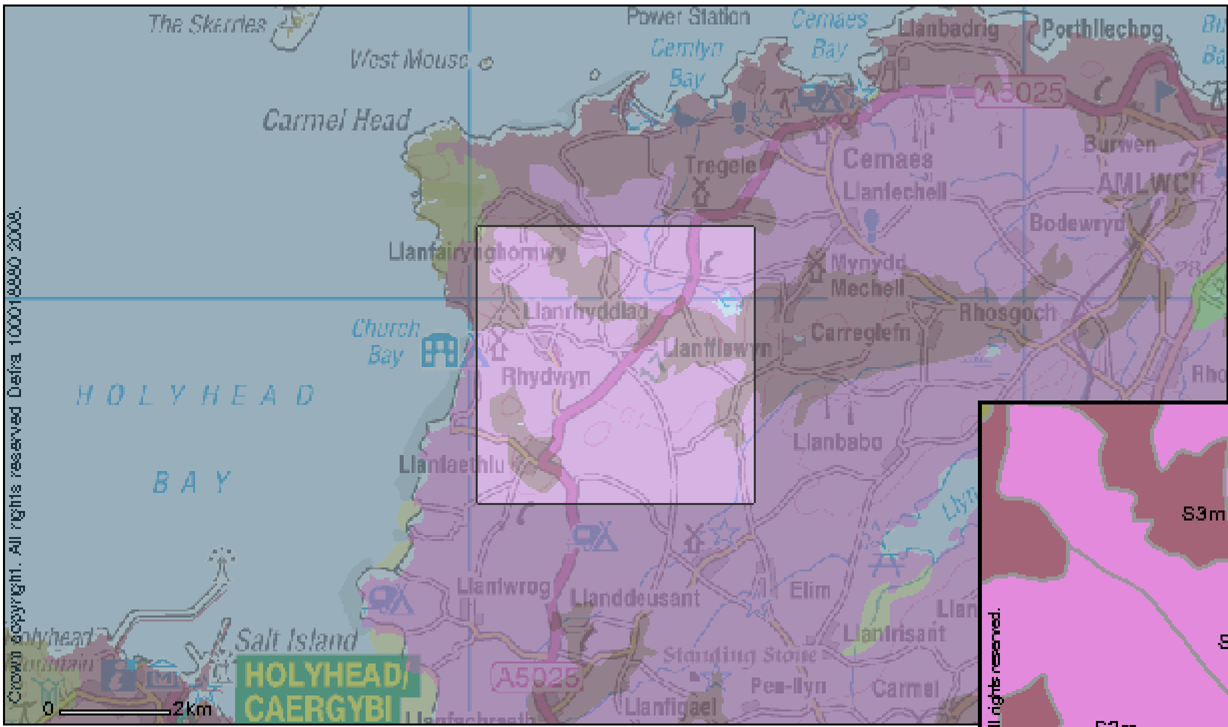
### PESTICIDE LEACHING CLASS DESCRIPTION

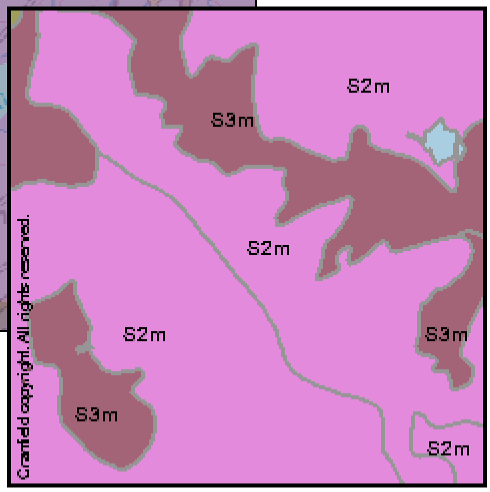
The natural permeability and water regime of soils are influential in determining the fate and behaviour of pesticides applied to the crop and soil surface (Hollis et al, 1995). A system of vulnerability assessment was devised as part of the national system for Policy and Practice for the Protection of Groundwater. This divided soils into three primary vulnerability classes.

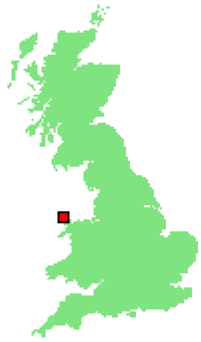
H - Soils of high leaching capacity with little ability to attenuate non-adsorbed pesticide leaching which leave underlying groundwater vulnerable to pesticide contamination.
I – Soils of intermediate leaching capacity with a moderate ability to attenuate pesticide leaching.
L - Soils of low leaching capacity through which pesticides are unlikely to leach.

The primary classes have been further subdivided into nearly forty subclasses. These subclasses, with their descriptions, are mapped above. These classes do not account for differences in land cultivation, which can also have a significant impact on pesticide behaviour.

## 1g. PESTICIDE RUNOFF RISK



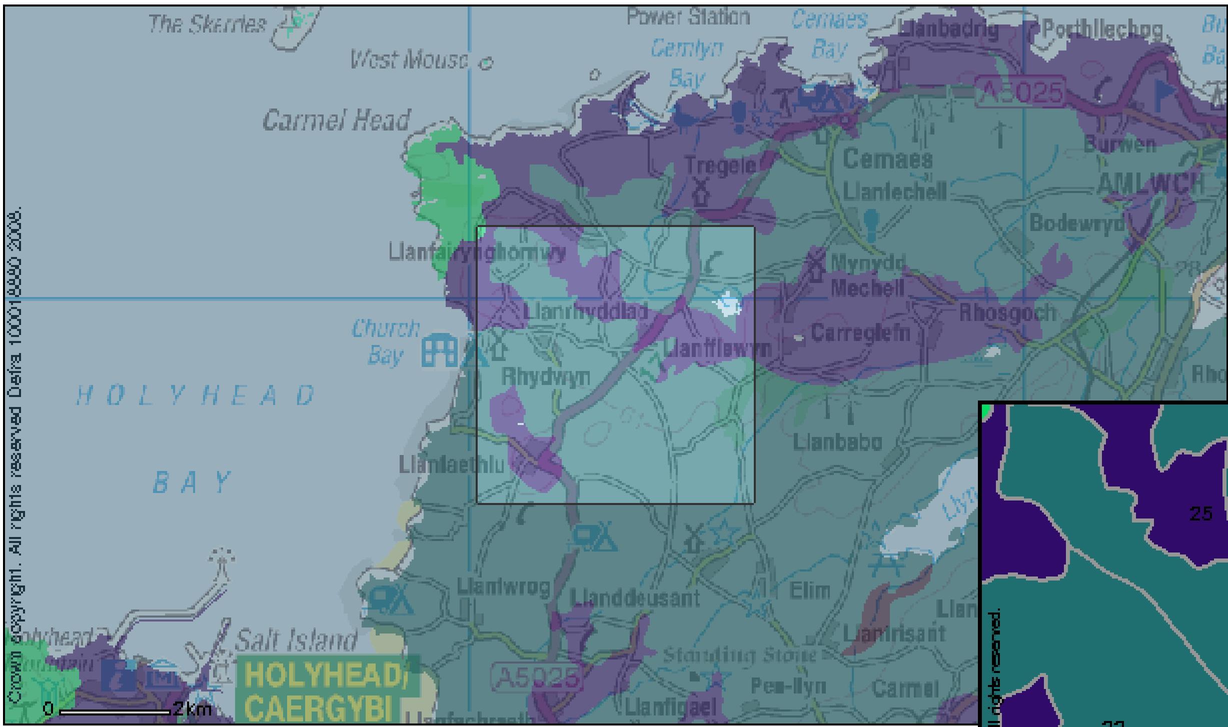
### PESTICIDE RUNOFF RISK KEY

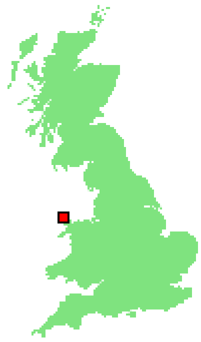
- S2m - *Soils with high run-off potential but moderate adsorption potential*
- S3m - *Soils with moderate run-off potential and moderate adsorption potential*
- S4m - *Soils with low run-off potential and moderate adsorption potential*

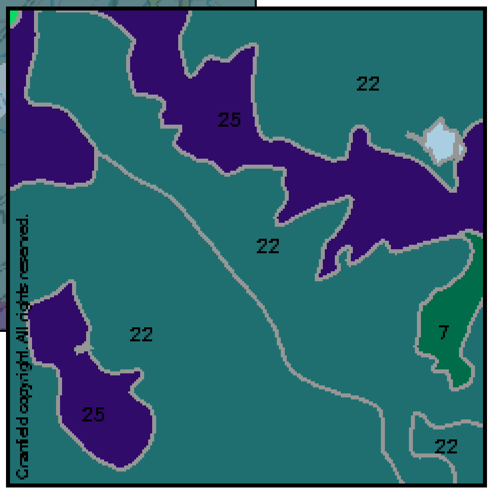
PESTICIDE RUNOFF RISK DESCRIPTION

The physical properties and natural water regime of soils influence the speed and extent of lateral water movement over and through the soil at different depths (Hollis et al, 1995). At as result, soils can be classed according to the potential for pesticide run-off. Five runoff potential classes are identified for mineral soils and a further two for peat soils. The mineral soil classes are further subdivided according to the potential for pesticide adsorption.

## 1h. HYDROGEOLOGICAL ROCK TYPE





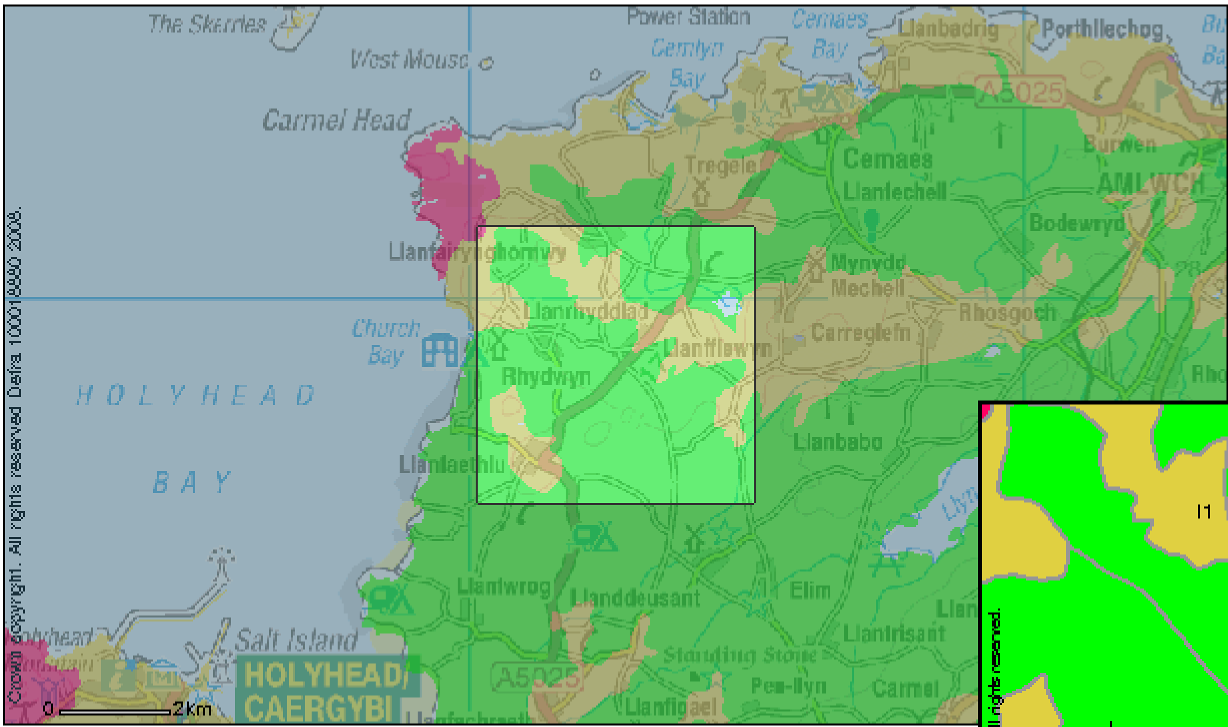

## HYDROGEOLOGICAL ROCK TYPE KEY

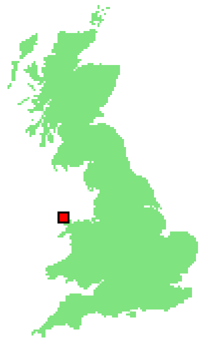
- 13 - *hard fissured sandstones*
- 22 - *till and compact Head*
- 25 - *loamy drift*
- 7 - *hard, but deeply shattered non-arenaceous rocks*

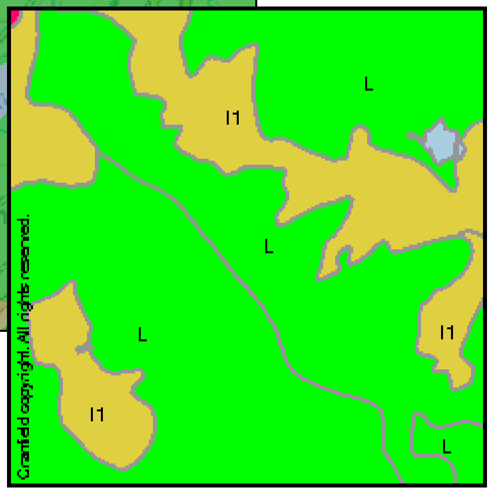
HYDROGEOLOGICAL ROCK TYPE DESCRIPTION

The hydrogeological classification of the soil parent materials provides a framework for distinguishing between soil substrates according to their general permeability and whether they are likely to overlie an aquifer. Every soil series has been assigned one of the 32 substrate classes and each of these is characterised according to its permeability (being characterised as permeable, slowly permeable or impermeable). For further information, see Boorman et al (1995).

## 1i. GROUND WATER PROTECTION POLICY (GWPP) LEACHING





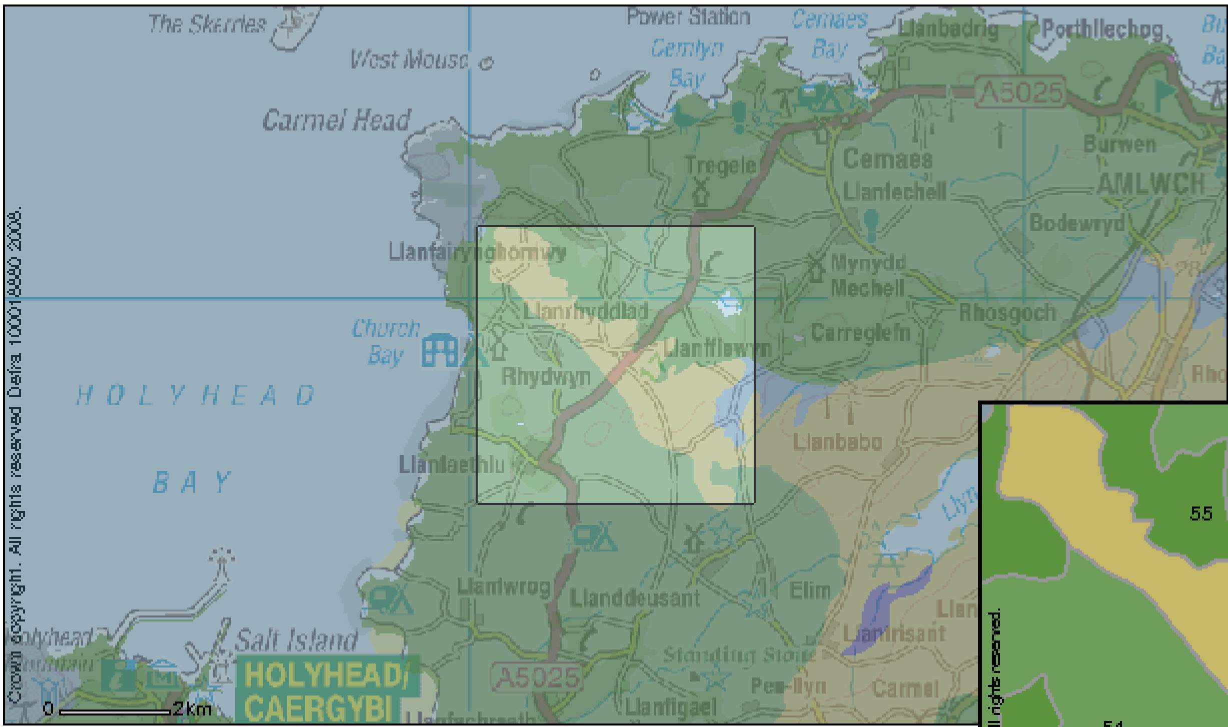

### GWPP LEACHING CLASS KEY

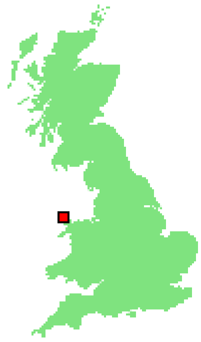
- H3 - *Coarse textured or moderately shallow soils of high leaching potential, which readily transmit non-adsorbed pollutants and liquid discharges but which have some ability to attenuate adsorbed pollutants because of their relatively large organic matter or clay content*
- I1 - *Soils of intermediate leaching potential which have a moderate ability to attenuate a wide range of diffuse source pollutants but in which it is possible that some non-adsorbed diffuse source pollutants and liquid discharges could penetrate the soil layer*
- L - *Soils in which pollutants are unlikely to penetrate the soil layer either because water movement is largely horizontal or because they have a large ability to attenuate diffuse source pollutants*

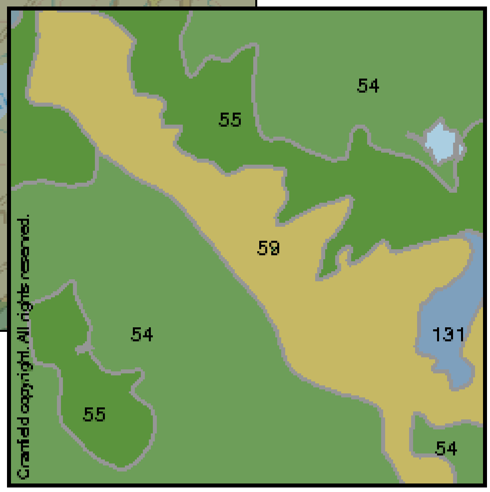
GWPP LEACHING CLASS DESCRIPTION

The Ground Water Protection Policy classes describe the leaching potential of pollutants through the soil (Hollis, 1991; Palmer et al, 1995). The likelihood of pollutants reaching ground water is described. Different classes of pollutants are described, including liquid discharges adsorbed and non-adsorbed pollutants.

## 1j. SOIL PARENT MATERIAL





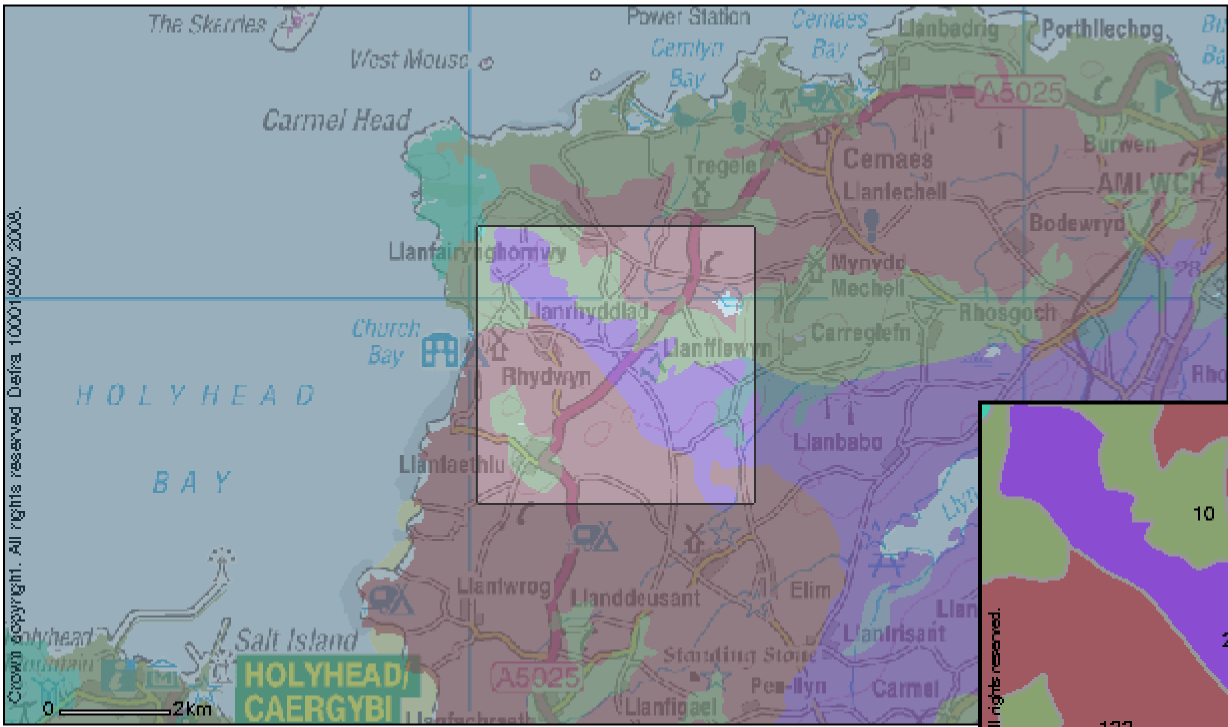

### SOIL PARENT MATERIAL KEY

- 124 - *Palaeozoic and Mesozoic sandstone*
- 131 - *Palaeozoic slaty mudstone and siltstone*
- 54 - *Drift from Palaeozoic and Mesozoic sandstone and shale*
- 55 - *Drift from Palaeozoic sandstone and shale*
- 59 - *Drift from Palaeozoic slaty mudstone and siltstone*

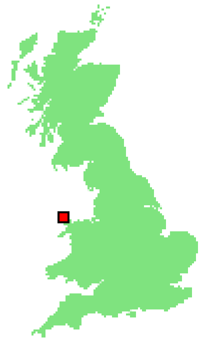
SOIL PARENT MATERIAL DESCRIPTION

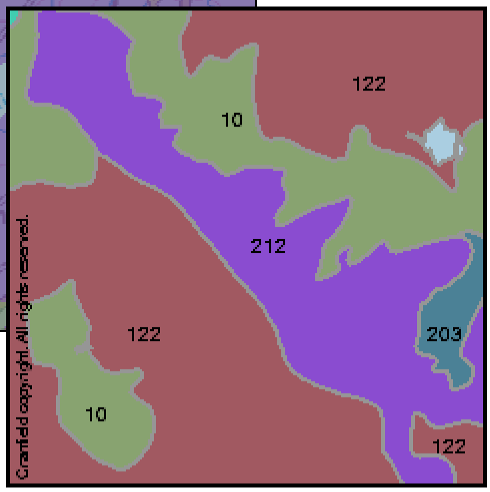
Along with the effects of climate, relief, organisms and time, the underlying geology or 'parent material' has a very strong influence on the development of the soils of England and Wales. Through weathering, rocks contribute inorganic mineral grains to the soils and thus exhibit control on the soil texture. During the course of the creation of the national soil map, soil surveyors noted the parent material underlying each soil in England and Wales. It is these general descriptions of the regional geology which is provided in this map.

## 1k. EXPECTED CROPS AND LAND USE











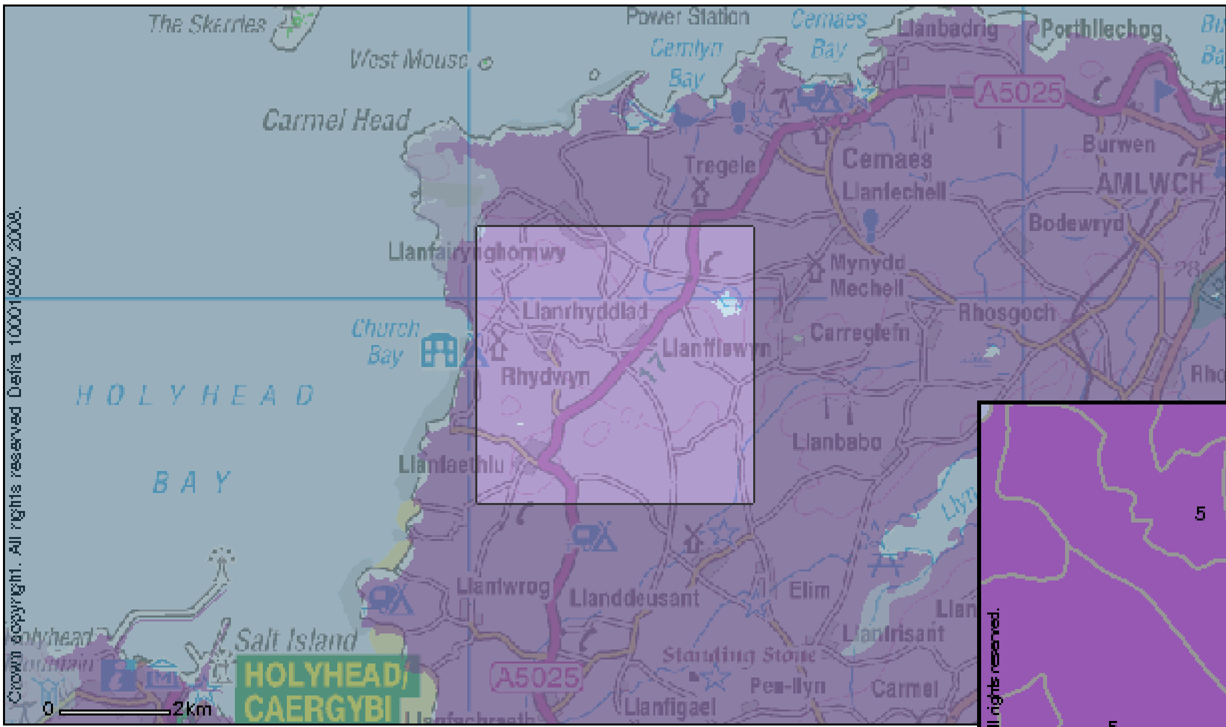
### EXPECTED CROPS AND LAND USE KEY

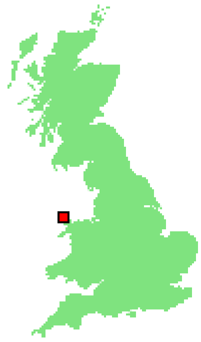
- 10 - *Cereals and grassland in the Northern Region; stock rearing on permanent grassland in Wales.*
- 122 - *Dairying and stock rearing on permanent or short term grassland; some cereals in drier areas.*
- 148 - *Dry moorland habitats of poor grazing value; coniferous woodland; recreation.*
- 203 - *Stock rearing in uplands, dairying and some cereals in moist lowlands; coniferous and deciduous woodland and rough*
- 212 - *Stock rearing on permanent grassland dairying on lower ground.*

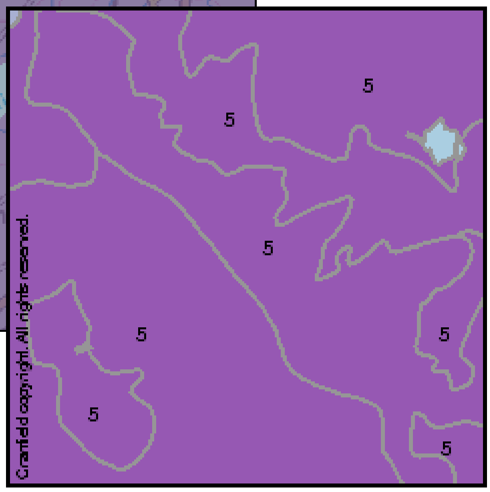
EXPECTED CROPS AND LAND USE DESCRIPTION

Individual soils are commonly associated with particular forms of land cover and land use. Whilst the soil surveyors were mapping the whole of England and Wales, they took careful note of the range of use to which the land was being put. This map shows the most common forms of land use found on each soil unit.

# 11. NATURAL SOIL FERTILITY





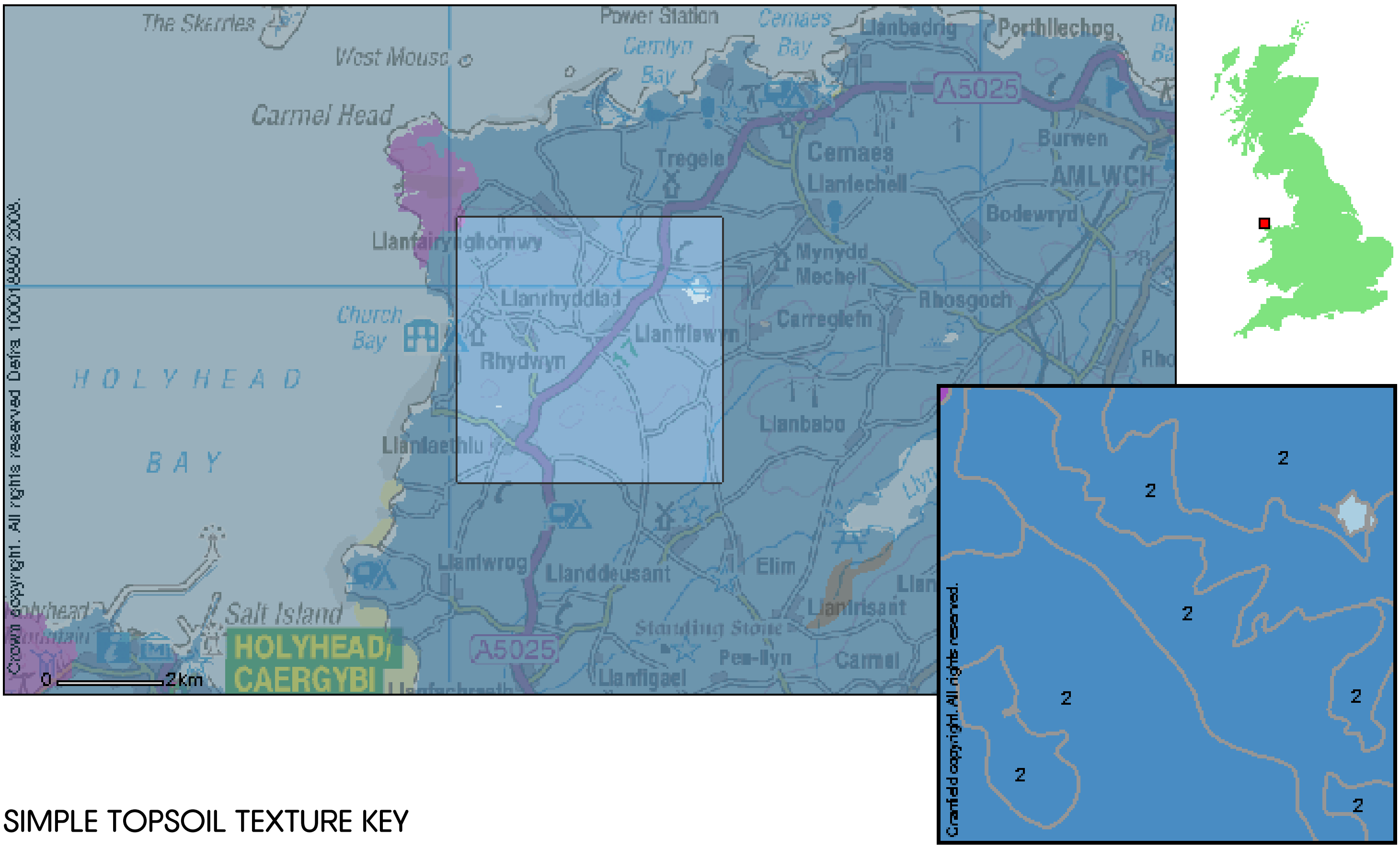

## NATURAL SOIL FERTILITY KEY

- 12 - *Very low*
- 5 - *Low*

NATURAL SOIL FERTILITY DESCRIPTION

Soil fertility can be greatly altered by land management especially through the application of manures, lime and mineral fertilisers. What is shown in this map, however, is the likely natural fertility of each soil type. Soils that are very acid have low numbers of soil-living organisms and support heathland and acid woodland habitats. These are shown as of very low natural fertility. Soils identified as of low natural fertility are usually acid in reaction and are associated with a wide range of habitat types. The moderate class contains neutral to slightly acid soils, again with a wide range of potential habitats. Soil of high natural fertility are both naturally productive and able to support the base-rich pastures and woodlands that are now rarely encountered. Lime-rich soils contain chalk and limestone in excess, and are associated with downland, herb-rich pastures and chalk and limestone woodlands.

## 1m. SIMPLE TOPSOIL TEXTURE




### SIMPLE TOPSOIL TEXTURE KEY

1 - *Clayey*

2 - *Loamy*

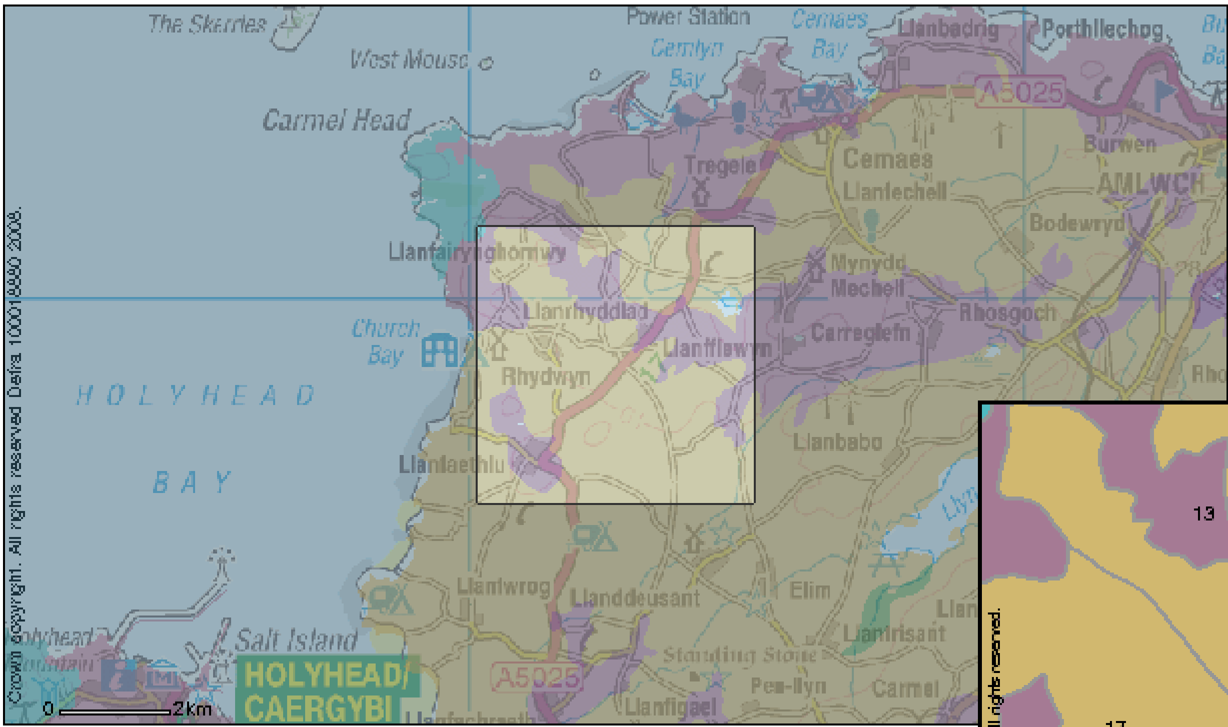
3 - *Peaty*

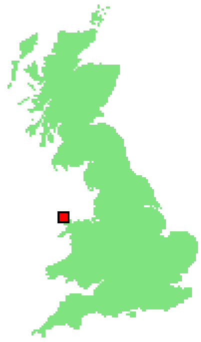
4 - *Sandy*

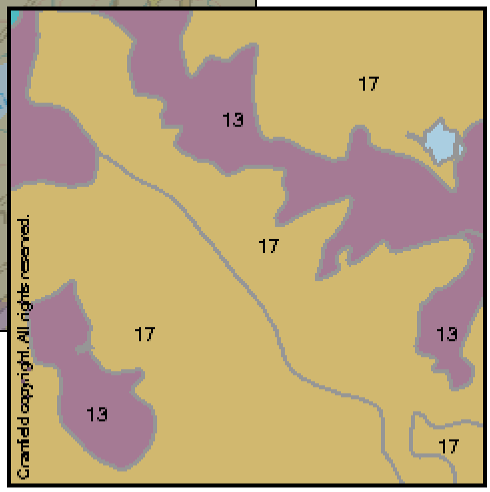
SIMPLE TOPSOIL TEXTURE DESCRIPTION

Soil texture is a term used in soil science to describe the physical composition of the soil in terms of the size of mineral particles in the soil. Specifically, we are concerned with the relative proportions of sand, silt and clay. Soil texture can vary between each soil layer or horizon as one moves down the profile. This map indicates the soil texture group of the upper 30 cm of the soil. ‘Light’ soils have more sand grains and are described as sandy, while ‘heavy’ soils have few sand grains but a lot of extremely small particles and are described as clayey. Loamy soils have a mix of sand, silt and clay-sized particles and are intermediate in character. Soils with a surface layer that is dominantly organic are described as Peaty. A good understanding of soil texture can enable better land management.

## 1n. TYPICAL HABITATS






### TYPICAL HABITATS KEY

- 12 - *Mostly lowland dry heath communities*
- 13 - *Neutral and acid pastures and deciduous woodlands; acid communities such as bracken and gorse in the uplands*
- 17 - *Seasonally wet pastures and woodlands*

TYPICAL HABITATS DESCRIPTION

There is a close relationship between vegetation and the underlying soil. Information about the types of broad habitat associated with each soil type is provided in this map. Soil fertility, pH, drainage and texture are important factors in determining the types of habitats which can be established. Elevation above sea level and sometimes even the aspect - the orientation of a hillslope - can affect the species present. This map does not take into account the recent land management or any urban development, but provides the likely natural habitats assuming good management has been carried out.

## 2. SOIL ASSOCIATION DESCRIPTIONS

The following pages describe the following soil map units, (soil associations), in more detail.

**DENBIGH 1** 541j
*Well drained fine loamy and fine silty soils over rock.*

**EAST KESWICK 1** 541x
*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

**ANGLEZARKE** 631a
*Well drained very acid coarse loamy soils over sandstone with a bleached subsurface horizon.*

**CEGIN** 713d
*Slowly permeable seasonally waterlogged fine silty and clayey soils.*

**BRICKFIELD 2** 713f
*Slowly permeable seasonally waterlogged fine loamy soils.*

The soil associations are described in terms of their texture and drainage properties and potential risks may be identified. The distribution of the soils across England and Wales are provided. Further to this, properties of each association's component soil series are described in relation to each other. Lastly, schematic diagrams of each component series are provided for greater understanding and in-field verification purposes.

# DENBIGH 1 (541j)

*Well drained fine loamy and fine silty soils over rock.*

**a. General Description**

Well drained fine loamy and fine silty soils over rock. Some similar soils with slowly permeable subsoils and slight seasonal waterlogging. Shallow soils and some bare rock locally. some bare rock locally.
The major landuse on this association is defined as stock rearing in uplands, dairying and some cereals in moist lowlands; coniferous and deciduous woodland and rough grazing on steep slopes.

**b. Distribution (England & Wales)**

The DENBIGH 1 association covers 4630km² of England and Wales which accounts for 3.06% of the landmass. The distribution of this association is shown in Figure 1. Note that the yellow shading represents a buffer to highlight the location of very small areas of the association.

**c. Comprising Soil Series**

Multiple soil series comprise a soil association. The soil series of the DENBIGH 1 association are outlined in Table 1 below. In some cases other minor soil series are present at a particular site, and these have been grouped together under the heading 'OTHER'. We have endevoured to present the likelihood of a minor, unnamed soil series occuring in your site in Table 1.

Schematic diagrams of the vertical soil profile of the major constituent soil series are provided in Section D to allow easier identification of the particular soil series at your site.

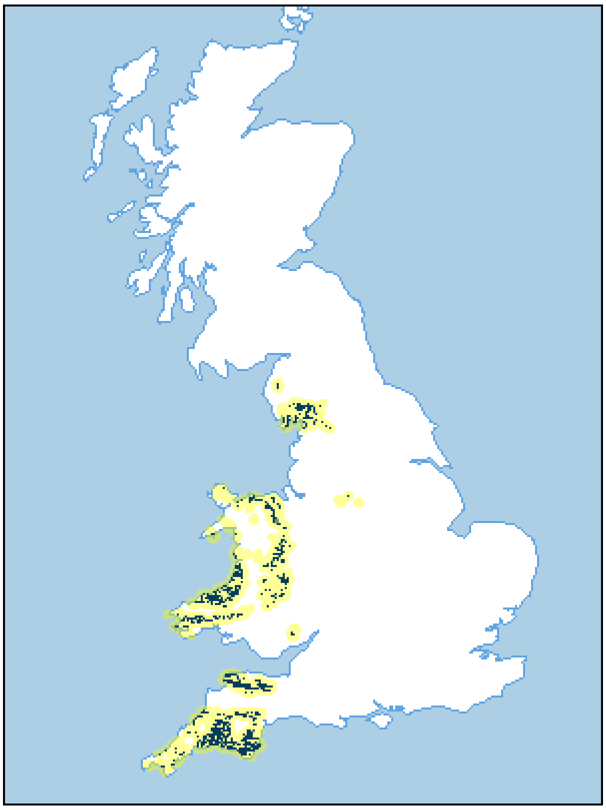


Figure 1. Association Distribution

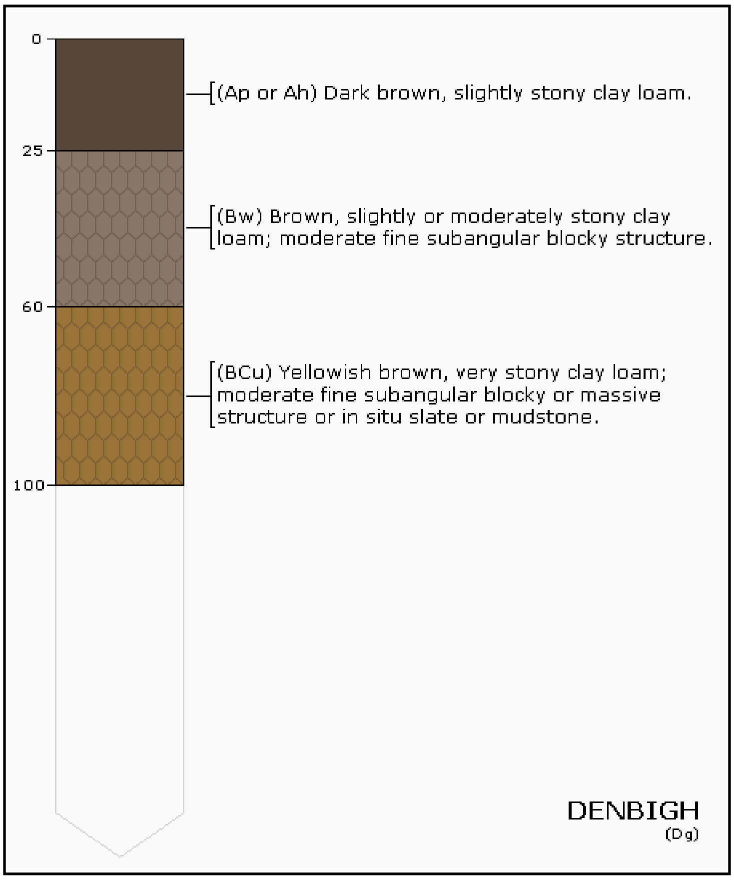
| Soil Series | Description | Area % |
|---|---|---|
| DENBIGH (Dg) | medium loamy material over lithoskeletal mudstone and sandstone or slate | 40% |
| BARTON (BT) | medium silty material over lithoskeletal siltstone | 10% |
| POWYS (Ph) | loamy lithoskeletal mudstone and sandstone or slate | 10% |
| SANNAN (Sn) | medium silty drift with siliceous stones | 10% |
| MANOD (Mj) | medium loamy material over lithoskeletal mudstone and sandstone or slate | 5% |
| OTHER | other minor soils | 25% |

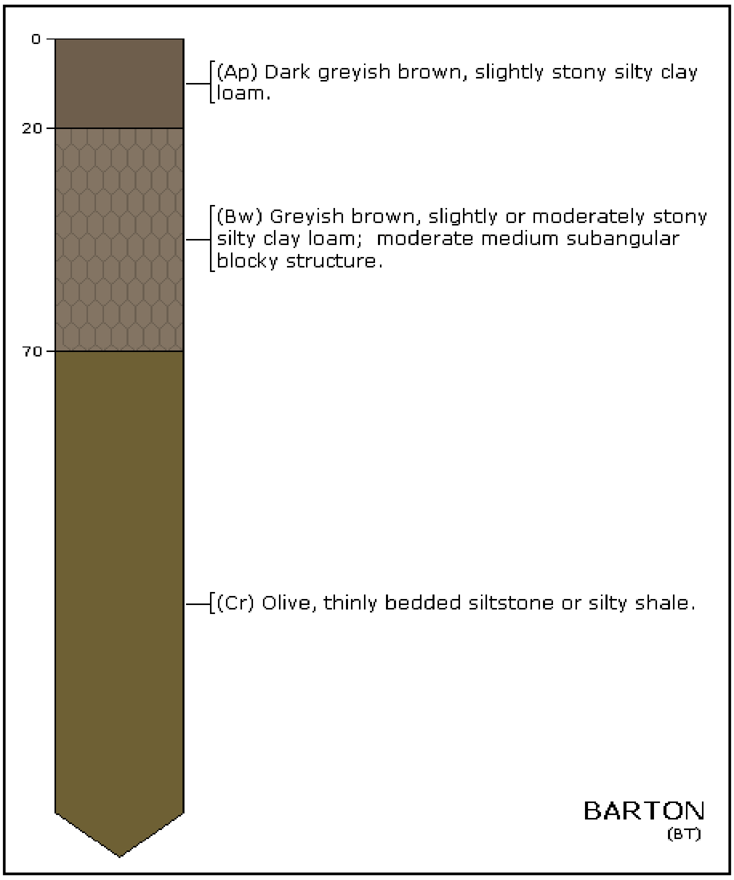
Table 1. The component soil series of the DENBIGH 1 soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

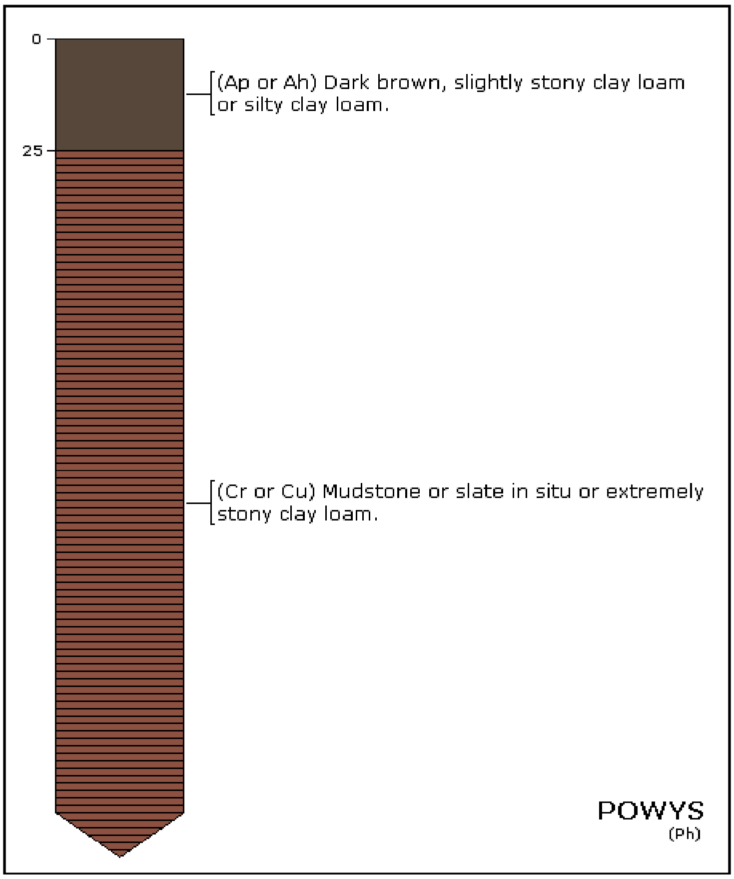
# DENBIGH 1 (541j)

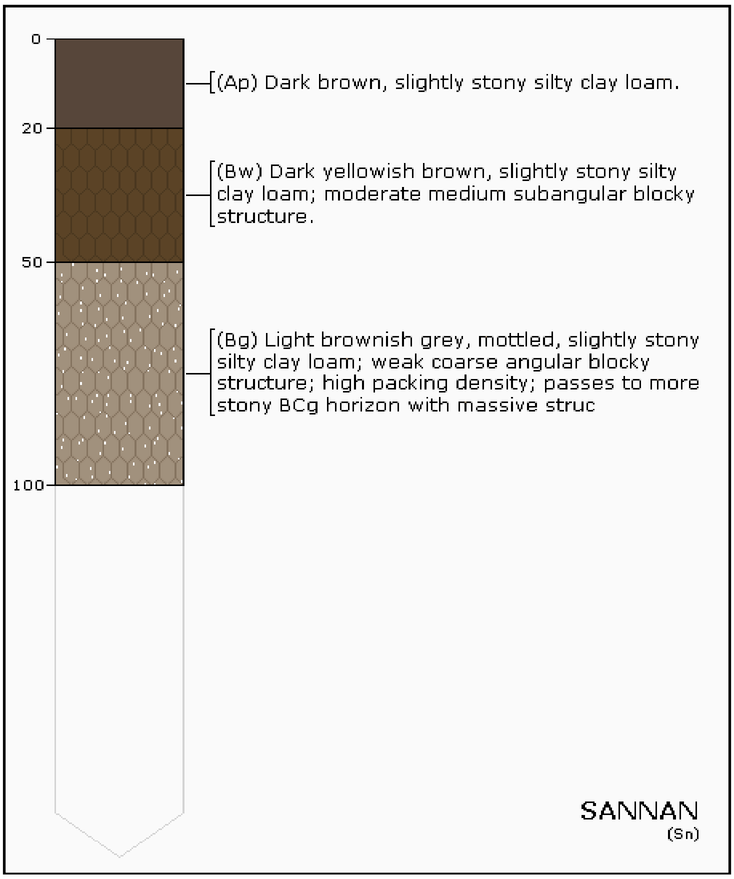
*Well drained fine loamy and fine silty soils over rock.*

## d. DENBIGH 1 Component Series Profiles



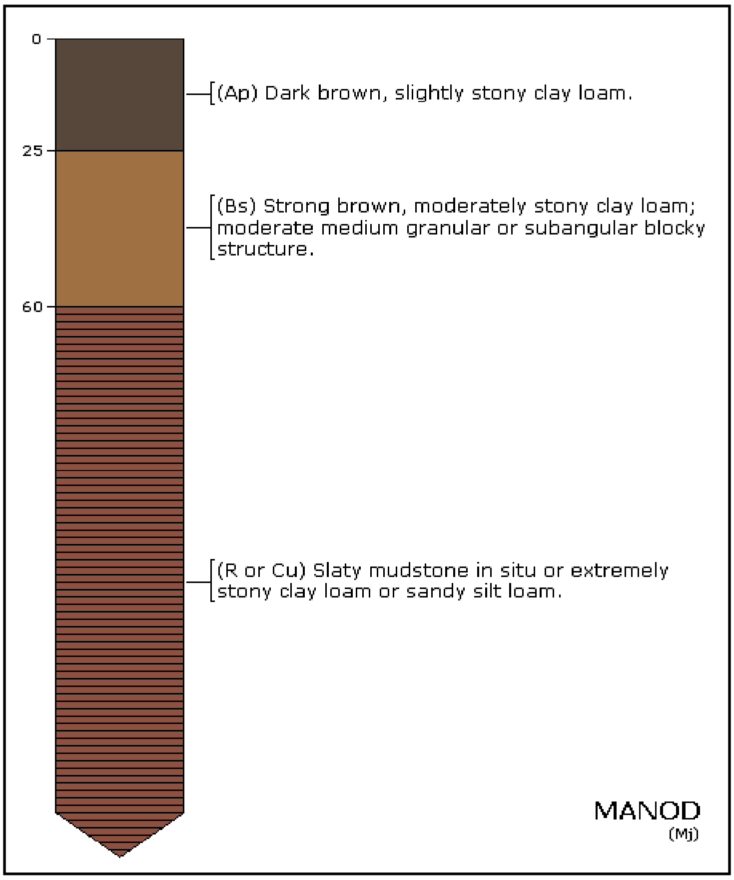



# DENBIGH 1 (541j)

*Well drained fine loamy and fine silty soils over rock.*

## d. DENBIGH 1 Component Series Profiles continued



# DENBIGH 1 (541j)

*Well drained fine loamy and fine silty soils over rock.*

## e. Soil Properties

This section provides graphical summaries of selected attribute data available for the component series in this association. The blue bars of the graphs presented in this section describe the range of property values for all soils across England and Wales. Superimposed on these graphs are the values for the component soil series in this association. This has been done to provide the reader with an understanding of where each property for each series sits within the national context.

| Soil Series | Description | Area % |
|---|---|---|
| DENBIGH (Dg) | medium loamy material over lithoskeletal mudstone and sandstone or slate | 40% |
| BARTON (BT) | medium silty material over lithoskeletal siltstone | 10% |
| POWYS (Ph) | loamy lithoskeletal mudstone and sandstone or slate | 10% |
| SANNAN (Sn) | medium silty drift with siliceous stones | 10% |
| MANOD (Mj) | medium loamy material over lithoskeletal mudstone and sandstone or slate | 5% |
| OTHER | other minor soils | 25% |

Table 1. The component soil series of the DENBIGH 1 soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

### e(i). Soil Depth Information and Depths to Important Layers

*Depth to rock* A mean depth to bedrock or very stony rubble which has been assigned to each soil series based on observed and recorded soil profiles.

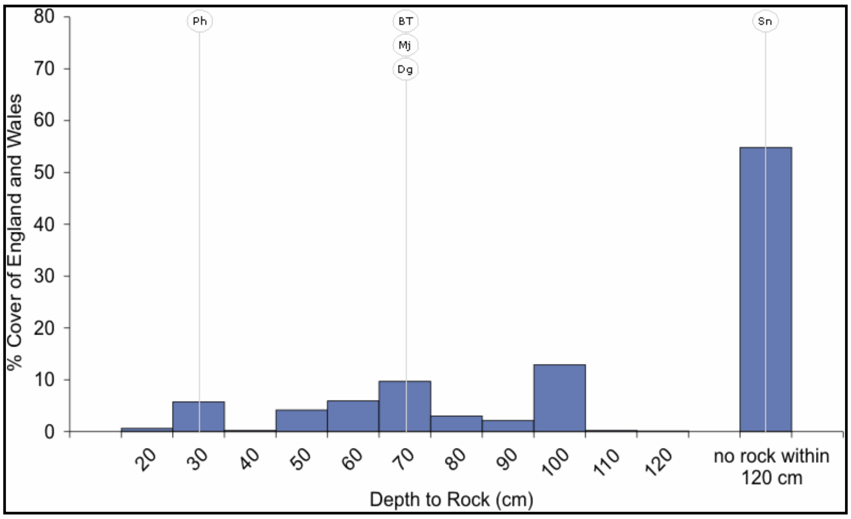



Figure 2. Depth of soil to Rock

*Depth to gleying*, the presence of grey and ochreous mottles within the soil, is caused by intermittent waterlogging. A mean depth to gleying has been assigned to each soil series based on observed and recorded soil profiles. The definition of a gleyed layer is designed to equate with saturation for at least 30 days in each year or the presence of artificial drainage.

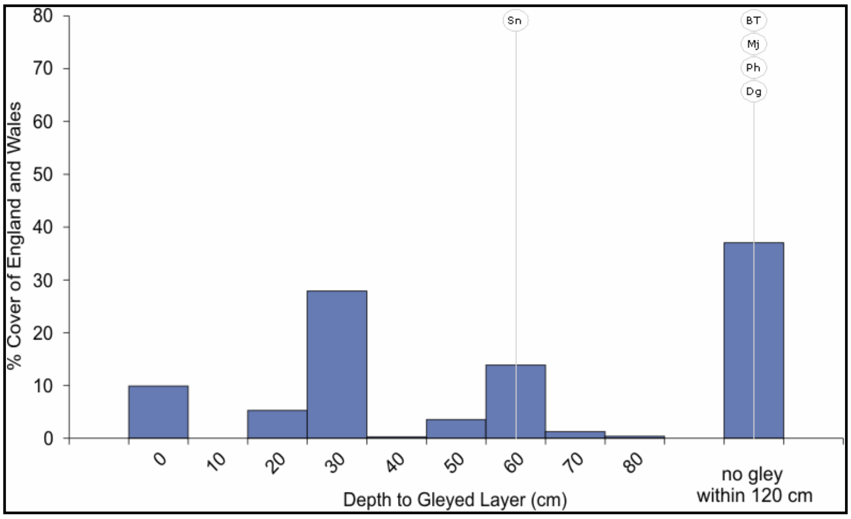



Figure 3. Depth of Soil to Gleying

# DENBIGH 1 (541j)

*Well drained fine loamy and fine silty soils over rock.*

## e(i). Soil Depth Information and Depths to Important Layers continued

*Depth to slowly permeable layer (downward percolation)* A mean depth to a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede downward percolation of excess soil water. This causes periodic saturation in the overlying soil, reduced storage capacity and therefore increased hydrological response to rainfall events.

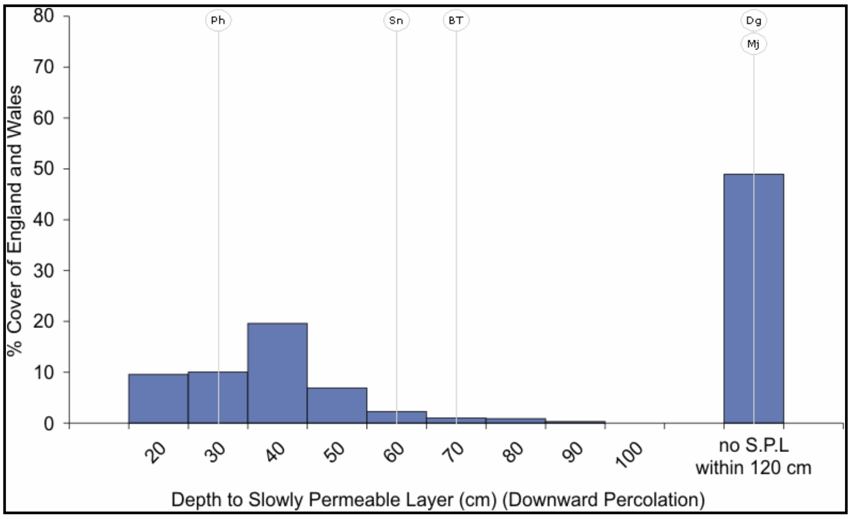



Figure 4. Depth to slowly permeable layer (downward percolation)

*Depth to Slowly Permeable Layer (upward diffusion)* A mean depth to the bottom of a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede upward diffusion of water and gasses.

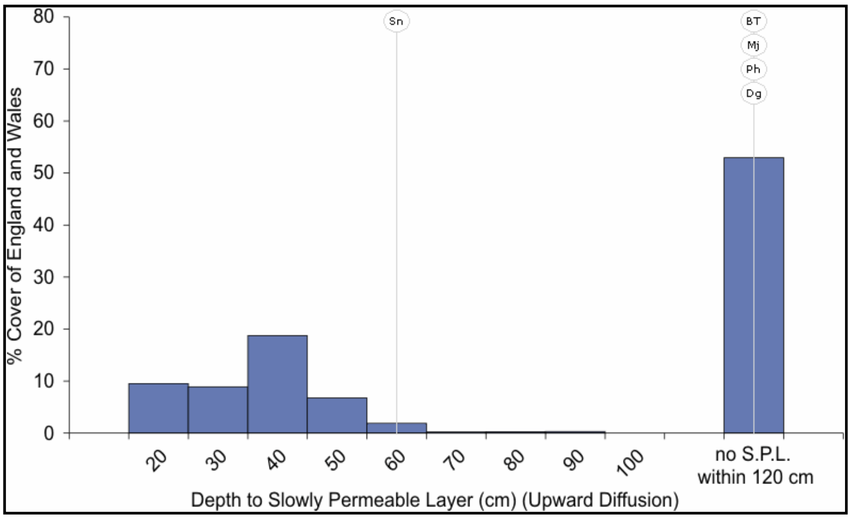



Figure 5. Depth to Slowly Permeable Layer (upward diffusion)

# DENBIGH 1 (541j)

*Well drained fine loamy and fine silty soils over rock.*

## e(ii). Soil Hydrological Information

*Integrated air capacity (IAC)* is the total coarse pore space (>60 $\mu$m diameter) to 1 m depth. This size of pore would normally be air-filled when the soil is fully moist but not waterlogged. A large IAC means that the soil is well aerated. This will encourage root development and, provided near surface soil structure is well developed, will allow rainfall to percolate into the ground thus mitigating against localised flooding.

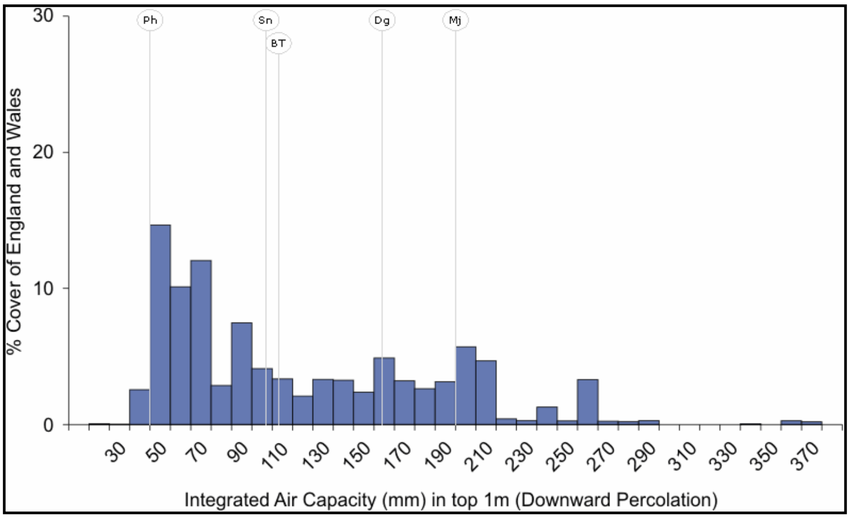



Figure 6. Integrated Air Capacity

*Standard Percentage Runoff (SPR)* is the percentage of rainfall that causes the short-term increase in flow seen at a catchment outlet following a storm event. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

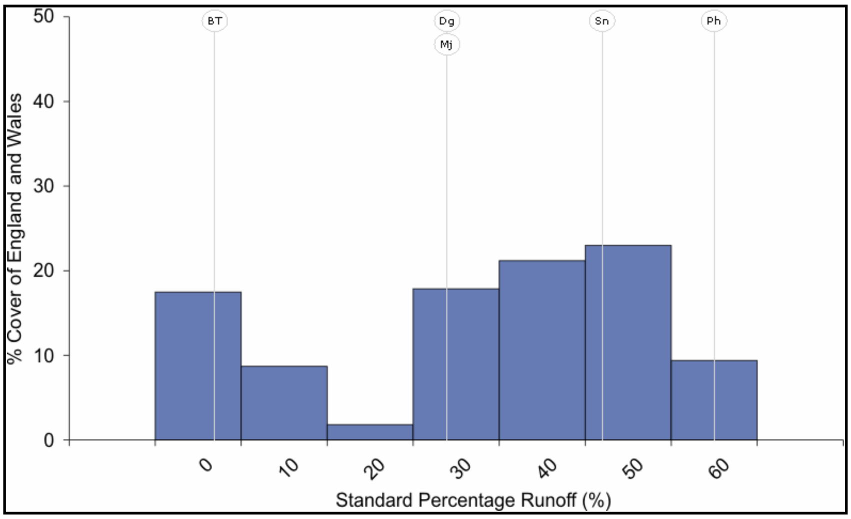



Figure 7. Standard Percentage Runoff

*Base flow index* is calculated from daily river flow data and expresses the volume of base flow of a river as a fraction of the total flow volume. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

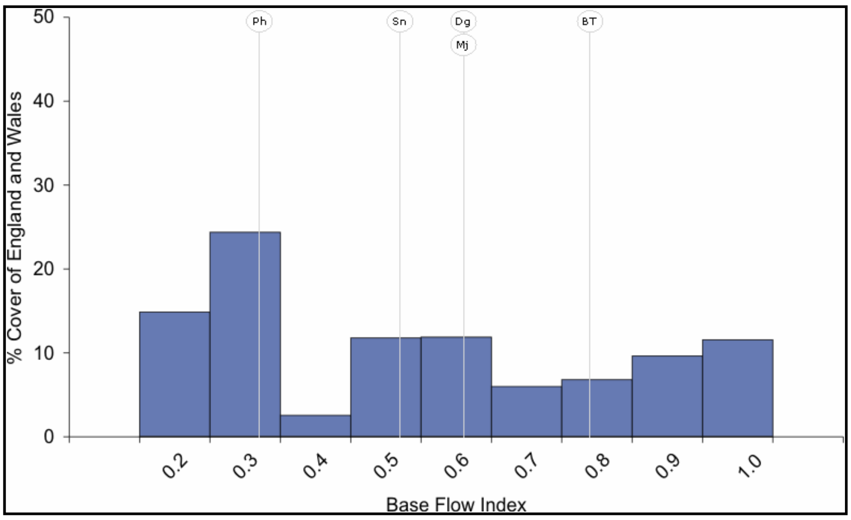



Figure 8. Base Flow Index

# DENBIGH 1 (541j)

*Well drained fine loamy and fine silty soils over rock.*

### e(iii). Available Water Content

*Available water content* for plants varies depending on a number of factors, including the rooting depth of the plants. Described below are differing available water contents for cereals, sugar beet, grass and potato crops, as well as a generic available water value to 1 m depth.

*Available water (by crop)* Available water content to 1 m for the specified soil series between suctions of 5 and 1500kPa.

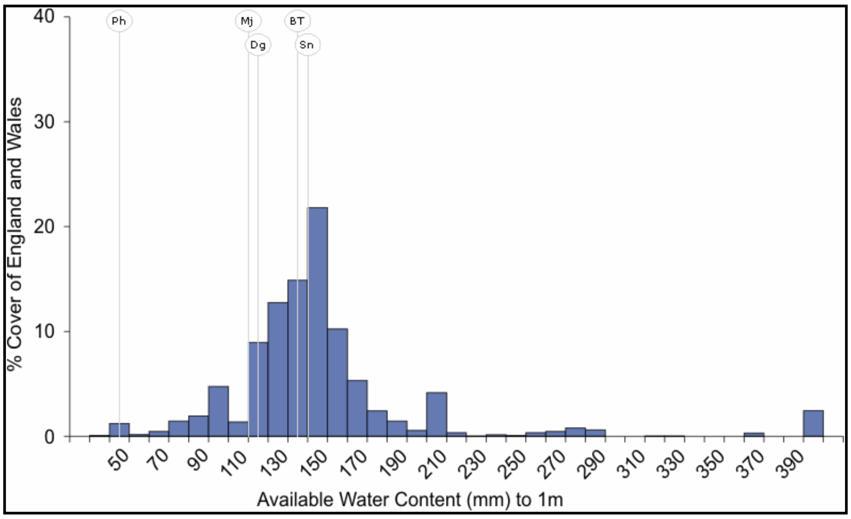



Figure 9. Available Water (by crop)

*Available water for grass* represents the water that is available to a permanent grass sward that is able to root to 100cm depth.

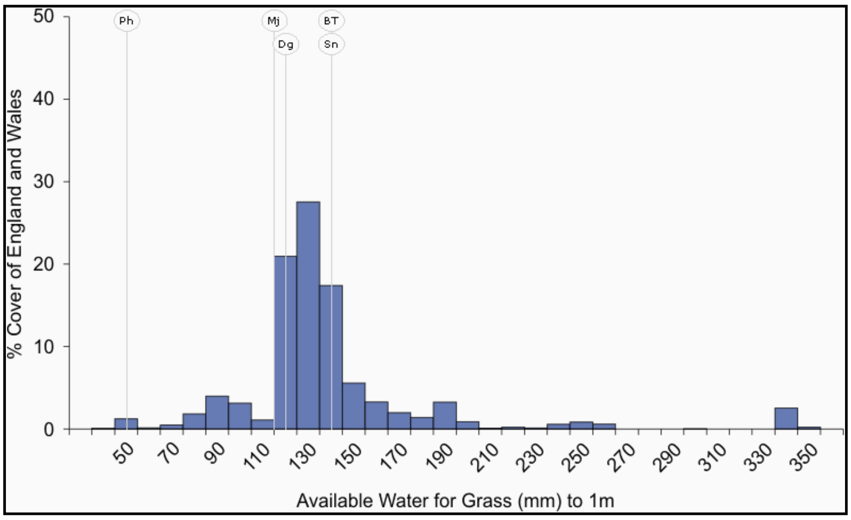



Figure 10. Available Water for Grass

## DENBIGH 1 (541j)

*Well drained fine loamy and fine silty soils over rock.*

### e(iii). Available Water Content continued

*Available water for cereal* represents the water that is available to a cereal crop that is able to root to 120cm depth.

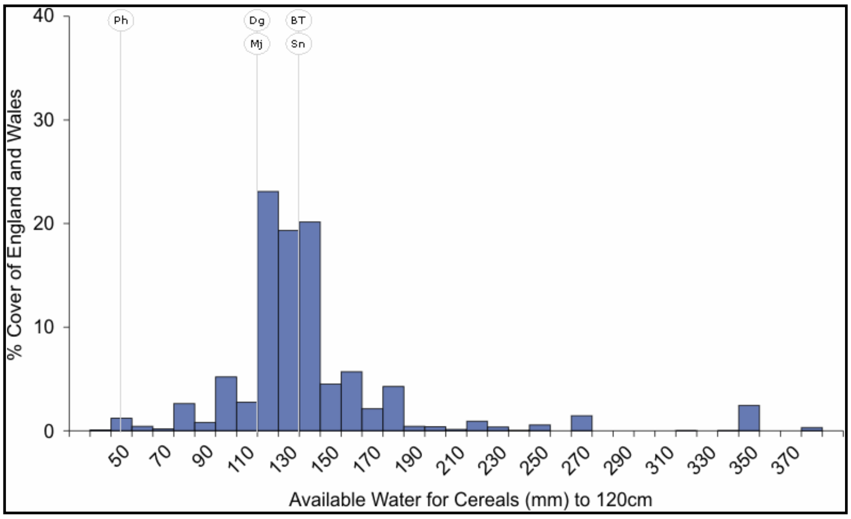



Figure 11. Available Water for Cereal

*Available water for Sugar Beet* represents the water that is available to a sugar beet crop that is able to root to 140cm depth.

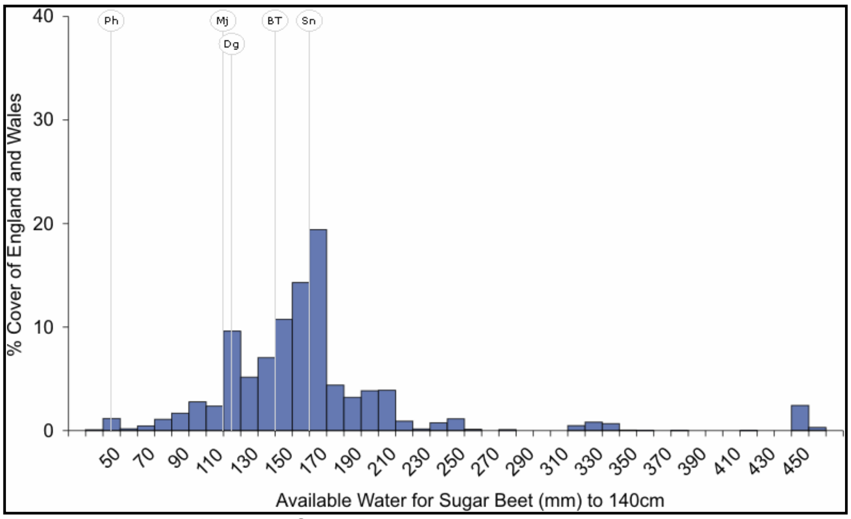



Figure 12. Available Water for Sugar Beet

*Available water for Potatoes* represents the water that is available to a potato crop that is able to root to 70cm depth.

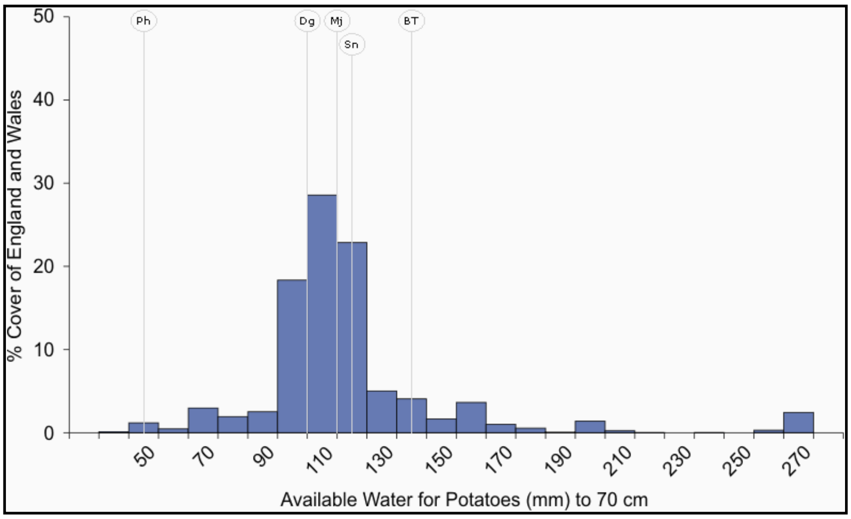



Figure 13. Available Water for Potatoes

# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

**a. General Description**

Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging. Some coarse loamy soils affected by groundwater.

The major landuse on this association is defined as cereals and grassland in the northern region; stock rearing on permanent grassland in wales.

**b. Distribution (England & Wales)**

The EAST KESWICK 1 association covers 804km² of England and Wales which accounts for 0.53% of the landmass. The distribution of this association is shown in Figure 14. Note that the yellow shading represents a buffer to highlight the location of very small areas of the association.

**c. Comprising Soil Series**

Multiple soil series comprise a soil association. The soil series of the EAST KESWICK 1 association are outlined in Table 2 below. In some cases other minor soil series are present at a particular site, and these have been grouped together under the heading 'OTHER'. We have endevoured to present the likelihood of a minor, unnamed soil series occuring in your site in Table 2.

Schematic diagrams of the vertical soil profile of the major constituent soil series are provided in Section D to allow easier identification of the particular soil series at your site.

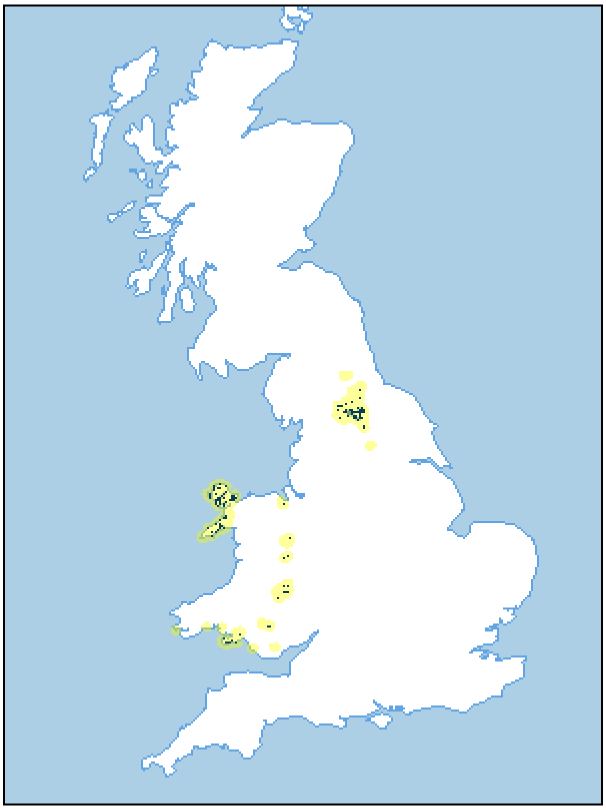


Figure 14. Association Distribution

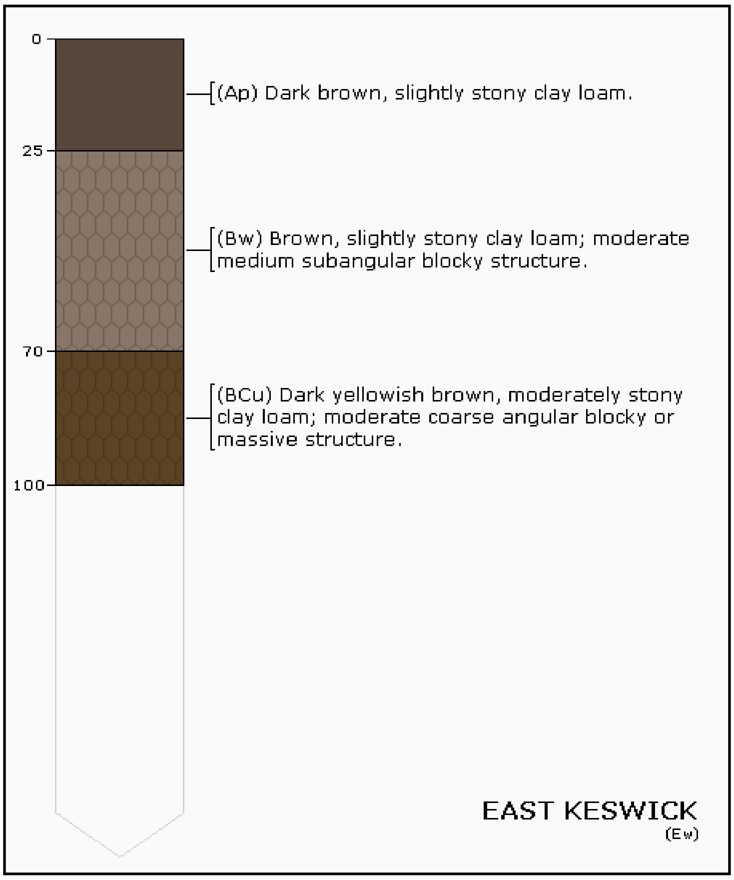
| Soil Series | Description | Area % |
|---|---|---|
| EAST KESWICK (Ew) | medium loamy drift with siliceous stones | 45% |
| NERCWYS (Nc) | medium loamy drift with siliceous stones | 30% |
| ARROW (aO) | light loamy drift with siliceous stones | 10% |
| OTHER | other minor soils | 15% |

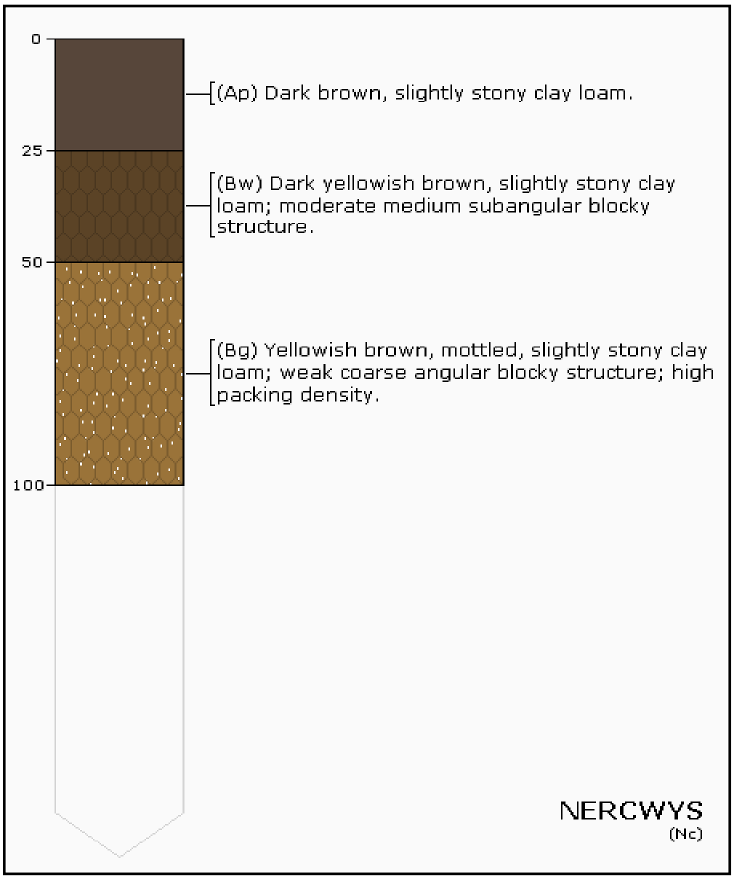
Table 2. The component soil series of the EAST KESWICK 1 soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

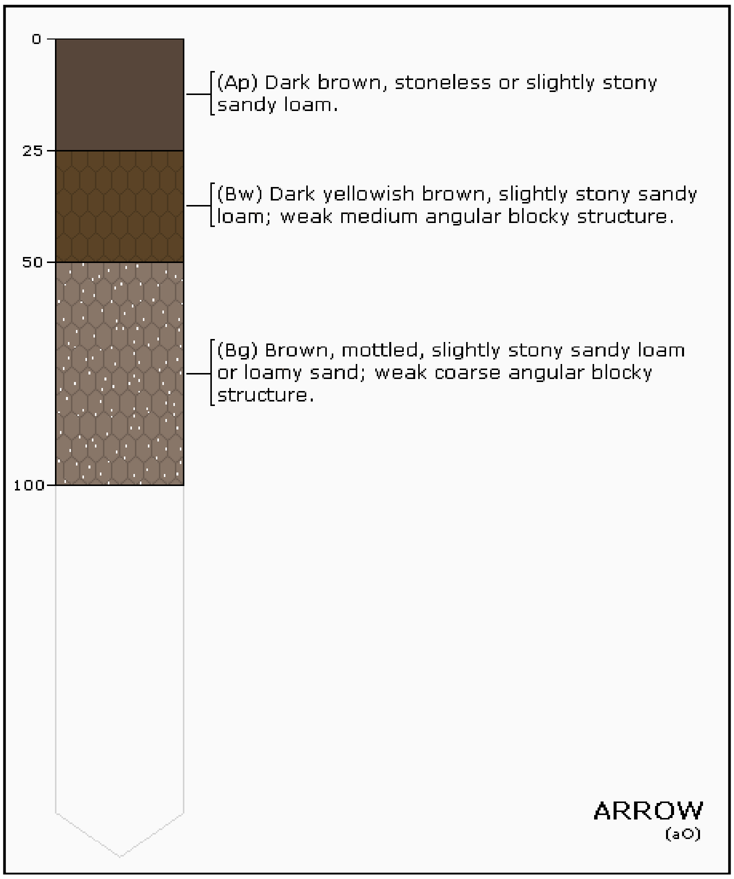
# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

## d. EAST KESWICK 1 Component Series Profiles



# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

## e. Soil Properties

This section provides graphical summaries of selected attribute data available for the component series in this association. The blue bars of the graphs presented in this section describe the range of property values for all soils across England and Wales. Superimposed on these graphs are the values for the component soil series in this association. This has been done to provide the reader with an understanding of where each property for each series sits within the national context.

| Soil Series | Description | Area % |
|---|---|---|
| EAST KESWICK (Ew) | medium loamy drift with siliceous stones | 45% |
| NERCWYS (Nc) | medium loamy drift with siliceous stones | 30% |
| ARROW (aO) | light loamy drift with siliceous stones | 10% |
| OTHER | other minor soils | 15% |

Table 2. The component soil series of the EAST KESWICK 1 soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

## e(i). Soil Depth Information and Depths to Important Layers

*Depth to rock* A mean depth to bedrock or very stony rubble which has been assigned to each soil series based on observed and recorded soil profiles.

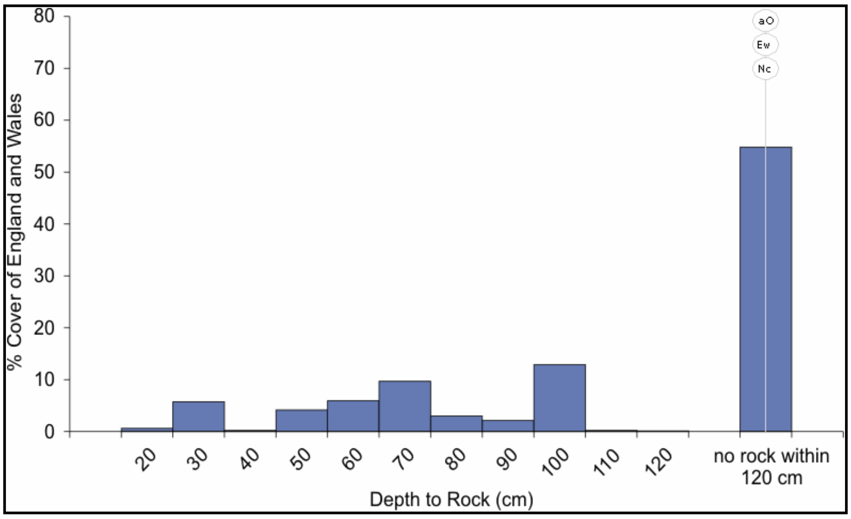



Figure 15. Depth of soil to Rock

*Depth to gleying*, the presence of grey and ochreous mottles within the soil, is caused by intermittent waterlogging. A mean depth to gleying has been assigned to each soil series based on observed and recorded soil profiles. The definition of a gleyed layer is designed to equate with saturation for at least 30 days in each year or the presence of artificial drainage.

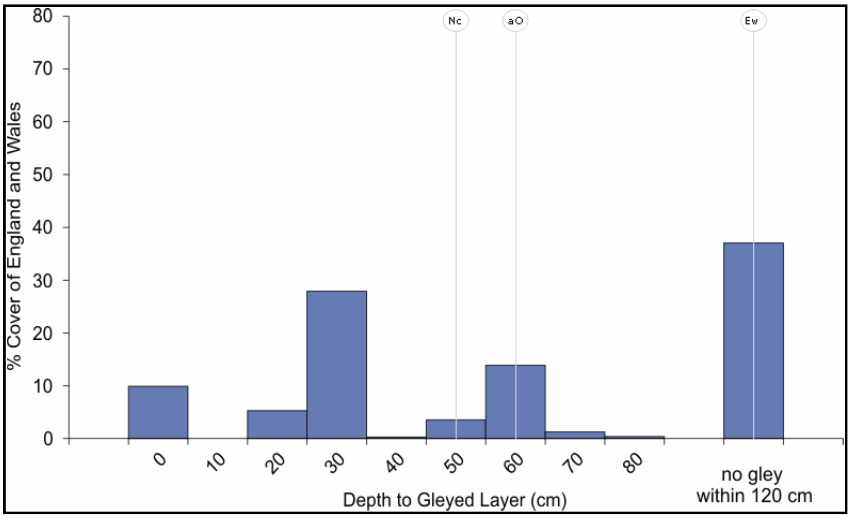



Figure 16. Depth of Soil to Gleying

# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

## e(i). Soil Depth Information and Depths to Important Layers continued

*Depth to slowly permeable layer (downward percolation)* A mean depth to a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede downward percolation of excess soil water. This causes periodic saturation in the overlying soil, reduced storage capacity and therefore increased hydrological response to rainfall events.

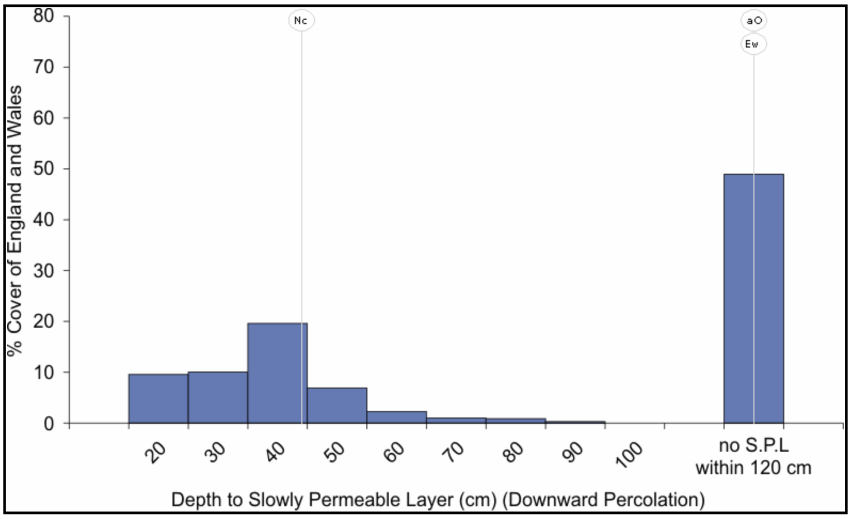



Figure 17. Depth to slowly permeable layer (downward percolation)

*Depth to Slowly Permeable Layer (upward diffusion)* A mean depth to the bottom of a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede upward diffusion of water and gasses.

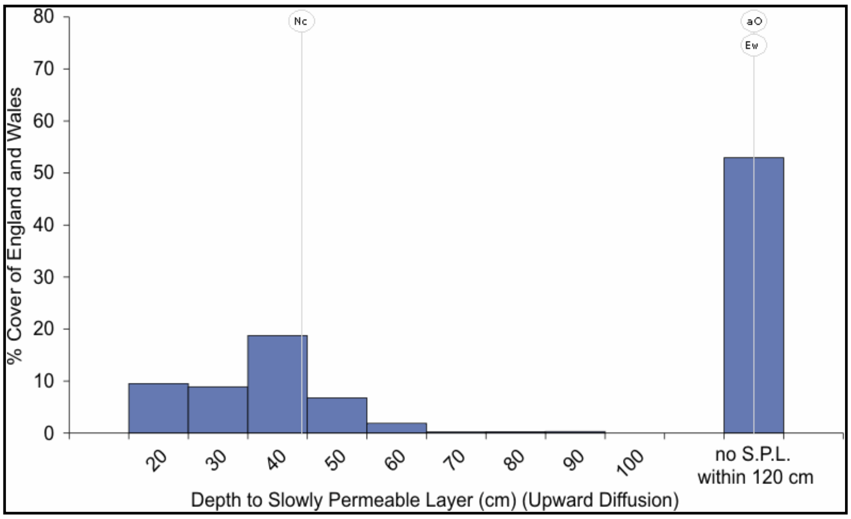



Figure 18. Depth to Slowly Permeable Layer (upward diffusion)

# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

## e(ii). Soil Hydrological Information

*Integrated air capacity (IAC)* is the total coarse pore space (>60 $\mu$m diameter) to 1 m depth. This size of pore would normally be air-filled when the soil is fully moist but not waterlogged. A large IAC means that the soil is well aerated. This will encourage root development and, provided near surface soil structure is well developed, will allow rainfall to percolate into the ground thus mitigating against localised flooding.

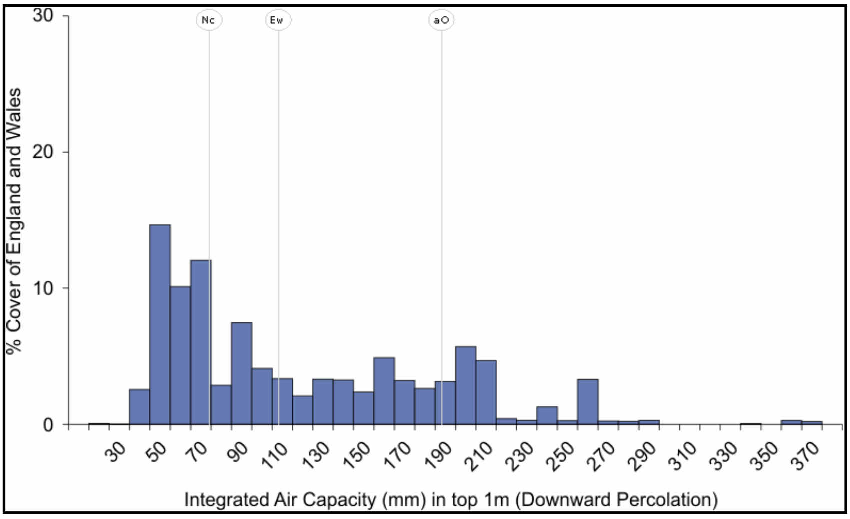



Figure 19. Integrated Air Capacity

*Standard Percentage Runoff (SPR)* is the percentage of rainfall that causes the short-term increase in flow seen at a catchment outlet following a storm event. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

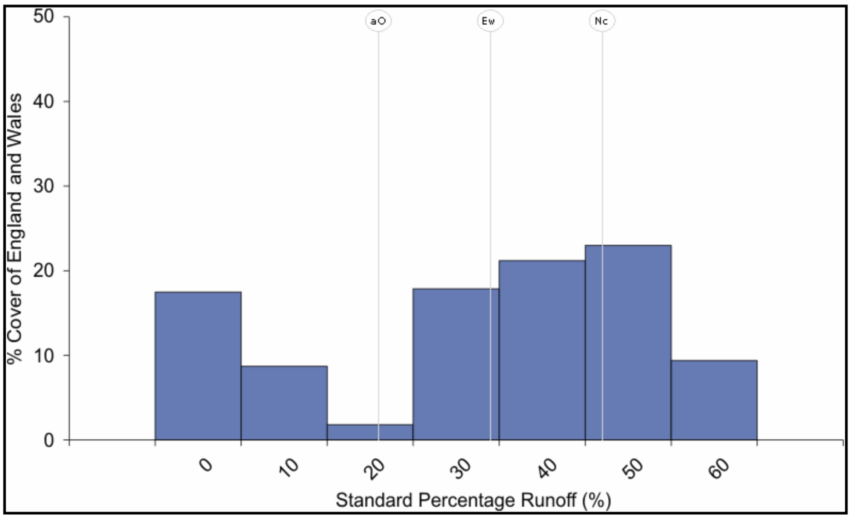



Figure 20. Standard Percentage Runoff

*Base flow index* is calculated from daily river flow data and expresses the volume of base flow of a river as a fraction of the total flow volume. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

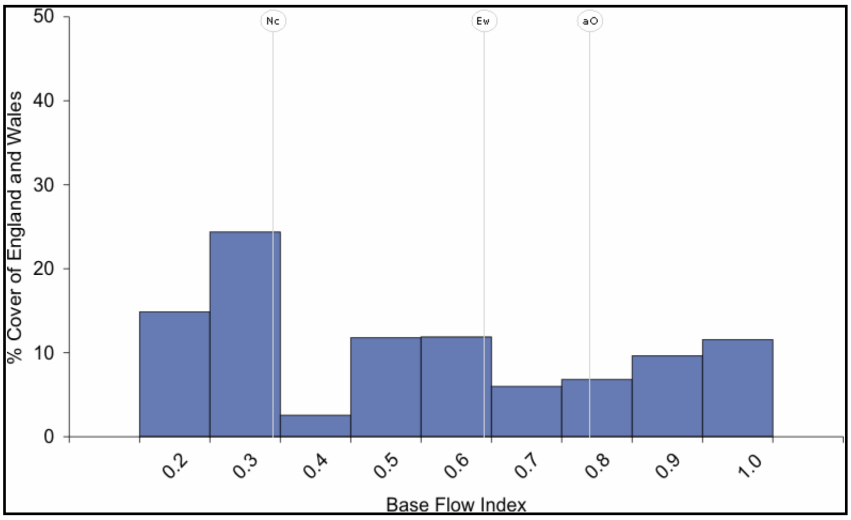



Figure 21. Base Flow Index

# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

## e(iii). Available Water Content

*Available water content* for plants varies depending on a number of factors, including the rooting depth of the plants. Described below are differing available water contents for cereals, sugar beet, grass and potato crops, as well as a generic available water value to 1 m depth.

*Available water (by crop)* Available water content to 1 m for the specified soil series between suctions of 5 and 1500kPa.

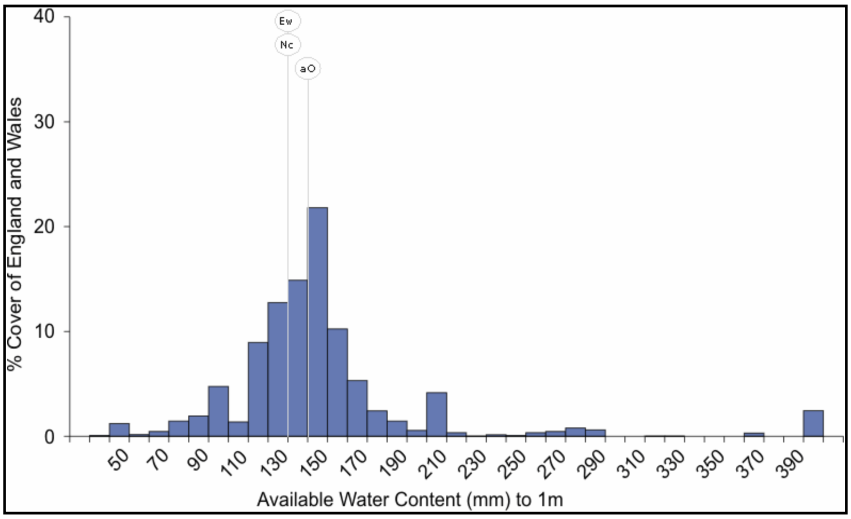



Figure 22. Available Water (by crop)

*Available water for grass* represents the water that is available to a permanent grass sward that is able to root to 100cm depth.

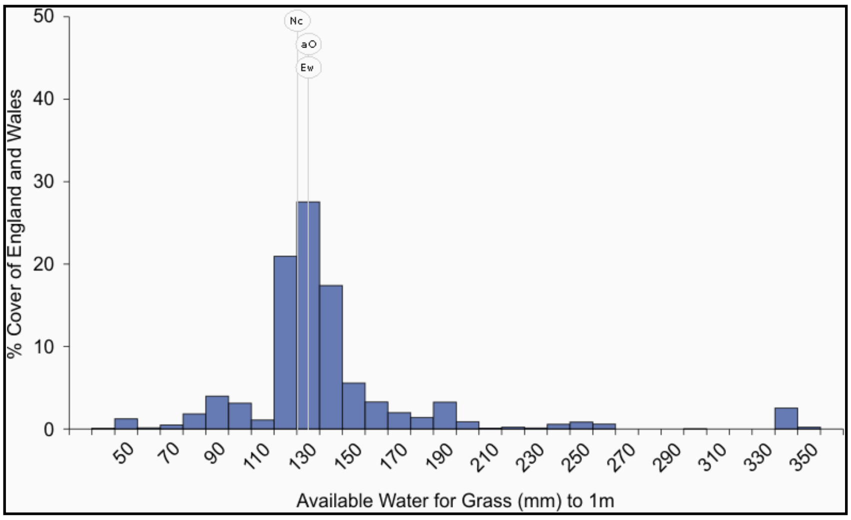



Figure 23. Available Water for Grass

# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

## e(iii). Available Water Content continued

*Available water for cereal* represents the water that is available to a cereal crop that is able to root to 120cm depth.

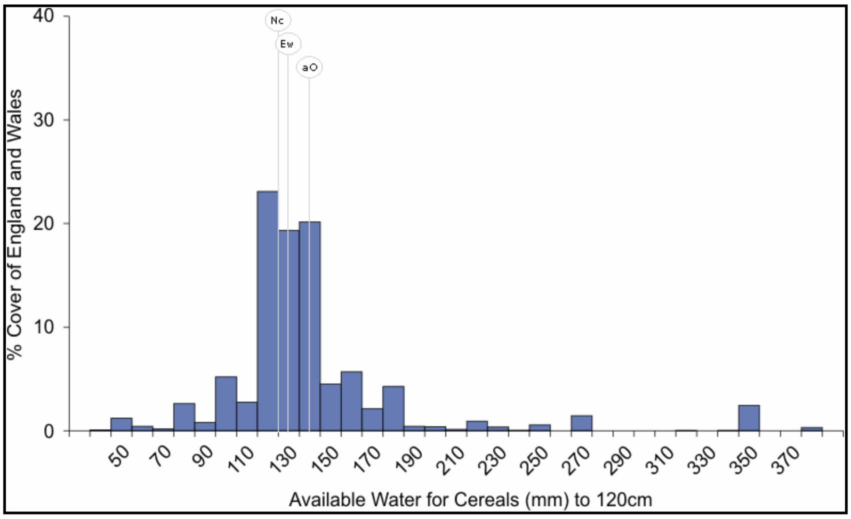



Figure 24. Available Water for Cereal

*Available water for Sugar Beet* represents the water that is available to a sugar beet crop that is able to root to 140cm depth.

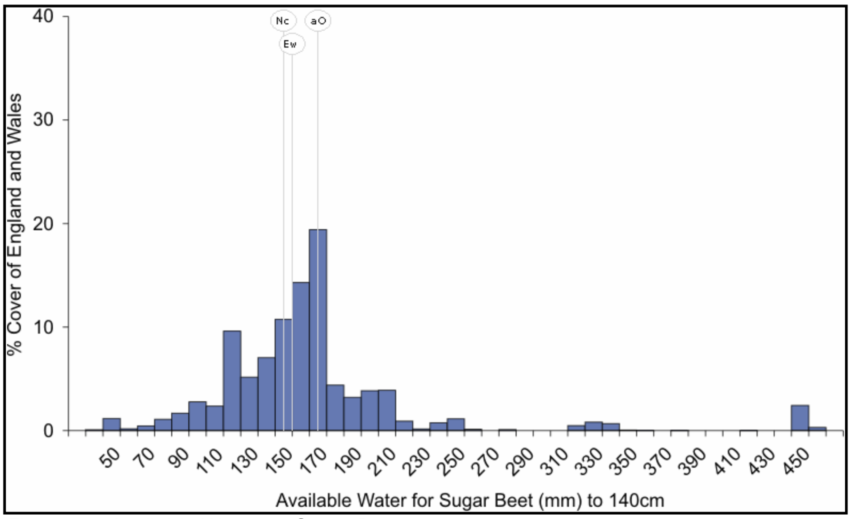



Figure 25. Available Water for Sugar Beet

*Available water for Potatoes* represents the water that is available to a potato crop that is able to root to 70cm depth.

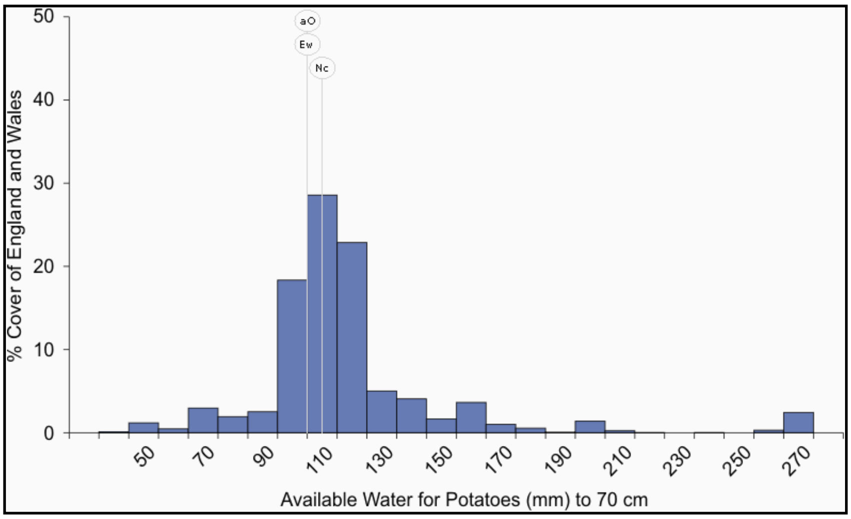



Figure 26. Available Water for Potatoes

# ANGLEZARKE (631a)

*Well drained very acid coarse loamy soils over sandstone with a bleached subsurface horizon.*

**a. General Description**

Well drained very acid coarse loamy soils over sandstone with a bleached subsurface horizon. Some shallow soils with a peaty or humose surface horizon. Rocks and boulders locally.

The major landuse on this association is defined as dry moorland habitats of poor grazing value; coniferous woodland; recreation.

**b. Distribution (England & Wales)**

The ANGLEZARKE association covers 437km² of England and Wales which accounts for 0.29% of the landmass. The distribution of this association is shown in Figure 27. Note that the yellow shading represents a buffer to highlight the location of very small areas of the association.

**c. Comprising Soil Series**

Multiple soil series comprise a soil association. The soil series of the ANGLEZARKE association are outlined in Table 3 below. In some cases other minor soil series are present at a particular site, and these have been grouped together under the heading 'OTHER'. We have endevoured to present the likelihood of a minor, unnamed soil series occuring in your site in Table 3.

Schematic diagrams of the vertical soil profile of the major constituent soil series are provided in Section D to allow easier identification of the particular soil series at your site.

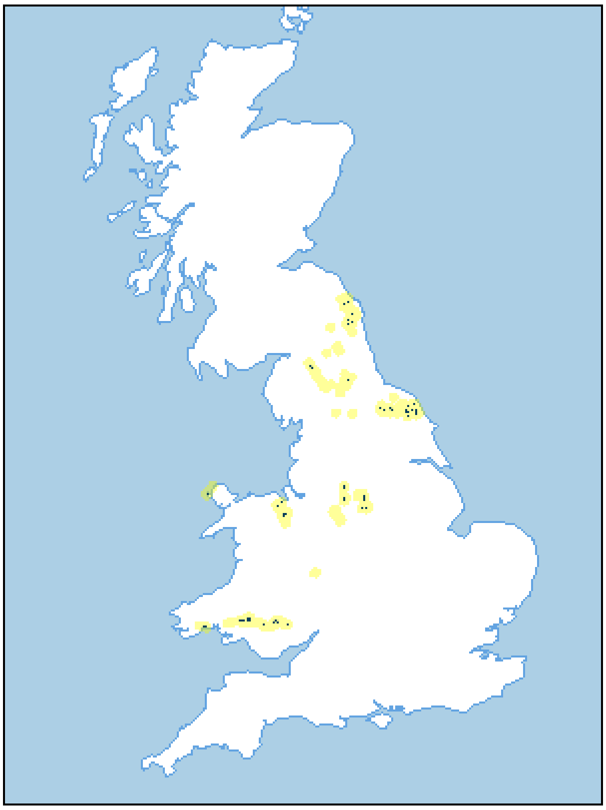


Figure 27. Association Distribution

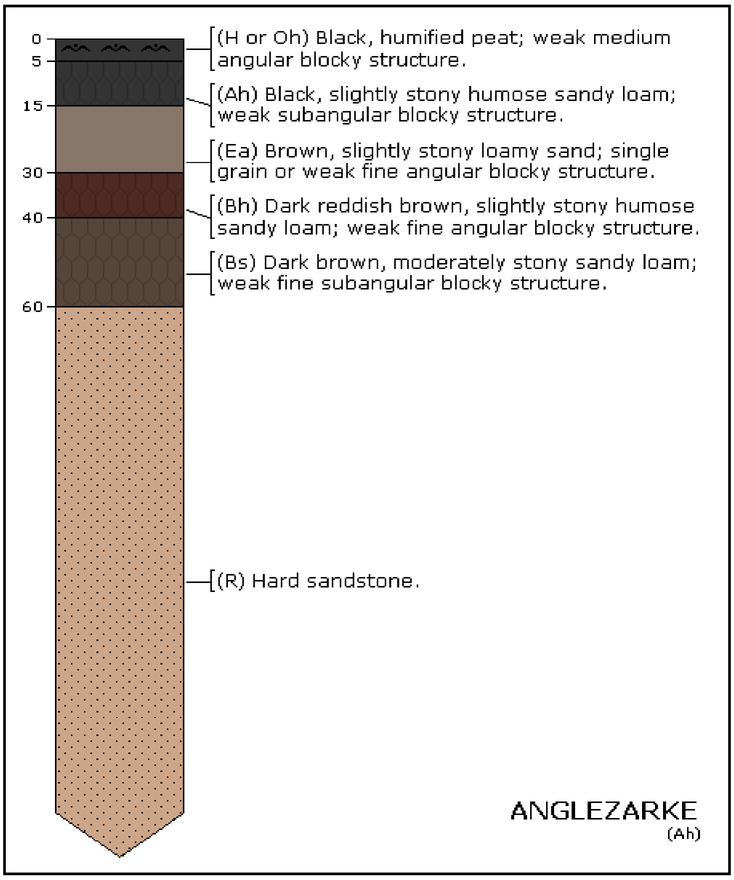
| Soil Series | Description | Area % |
|---|---|---|
| ANGLEZARKE (Ah) | light loamy material over lithoskeletal sandstone | 60% |
| REVIDGE (rV) | loamy or peaty lithoskeletal sandstone | 40% |

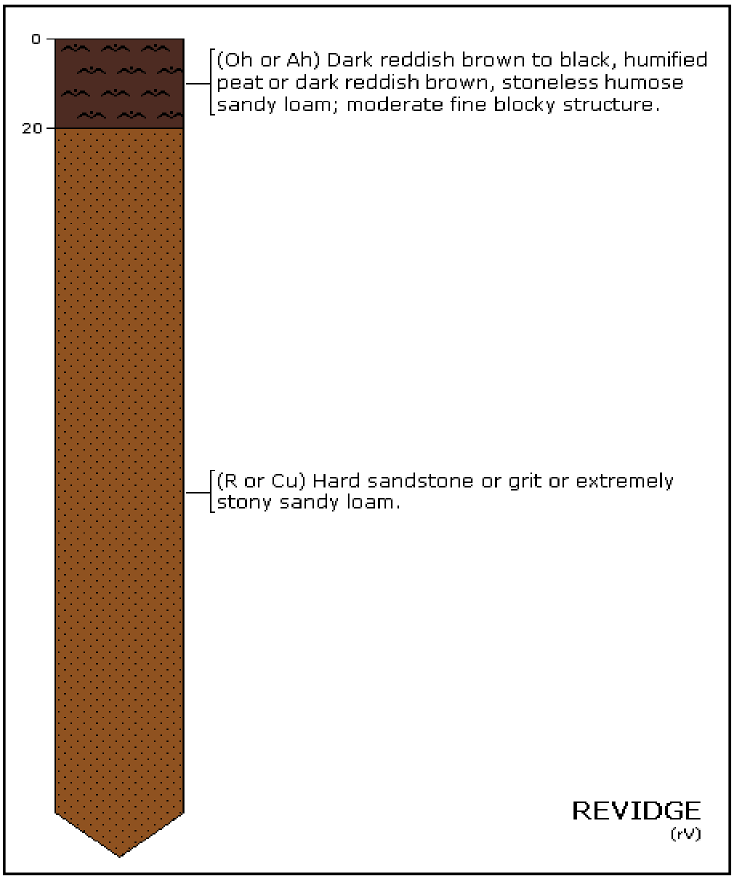
Table 3. The component soil series of the ANGLEZARKE soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

# ANGLEZARKE (631a)

*Well drained very acid coarse loamy soils over sandstone with a bleached subsurface horizon.*

## d. ANGLEZARKE Component Series Profiles



## ANGLEZARKE (631a)

*Well drained very acid coarse loamy soils over sandstone with a bleached subsurface horizon.*

### e. Soil Properties

This section provides graphical summaries of selected attribute data available for the component series in this association. The blue bars of the graphs presented in this section describe the range of property values for all soils across England and Wales. Superimposed on these graphs are the values for the component soil series in this association. This has been done to provide the reader with an understanding of where each property for each series sits within the national context.

| Soil Series | Description | Area % |
|---|---|---|
| ANGLEZARKE (Ah) | light loamy material over lithoskeletal sandstone | 60% |
| REVIDGE (rV) | loamy or peaty lithoskeletal sandstone | 40% |

Table 3. The component soil series of the ANGLEZARKE soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

### e(i). Soil Depth Information and Depths to Important Layers

*Depth to rock* A mean depth to bedrock or very stony rubble which has been assigned to each soil series based on observed and recorded soil profiles.

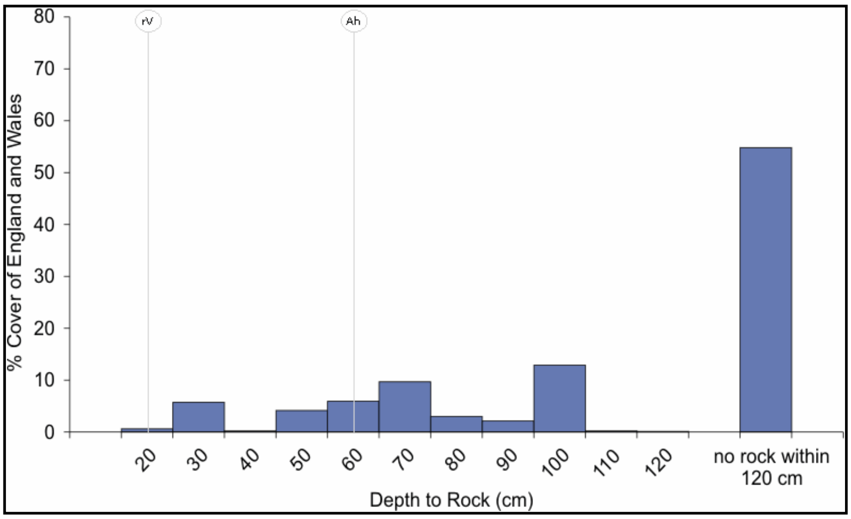



Figure 28. Depth of soil to Rock

*Depth to gleying*, the presence of grey and ochreous mottles within the soil, is caused by intermittent waterlogging. A mean depth to gleying has been assigned to each soil series based on observed and recorded soil profiles. The definition of a gleyed layer is designed to equate with saturation for at least 30 days in each year or the presence of artificial drainage.

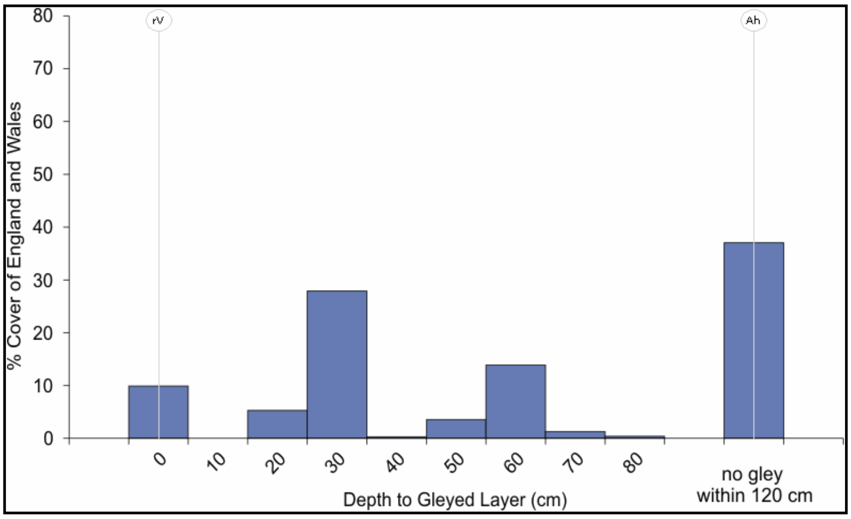



Figure 29. Depth of Soil to Gleying

# ANGLEZARKE (631a)

*Well drained very acid coarse loamy soils over sandstone with a bleached subsurface horizon.*

## e(i). Soil Depth Information and Depths to Important Layers continued

*Depth to slowly permeable layer (downward percolation)* A mean depth to a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede downward percolation of excess soil water. This causes periodic saturation in the overlying soil, reduced storage capacity and therefore increased hydrological response to rainfall events.

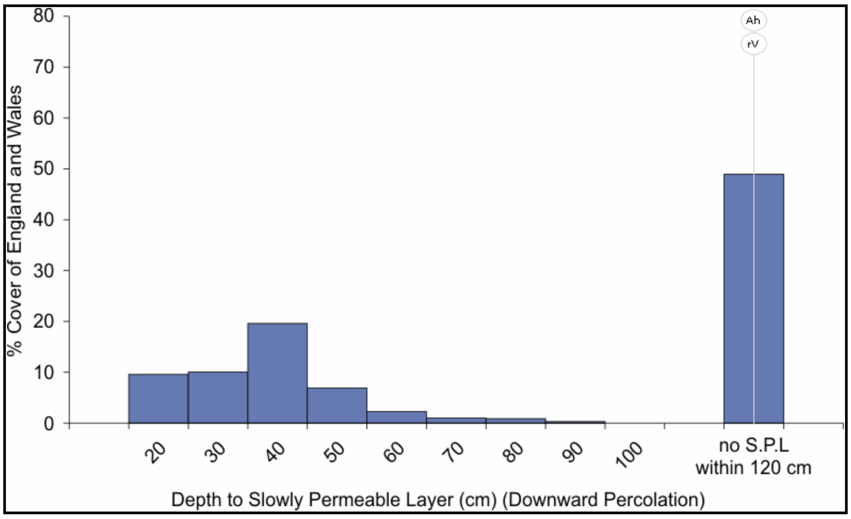



Figure 30. Depth to slowly permeable layer (downward percolation)

*Depth to Slowly Permeable Layer (upward diffusion)* A mean depth to the bottom of a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede upward diffusion of water and gasses.

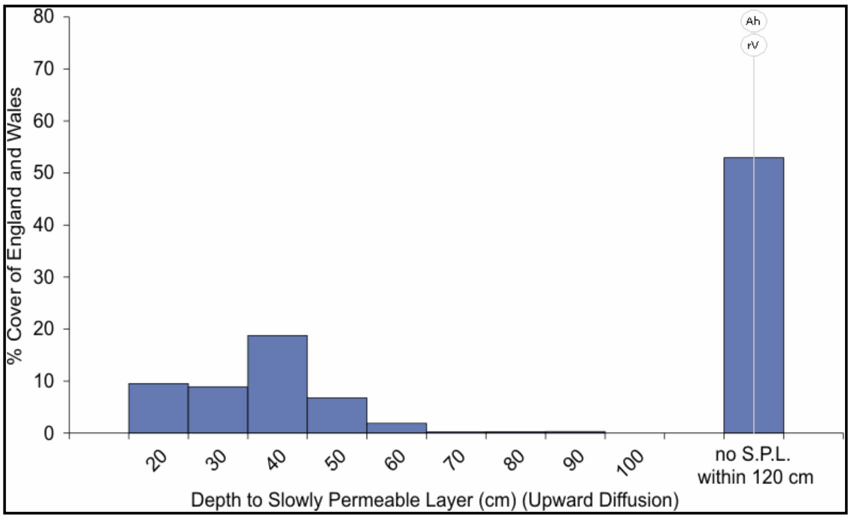



Figure 31. Depth to Slowly Permeable Layer (upward diffusion)

## ANGLEZARKE (631a)

*Well drained very acid coarse loamy soils over sandstone with a bleached subsurface horizon.*

### e(ii). Soil Hydrological Information

*Integrated air capacity (IAC)* is the total coarse pore space (>60 $\mu$m diameter) to 1 m depth. This size of pore would normally be air-filled when the soil is fully moist but not waterlogged. A large IAC means that the soil is well aerated. This will encourage root development and, provided near surface soil structure is well developed, will allow rainfall to percolate into the ground thus mitigating against localised flooding.

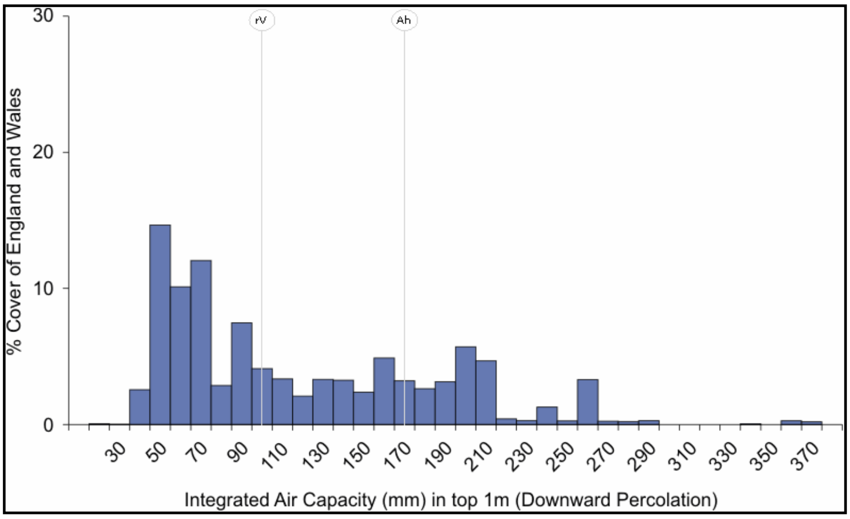



Figure 32. Integrated Air Capacity

*Standard Percentage Runoff (SPR)* is the percentage of rainfall that causes the short-term increase in flow seen at a catchment outlet following a storm event. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

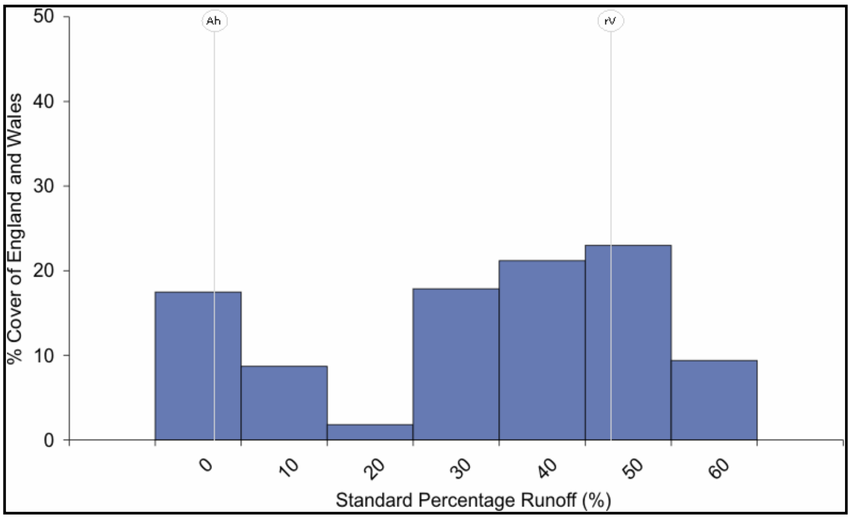



Figure 33. Standard Percentage Runoff

*Base flow index* is calculated from daily river flow data and expresses the volume of base flow of a river as a fraction of the total flow volume. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

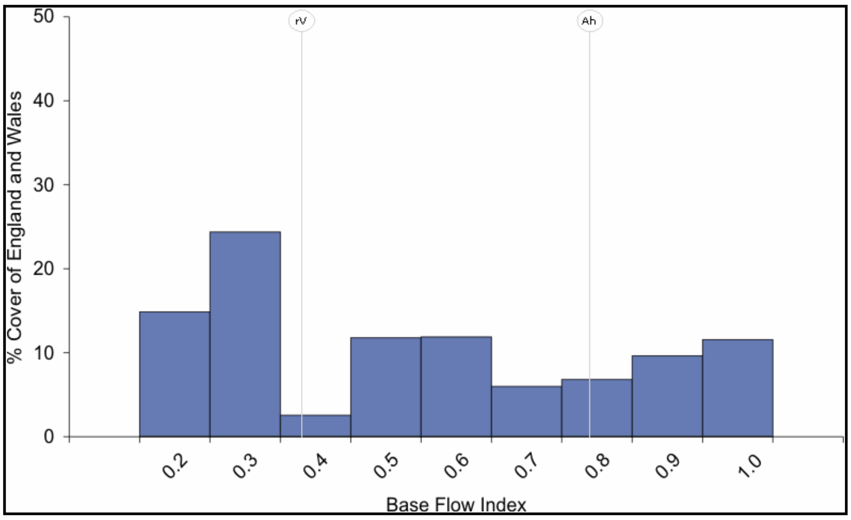



Figure 34. Base Flow Index

# ANGLEZARKE (631a)

*Well drained very acid coarse loamy soils over sandstone with a bleached subsurface horizon.*

## e(iii). Available Water Content

*Available water content* for plants varies depending on a number of factors, including the rooting depth of the plants. Described below are differing available water contents for cereals, sugar beet, grass and potato crops, as well as a generic available water value to 1 m depth.

*Available water (by crop)* Available water content to 1 m for the specified soil series between suctions of 5 and 1500kPa.

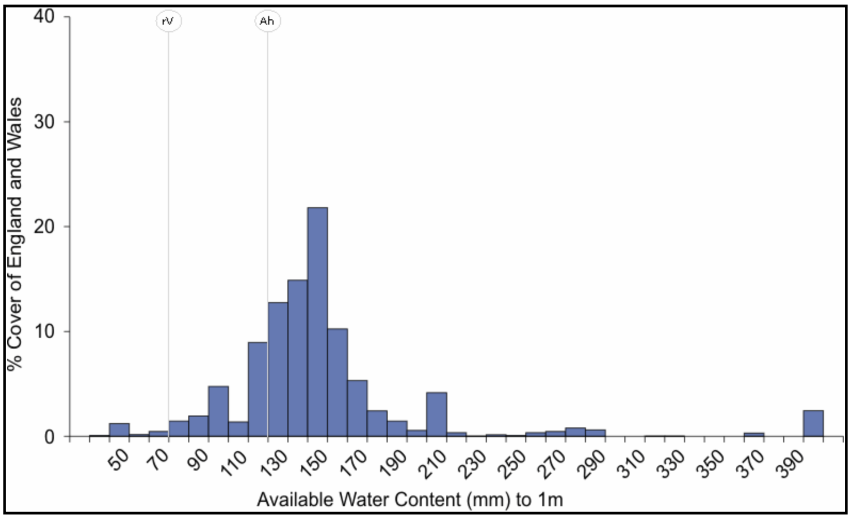



Figure 35. Available Water (by crop)

*Available water for grass* represents the water that is available to a permanent grass sward that is able to root to 100cm depth.

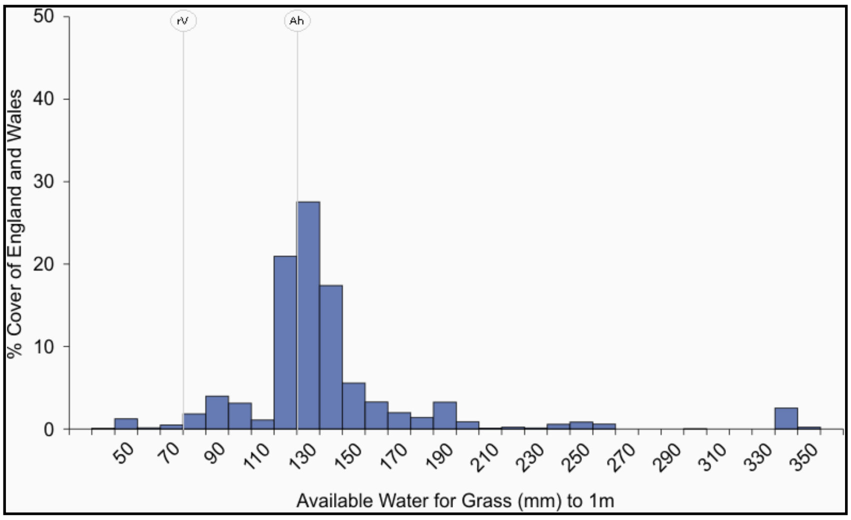



Figure 36. Available Water for Grass

## ANGLEZARKE (631a)

*Well drained very acid coarse loamy soils over sandstone with a bleached subsurface horizon.*

### e(iii). Available Water Content continued

*Available water for cereal* represents the water that is available to a cereal crop that is able to root to 120cm depth.

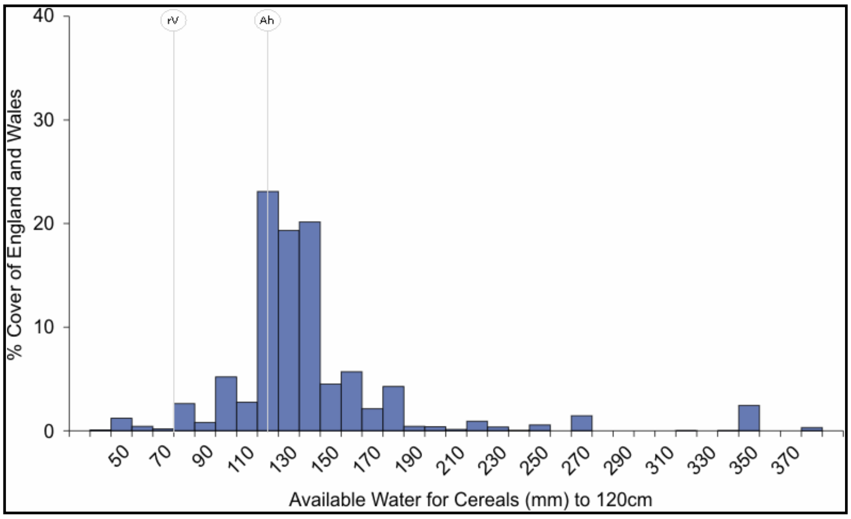



Figure 37. Available Water for Cereal

*Available water for Sugar Beet* represents the water that is available to a sugar beet crop that is able to root to 140cm depth.

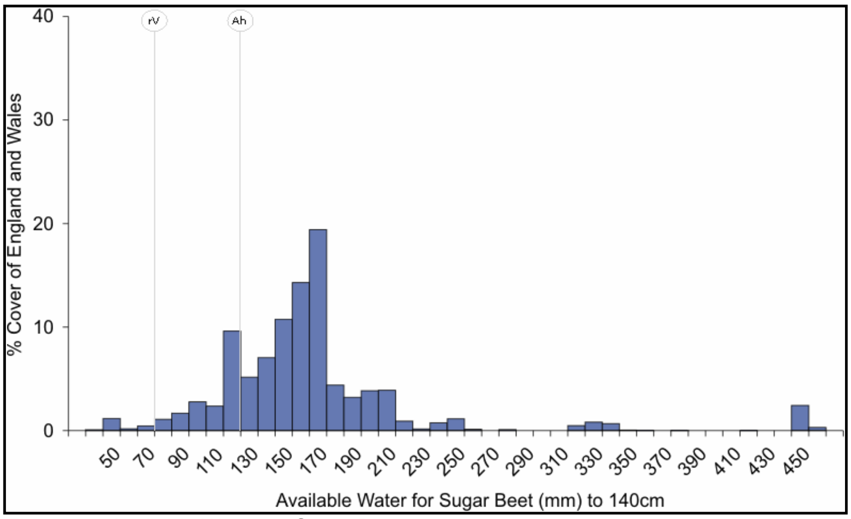



Figure 38. Available Water for Sugar Beet

*Available water for Potatoes* represents the water that is available to a potato crop that is able to root to 70cm depth.

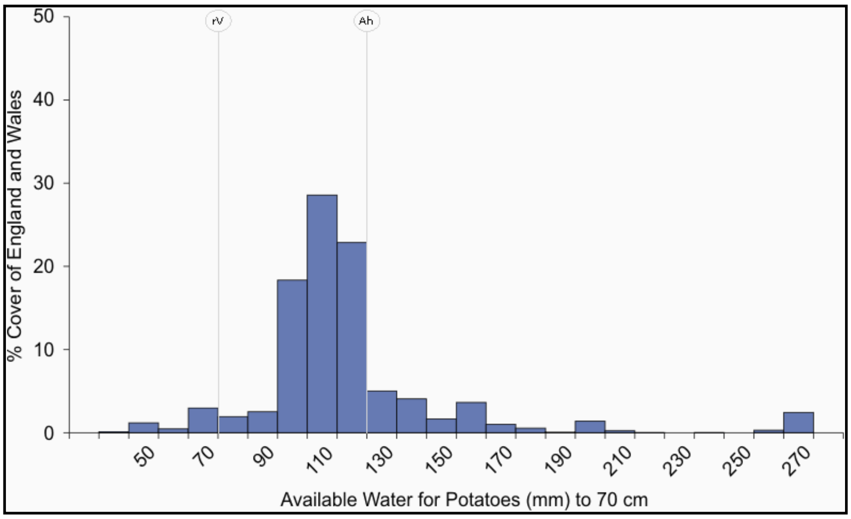



Figure 39. Available Water for Potatoes

# CEGIN (713d)

*Slowly permeable seasonally waterlogged fine silty and clayey soils.*

**a. General Description**

Slowly permeable seasonally waterlogged fine silty and clayey soils. Some fine silty and fine loamy soils with slowly permeable subsoils and slight seasonal waterlogging on slopes. Well drained fine loamy soils over rock in places.

The major landuse on this association is defined as stock rearing on permanent grassland dairying on lower ground.

**b. Distribution (England & Wales)**

The CEGIN association covers 1602km² of England and Wales which accounts for 1.06% of the landmass. The distribution of this association is shown in Figure 40. Note that the yellow shading represents a buffer to highlight the location of very small areas of the association.

**c. Comprising Soil Series**

Multiple soil series comprise a soil association. The soil series of the CEGIN association are outlined in Table 4 below. In some cases other minor soil series are present at a particular site, and these have been grouped together under the heading 'OTHER'. We have endevoured to present the likelihood of a minor, unnamed soil series occuring in your site in Table 4.

Schematic diagrams of the vertical soil profile of the major constituent soil series are provided in Section D to allow easier identification of the particular soil series at your site.

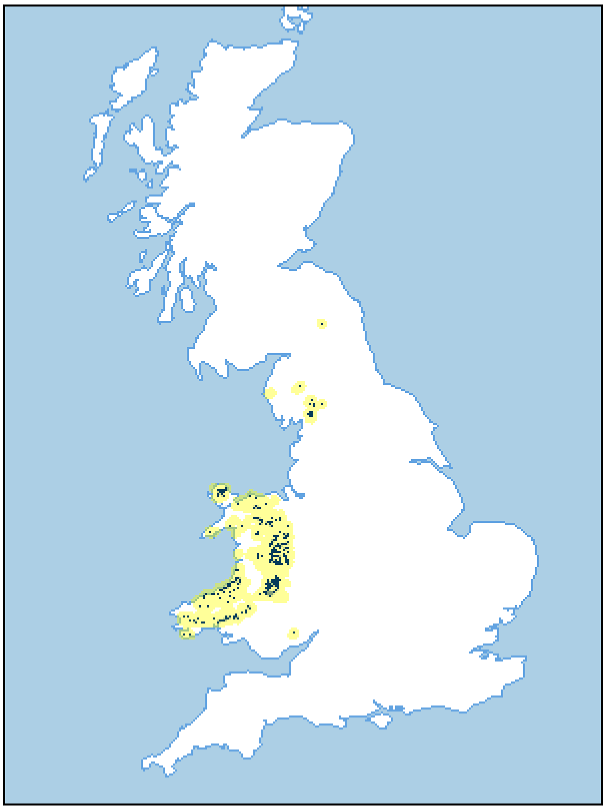


Figure 40. Association Distribution

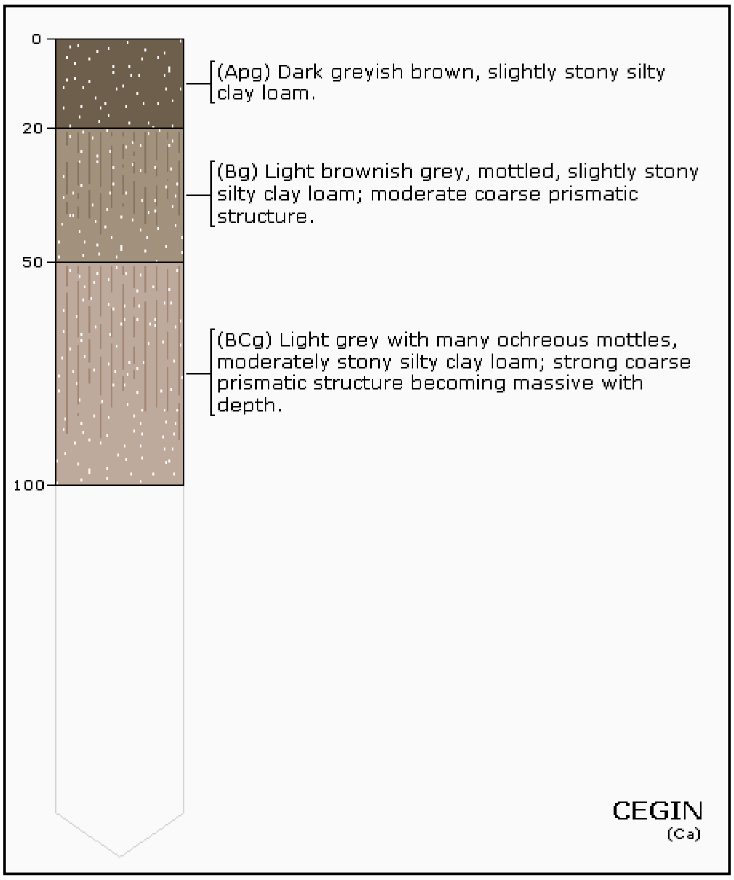
| Soil Series | Description | Area % |
|---|---|---|
| CEGIN (Ca) | medium silty drift with siliceous stones | 40% |
| GREYLAND (gJ) | medium loamy over clayey drift with siliceous stones | 15% |
| BRICKFIELD (Br) | medium loamy drift with siliceous stones | 10% |
| DENBIGH (Dg) | medium loamy material over lithoskeletal mudstone and sandstone or slate | 10% |
| SANNAN (Sn) | medium silty drift with siliceous stones | 10% |
| OTHER | other minor soils | 15% |

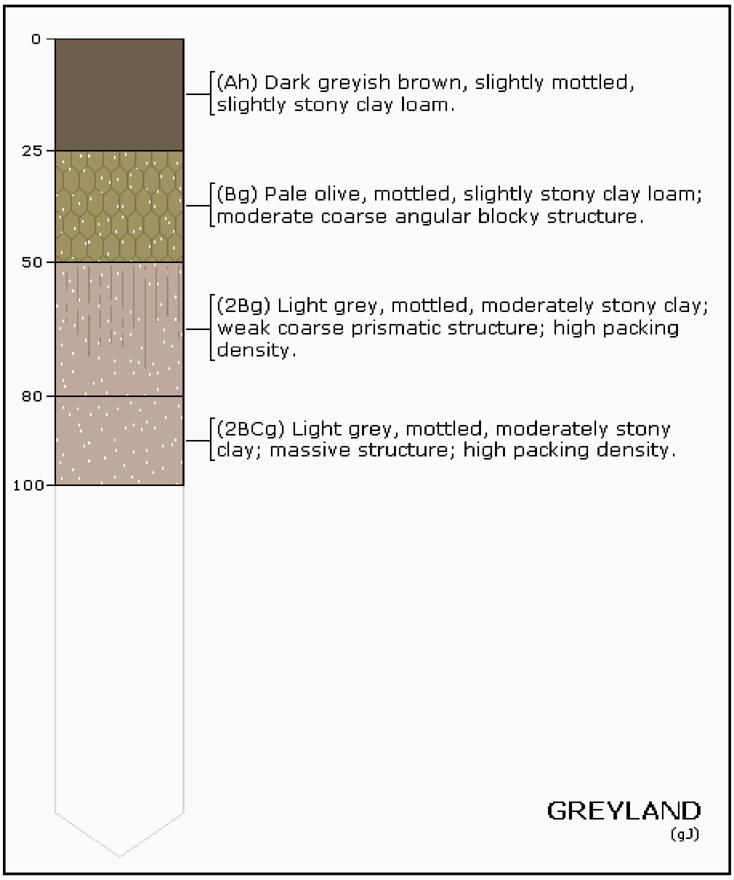
Table 4. The component soil series of the CEGIN soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

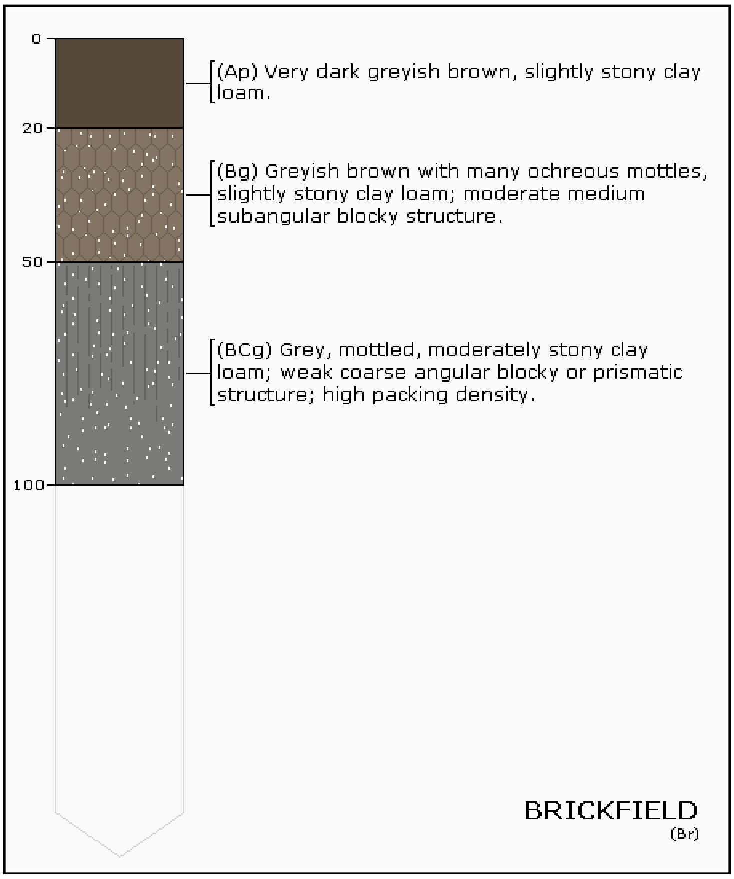
# CEGIN (713d)

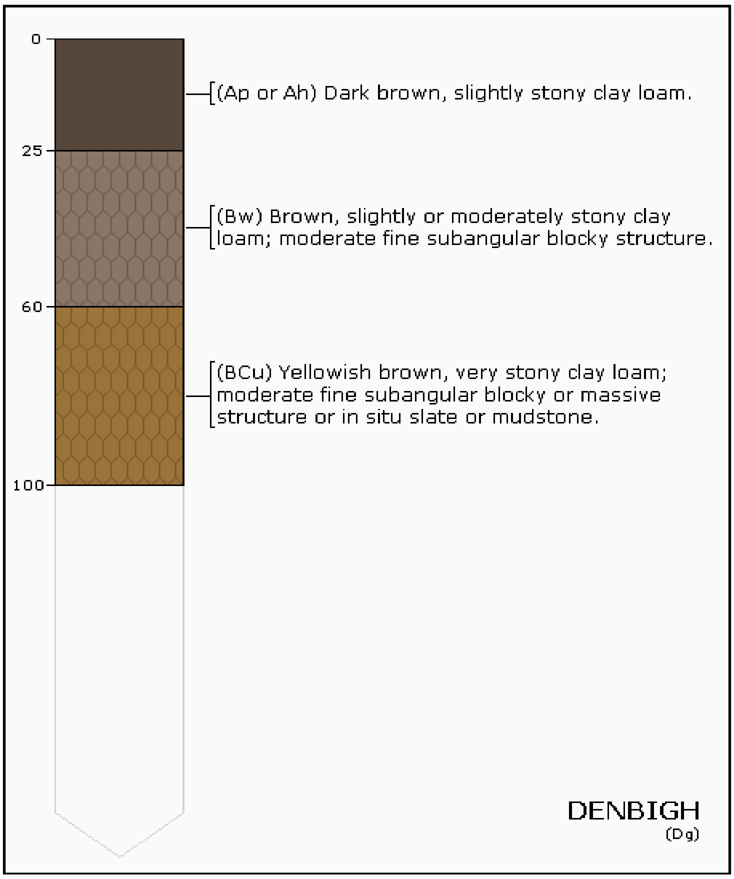
*Slowly permeable seasonally waterlogged fine silty and clayey soils.*

## d. CEGIN Component Series Profiles



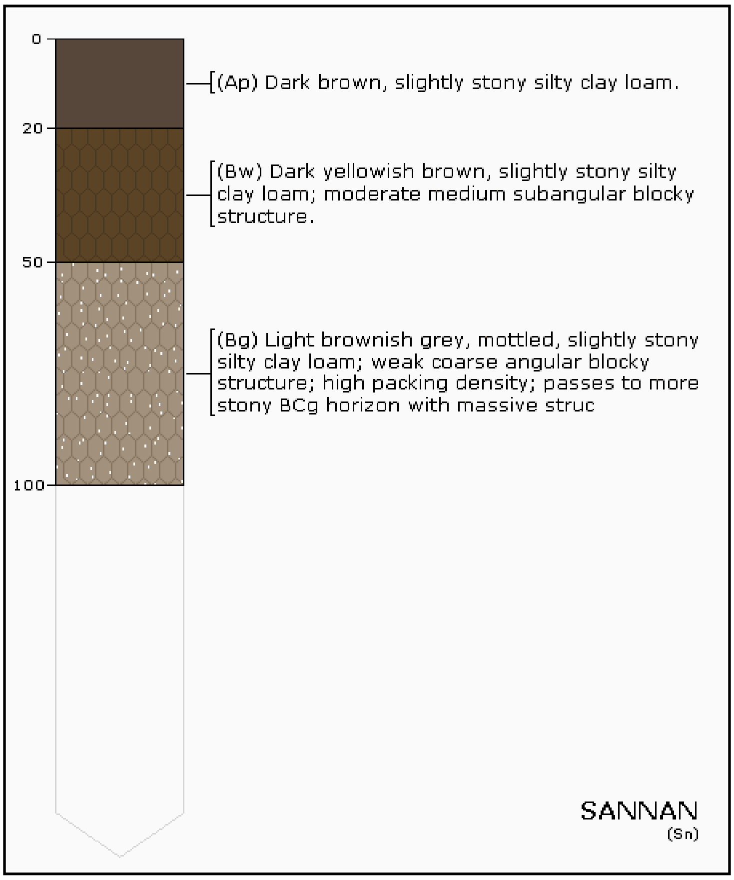



# CEGIN (713d)

*Slowly permeable seasonally waterlogged fine silty and clayey soils.*

## d. CEGIN Component Series Profiles continued



# CEGIN (713d)

*Slowly permeable seasonally waterlogged fine silty and clayey soils.*

## e. Soil Properties

This section provides graphical summaries of selected attribute data available for the component series in this association. The blue bars of the graphs presented in this section describe the range of property values for all soils across England and Wales. Superimposed on these graphs are the values for the component soil series in this association. This has been done to provide the reader with an understanding of where each property for each series sits within the national context.

| Soil Series | Description | Area % |
|---|---|---|
| CEGIN (Ca) | medium silty drift with siliceous stones | 40% |
| GREYLAND (gJ) | medium loamy over clayey drift with siliceous stones | 15% |
| BRICKFIELD (Br) | medium loamy drift with siliceous stones | 10% |
| DENBIGH (Dg) | medium loamy material over lithoskeletal mudstone and sandstone or slate | 10% |
| SANNAN (Sn) | medium silty drift with siliceous stones | 10% |
| OTHER | other minor soils | 15% |

Table 4. The component soil series of the CEGIN soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

## e(i). Soil Depth Information and Depths to Important Layers

*Depth to rock* A mean depth to bedrock or very stony rubble which has been assigned to each soil series based on observed and recorded soil profiles.

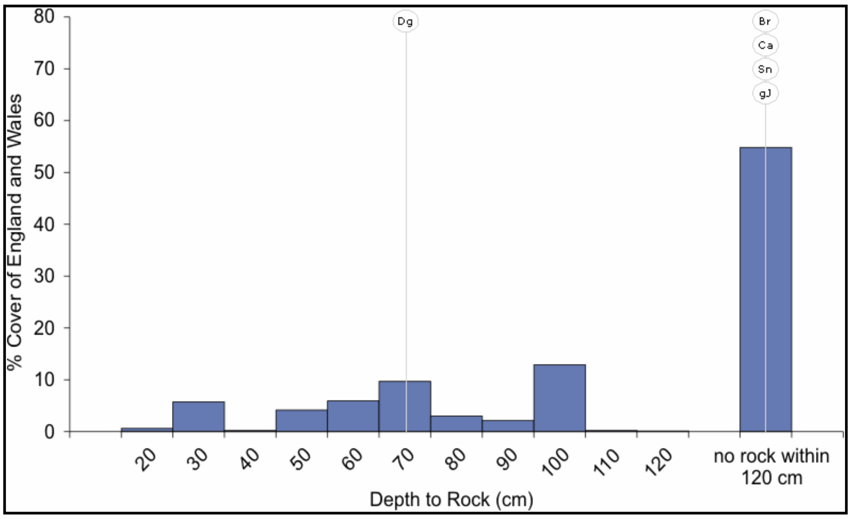



Figure 41. Depth of soil to Rock

*Depth to gleying*, the presence of grey and ochreous mottles within the soil, is caused by intermittent waterlogging. A mean depth to gleying has been assigned to each soil series based on observed and recorded soil profiles. The definition of a gleyed layer is designed to equate with saturation for at least 30 days in each year or the presence of artificial drainage.

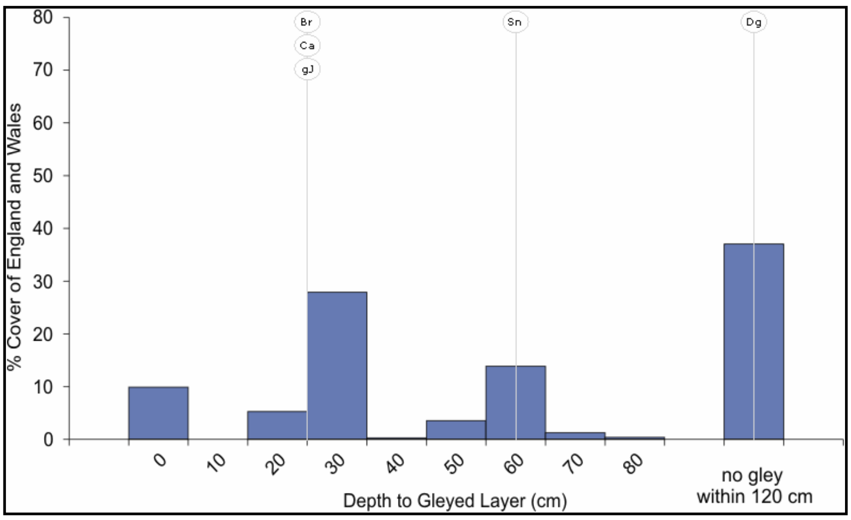



Figure 42. Depth of Soil to Gleying

# CEGIN (713d)

*Slowly permeable seasonally waterlogged fine silty and clayey soils.*

## e(i). Soil Depth Information and Depths to Important Layers continued

*Depth to slowly permeable layer (downward percolation)* A mean depth to a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede downward percolation of excess soil water. This causes periodic saturation in the overlying soil, reduced storage capacity and therefore increased hydrological response to rainfall events.

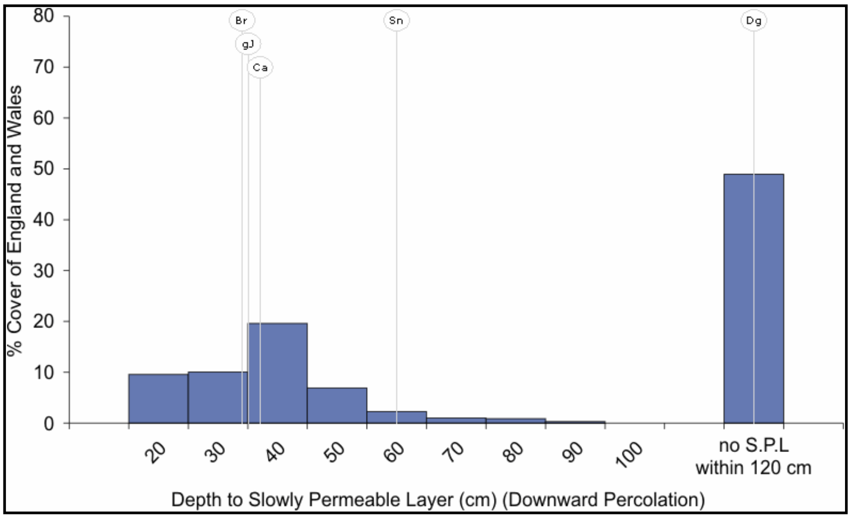



Figure 43. Depth to slowly permeable layer (downward percolation)

*Depth to Slowly Permeable Layer (upward diffusion)* A mean depth to the bottom of a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede upward diffusion of water and gasses.

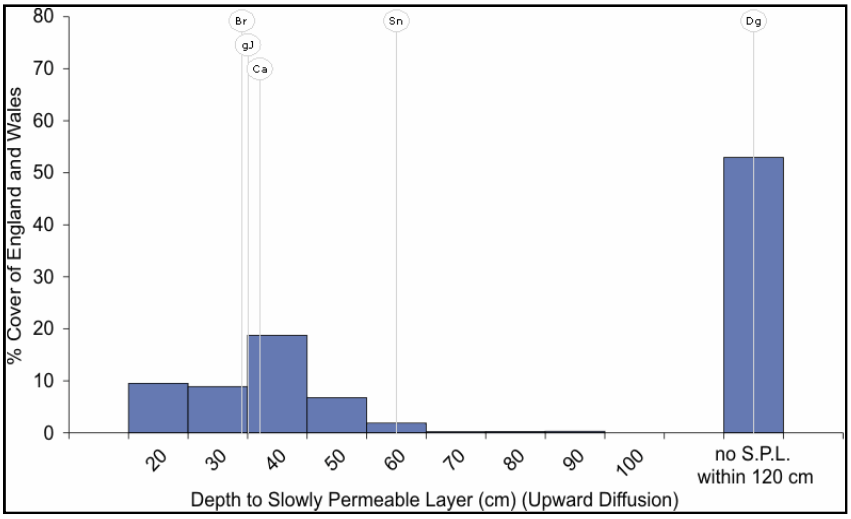



Figure 44. Depth to Slowly Permeable Layer (upward diffusion)

## CEGIN (713d)

*Slowly permeable seasonally waterlogged fine silty and clayey soils.*

### e(ii). Soil Hydrological Information

*Integrated air capacity (IAC)* is the total coarse pore space (>60 $\mu$m diameter) to 1 m depth. This size of pore would normally be air-filled when the soil is fully moist but not waterlogged. A large IAC means that the soil is well aerated. This will encourage root development and, provided near surface soil structure is well developed, will allow rainfall to percolate into the ground thus mitigating against localised flooding.

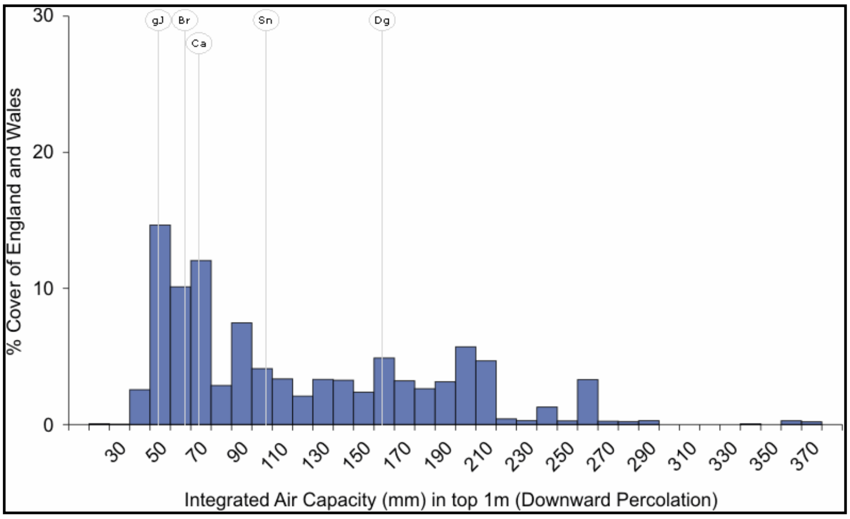



Figure 45. Integrated Air Capacity

*Standard Percentage Runoff (SPR)* is the percentage of rainfall that causes the short-term increase in flow seen at a catchment outlet following a storm event. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

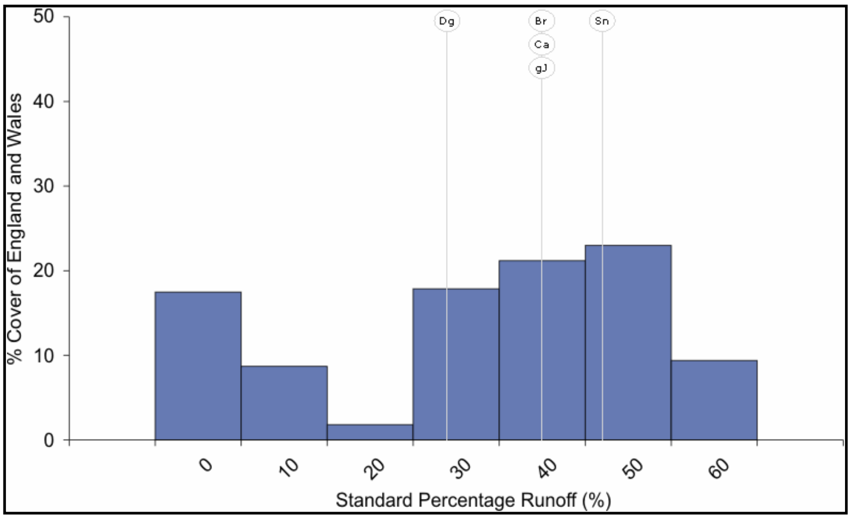



Figure 46. Standard Percentage Runoff

*Base flow index* is calculated from daily river flow data and expresses the volume of base flow of a river as a fraction of the total flow volume. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

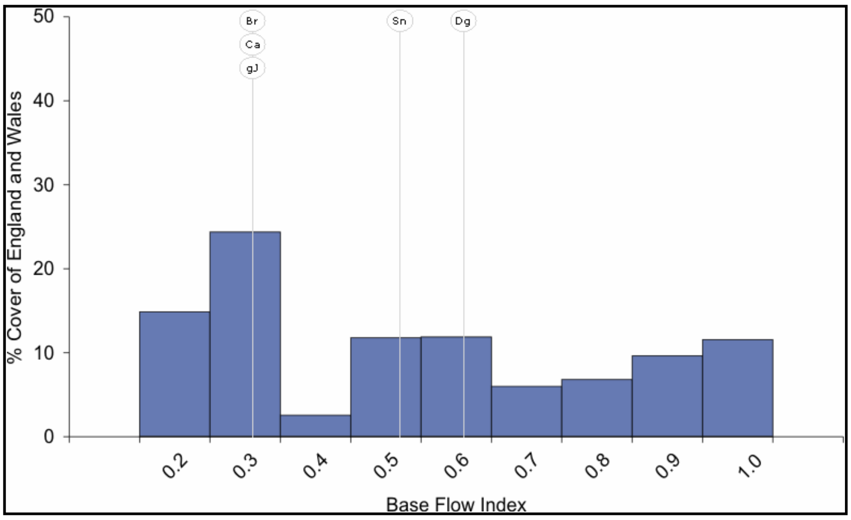



Figure 47. Base Flow Index

## CEGIN (713d)

*Slowly permeable seasonally waterlogged fine silty and clayey soils.*

### e(iii). Available Water Content

*Available water content* for plants varies depending on a number of factors, including the rooting depth of the plants. Described below are differing available water contents for cereals, sugar beet, grass and potato crops, as well as a generic available water value to 1 m depth.

*Available water (by crop)* Available water content to 1 m for the specified soil series between suctions of 5 and 1500kPa.

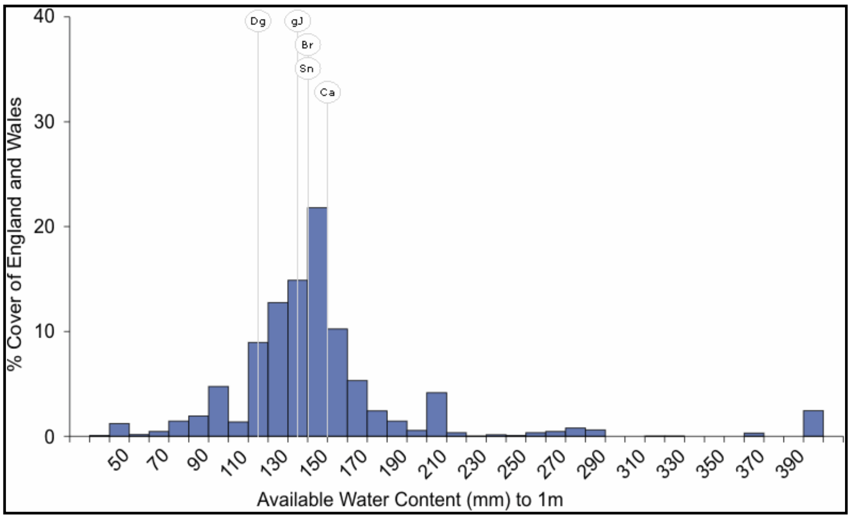



Figure 48. Available Water (by crop)

*Available water for grass* represents the water that is available to a permanent grass sward that is able to root to 100cm depth.

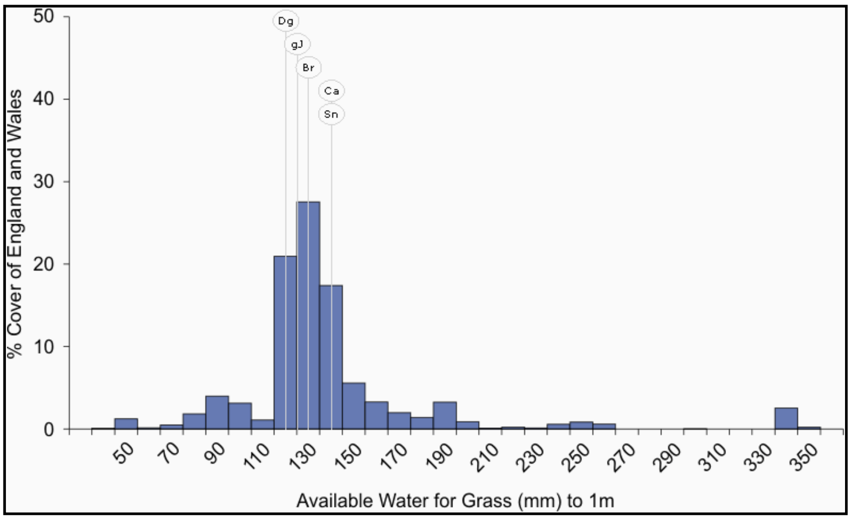



Figure 49. Available Water for Grass

## CEGIN (713d)

*Slowly permeable seasonally waterlogged fine silty and clayey soils.*

### e(iii). Available Water Content continued

*Available water for cereal* represents the water that is available to a cereal crop that is able to root to 120cm depth.

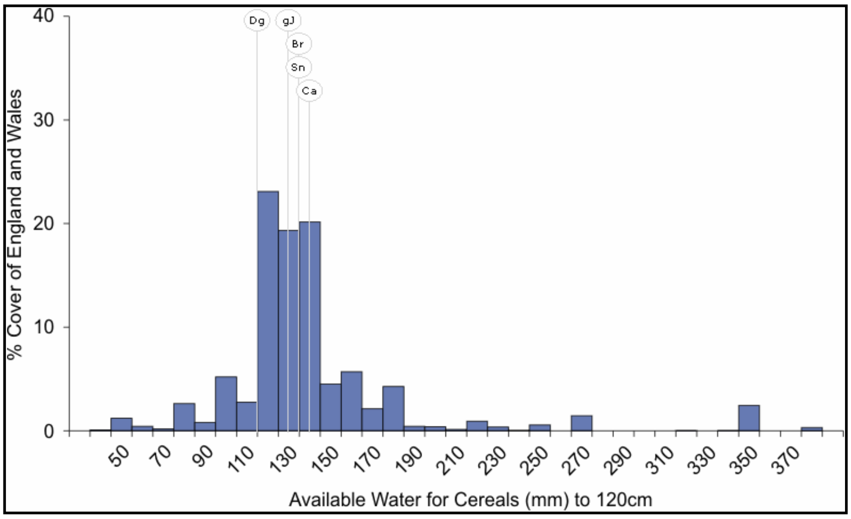



Figure 50. Available Water for Cereal

*Available water for Sugar Beet* represents the water that is available to a sugar beet crop that is able to root to 140cm depth.

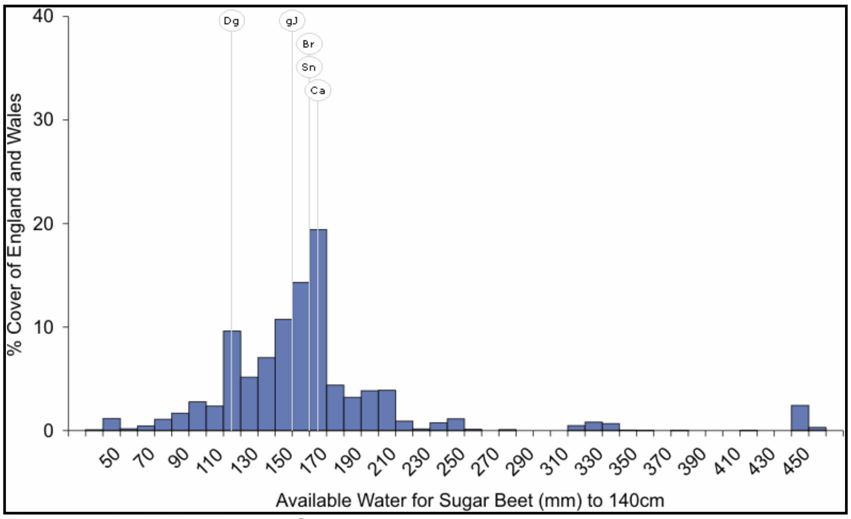



Figure 51. Available Water for Sugar Beet

*Available water for Potatoes* represents the water that is available to a potato crop that is able to root to 70cm depth.

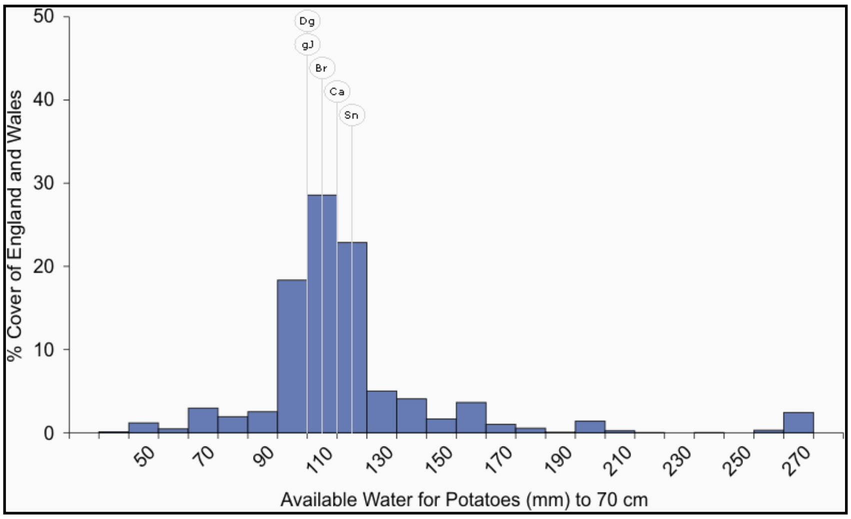



Figure 52. Available Water for Potatoes

# BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

**a. General Description**

Slowly permeable seasonally waterlogged fine loamy soils. Associated with fine loamy soils with only slight waterlogging and some deep well drained fine loamy soils.
The major landuse on this association is defined as dairying and stock rearing on permanent or short term grassland; some cereals in drier areas.

**b. Distribution (England & Wales)**

The BRICKFIELD 2 association covers 1596km² of England and Wales which accounts for 1.06% of the landmass. The distribution of this association is shown in Figure 53. Note that the yellow shading represents a buffer to highlight the location of very small areas of the association.

**c. Comprising Soil Series**

Multiple soil series comprise a soil association. The soil series of the BRICKFIELD 2 association are outlined in Table 5 below. In some cases other minor soil series are present at a particular site, and these have been grouped together under the heading 'OTHER'. We have endevoured to present the likelihood of a minor, unnamed soil series occuring in your site in Table 5.

Schematic diagrams of the vertical soil profile of the major constituent soil series are provided in Section D to allow easier identification of the particular soil series at your site.

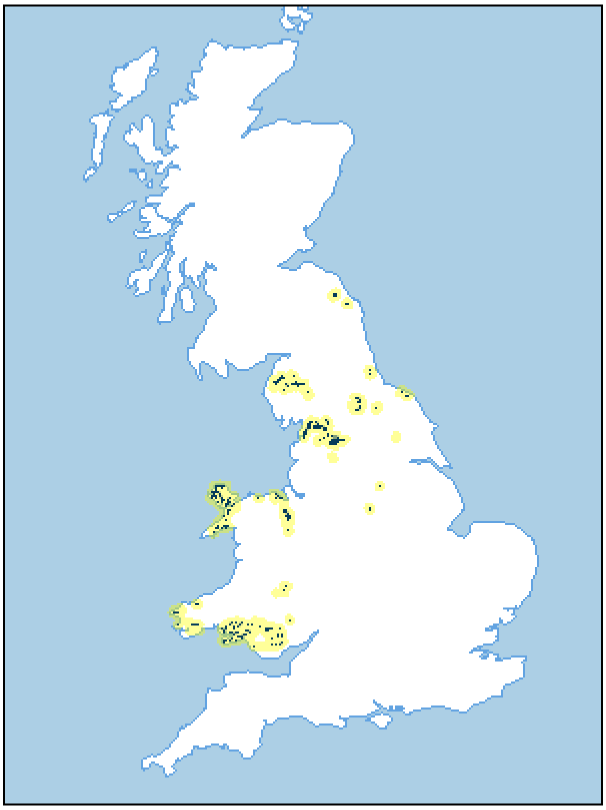


Figure 53. Association Distribution

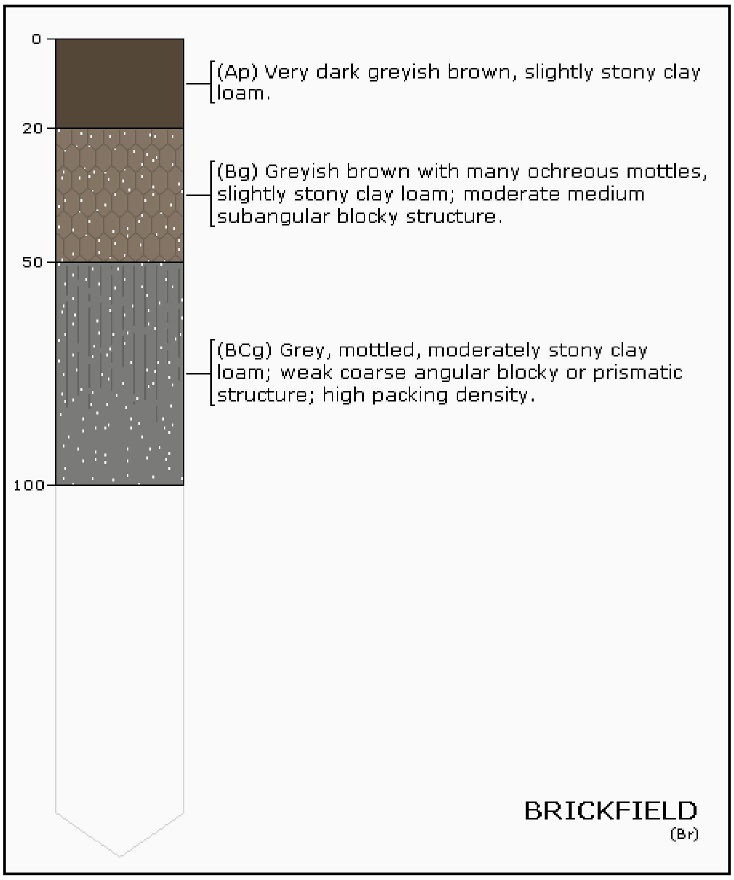
| Soil Series | Description | Area % |
|---|---|---|
| BRICKFIELD (Br) | medium loamy drift with siliceous stones | 40% |
| NERCWYS (Nc) | medium loamy drift with siliceous stones | 20% |
| EAST KESWICK (Ew) | medium loamy drift with siliceous stones | 15% |
| OTHER | other minor soils | 25% |

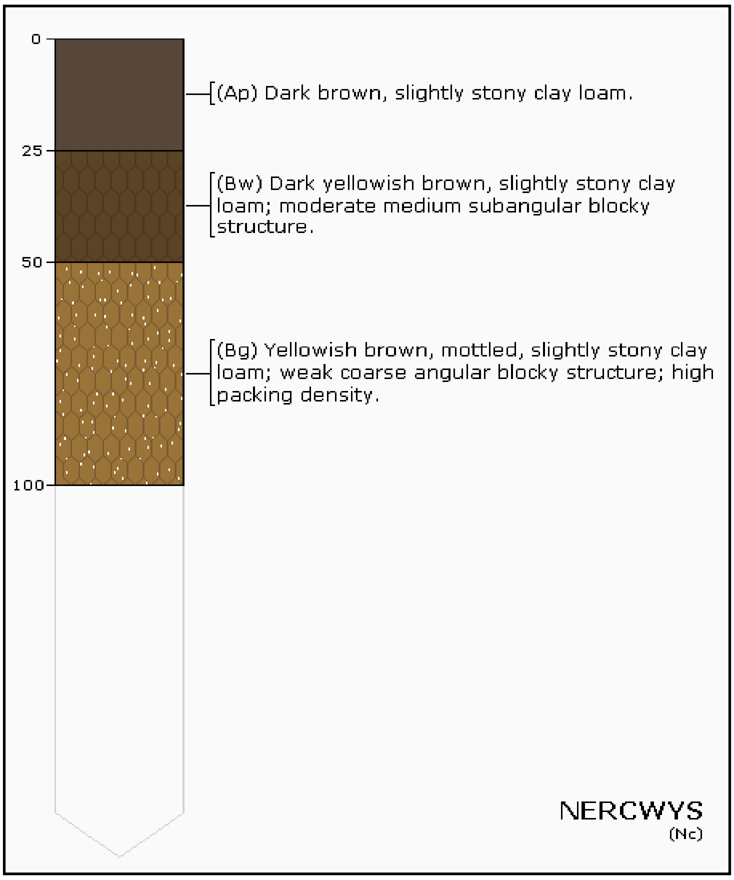
Table 5. The component soil series of the BRICKFIELD 2 soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

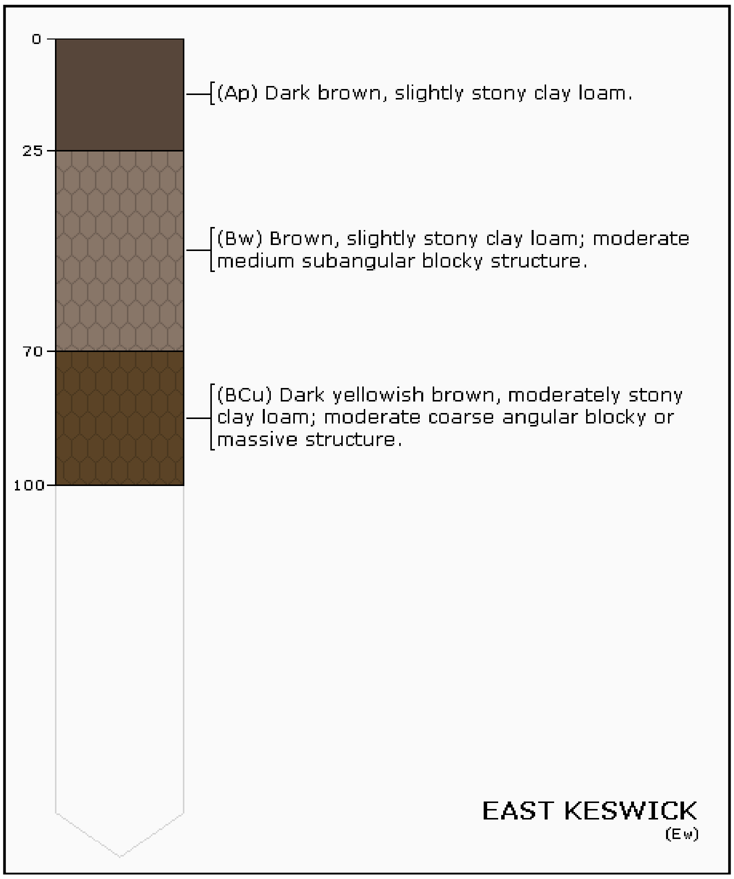
# BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

## d. BRICKFIELD 2 Component Series Profiles



# BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

## e. Soil Properties

This section provides graphical summaries of selected attribute data available for the component series in this association. The blue bars of the graphs presented in this section describe the range of property values for all soils across England and Wales. Superimposed on these graphs are the values for the component soil series in this association. This has been done to provide the reader with an understanding of where each property for each series sits within the national context.

| Soil Series | Description | Area % |
|---|---|---|
| BRICKFIELD (Br) | medium loamy drift with siliceous stones | 40% |
| NERCWYS (Nc) | medium loamy drift with siliceous stones | 20% |
| EAST KESWICK (Ew) | medium loamy drift with siliceous stones | 15% |
| OTHER | other minor soils | 25% |

Table 5. The component soil series of the BRICKFIELD 2 soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

## e(i). Soil Depth Information and Depths to Important Layers

*Depth to rock* A mean depth to bedrock or very stony rubble which has been assigned to each soil series based on observed and recorded soil profiles.

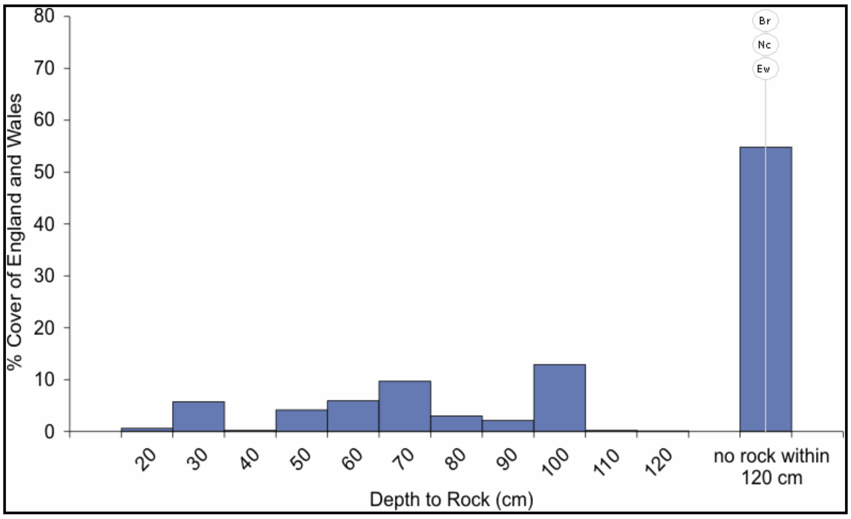



Figure 54. Depth of soil to Rock

*Depth to gleying*, the presence of grey and ochreous mottles within the soil, is caused by intermittent waterlogging. A mean depth to gleying has been assigned to each soil series based on observed and recorded soil profiles. The definition of a gleyed layer is designed to equate with saturation for at least 30 days in each year or the presence of artificial drainage.

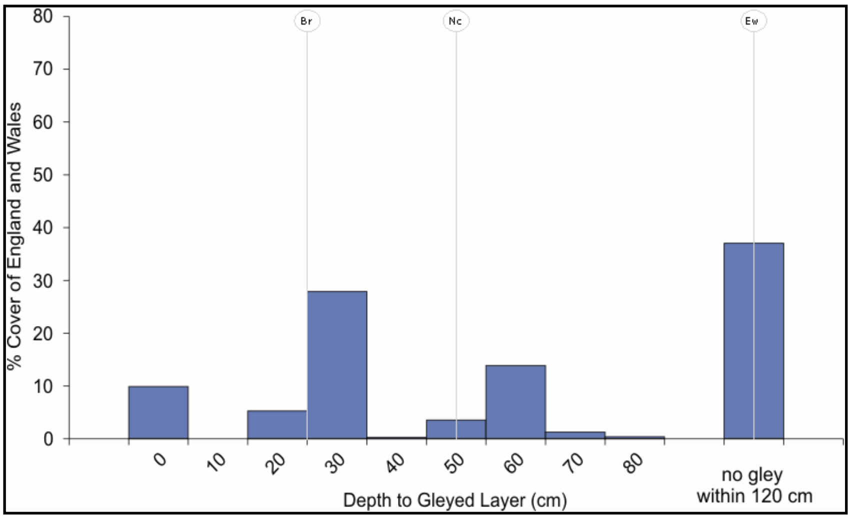



Figure 55. Depth of Soil to Gleying

## BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

### e(i). Soil Depth Information and Depths to Important Layers continued

*Depth to slowly permeable layer (downward percolation)* A mean depth to a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede downward percolation of excess soil water. This causes periodic saturation in the overlying soil, reduced storage capacity and therefore increased hydrological response to rainfall events.

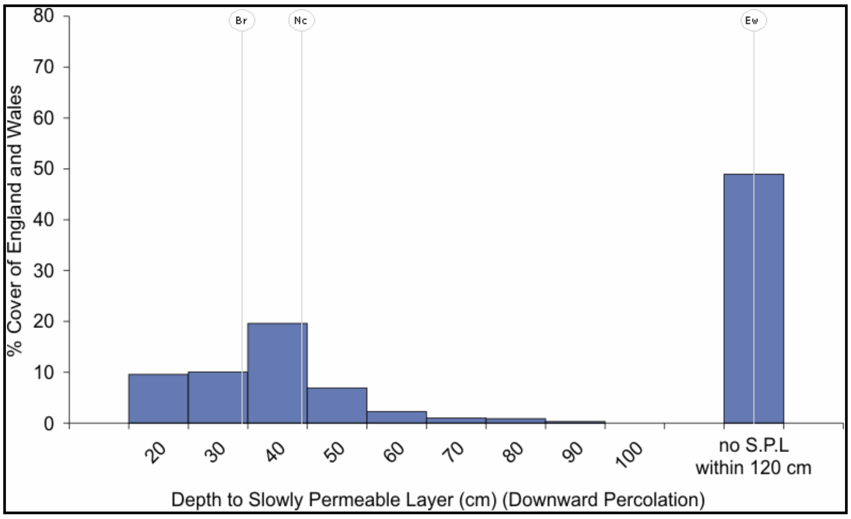



Figure 56. Depth to slowly permeable layer (downward percolation)

*Depth to Slowly Permeable Layer (upward diffusion)* A mean depth to the bottom of a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede upward diffusion of water and gasses.

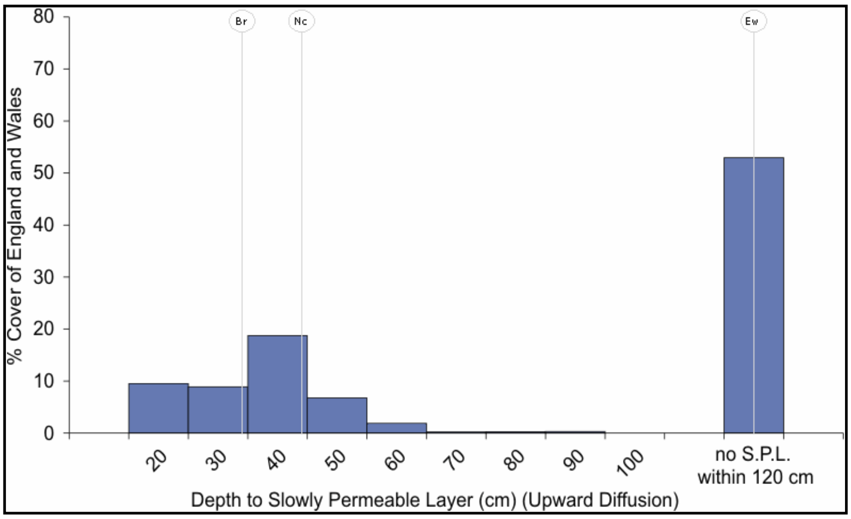



Figure 57. Depth to Slowly Permeable Layer (upward diffusion)

## BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

### e(ii). Soil Hydrological Information

*Integrated air capacity (IAC)* is the total coarse pore space (>60 $\mu$m diameter) to 1 m depth. This size of pore would normally be air-filled when the soil is fully moist but not waterlogged. A large IAC means that the soil is well aerated. This will encourage root development and, provided near surface soil structure is well developed, will allow rainfall to percolate into the ground thus mitigating against localised flooding.

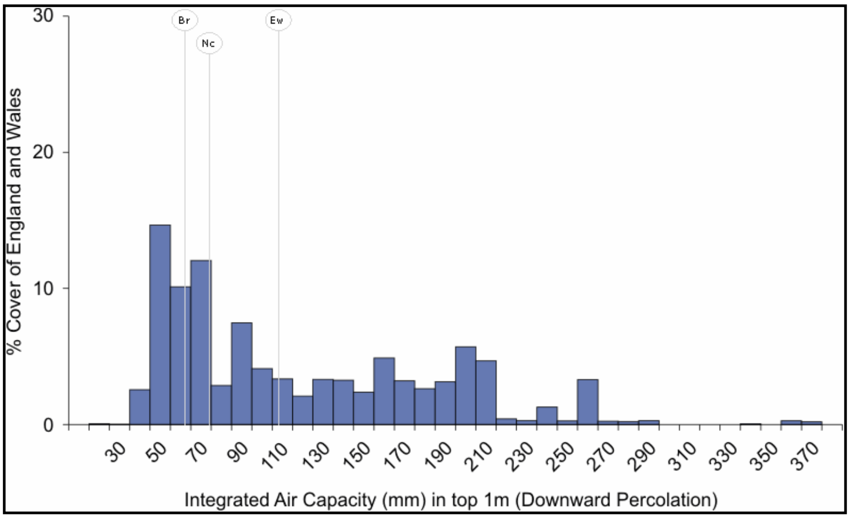



Figure 58. Integrated Air Capacity

*Standard Percentage Runoff (SPR)* is the percentage of rainfall that causes the short-term increase in flow seen at a catchment outlet following a storm event. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

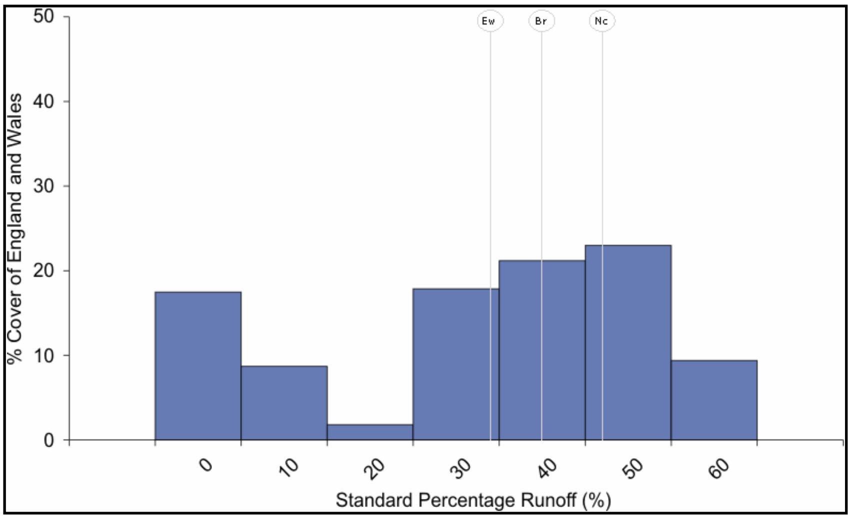



Figure 59. Standard Percentage Runoff

*Base flow index* is calculated from daily river flow data and expresses the volume of base flow of a river as a fraction of the total flow volume. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

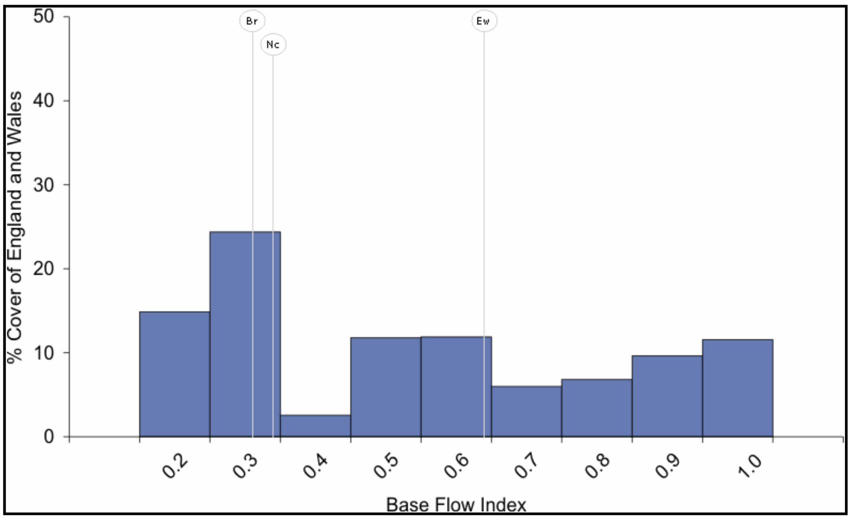



Figure 60. Base Flow Index

# BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

## e(iii). Available Water Content

*Available water content* for plants varies depending on a number of factors, including the rooting depth of the plants. Described below are differing available water contents for cereals, sugar beet, grass and potato crops, as well as a generic available water value to 1 m depth.

*Available water (by crop)* Available water content to 1 m for the specified soil series between suctions of 5 and 1500kPa.

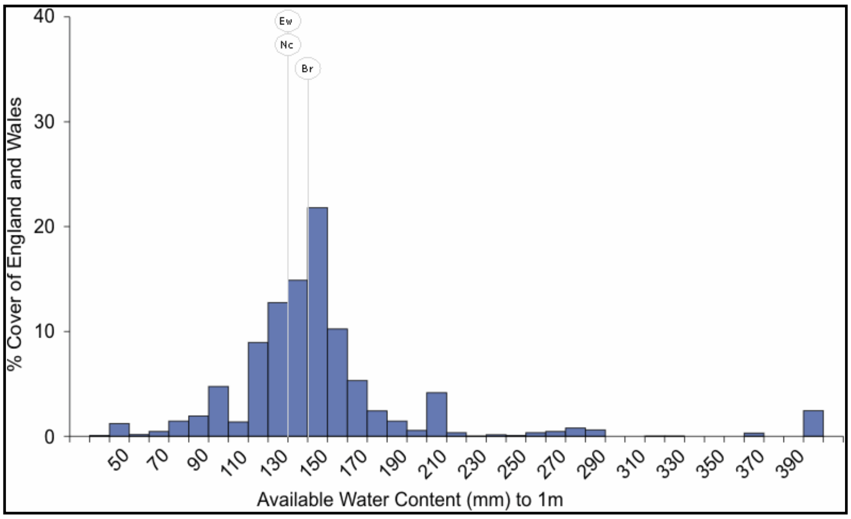



Figure 61. Available Water (by crop)

*Available water for grass* represents the water that is available to a permanent grass sward that is able to root to 100cm depth.

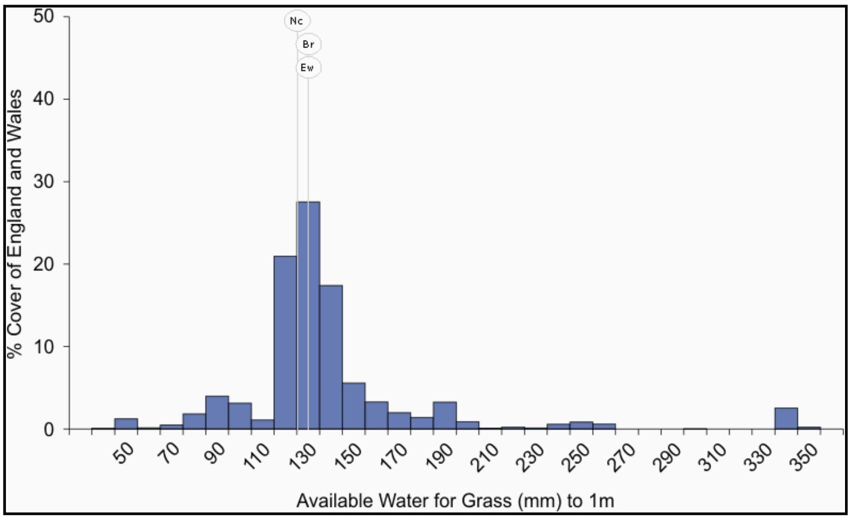



Figure 62. Available Water for Grass

# BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

## e(iii). Available Water Content continued

*Available water for cereal* represents the water that is available to a cereal crop that is able to root to 120cm depth.

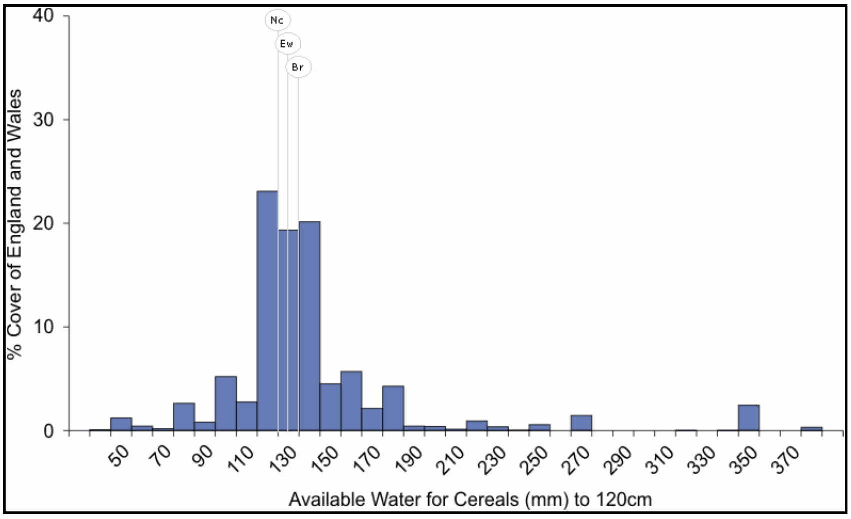



Figure 63. Available Water for Cereal

*Available water for Sugar Beet* represents the water that is available to a sugar beet crop that is able to root to 140cm depth.

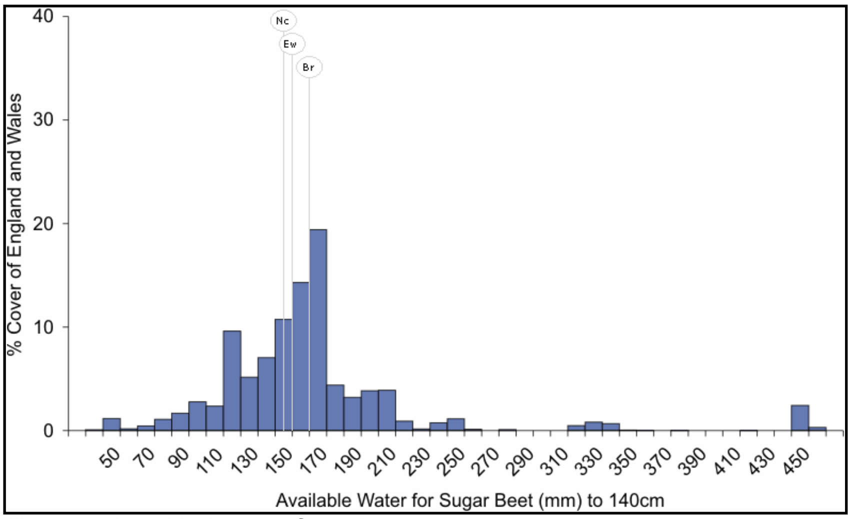



Figure 64. Available Water for Sugar Beet

*Available water for Potatoes* represents the water that is available to a potato crop that is able to root to 70cm depth.

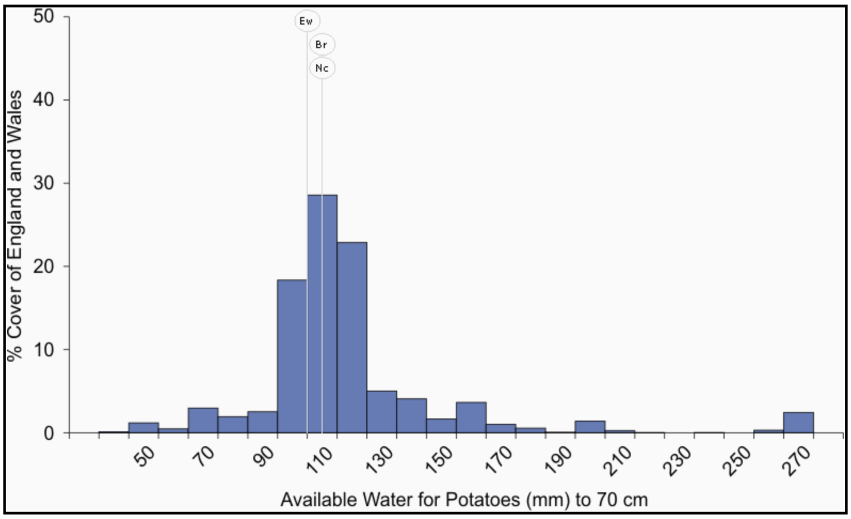
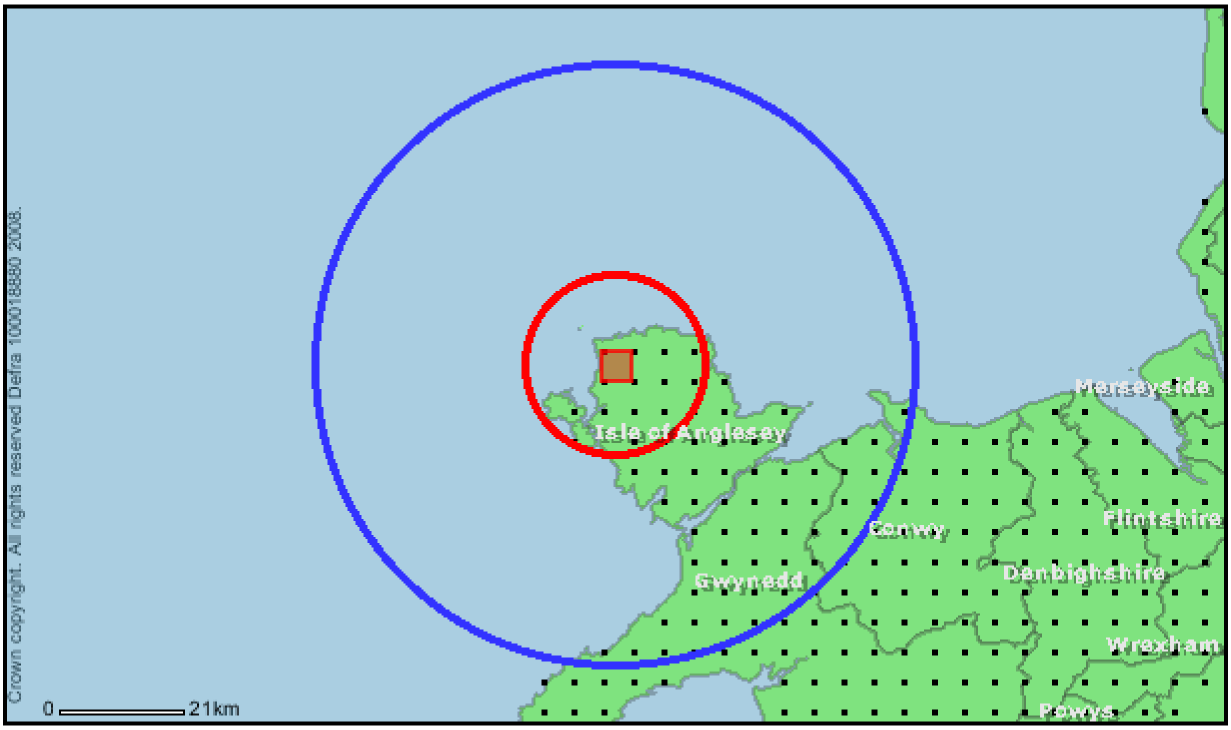
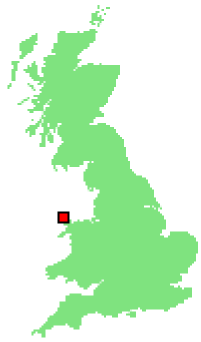



Figure 65. Available Water for Potatoes

# 3. TOPSOIL ELEMENT BACKGROUND LEVELS



## TOPSOIL ELEMENT BACKGROUND LEVELS KEY

- NSI sample points
- Report area
- 15 km radius - local area
- 50 km radius - regional area

TOPSOIL ELEMENT BACKGROUND LEVELS DESCRIPTION

The National Soil Inventory (NSI) covers England and Wales on a 5 km grid and provides detailed information for each intersect of the grid. Collectively NSI data are statistically representative of England and Wales soils. The original sampling was undertaken around 1980 and there were partial resamplings in the mid-1990s. The most up-to-date data is presented here.

Analysis of the NSI samples provides detailed measurements of over 20 elements from the soils, in addition to pH. This data is summarised over three areas to provide you with an understanding of how your site, and your data for it, sits within the local, regional and national context.

Where available, the soil element levels are compared with the Soil Guideline Values and where a soil sample we have analysed has been found in excess of the SGV guidelines for "residential with plant uptake" land, this is displayed in red in the tables which follow.

SGV levels are provided for the following elements: lead, selenium, nickel, mercury, chromium, cadmium and arsenic.

In the following pages, a number of analyses of the topsoil are provided. The majority of analyses have been performed on the full compliment of sample points, however, in some areas, for some elements, only a few samples were analysed as part of subsequent programmes. In order to present the full suite of possible datasets, and accurately convey the validity of the data, the number of actual measured samples is stated for each analysis. Care should be taken where the number of samples is disproportionately low.

# 3a. Analyses Within a 15 km Radius (14 Sample Points)

| ANALYSES | SAMPLES | MEAN | MIN | MAX | ST. DEV |
|---|---|---|---|---|---|
| pH (PH) | 14 | 5.1 | 4.5 | 5.6 | 0.4 |
| Carbon (CARBON) | 14 | 4.7 | 2.2 | 13.5 | 2.9 |
| Aluminium (AL_ACID) | 14 | 33,346.3 | 13,802.0 | 53,950.0 | 9,671.8 |
| Arsenic (AS_ACID) | 12 | 3.8 | 2.0 | 9.6 | 2.0 |
| Barium (BA_ACID) | 14 | 189.4 | 76.0 | 372.0 | 89.7 |
| Calcium (CA_ACID) | 14 | 2,958.9 | 353.0 | 4,696.0 | 1,357.5 |
| Cadmium (CD_ACID) | 14 | 0.6 | 0.1 | 1.3 | 0.4 |
| Cadmium (Extractable) (CD_EDTA) | 14 | 0.2 | 0.1 | 0.4 | 0.1 |
| Cobalt (CO_ACID) | 14 | 11.9 | 3.6 | 26.1 | 7.0 |
| Cobalt (Extractable) (CO_EDTA) | 14 | 0.7 | 0.1 | 2.1 | 0.7 |
| Chromium (CR_ACID) | 14 | 51.0 | 34.8 | 88.4 | 16.3 |
| Copper (CU_ACID) | 14 | 28.4 | 5.8 | 103.7 | 24.0 |
| Copper (Extractable) (CU_EDTA) | 14 | 8.3 | 1.2 | 39.2 | 9.2 |
| Flouride (F_ACID) | 13 | 45.1 | 0.0 | 137.0 | 39.0 |
| Iron (FE_ACID) | 14 | 33,349.7 | 17,114.0 | 53,860.0 | 10,669.5 |
| Mercury (HG_ACID) | 12 | 0.0 | 0.0 | 0.1 | 0.0 |
| Potassium (K_ACID) | 14 | 5,181.6 | 2,280.0 | 8,269.0 | 1,751.2 |
| Potassium (Extractable) (K_NITRATE) | 14 | 107.3 | 38.0 | 247.0 | 55.6 |
| Magnesium (MG_ACID) | 14 | 3,903.4 | 2,138.0 | 5,459.0 | 930.7 |
| Magnesium (Extractable) (MG_NITRATE) | 14 | 133.6 | 55.0 | 307.0 | 65.3 |
| Manganese (MN_ACID) | 14 | 1,110.6 | 231.0 | 2,707.0 | 881.9 |
| Manganese (Extractable) (MN_EDTA) | 14 | 156.3 | 9.0 | 589.0 | 158.9 |
| Molybdenum (MO_ACID) | 13 | 1.0 | 0.0 | 2.9 | 0.7 |
| Sodium (NA_ACID) | 14 | 620.8 | 193.0 | 1,176.0 | 355.1 |
| Nickel (NI_ACID) | 14 | 21.6 | 10.0 | 33.0 | 7.5 |
| Nickel (Extractable) (NI_EDTA) | 14 | 0.9 | 0.3 | 2.9 | 0.7 |
| Phosphorus (P_ACID) | 14 | 869.1 | 175.0 | 2,016.0 | 492.3 |
| Phosphorus (Extractable) (P_OLSEN) | 14 | 22.9 | 6.0 | 58.0 | 13.7 |
| Lead (PB_ACID) | 14 | 46.9 | 15.0 | 151.0 | 33.4 |
| Lead (Extractable) (PB_EDTA) | 14 | 13.5 | 3.6 | 56.7 | 14.2 |
| Selenium (SE_ACID) | 12 | 0.6 | 0.2 | 1.0 | 0.2 |
| Strontium (SR_ACID) | 14 | 30.8 | 2.0 | 54.0 | 12.3 |
| Vanadium (V_ACID) | 13 | 38.3 | 6.7 | 52.3 | 12.1 |
| Zinc (ZN_ACID) | 14 | 89.4 | 25.0 | 237.0 | 52.8 |
| Zinc (Extractable) (ZN_EDTA) | 14 | 3.7 | 1.1 | 10.2 | 2.3 |

for units, see Analyses Definitions (p65)

## 3b. Analyses Within a 50 km Radius (66 Sample Points)

| ANALYSES | SAMPLES | MEAN | MIN | MAX | ST. DEV |
|---|---|---|---|---|---|
| pH (PH) | 66 | 4.8 | 3.5 | 6.2 | 0.6 |
| Carbon (CARBON) | 66 | 10.1 | 0.2 | 44.1 | 11.0 |
| Aluminium (AL_ACID) | 66 | 24,787.4 | 3,269.0 | 53,950.0 | 11,212.2 |
| Arsenic (AS_ACID) | 42 | 5.2 | 0.4 | 25.2 | 4.1 |
| Barium (BA_ACID) | 66 | 149.3 | 11.0 | 393.0 | 87.1 |
| Calcium (CA_ACID) | 66 | 1,980.5 | 100.0 | 5,800.0 | 1,511.1 |
| Cadmium (CD_ACID) | 66 | 0.6 | 0.0 | 4.5 | 0.6 |
| Cadmium (Extractable) (CD_EDTA) | 65 | 1.3 | 0.0 | 75.0 | 9.3 |
| Cobalt (CO_ACID) | 66 | 16.5 | 0.7 | 321.8 | 43.1 |
| Cobalt (Extractable) (CO_EDTA) | 65 | 0.9 | 0.0 | 10.8 | 1.8 |
| Chromium (CR_ACID) | 66 | 36.8 | 4.3 | 95.4 | 21.1 |
| Copper (CU_ACID) | 66 | 22.5 | 2.4 | 103.7 | 17.4 |
| Copper (Extractable) (CU_EDTA) | 65 | 5.5 | 1.2 | 39.2 | 5.0 |
| Flouride (F_ACID) | 55 | 49.1 | 0.0 | 340.7 | 68.2 |
| Iron (FE_ACID) | 66 | 28,449.2 | 4,223.0 | 83,515.0 | 14,519.8 |
| Mercury (HG_ACID) | 42 | 0.1 | 0.0 | 1.2 | 0.2 |
| Potassium (K_ACID) | 66 | 3,903.9 | 581.0 | 8,269.0 | 1,913.2 |
| Potassium (Extractable) (K_NITRATE) | 66 | 105.2 | 13.0 | 256.0 | 49.9 |
| Magnesium (MG_ACID) | 66 | 3,202.6 | 322.0 | 11,264.0 | 2,123.2 |
| Magnesium (Extractable) (MG_NITRATE) | 66 | 107.0 | 24.0 | 307.0 | 51.2 |
| Manganese (MN_ACID) | 66 | 1,336.8 | 32.0 | 13,613.0 | 1,835.3 |
| Manganese (Extractable) (MN_EDTA) | 65 | 176.7 | 1.0 | 2,347.0 | 301.5 |
| Molybdenum (MO_ACID) | 55 | 1.3 | 0.0 | 5.9 | 1.3 |
| Sodium (NA_ACID) | 66 | 453.7 | 137.0 | 2,209.0 | 350.4 |
| Nickel (NI_ACID) | 66 | 17.9 | 2.9 | 61.0 | 11.4 |
| Nickel (Extractable) (NI_EDTA) | 65 | 0.7 | 0.1 | 2.9 | 0.5 |
| Phosphorus (P_ACID) | 66 | 940.9 | 175.0 | 2,214.0 | 384.7 |
| Phosphorus (Extractable) (P_OLSEN) | 66 | 20.7 | 3.0 | 88.0 | 14.3 |
| Lead (PB_ACID) | 66 | 77.0 | 6.0 | 795.0 | 99.4 |
| Lead (Extractable) (PB_EDTA) | 65 | 18.8 | 3.6 | 108.0 | 18.1 |
| Selenium (SE_ACID) | 42 | 1.0 | 0.0 | 6.4 | 1.1 |
| Strontium (SR_ACID) | 66 | 19.3 | 0.0 | 54.0 | 11.8 |
| Vanadium (V_ACID) | 56 | 35.0 | 0.0 | 96.1 | 26.2 |
| Zinc (ZN_ACID) | 66 | 71.7 | 21.0 | 237.0 | 41.0 |
| Zinc (Extractable) (ZN_EDTA) | 65 | 5.1 | 1.1 | 21.1 | 3.7 |

for units, see Analyses Definitions (p65)

## 3c. National Analyses (5686 Sample Points)

| ANALYSES | SAMPLES | MEAN | MIN | MAX | ST. DEV |
|---|---|---|---|---|---|
| pH (PH) | 5,630 | 6.0 | 3.1 | 9.2 | 1.3 |
| Carbon (CARBON) | 5,672 | 6.1 | 0.1 | 61.5 | 8.9 |
| Aluminium (AL_ACID) | 5,677 | 26,775.3 | 491.0 | 79,355.0 | 12,772.2 |
| Arsenic (AS_ACID) | 2,729 | 4.6 | 0.0 | 110.0 | 5.7 |
| Barium (BA_ACID) | 5,677 | 150.0 | 7.0 | 3,840.0 | 159.5 |
| Calcium (CA_ACID) | 5,677 | 13,768.7 | 0.0 | 339,630.0 | 37,785.0 |
| Cadmium (CD_ACID) | 5,677 | 0.7 | 0.0 | 40.9 | 1.0 |
| Cadmium (Extractable) (CD_EDTA) | 5,655 | 0.5 | 0.0 | 85.0 | 3.0 |
| Cobalt (CO_ACID) | 5,677 | 10.6 | 0.0 | 567.0 | 13.7 |
| Cobalt (Extractable) (CO_EDTA) | 5,655 | 1.1 | 0.0 | 26.5 | 1.2 |
| Chromium (CR_ACID) | 5,677 | 38.9 | 0.0 | 2,339.8 | 43.7 |
| Copper (CU_ACID) | 5,677 | 22.6 | 0.0 | 1,507.7 | 36.8 |
| Copper (Extractable) (CU_EDTA) | 5,655 | 6.4 | 0.3 | 431.4 | 11.1 |
| Flouride (F_ACID) | 3,320 | 58.5 | 0.0 | 6,307.9 | 186.2 |
| Iron (FE_ACID) | 5,677 | 28,147.8 | 395.0 | 264,405.0 | 16,510.5 |
| Mercury (HG_ACID) | 2,159 | 0.1 | 0.0 | 2.4 | 0.2 |
| Potassium (K_ACID) | 5,677 | 4,727.7 | 60.0 | 23,905.0 | 2,700.2 |
| Potassium (Extractable) (K_NITRATE) | 5,609 | 182.0 | 6.0 | 2,776.0 | 151.6 |
| Magnesium (MG_ACID) | 5,677 | 3,648.1 | 0.0 | 62,690.0 | 3,284.1 |
| Magnesium (Extractable) (MG_NITRATE) | 5,609 | 146.0 | 1.0 | 1,601.0 | 147.5 |
| Manganese (MN_ACID) | 5,677 | 777.0 | 3.0 | 42,603.0 | 1,068.8 |
| Manganese (Extractable) (MN_EDTA) | 5,654 | 159.4 | 0.0 | 3,108.0 | 188.6 |
| Molybdenum (MO_ACID) | 4,417 | 0.9 | 0.0 | 56.3 | 2.0 |
| Sodium (NA_ACID) | 5,677 | 323.3 | 17.0 | 25,152.0 | 572.3 |
| Nickel (NI_ACID) | 5,677 | 25.4 | 0.0 | 1,350.2 | 29.2 |
| Nickel (Extractable) (NI_EDTA) | 5,655 | 1.6 | 0.1 | 73.2 | 2.0 |
| Phosphorus (P_ACID) | 5,677 | 792.1 | 41.0 | 6,273.0 | 433.9 |
| Phosphorus (Extractable) (P_OLSEN) | 5,604 | 27.4 | 0.0 | 534.0 | 25.5 |
| Lead (PB_ACID) | 5,677 | 73.3 | 0.0 | 17,365.0 | 280.6 |
| Lead (Extractable) (PB_EDTA) | 5,655 | 27.8 | 1.2 | 6,056.5 | 119.7 |
| Selenium (SE_ACID) | 2,729 | 0.6 | 0.0 | 22.8 | 0.8 |
| Strontium (SR_ACID) | 5,677 | 42.3 | 0.0 | 1,445.0 | 67.8 |
| Vanadium (V_ACID) | 4,428 | 41.0 | 0.0 | 854.4 | 33.9 |
| Zinc (ZN_ACID) | 5,677 | 90.2 | 0.0 | 3,648.0 | 104.4 |
| Zinc (Extractable) (ZN_EDTA) | 5,655 | 9.6 | 0.5 | 712.0 | 24.6 |

for units, see Analyses Definitions (p65)

## SOIL GUIDELINE VALUES (SGV)

Defra and the Environment Agency have produced soil guideline values (SGVs) as an aid to preliminary assessment of potential risk to human health from land that may be contaminated. SGVs represent 'intervention values', which, if exceeded, act as indicators of potential unacceptable risk to humans, so that more detailed risk assessment is needed.

The SGVs were derived using the Contaminated Land Exposure Assessment (CLEA) model for four land uses:

1. residential (with plant uptake / vegetable growing)
2. residential (without vegetable growing)
3. allotments
4. commercial / industrial

SGVs are only designed to indicate whether further site-specific investigation is needed. Where a soil guideline value is exceeded, it does not mean that there is necessarily a chronic or acute risk to human health.

The values presented in this report represent those from a number of sample points ( given in the "Samples" column in each table) providing local, regional and national background levels. Figures which appear in red indicate that a bulked sample from 20m surrounding a sample point, has at a past date, exceeded the SGV for the 'residential with plant uptake' land use.

It is always advisable to perform site specific investigations.

More details on all the SGVs can be found on the Environment Agency Website.

All units are mg/kg which is equivalent to parts per million (ppm)

| SUBSTANCE | RESIDENTIAL WITH PLANT UPTAKE | RESIDENTIAL WITHOUT PLANT UPTAKE | ALLOTMENTS | COMMERCIAL / INDUSTRIAL |
|---|---|---|---|---|
| LEAD | 450 | 450 | 450 | 750 |
| SELENIUM | 35 | 260 | 35 | 8000 |
| NICKEL | 50 | 75 | 50 | 5000 |
| MERCURY | 8 | 15 | 8 | 480 |
| CHROMIUM | 130 | 200 | 130 | 5000 |
| CADMIUM (pH 6) | 1 | 30 | 1 | 1400 |
| CADMIUM (pH 7) | 2 | 30 | 2 | 1400 |
| CADMIUM (pH 8) | 8 | 30 | 8 | 1400 |
| ARSENIC | 20 | 20 | 20 | 500 |

## ANALYSES DEFINITIONS

### PH (pH)
pH of soil measure after shaking 10ml of soil for 15 minutes with 25ml of water

### CARBON (Carbon)
Organic Carbon (% by wt) measured either by loss-on-ignition for soils estimated to contain more than about 20% organic carbon or by dichromate digestion.

### AL_ACID (Aluminium)
Total Aluminium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### AS_ACID (Arsenic)
Total Arsenic concentration (mg/kg) determined by Hydride Atomic Absorption Spectrometry (AAS), extracted into hydrochloric acid after digestion with nitric acid and ashing with magnesium nitrate

### BA_ACID (Barium)
Total Barium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### CA_ACID (Calcium)
Total Calcium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### CD_ACID (Cadmium)
Total Cadmium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### CD_EDTA (Cadmium Extractable)
Extractable Cadmium concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### CO_ACID (Cobalt)
Total Cobalt concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### CO_EDTA (Cobalt Extractable)
Extractable Cobalt concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### CR_ACID (Chromium)
Total Chromium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### CU_ACID (Copper)
Total Copper concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### CU_EDTA (Copper Extractable)
Extractable Copper concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### F_ACID (Flouride)
Flouride extracted with 1mol / l sulphuric acid and determined by Ion Selective Electrode (ISE)

### FE_ACID (Iron)
Total Iron concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### HG_ACID (Mercury)
Total Mercury concentration (mg/kg) determined by Hydride Atomic Absorption Spectrometry (AAS), digested in a nitric/sulphuric acid mixture

### K_ACID (Potassium)
Total Potassium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### K_NITRATE (Potassium Extractable)
Extractable Potassium concentration (mg/l) determined by shaking 10ml of air dry soil with 50ml of 1.0M ammonium nitrate for 30mins, filtering and then measuring the concentration by flame photometry

## ANALYSES DEFINITIONS continued

### MG_ACID (Magnesium)
Total Magnesium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### MG_NITRATE (Magnesium Extractable)
Extractable Magnesium concentration (mg/l) determined by shaking 10ml of air dry soil with 50ml of 1.0M ammonium nitrate for 30mins, filtering and then measuring the concentration by flame photometry

### MN_ACID (Manganese)
Total Manganese concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### MN_EDTA (Manganese Extractable)
Extractable Manganese concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### MO_ACID (Molybdenum)
Total Molybdenum concentration (mg/kg) determined by Atomic Adsorption Spectrometyr (AAS) in an aqua regia digest

### MO_EDTA (Molybdenum Extractable)
Extractable Molybdenum concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### NA_ACID (Sodium)
Total Sodium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### NI_ACID (Nickel)
Total Nickel concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### NI_EDTA (Nickel Extractable)
Extractable Nickel concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### P_ACID (Phosphorus)
Total Phosphorus concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### P_OLSON (Phosphorous Extractable)
Extractable Phosphorus concentration (mg/l) determined by shaking 5ml of air dry soil with 100ml of 0.5M sodium bicarbonate for 30mins at 20 deg.C, filtering and then measuring the absorbance at 880 nm colorimetrically with acid ammonium molybdate solution

### PB_ACID (Lead)
Total Lead concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### PB_EDTA (Lead Extractable)
Extractable Lead concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### SE_ACID (Selenium)
Total Selenium concentration (mg/kg) determined by Hydride Atomic Absorption Spectrometry (AAS), extracted into hydrochloric acid after digestion with nitric acid and ashing with magnesium nitrate

### SR_ACID (Strontium)
Total Strontium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### V_ACID (Vanadium)
Total Vanadium concentration (mg/kg) determined by Atomic Adsorption Spectrometyr (AAS) in an aqua regia digest

### ZN_ACID (Zinc)
Total Zinc concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### ZN_EDTA (Zinc Extractable)
Extractable Zinc concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

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To view the glossary visit: www.landis.org.uk/sitereporter/GLOSSARY.pdf

For a list of further reading visit: www.landis.org.uk/sitereporter/FURTHER_READING.pdf

For more information visit: www.landis.org.uk/reports

**GIS DATASETS:**
The GIS data used in the creation of this report is available to lease for use in projects.
To learn more about, or acquire the GIS datasets used in the creation of this report, please contact the National Soil Resources Institute:
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## Appendix A3 NSRI Soil Report – Section 5

# National Soil Resources Institute

Cranfield UNIVERSITY

## Soils Site Report

Full Soil Report

National Grid Reference: SH3160184581
Easting: 231601
Northing: 384581
Site Area: 5km x 5km

Prepared by
authorised user:
**Joanne Jeffreys**
Jacobs

2 March 2015

# Citations

Citations to this report should be made as follows:

National Soil Resources Institute (2015) Full Soils Site Report for location 231601E, 384581N, 5km x 5km, National Soil Resources Institute, Cranfield University. Accessed via https://www.landis.org.uk/sitereporter/.

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# About this report

This Soils Site Report identifies and describes the properties and capacities of the soil at your specified location as recorded in the 1:250,000 scale National Soil Map for England and Wales. It has been produced by Cranfield University's National Soil Resources Institute.

The National Soil Map represents the most accurate comprehensive source of information about the soil at the national coverage in England and Wales. It maps the distribution of soil mapping units (termed soil associations) which are defined in terms of the main soil types (or soil series) that were recorded for each soil association during field soil survey. Each soil association is named after its principal soil series and these bear the location name from where they were first described (e.g. Windsor). Each of these soil associations have differing environmental characteristics (physical, chemical and biological) and it is by mapping these properties that the range of thematic maps in this report have been produced.

Soil types and properties vary locally, as well as at the landscape scale. It is not possible to identify precisely the soil conditions at a specific location without first making a site visit. We have therefore provided you with information about the range of soil types we have identified at and around your selected location. Schematic diagrams are also provided to aid accurate identification of the soil series at your site.

Whilst an eight-figure national grid reference should be accurate to within 100m, a single rural Postcode can cover a relatively large geographical area. Postcodes can therefore be a less precise basis for specifying a location. The maps indicate the bounded area the reports relate to.

Your Soils Site Report will enable you to:

- identify the soils most likely to be present at and immediately around your specified location;
- understand the patterns of soil variation around your location and how these correlate with changes in landscape;
- identify the nature and properties of each soil type present within the area;
- understand the relevant capacities and limitations of each of the soils and how these might impact on a range of factors such as surface water quality.

Provided that this Soils Site Report is not modified in any way, you may reproduce it for a third-party.

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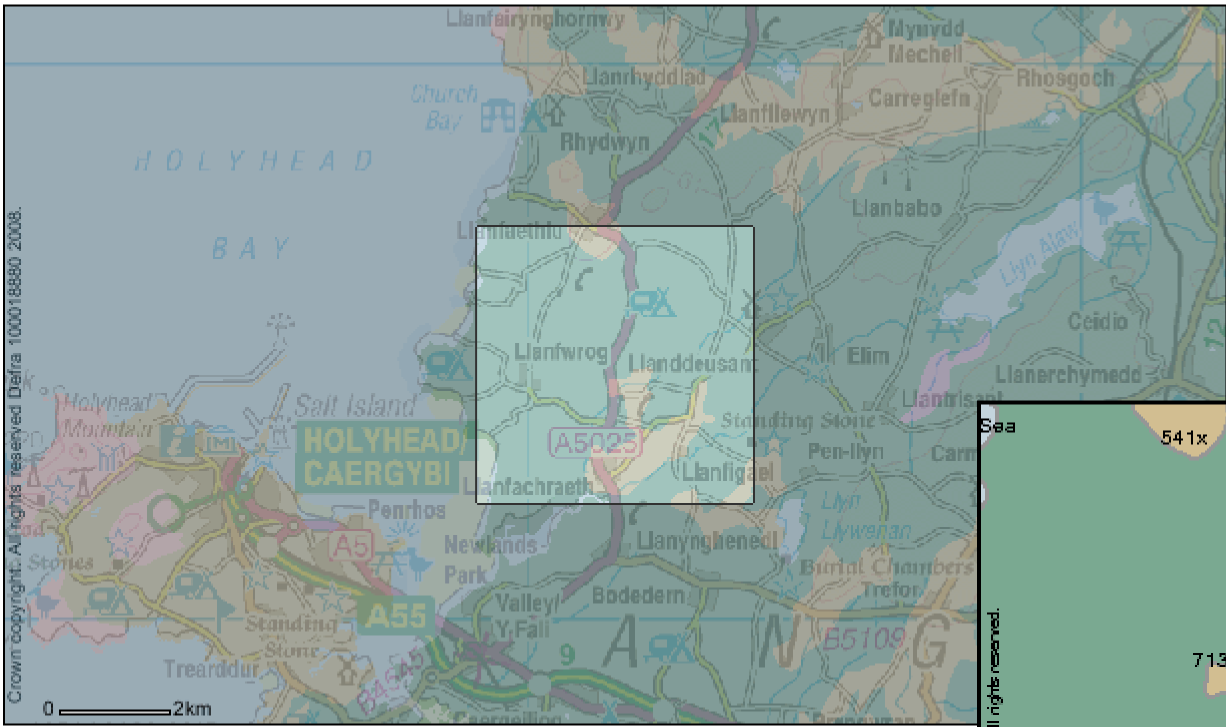
# Table of Contents

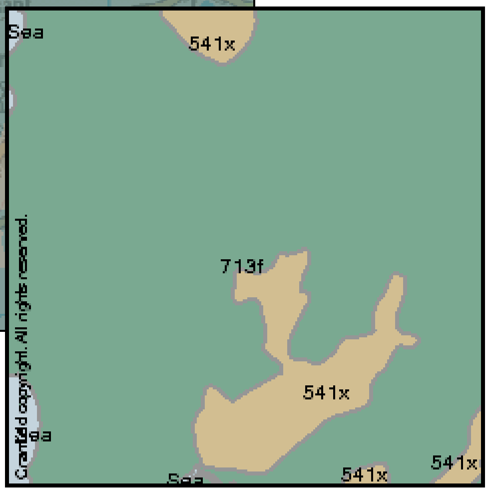
# 1. SOIL THEMATIC MAPS

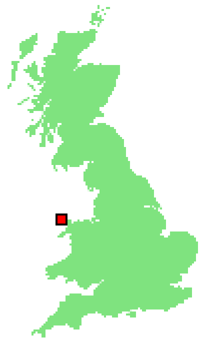
This section contains a series of maps of the area surrounding your selected location, based on the 1:250,000 scale National Soil Map, presenting a number of thematic maps relating to the characteristics of the soils. These provide an overview of the nature and condition of the local soil conditions. It is these conditions that may be used to infer the response of an area to certain events (with the soil as a receptor), such as pollution contamination from a chemical spill, or an inappropriate pesticide application and the likelihood of these materials passing though the soil to groundwater. Other assessments provide an insight into the way a location may impact, by corrosive attack or ground movement, upon structures or assets within the ground, for example building or engineering foundations or pipes and street furniture.

Soil is a dynamic environment with many intersecting processes, chemical, physical and biological at play. Even soils 'sealed' over by concrete and bitumen are not completely dormant. The way soils respond to events and actions can vary considerably according to the properties of the soil as well as other related factors such as land-use, vegetation, topography and climate. There are many threats facing our national soil resource today and forthcoming legislation such as the proposed Soil Framework Directive (SFD) (COM(2006) 232) will seek to identify measures aimed towards soil protection and ensuring the usage of soils in the most sustainable way. This report is therefore a useful snapshot of the soil properties for your given area, providing a summary of a broad range of ground conditions.

## 1a. SOILS - SPATIAL DISTRIBUTION



## SOIL ASSOCIATION MAP UNIT KEY

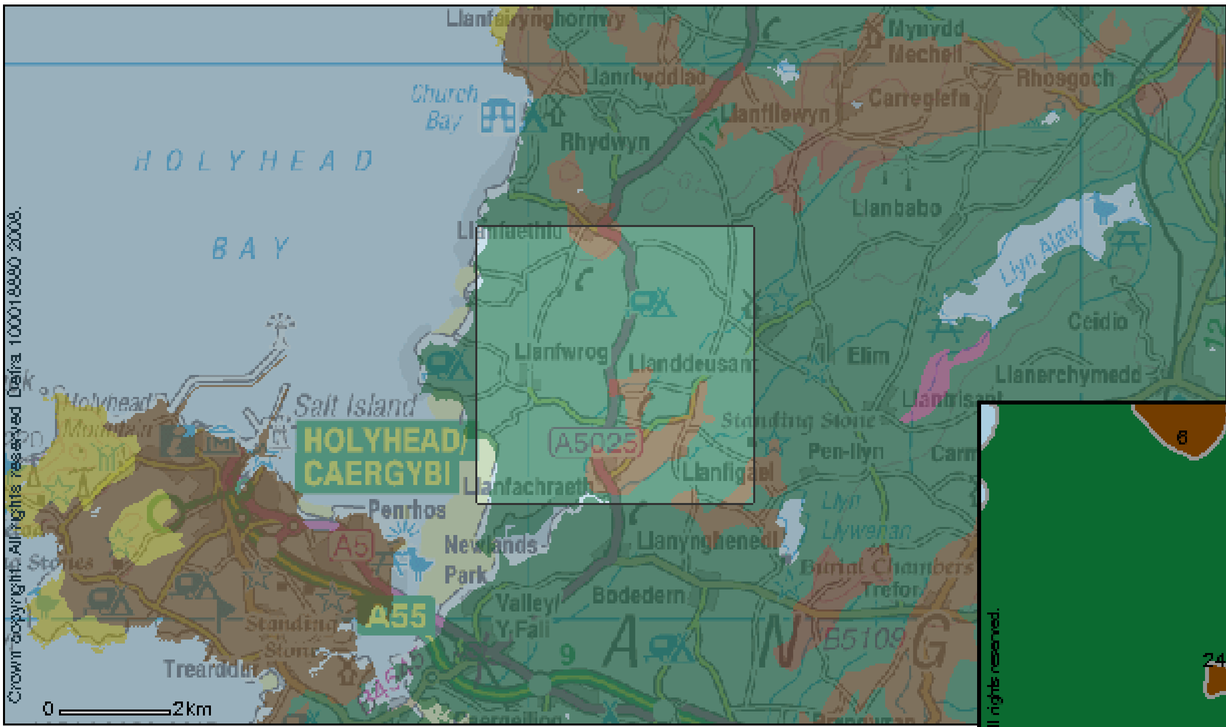
**EAST KESWICK 1** 541x
*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

**CEGIN** 713d
*Slowly permeable seasonally waterlogged fine silty and clayey soils.*

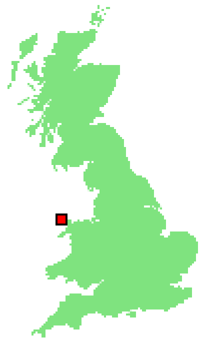
**BRICKFIELD 2** 713f
*Slowly permeable seasonally waterlogged fine loamy soils.*

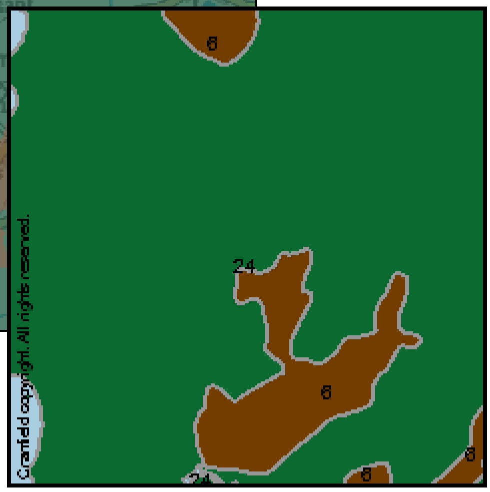
Soil associations represent a group of soil series (soil types) which are typically found occurring together, associated in the landscape (Avery, 1973; 1980; Clayden and Hollis, 1984). Soil associations may occur in many geographical locations around the country where the environmental conditions are comparable. For each of these soil associations, a collection of soil types (or soil series) are recorded together with their approximate proportions within the association. Soil associations have codes as well as textual names, thus code '554a' refers to the 'Frilford' association. Where a code is prefixed with 'U', the area is predominantly urbanised (e.g. 'U571v'). The soil associations for your location, as mapped above, are described in more detail in Section 2: Soil Association Descriptions.

## 1b. HYDROLOGY OF SOIL TYPE (HOST)











### HYDROLOGY OF SOIL TYPE KEY

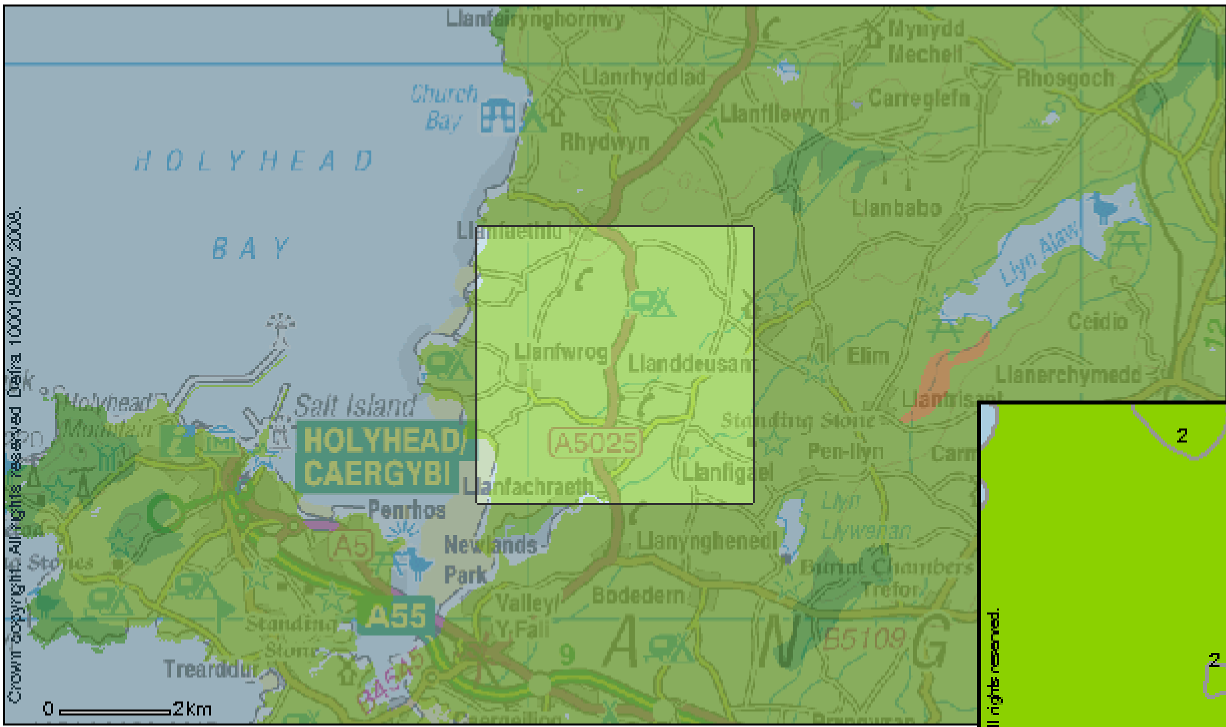
24 - *Slowly permeable, seasonally waterlogged soils over slowly permeable substrates with negligible storage capacity*

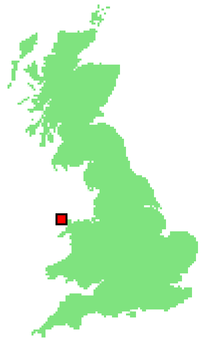
6 - *Free draining permeable soils in unconsolidated loams or clays with low permeability and storage capacity*

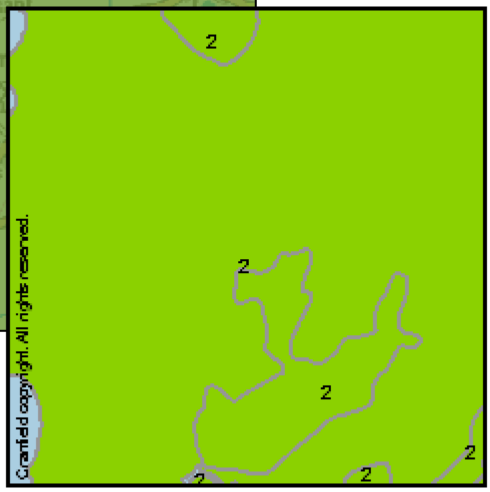
HOST CLASS DESCRIPTION

The Hydrology of Soil Types (HOST) classification describes the dominant pathways of water movement through the soil and, where appropriate, the underlying substrate. Eleven drainage models are defined according to the permeability of the soil and its substrate and the depth to a groundwater table, where one is present (Boorman et al,1995). These are further subdivided into 29 HOST classes to which all soil series have been assigned. These classes identify the way soil water flows are partitioned, with water passing over, laterally through, or vertically down the soil column. Analysis of the river hydrograph and the extent of soil series for several hundred gauged catchments allowed mean values for catchment hydrological variables to be identified for each HOST class, The HOST classification is widely used to predict river flows and the frequency and severity of flood events and also to model the behaviour of diffuse pollutants (Hollis et al, 1995).

# 1c. GROUND MOVEMENT POTENTIAL






## GROUND MOVEMENT POTENTIAL KEY

- 1 - *Very low*
- 2 - *Low*
- 3 - *Moderate*
- 4 - *High*
- 5 - *Very high*

* If a High class is starred, a 'Very High' ground movement potential is likely to be achieved if these soils are drained to an effective depth of at least two metres.

### GROUND MOVEMENT POTENTIAL DESCRIPTION

Clay-related ground movement is the most widespread cause of foundation failure in the UK and is linked to seasonal swelling and shrinkage of the clay. The content of clay within the soils of your selected area has therefore a direct bearing upon the likelihood of ground movement.

Among the inorganic particles that constitute the solid component of any soil, clay particles are the smallest and defined as being <0.002 mm - equivalent spherical diameter (esd) in size. Clay particles occur in most kinds of soil but they only begin to exert a predominant influence on the behaviour of the whole soil where there is more than 35 per cent (by weight) of clay-sized material present.

Because clay particles are very small and commonly platy in shape they have an immense surface area onto which water can be attracted, relative to the total volume of the soil material. In addition to surface attraction or inter-crystalline absorption of water, some clay minerals, those with three layers of atoms (most other kinds of clay have only two layers of atoms) are able to absorb and hold additional water between these layers. It is these types of clay mineral, which are widespread in British soils and commonly known as *smectites* that have the greatest capacity to shrink and swell.

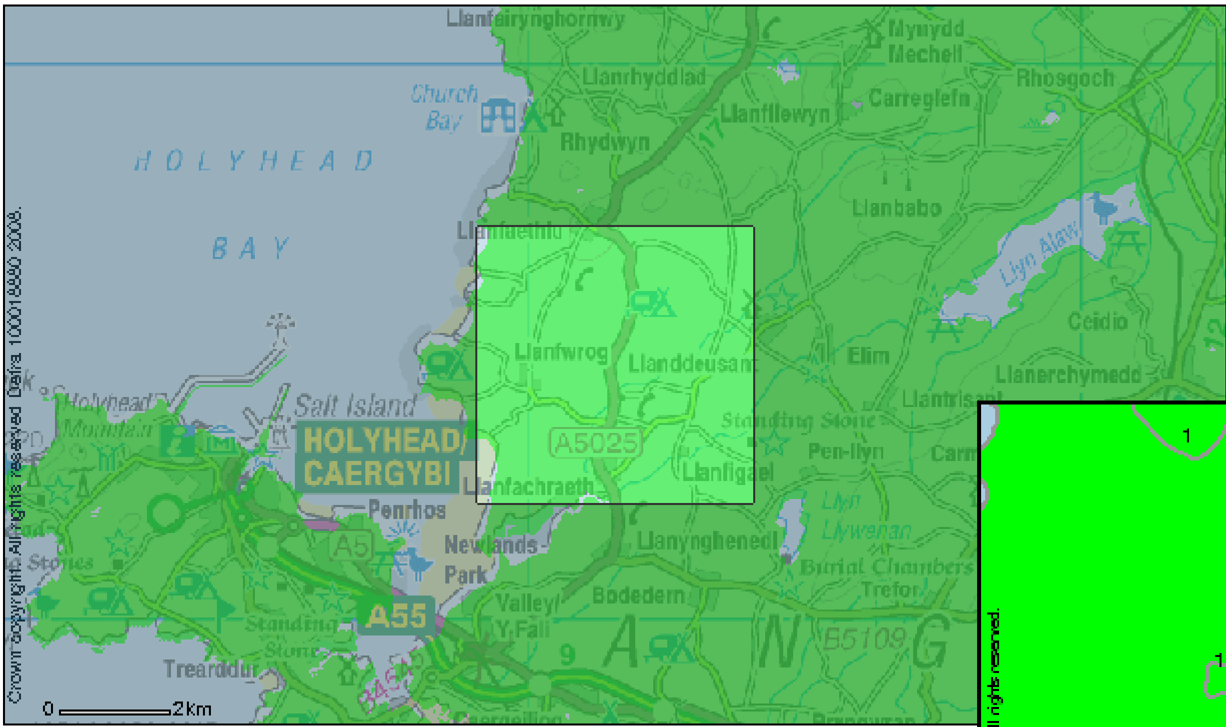
In a natural undisturbed condition, the moisture content of deep subsoil clay does not change greatly through the year and consequently there are no changes in volume leading to shrinkage and swelling. However, when clays are exposed at or near the ground surface and especially when vegetation is rooting in them seasonal moisture and volume changes can be dramatic. Plants and trees transpire moisture from the soil to support their growth and transfer necessary nutrients into their structures. Surface evaporation

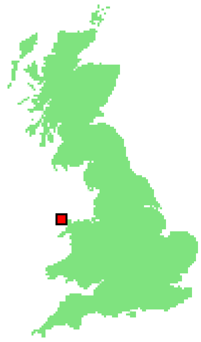
also takes place from soil and plant structures, and the combination of evaporation from surfaces and transpiration by plants and trees is termed *evapotranspiration*. Thus, the layer of soil material down to 2m depth into which plants will root is critical when assessing the vulnerability of land to subsidence.

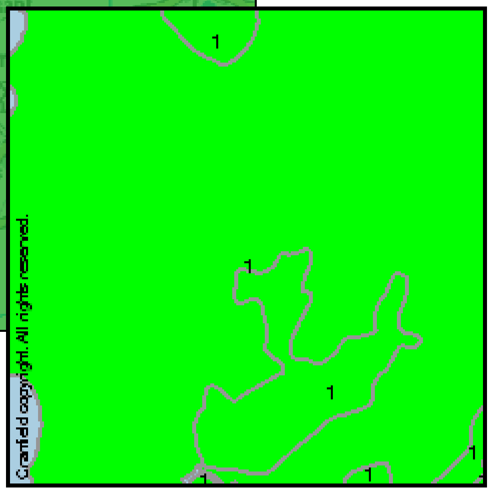
Whenever soil moisture is continuously being replenished by rainfall, the soil moisture reserves will be unaffected by the removal of moisture by plants as there is no net loss. However, in many parts of Britain, particularly in the south and east, summer rainfall is small and is exceeded by evapotranspiration. Water reserves are then not sufficiently replenished by rainfall and so a soil moisture deficit develops. The water removed from a clayey soil by evapotranspiration leads to a reduction in soil volume and the consequent shrinkage causes stress in the soil materials leading in turn to stress on building foundations that are resting in the soil (Hallett, et al, 1994).

The foundations themselves may then move and thus cause damage to building structures. This problem can be exacerbated by the fact that the soil beneath the structure may not dry out uniformly, so that any lateral pressure exerted on the building foundation is made effectively greater. This assessment identifies the likelihood of soil conditions being prone to ground movement given these other factors.

# 1d. FLOOD VULNERABILITY






## FLOOD VULNERABILITY CLASS KEY

0 - *Major risk*

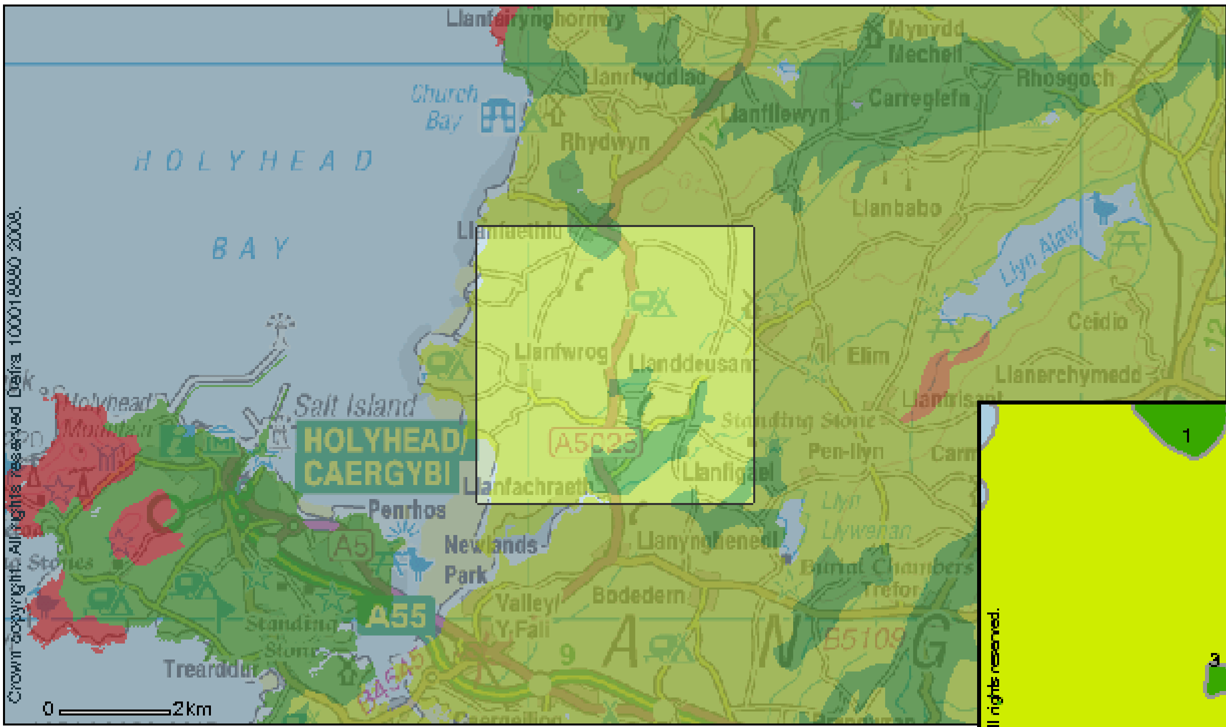
1 - *Minor risk*

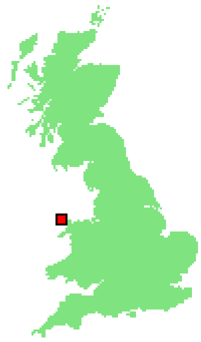
FLOOD VULNERABILITY DESCRIPTION

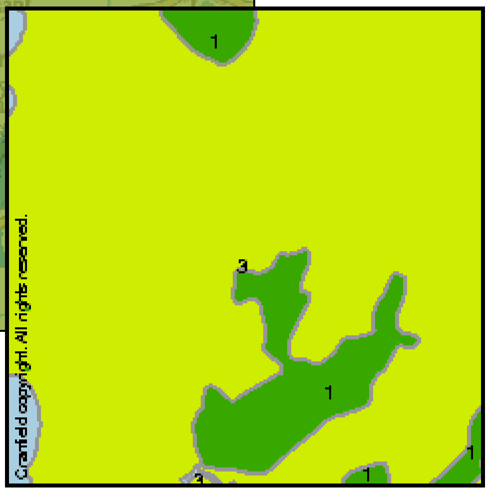
The inundation of properties by flood water can occur in a number of circumstances. Surface run-off can collect on low-lying land from upslope following heavy rainfall. More commonly rivers, lakes and/or the sea extend beyond their normal limits as a result of prolonged or intense rainfall, unusually high tides and/or extreme wind events. Water damage to properties and their contents is compounded by the deposition of sediment suspended in the flood waters. The spatial distribution of such waterborne sediment (or alluvium as defined in soil science) is one basis upon which land that has been subject to historical flooding can be mapped, and this forms a basis for present-day flooding risk assessment.

Both riverine and marine alluvium are identified as distinct soil parent materials within the British soil classifications. Combining soil map units that are dominated by soil series developed in alluvium across Great Britain identifies most of the land that is vulnerable to flooding. This assessment does not account for man-made flood defence measures, showing instead the areas where once water has stood.

# 1e. RISK OF CORROSION TO FERROUS IRON






## RISK OF CORROSION TO FERROUS IRON KEY

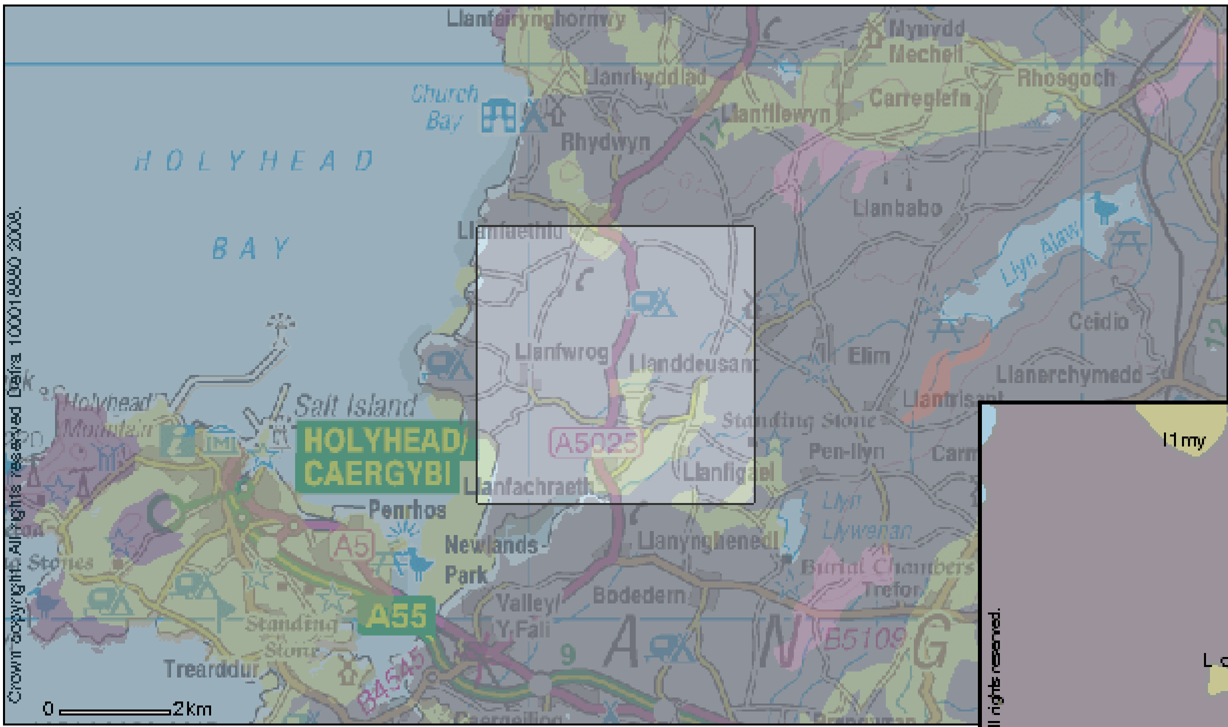
- 1 - *Non-aggressive*
- 2 - *Slightly Aggressive*
- 3 - *Moderately Aggressive*
- 4 - *Highly Aggressive*
- 5 - *Very highly Aggressive*
- 6 - *Impermeable Rock*

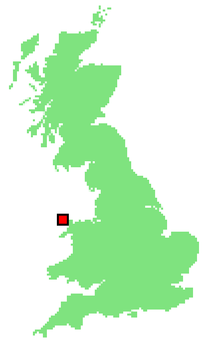
* If a class is starred, it is assumed that there are moderate amounts of sulphate in the soil. If there is abundant sulphate present, the soil may be one class more aggressive. Conversely, if there is very little sulphate, the soil may be one class less aggressive to buried ferrous iron.

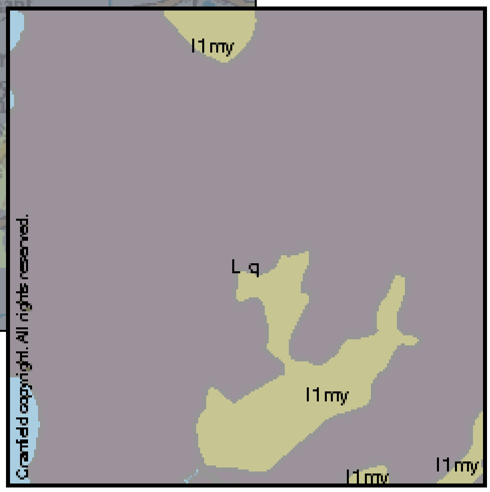
RISK OF CORROSION TO FERROUS IRON DESCRIPTION

Buried iron pipes and other infrastructure corrode at rates that are influenced by soil conditions (Jarvis and Hedges, 1994). Soil acidity, sulphide content, aeration and wetness all influence the corrosivity of the soil. These factors are used to map 5 major classes of relative corrosivity.

## 1f. PESTICIDE LEACHING RISK






### PESTICIDE LEACHING CLASS KEY

l1my - *Deep loamy soil; groundwater at moderate depth*

L q - *Impermeable soils over soft substrates of low or negligible storage capacity that sometimes conceal groundwater bearing rocks at depth*

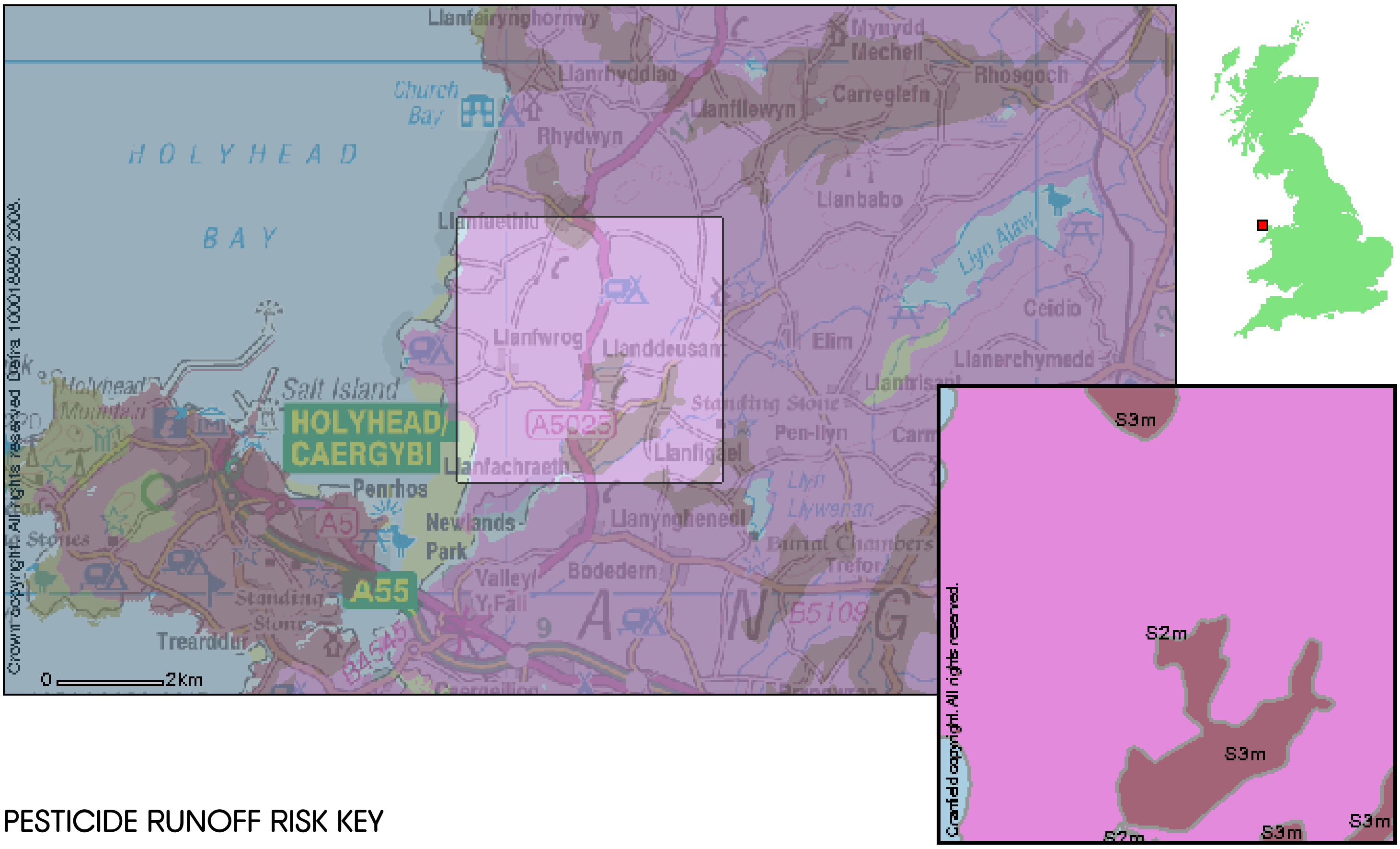
PESTICIDE LEACHING CLASS DESCRIPTION

The natural permeability and water regime of soils are influential in determining the fate and behaviour of pesticides applied to the crop and soil surface (Hollis et al, 1995). A system of vulnerability assessment was devised as part of the national system for Policy and Practice for the Protection of Groundwater. This divided soils into three primary vulnerability classes.

H - Soils of high leaching capacity with little ability to attenuate non-adsorbed pesticide leaching which leave underlying groundwater vulnerable to pesticide contamination.
I – Soils of intermediate leaching capacity with a moderate ability to attenuate pesticide leaching.
L - Soils of low leaching capacity through which pesticides are unlikely to leach.

The primary classes have been further subdivided into nearly forty subclasses. These subclasses, with their descriptions, are mapped above. These classes do not account for differences in land cultivation, which can also have a significant impact on pesticide behaviour.

## 1g. PESTICIDE RUNOFF RISK



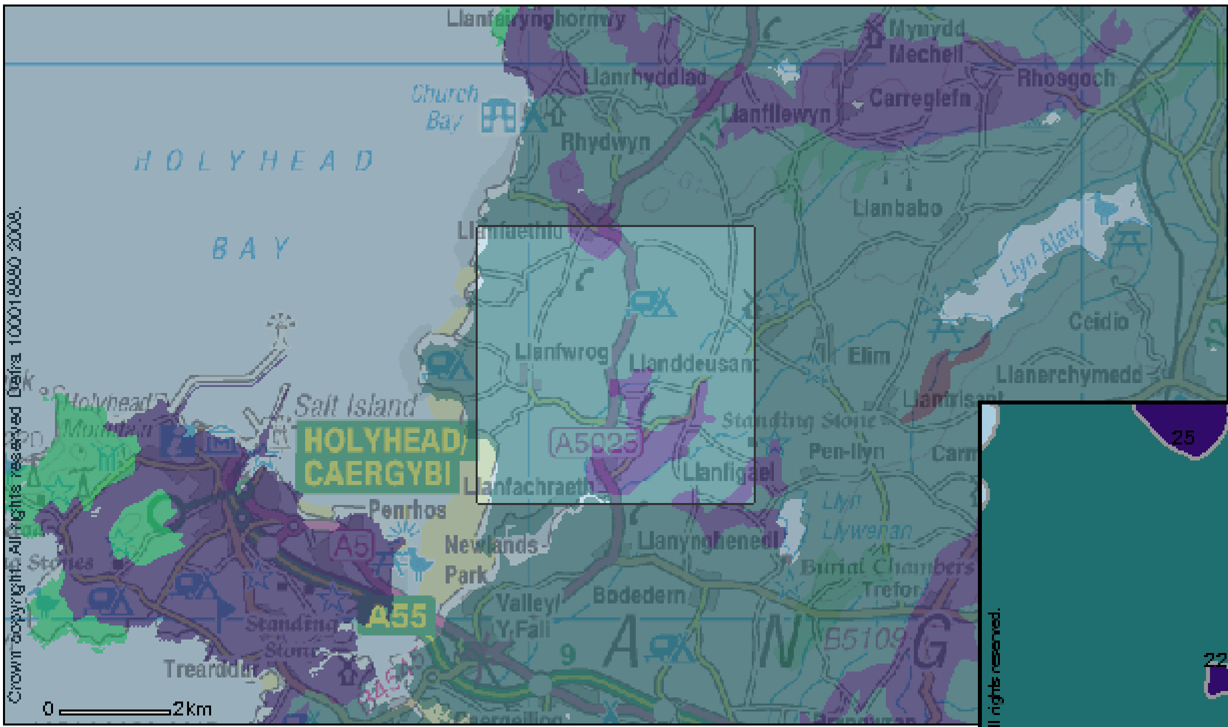

## PESTICIDE RUNOFF RISK KEY

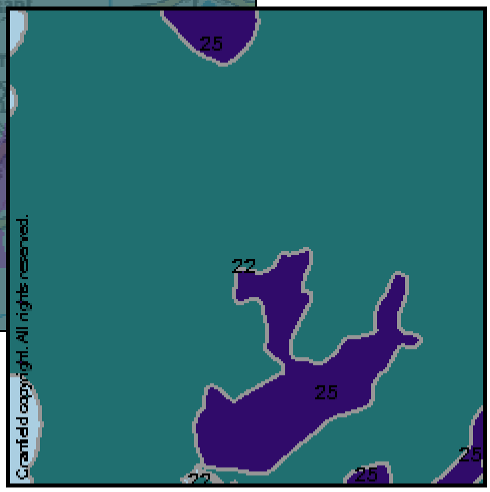
- **S2m** - *Soils with high run-off potential but moderate adsorption potential*
- **S3m** - *Soils with moderate run-off potential and moderate adsorption potential*

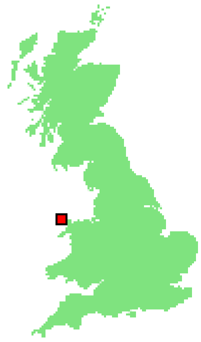
### PESTICIDE RUNOFF RISK DESCRIPTION

The physical properties and natural water regime of soils influence the speed and extent of lateral water movement over and through the soil at different depths (Hollis et al, 1995). At as result, soils can be classed according to the potential for pesticide run-off. Five runoff potential classes are identified for mineral soils and a further two for peat soils. The mineral soil classes are further subdivided according to the potential for pesticide adsorption.

## 1h. HYDROGEOLOGICAL ROCK TYPE





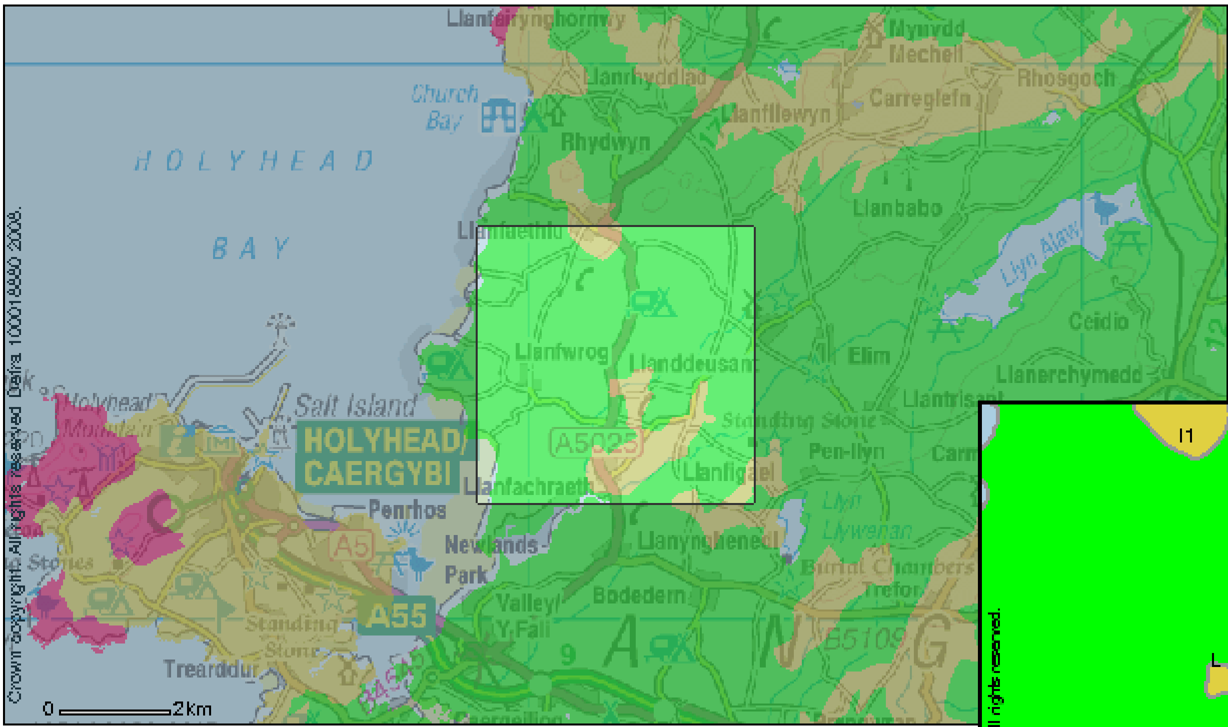
## HYDROGEOLOGICAL ROCK TYPE KEY

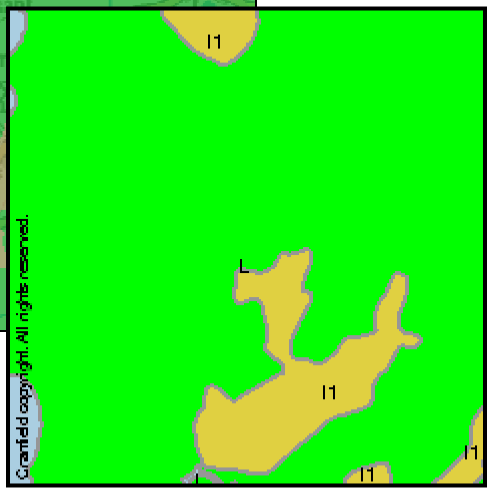
- 22 - *till and compact Head*
- 25 - *loamy drift*

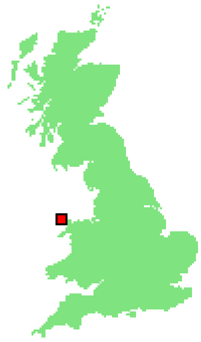
HYDROGEOLOGICAL ROCK TYPE DESCRIPTION

The hydrogeological classification of the soil parent materials provides a framework for distinguishing between soil substrates according to their general permeability and whether they are likely to overlie an aquifer. Every soil series has been assigned one of the 32 substrate classes and each of these is characterised according to its permeability (being characterised as permeable, slowly permeable or impermeable). For further information, see Boorman et al (1995).

## 1i. GROUND WATER PROTECTION POLICY (GWPP) LEACHING



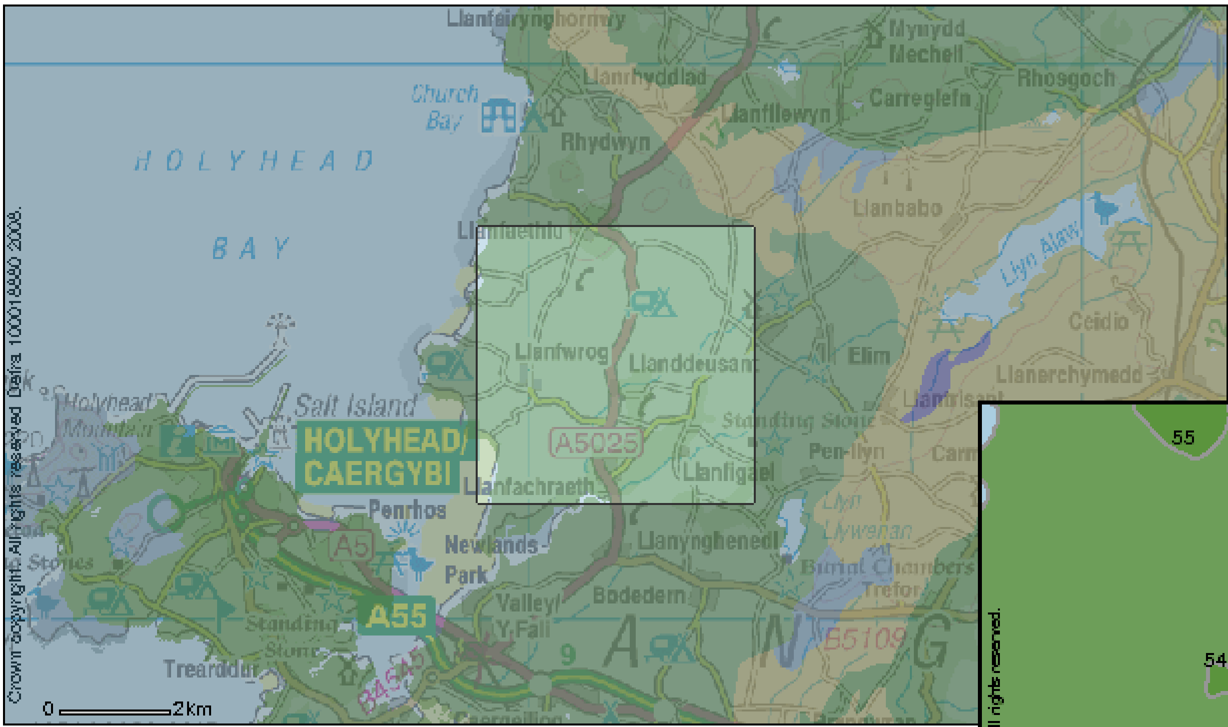
## GWPP LEACHING CLASS KEY

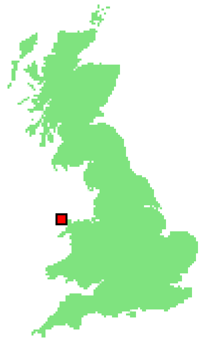
- I1 - *Soils of intermediate leaching potential which have a moderate ability to attenuate a wide range of diffuse source pollutants but in which it is possible that some non-adsorbed diffuse source pollutants and liquid discharges could penetrate the soil layer*
- L - *Soils in which pollutants are unlikely to penetrate the soil layer either because water movement is largely horizontal or because they have a large ability to attenuate diffuse source pollutants*

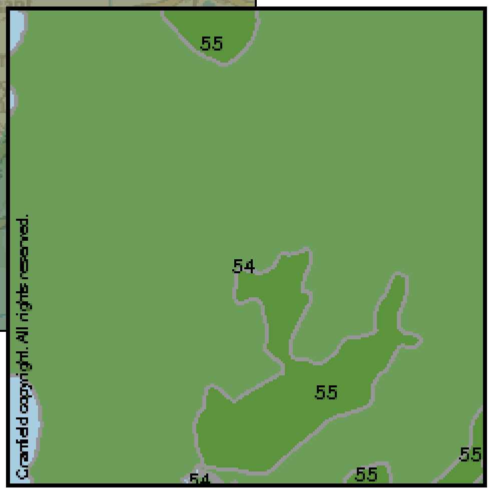
### GWPP LEACHING CLASS DESCRIPTION

The Ground Water Protection Policy classes describe the leaching potential of pollutants through the soil (Hollis, 1991; Palmer et al, 1995). The likelihood of pollutants reaching ground water is described. Different classes of pollutants are described, including liquid discharges adsorbed and non-adsorbed pollutants.

## 1j. SOIL PARENT MATERIAL





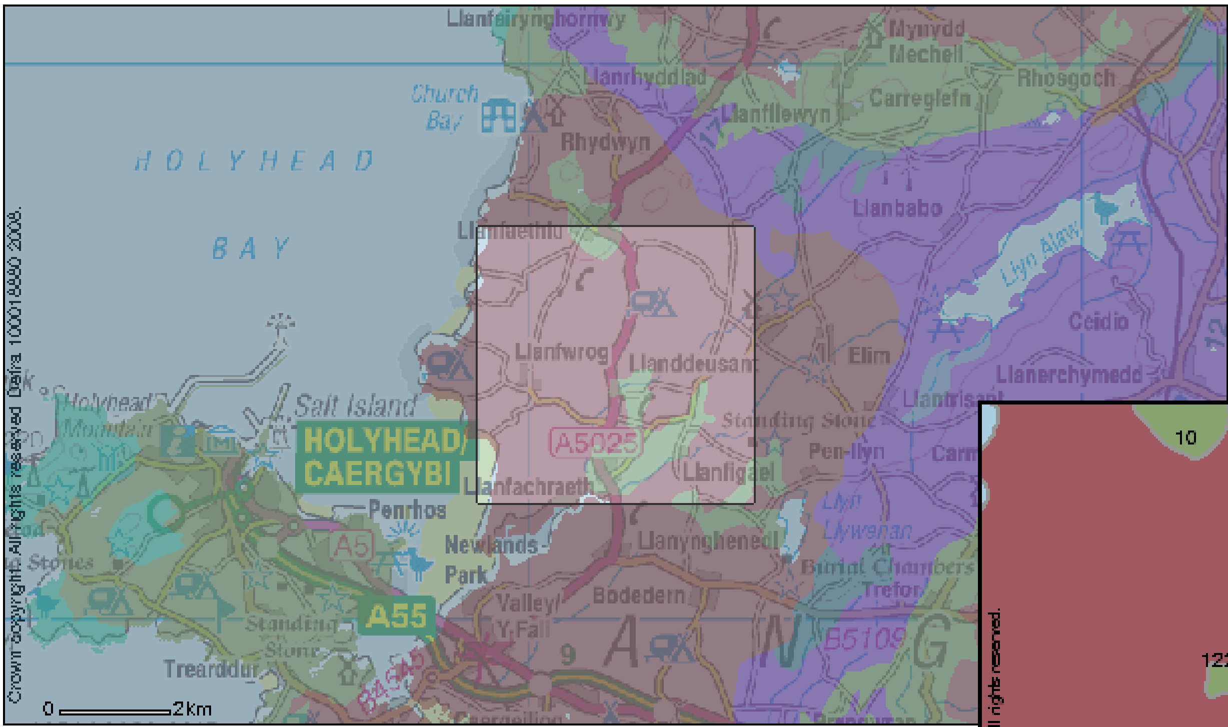

## SOIL PARENT MATERIAL KEY

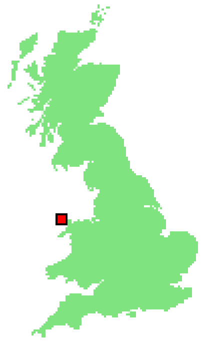
- 54 - *Drift from Palaeozoic and Mesozoic sandstone and shale*
- 55 - *Drift from Palaeozoic sandstone and shale*
- 59 - *Drift from Palaeozoic slaty mudstone and siltstone*

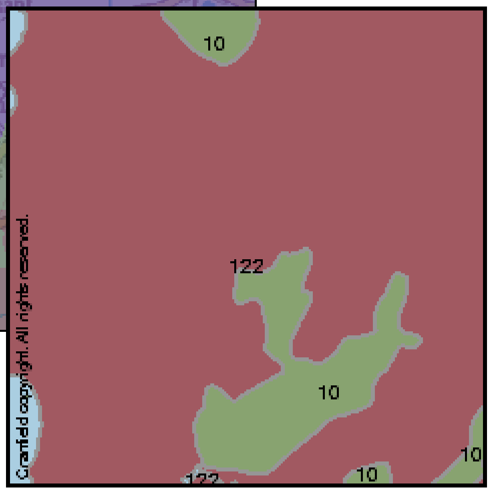
SOIL PARENT MATERIAL DESCRIPTION

Along with the effects of climate, relief, organisms and time, the underlying geology or 'parent material' has a very strong influence on the development of the soils of England and Wales. Through weathering, rocks contribute inorganic mineral grains to the soils and thus exhibit control on the soil texture. During the course of the creation of the national soil map, soil surveyors noted the parent material underlying each soil in England and Wales. It is these general descriptions of the regional geology which is provided in this map.

# 1k. EXPECTED CROPS AND LAND USE





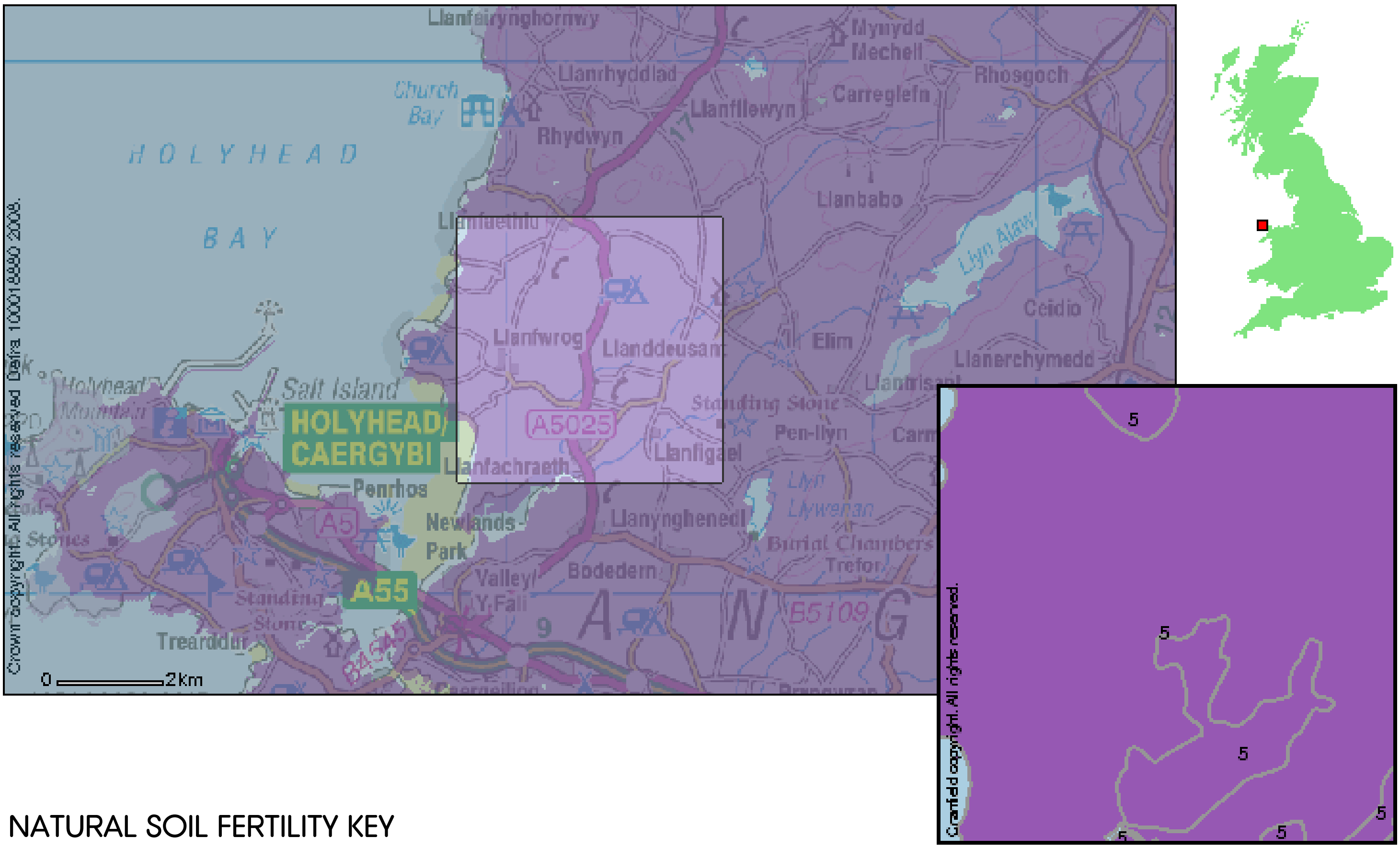

## EXPECTED CROPS AND LAND USE KEY

- 10 - *Cereals and grassland in the Northern Region; stock rearing on permanent grassland in Wales.*
- 122 - *Dairying and stock rearing on permanent or short term grassland; some cereals in drier areas.*
- 212 - *Stock rearing on permanent grassland dairying on lower ground.*

EXPECTED CROPS AND LAND USE DESCRIPTION

Individual soils are commonly associated with particular forms of land cover and land use. Whilst the soil surveyors were mapping the whole of England and Wales, they took careful note of the range of use to which the land was being put. This map shows the most common forms of land use found on each soil unit.

# 11. NATURAL SOIL FERTILITY



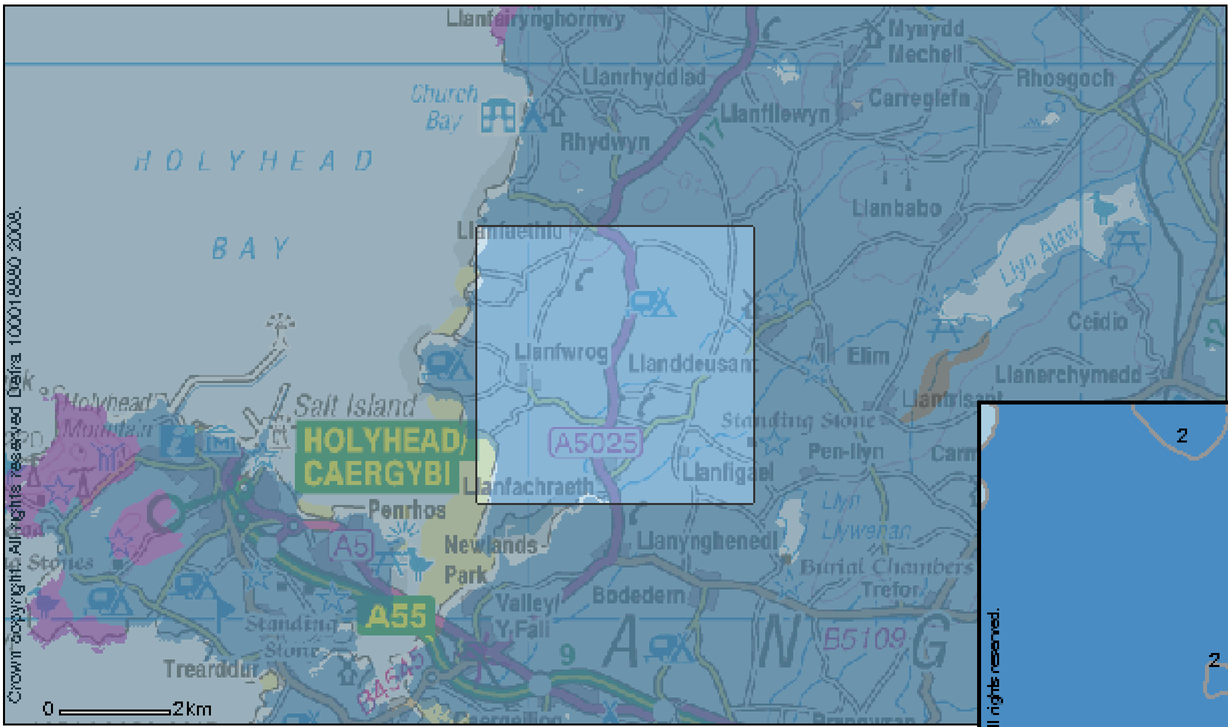

## NATURAL SOIL FERTILITY KEY

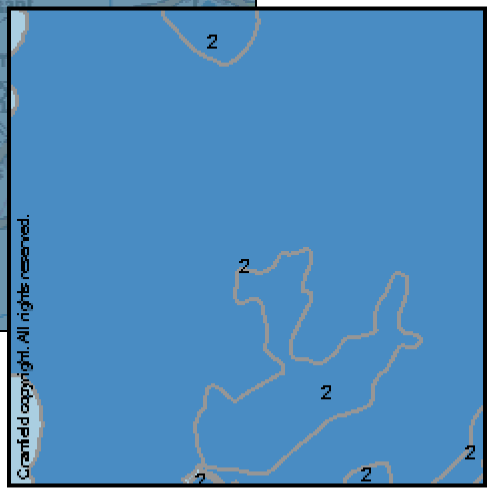
5 - *Low*

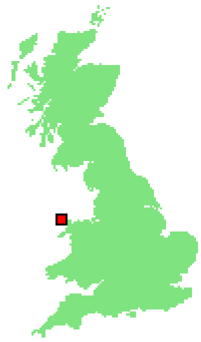
NATURAL SOIL FERTILITY DESCRIPTION

Soil fertility can be greatly altered by land management especially through the application of manures, lime and mineral fertilisers. What is shown in this map, however, is the likely natural fertility of each soil type. Soils that are very acid have low numbers of soil-living organisms and support heathland and acid woodland habitats. These are shown as of very low natural fertility. Soils identified as of low natural fertility are usually acid in reaction and are associated with a wide range of habitat types. The moderate class contains neutral to slightly acid soils, again with a wide range of potential habitats. Soil of high natural fertility are both naturally productive and able to support the base-rich pastures and woodlands that are now rarely encountered. Lime-rich soils contain chalk and limestone in excess, and are associated with downland, herb-rich pastures and chalk and limestone woodlands.

## 1m. SIMPLE TOPSOIL TEXTURE



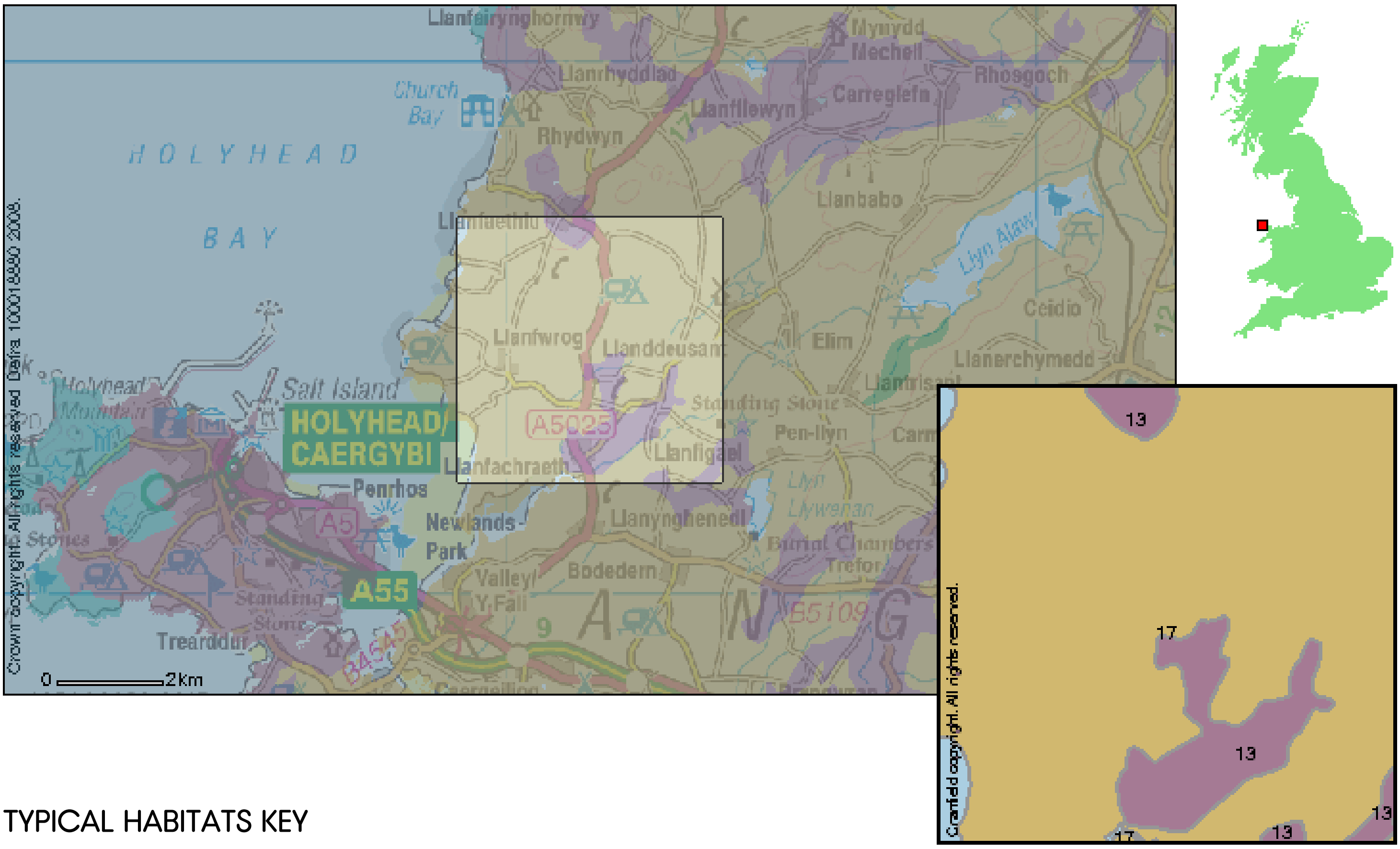
## SIMPLE TOPSOIL TEXTURE KEY

- 1 - *Clayey*
- 2 - *Loamy*
- 3 - *Peaty*
- 4 - *Sandy*

SIMPLE TOPSOIL TEXTURE DESCRIPTION

Soil texture is a term used in soil science to describe the physical composition of the soil in terms of the size of mineral particles in the soil. Specifically, we are concerned with the relative proportions of sand, silt and clay. Soil texture can vary between each soil layer or horizon as one moves down the profile. This map indicates the soil texture group of the upper 30 cm of the soil. 'Light' soils have more sand grains and are described as sandy, while 'heavy' soils have few sand grains but a lot of extremely small particles and are described as clayey. Loamy soils have a mix of sand, silt and clay-sized particles and are intermediate in character. Soils with a surface layer that is dominantly organic are described as Peaty. A good understanding of soil texture can enable better land management.

## 1n. TYPICAL HABITATS




## TYPICAL HABITATS KEY

- 13 - *Neutral and acid pastures and deciduous woodlands; acid communities such as bracken and gorse in the uplands*
- 17 - *Seasonally wet pastures and woodlands*

TYPICAL HABITATS DESCRIPTION

There is a close relationship between vegetation and the underlying soil. Information about the types of broad habitat associated with each soil type is provided in this map. Soil fertility, pH, drainage and texture are important factors in determining the types of habitats which can be established. Elevation above sea level and sometimes even the aspect - the orientation of a hillslope - can affect the species present. This map does not take into account the recent land management or any urban development, but provides the likely natural habitats assuming good management has been carried out.

## 2. SOIL ASSOCIATION DESCRIPTIONS

The following pages describe the following soil map units, (soil associations), in more detail.

**EAST KESWICK 1** 541x

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

**CEGIN** 713d

*Slowly permeable seasonally waterlogged fine silty and clayey soils.*

**BRICKFIELD 2** 713f

*Slowly permeable seasonally waterlogged fine loamy soils.*

The soil associations are described in terms of their texture and drainage properties and potential risks may be identified. The distribution of the soils across England and Wales are provided. Further to this, properties of each association's component soil series are described in relation to each other. Lastly, schematic diagrams of each component series are provided for greater understanding and in-field verification purposes.

# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

**a. General Description**

Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging. Some coarse loamy soils affected by groundwater.
The major landuse on this association is defined as cereals and grassland in the northern region; stock rearing on permanent grassland in wales.

**b. Distribution (England & Wales)**

The EAST KESWICK 1 association covers 804km² of England and Wales which accounts for 0.53% of the landmass. The distribution of this association is shown in Figure 1. Note that the yellow shading represents a buffer to highlight the location of very small areas of the association.

**c. Comprising Soil Series**

Multiple soil series comprise a soil association. The soil series of the EAST KESWICK 1 association are outlined in Table 1 below. In some cases other minor soil series are present at a particular site, and these have been grouped together under the heading 'OTHER'. We have endevoured to present the likelihood of a minor, unnamed soil series occuring in your site in Table 1.

Schematic diagrams of the vertical soil profile of the major constituent soil series are provided in Section D to allow easier identification of the particular soil series at your site.

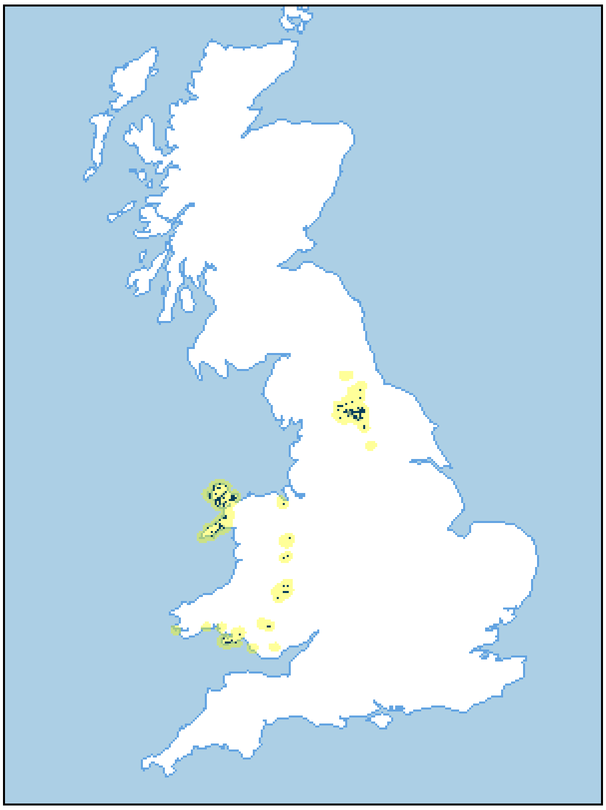


Figure 1. Association Distribution

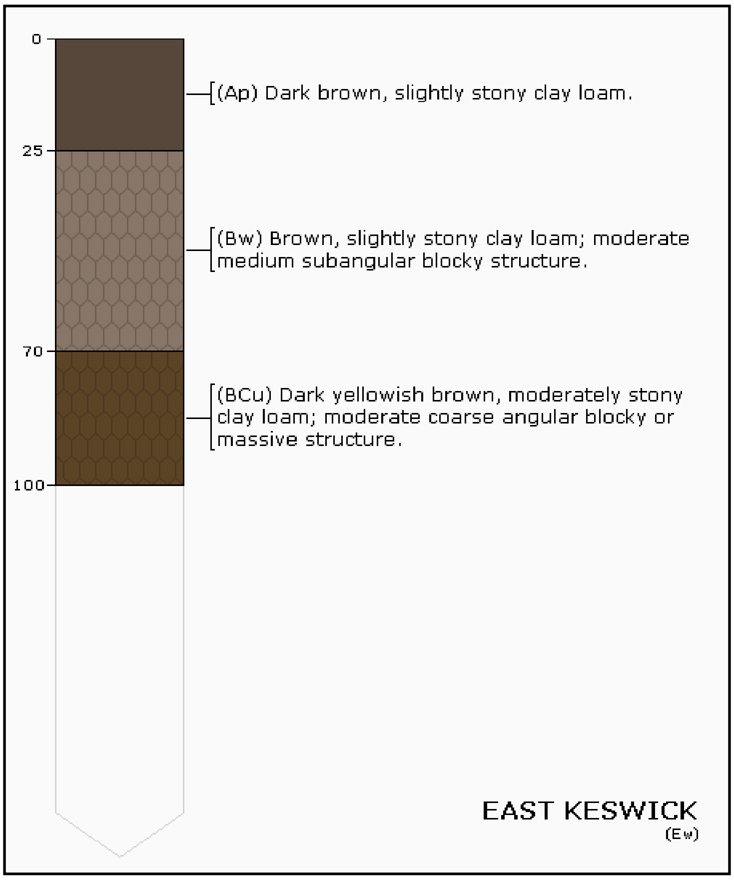
| Soil Series | Description | Area % |
|---|---|---|
| EAST KESWICK (Ew) | medium loamy drift with siliceous stones | 45% |
| NERCWYS (Nc) | medium loamy drift with siliceous stones | 30% |
| ARROW (aO) | light loamy drift with siliceous stones | 10% |
| OTHER | other minor soils | 15% |

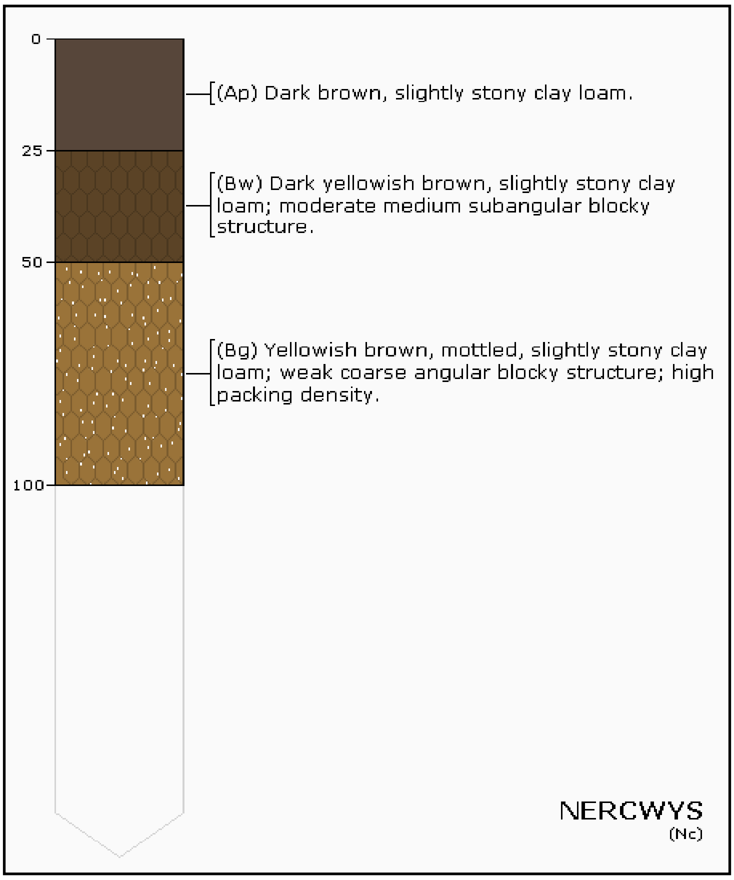
Table 1. The component soil series of the EAST KESWICK 1 soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

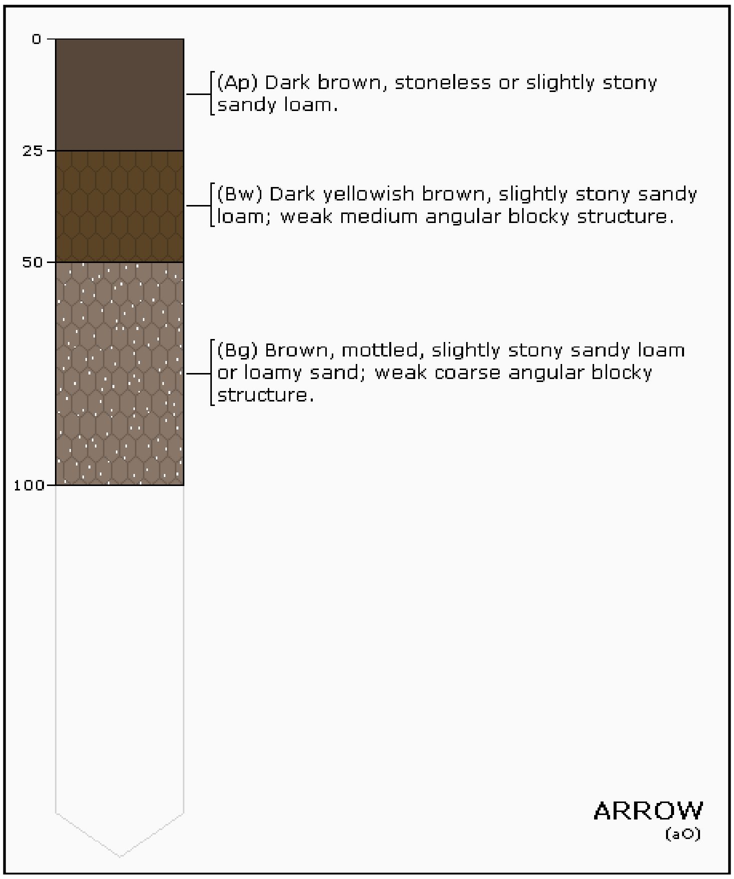
# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

## d. EAST KESWICK 1 Component Series Profiles



## EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

### e. Soil Properties

This section provides graphical summaries of selected attribute data available for the component series in this association. The blue bars of the graphs presented in this section describe the range of property values for all soils across England and Wales. Superimposed on these graphs are the values for the component soil series in this association. This has been done to provide the reader with an understanding of where each property for each series sits within the national context.

| Soil Series | Description | Area % |
|---|---|---|
| EAST KESWICK (Ew) | medium loamy drift with siliceous stones | 45% |
| NERCWYS (Nc) | medium loamy drift with siliceous stones | 30% |
| ARROW (aO) | light loamy drift with siliceous stones | 10% |
| OTHER | other minor soils | 15% |

Table 1. The component soil series of the EAST KESWICK 1 soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

### e(i). Soil Depth Information and Depths to Important Layers

*Depth to rock* A mean depth to bedrock or very stony rubble which has been assigned to each soil series based on observed and recorded soil profiles.

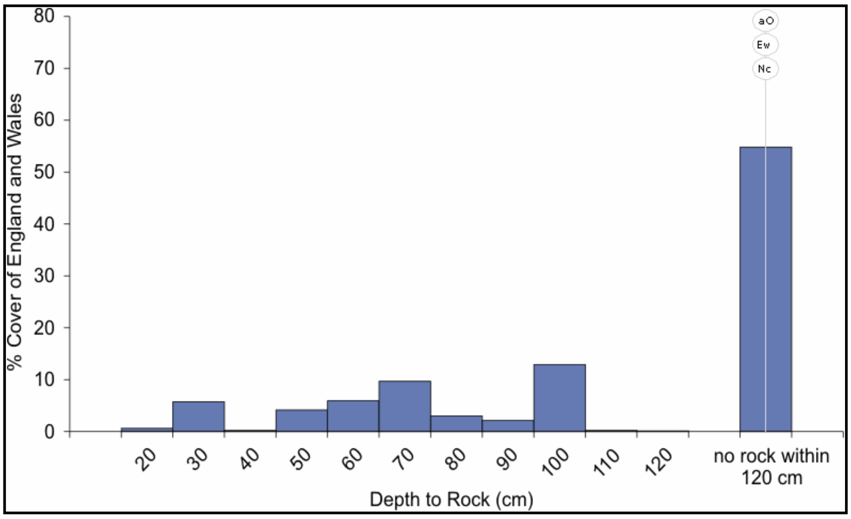



Figure 2. Depth of soil to Rock

*Depth to gleying*, the presence of grey and ochreous mottles within the soil, is caused by intermittent waterlogging. A mean depth to gleying has been assigned to each soil series based on observed and recorded soil profiles. The definition of a gleyed layer is designed to equate with saturation for at least 30 days in each year or the presence of artificial drainage.

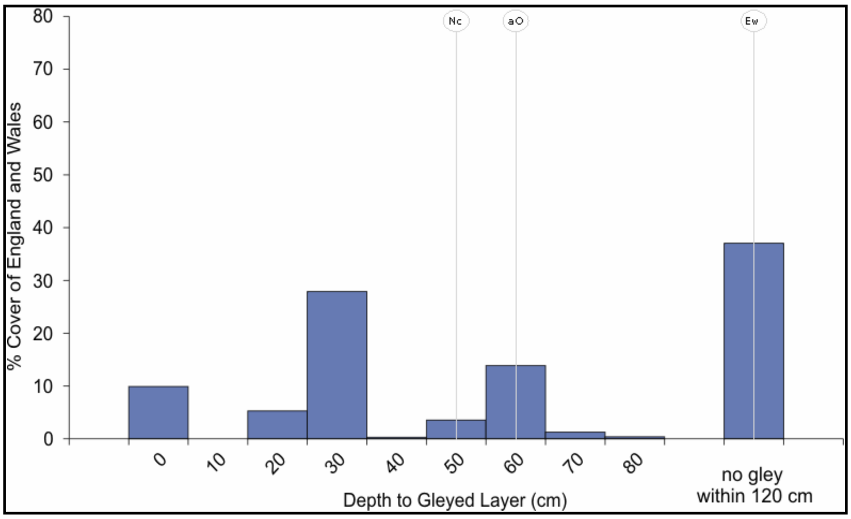



Figure 3. Depth of Soil to Gleying

## EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

### e(i). Soil Depth Information and Depths to Important Layers continued

*Depth to slowly permeable layer (downward percolation)* A mean depth to a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede downward percolation of excess soil water. This causes periodic saturation in the overlying soil, reduced storage capacity and therefore increased hydrological response to rainfall events.

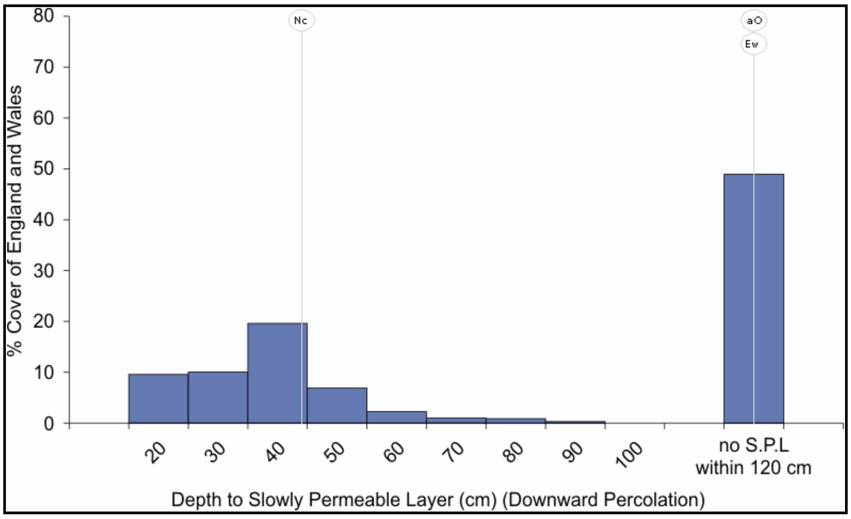



Figure 4. Depth to slowly permeable layer (downward percolation)

*Depth to Slowly Permeable Layer (upward diffusion)* A mean depth to the bottom of a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede upward diffusion of water and gasses.

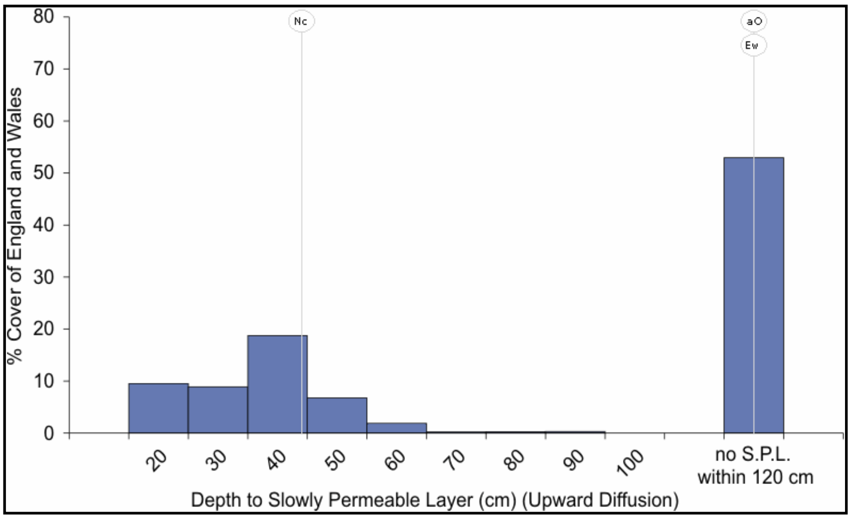



Figure 5. Depth to Slowly Permeable Layer (upward diffusion)

# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

## e(ii). Soil Hydrological Information

*Integrated air capacity (IAC)* is the total coarse pore space (>60 $\mu$m diameter) to 1 m depth. This size of pore would normally be air-filled when the soil is fully moist but not waterlogged. A large IAC means that the soil is well aerated. This will encourage root development and, provided near surface soil structure is well developed, will allow rainfall to percolate into the ground thus mitigating against localised flooding.

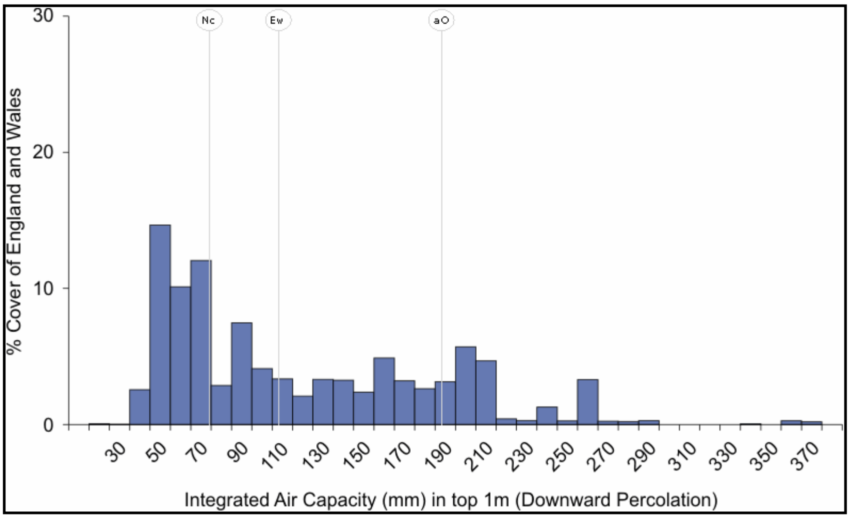



Figure 6. Integrated Air Capacity

*Standard Percentage Runoff (SPR)* is the percentage of rainfall that causes the short-term increase in flow seen at a catchment outlet following a storm event. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

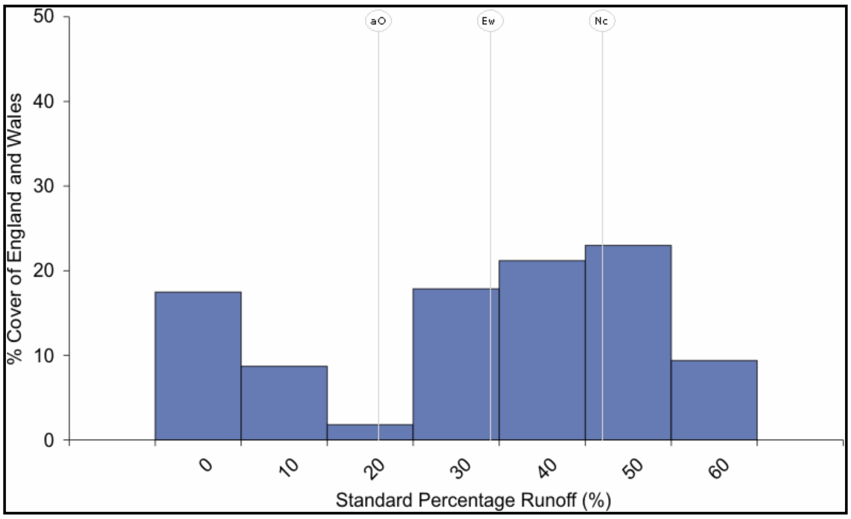



Figure 7. Standard Percentage Runoff

*Base flow index* is calculated from daily river flow data and expresses the volume of base flow of a river as a fraction of the total flow volume. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

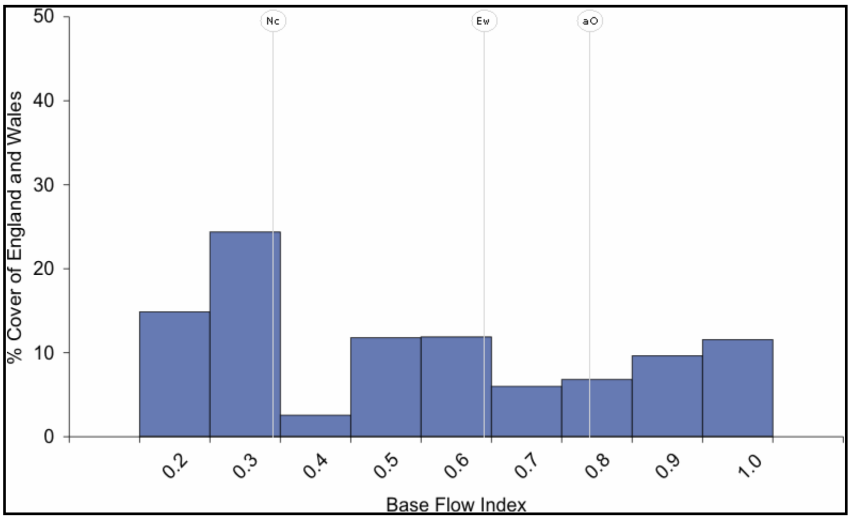



Figure 8. Base Flow Index

# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

## e(iii). Available Water Content

*Available water content* for plants varies depending on a number of factors, including the rooting depth of the plants. Described below are differing available water contents for cereals, sugar beet, grass and potato crops, as well as a generic available water value to 1 m depth.

*Available water (by crop)* Available water content to 1 m for the specified soil series between suctions of 5 and 1500kPa.

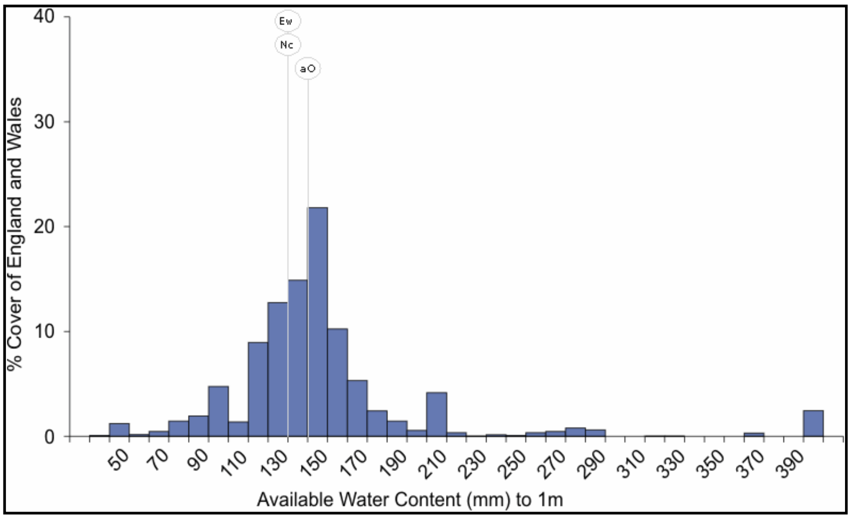



Figure 9. Available Water (by crop)

*Available water for grass* represents the water that is available to a permanent grass sward that is able to root to 100cm depth.

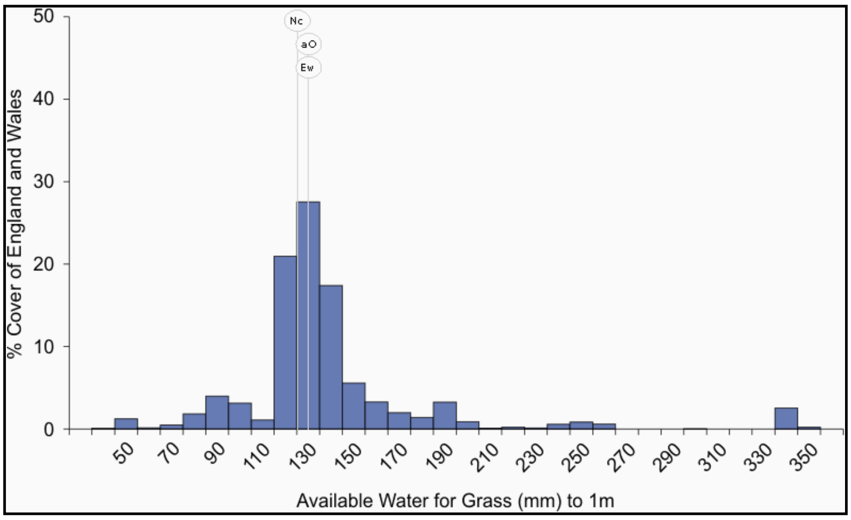



Figure 10. Available Water for Grass

## EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

### e(iii). Available Water Content continued

*Available water for cereal* represents the water that is available to a cereal crop that is able to root to 120cm depth.

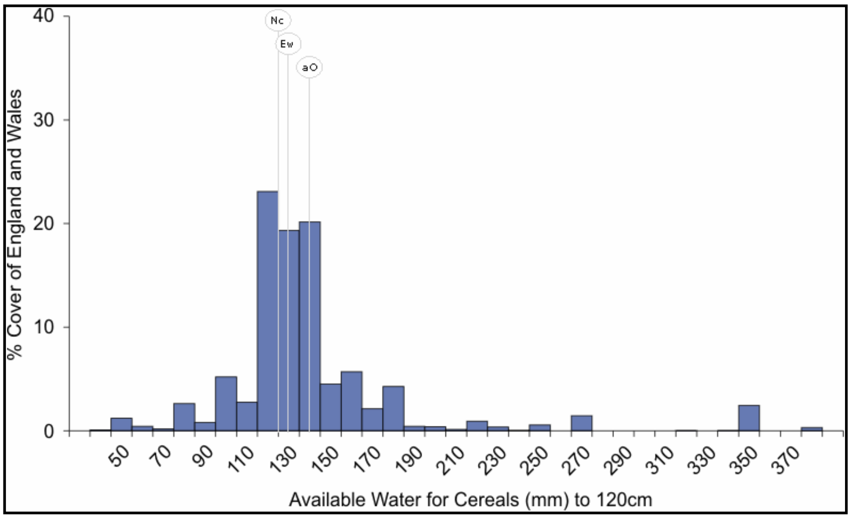



Figure 11. Available Water for Cereal

*Available water for Sugar Beet* represents the water that is available to a sugar beet crop that is able to root to 140cm depth.

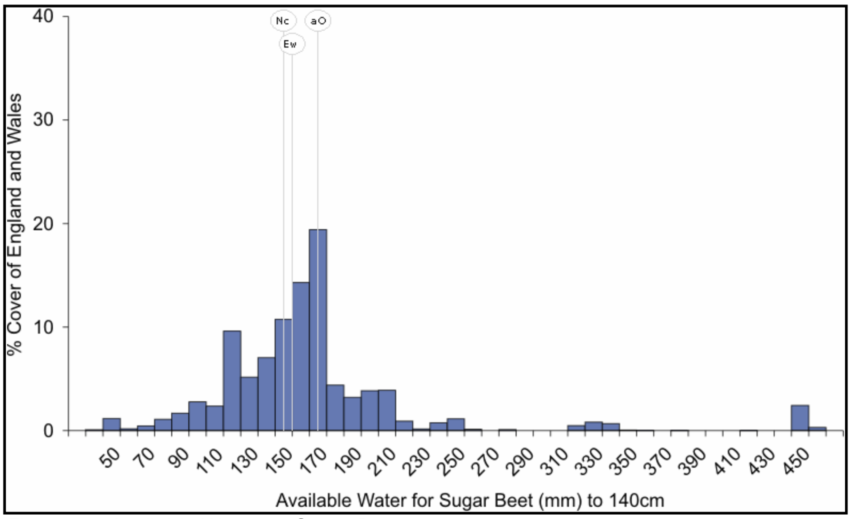



Figure 12. Available Water for Sugar Beet

*Available water for Potatoes* represents the water that is available to a potato crop that is able to root to 70cm depth.

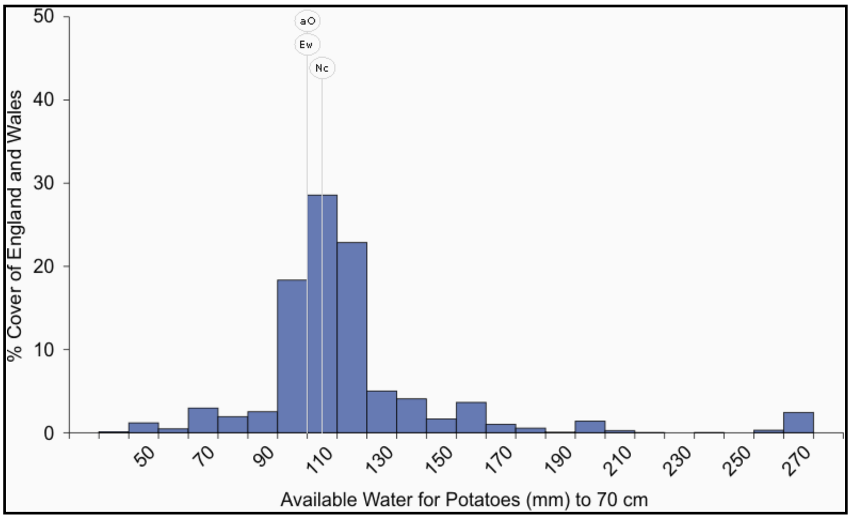



Figure 13. Available Water for Potatoes

## CEGIN (713d)

*Slowly permeable seasonally waterlogged fine silty and clayey soils.*

**a. General Description**

Slowly permeable seasonally waterlogged fine silty and clayey soils. Some fine silty and fine loamy soils with slowly permeable subsoils and slight seasonal waterlogging on slopes. Well drained fine loamy soils over rock in places.
The major landuse on this association is defined as stock rearing on permanent grassland dairying on lower ground.

**b. Distribution (England & Wales)**

The CEGIN association covers 1602km² of England and Wales which accounts for 1.06% of the landmass. The distribution of this association is shown in Figure 14. Note that the yellow shading represents a buffer to highlight the location of very small areas of the association.

**c. Comprising Soil Series**

Multiple soil series comprise a soil association. The soil series of the CEGIN association are outlined in Table 2 below. In some cases other minor soil series are present at a particular site, and these have been grouped together under the heading 'OTHER'. We have endevoured to present the likelihood of a minor, unnamed soil series occuring in your site in Table 2.

Schematic diagrams of the vertical soil profile of the major constituent soil series are provided in Section D to allow easier identification of the particular soil series at your site.

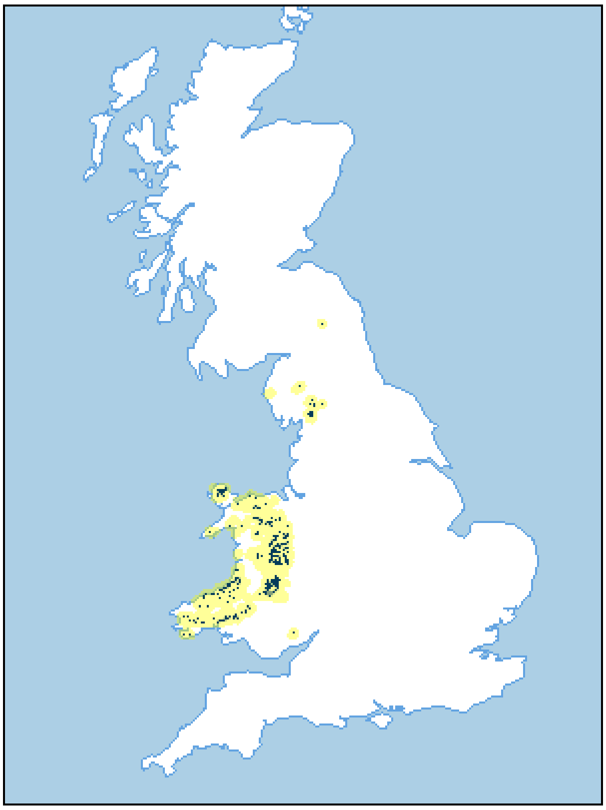


Figure 14. Association Distribution

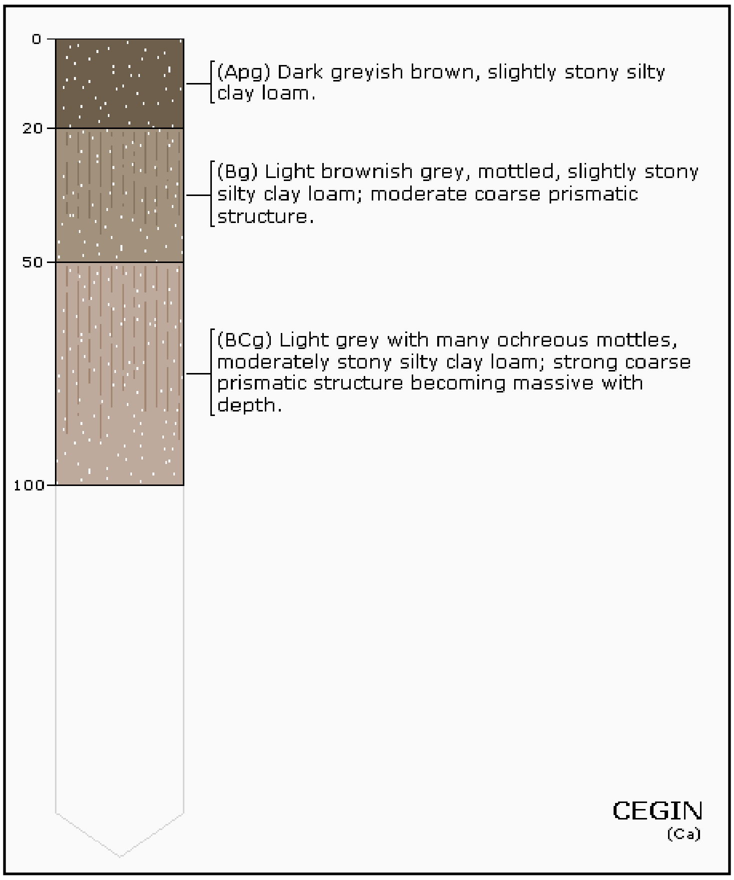
| Soil Series | Description | Area % |
|---|---|---|
| CEGIN (Ca) | medium silty drift with siliceous stones | 40% |
| GREYLAND (gJ) | medium loamy over clayey drift with siliceous stones | 15% |
| BRICKFIELD (Br) | medium loamy drift with siliceous stones | 10% |
| DENBIGH (Dg) | medium loamy material over lithoskeletal mudstone and sandstone or slate | 10% |
| SANNAN (Sn) | medium silty drift with siliceous stones | 10% |
| OTHER | other minor soils | 15% |

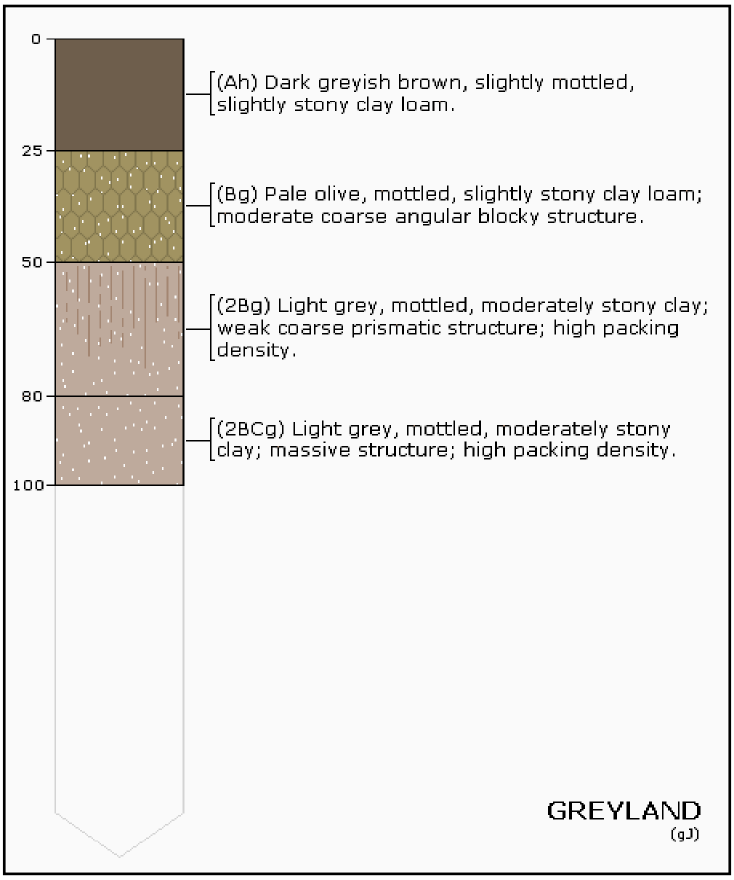
Table 2. The component soil series of the CEGIN soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

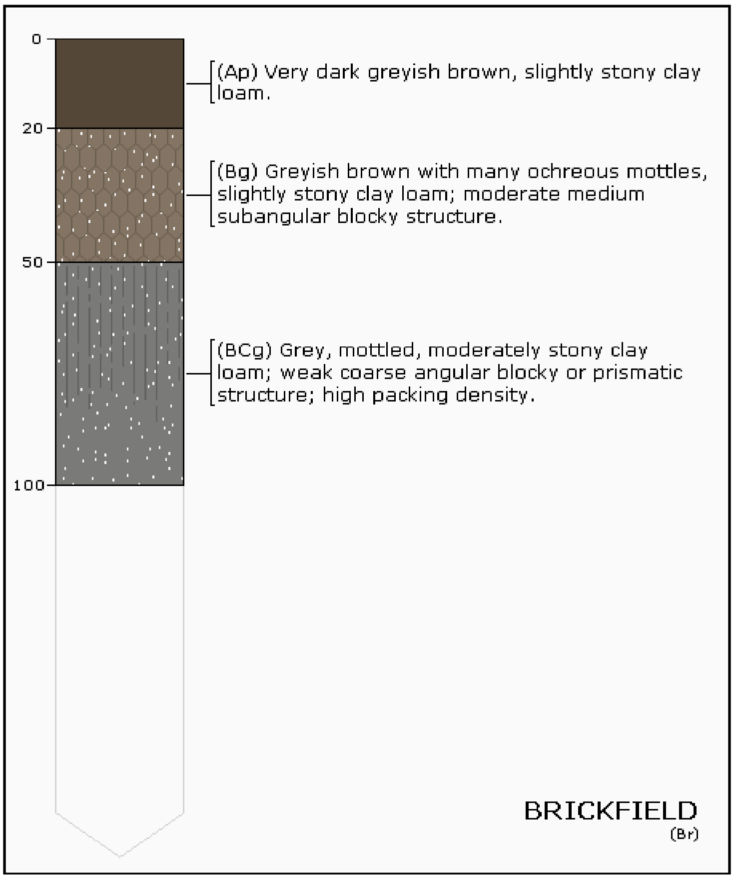
## CEGIN (713d)

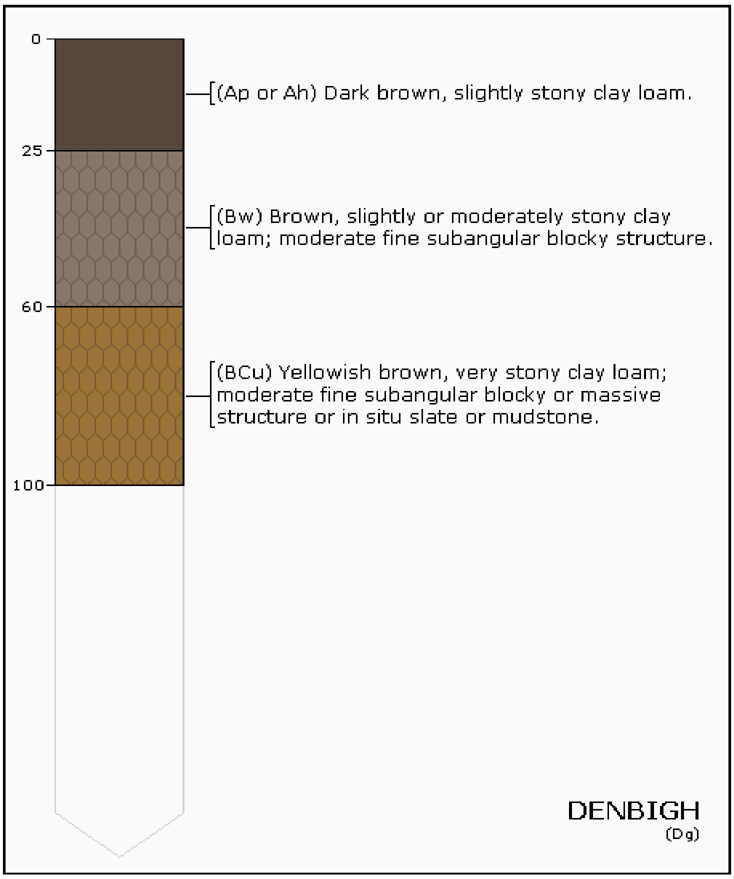
*Slowly permeable seasonally waterlogged fine silty and clayey soils.*

### d. CEGIN Component Series Profiles



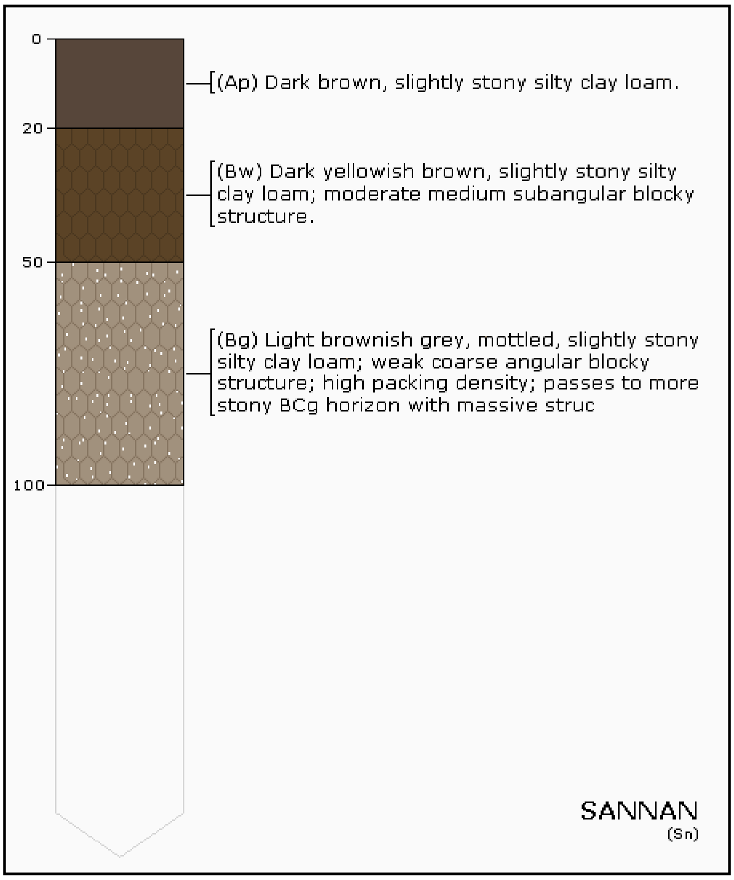



# CEGIN (713d)

*Slowly permeable seasonally waterlogged fine silty and clayey soils.*

## d. CEGIN Component Series Profiles continued



# CEGIN (713d)

*Slowly permeable seasonally waterlogged fine silty and clayey soils.*

## e. Soil Properties

This section provides graphical summaries of selected attribute data available for the component series in this association. The blue bars of the graphs presented in this section describe the range of property values for all soils across England and Wales. Superimposed on these graphs are the values for the component soil series in this association. This has been done to provide the reader with an understanding of where each property for each series sits within the national context.

| Soil Series | Description | Area % |
|---|---|---|
| CEGIN (Ca) | medium silty drift with siliceous stones | 40% |
| GREYLAND (gJ) | medium loamy over clayey drift with siliceous stones | 15% |
| BRICKFIELD (Br) | medium loamy drift with siliceous stones | 10% |
| DENBIGH (Dg) | medium loamy material over lithoskeletal mudstone and sandstone or slate | 10% |
| SANNAN (Sn) | medium silty drift with siliceous stones | 10% |
| OTHER | other minor soils | 15% |

Table 2. The component soil series of the CEGIN soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

## e(i). Soil Depth Information and Depths to Important Layers

*Depth to rock* A mean depth to bedrock or very stony rubble which has been assigned to each soil series based on observed and recorded soil profiles.

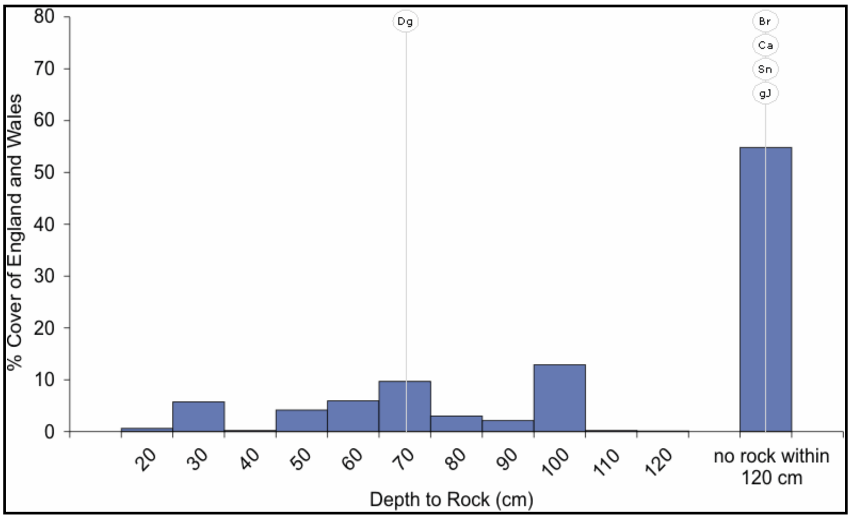



Figure 15. Depth of soil to Rock

*Depth to gleying*, the presence of grey and ochreous mottles within the soil, is caused by intermittent waterlogging. A mean depth to gleying has been assigned to each soil series based on observed and recorded soil profiles. The definition of a gleyed layer is designed to equate with saturation for at least 30 days in each year or the presence of artificial drainage.

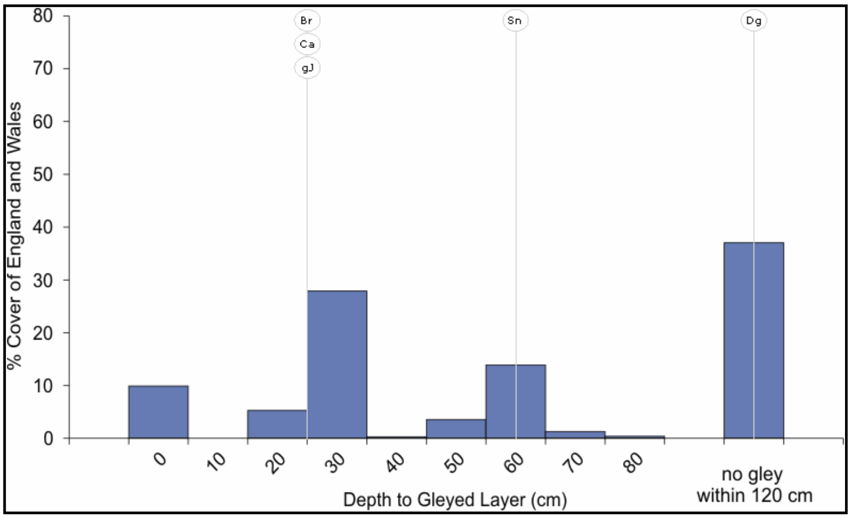



Figure 16. Depth of Soil to Gleying

# CEGIN (713d)

*Slowly permeable seasonally waterlogged fine silty and clayey soils.*

## e(i). Soil Depth Information and Depths to Important Layers continued

*Depth to slowly permeable layer (downward percolation)* A mean depth to a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede downward percolation of excess soil water. This causes periodic saturation in the overlying soil, reduced storage capacity and therefore increased hydrological response to rainfall events.

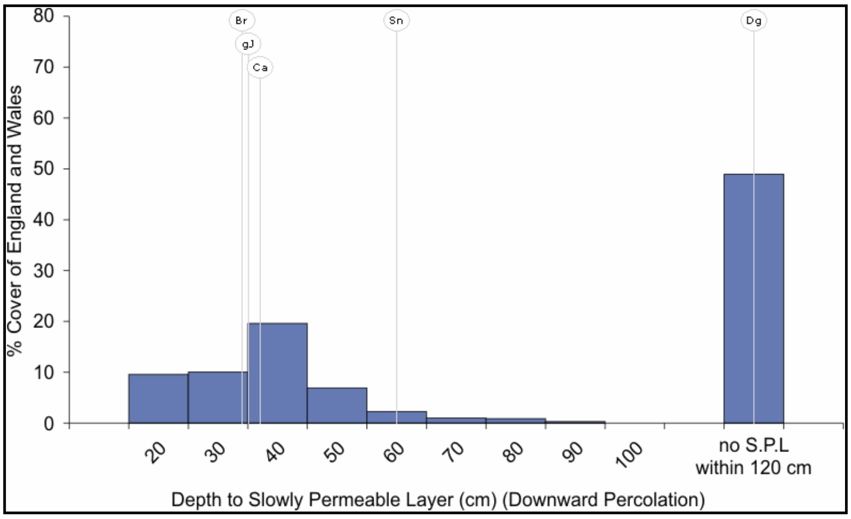



Figure 17. Depth to slowly permeable layer (downward percolation)

*Depth to Slowly Permeable Layer (upward diffusion)* A mean depth to the bottom of a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede upward diffusion of water and gasses.

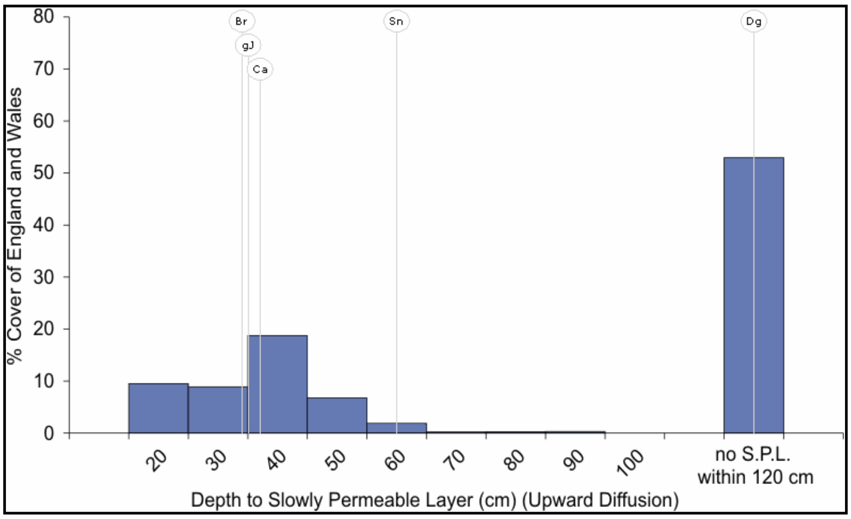



Figure 18. Depth to Slowly Permeable Layer (upward diffusion)

## CEGIN (713d)

*Slowly permeable seasonally waterlogged fine silty and clayey soils.*

### e(ii). Soil Hydrological Information

*Integrated air capacity (IAC)* is the total coarse pore space (>60 μm diameter) to 1 m depth. This size of pore would normally be air-filled when the soil is fully moist but not waterlogged. A large IAC means that the soil is well aerated. This will encourage root development and, provided near surface soil structure is well developed, will allow rainfall to percolate into the ground thus mitigating against localised flooding.

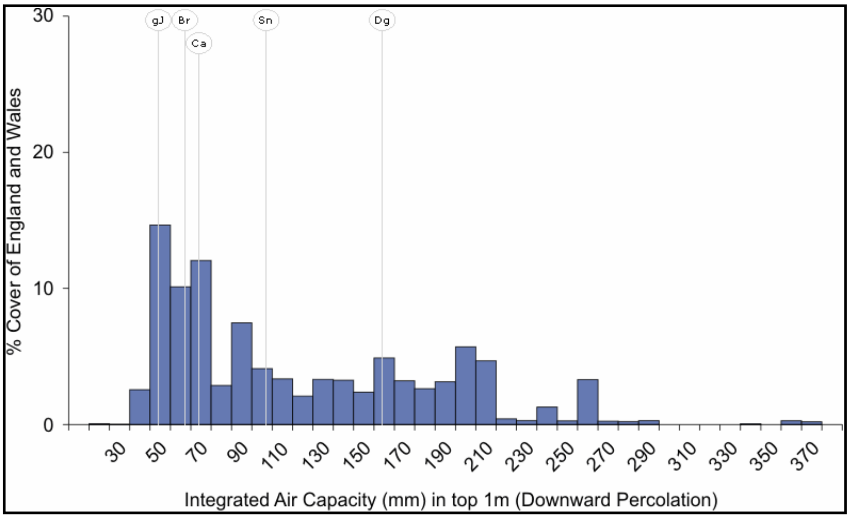



Figure 19. Integrated Air Capacity

*Standard Percentage Runoff (SPR)* is the percentage of rainfall that causes the short-term increase in flow seen at a catchment outlet following a storm event. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

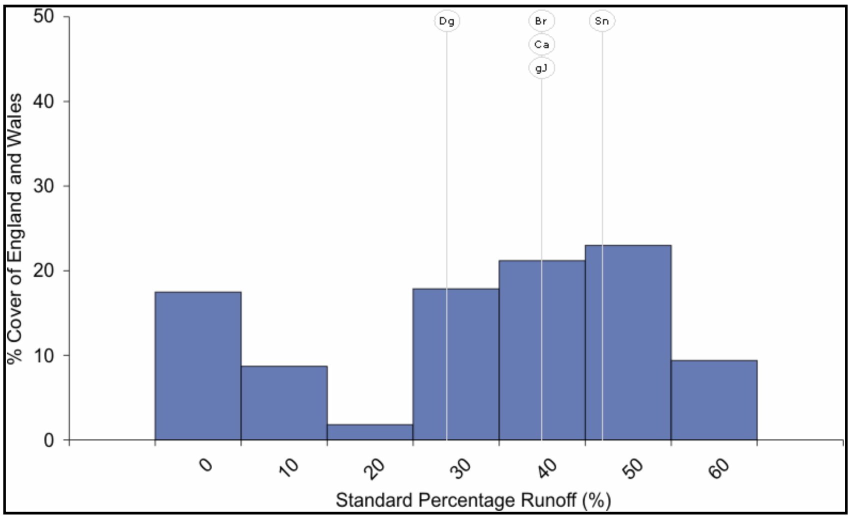



Figure 20. Standard Percentage Runoff

*Base flow index* is calculated from daily river flow data and expresses the volume of base flow of a river as a fraction of the total flow volume. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

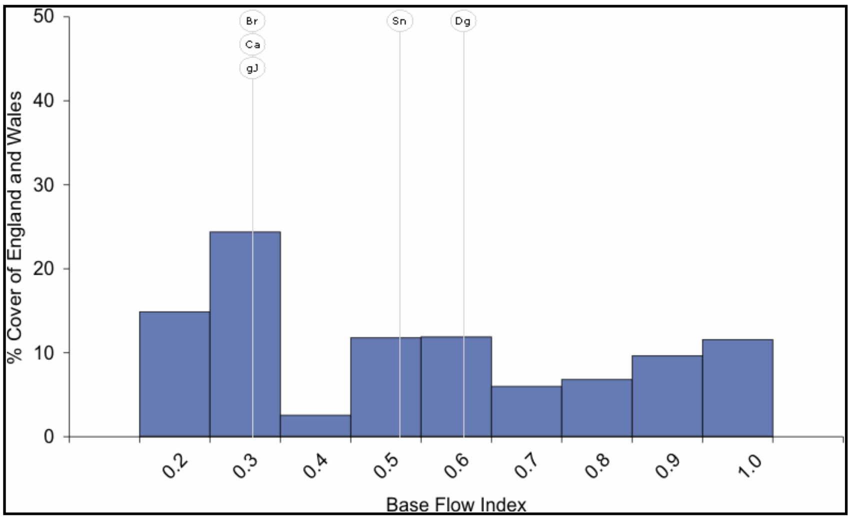



Figure 21. Base Flow Index

## CEGIN (713d)

*Slowly permeable seasonally waterlogged fine silty and clayey soils.*

### e(iii). Available Water Content

*Available water content* for plants varies depending on a number of factors, including the rooting depth of the plants. Described below are differing available water contents for cereals, sugar beet, grass and potato crops, as well as a generic available water value to 1 m depth.

*Available water (by crop)* Available water content to 1 m for the specified soil series between suctions of 5 and 1500kPa.

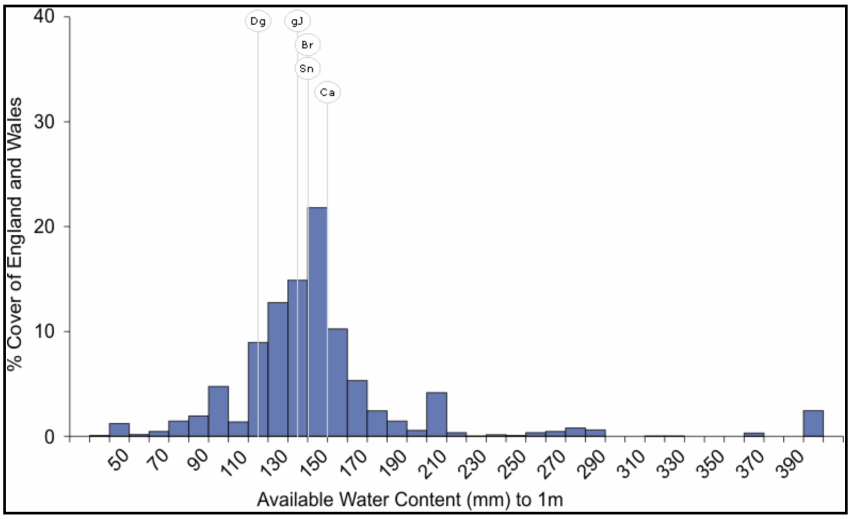



Figure 22. Available Water (by crop)

*Available water for grass* represents the water that is available to a permanent grass sward that is able to root to 100cm depth.

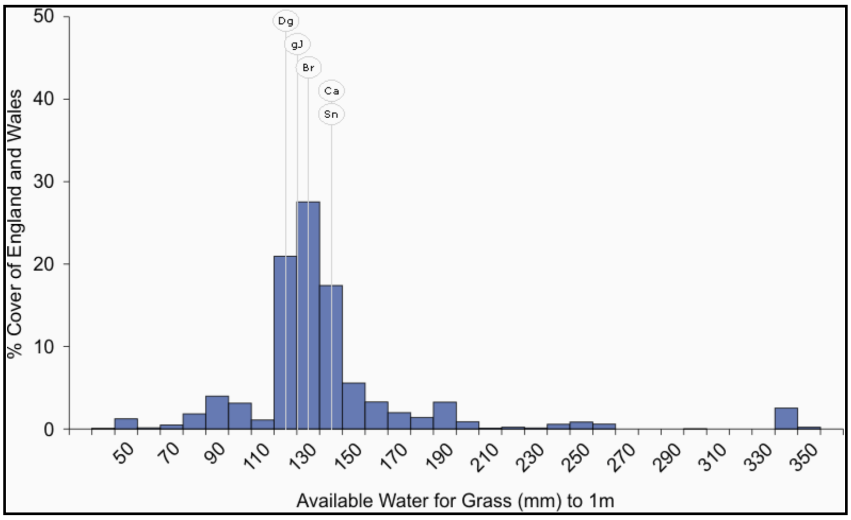



Figure 23. Available Water for Grass

## CEGIN (713d)

*Slowly permeable seasonally waterlogged fine silty and clayey soils.*

### e(iii). Available Water Content continued

*Available water for cereal* represents the water that is available to a cereal crop that is able to root to 120cm depth.

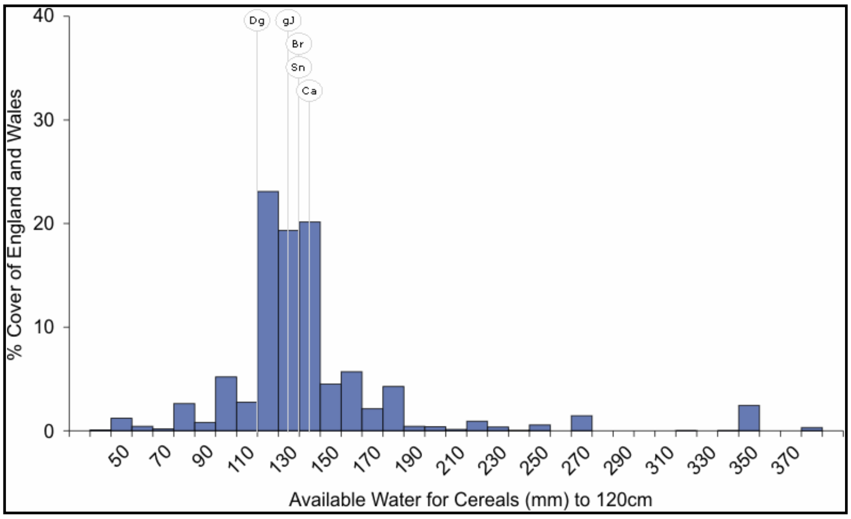



Figure 24. Available Water for Cereal

*Available water for Sugar Beet* represents the water that is available to a sugar beet crop that is able to root to 140cm depth.

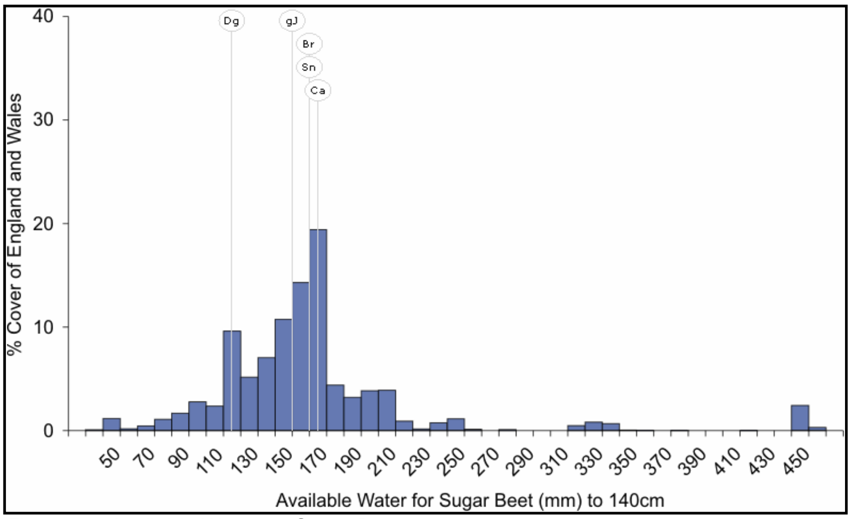



Figure 25. Available Water for Sugar Beet

*Available water for Potatoes* represents the water that is available to a potato crop that is able to root to 70cm depth.

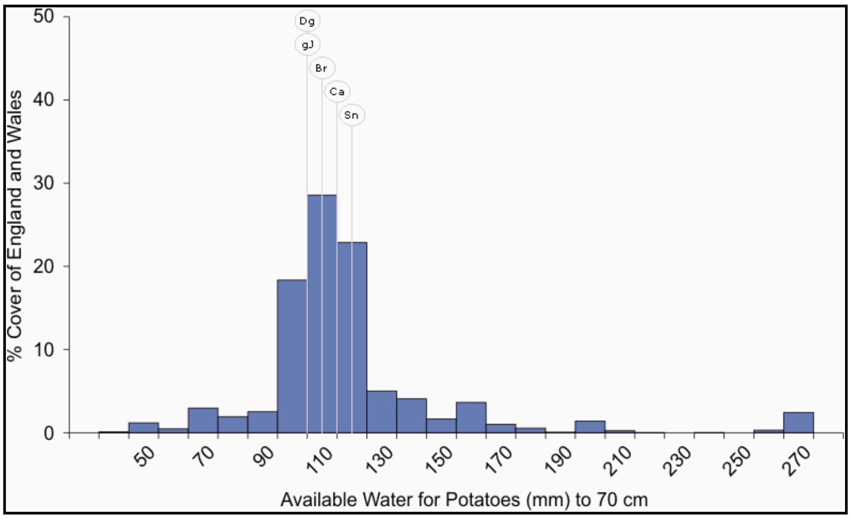



Figure 26. Available Water for Potatoes

# BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

**a. General Description**

Slowly permeable seasonally waterlogged fine loamy soils. Associated with fine loamy soils with only slight waterlogging and some deep well drained fine loamy soils.
The major landuse on this association is defined as dairying and stock rearing on permanent or short term grassland; some cereals in drier areas.

**b. Distribution (England & Wales)**

The BRICKFIELD 2 association covers 1596km² of England and Wales which accounts for 1.06% of the landmass. The distribution of this association is shown in Figure 27. Note that the yellow shading represents a buffer to highlight the location of very small areas of the association.

**c. Comprising Soil Series**

Multiple soil series comprise a soil association. The soil series of the BRICKFIELD 2 association are outlined in Table 3 below. In some cases other minor soil series are present at a particular site, and these have been grouped together under the heading 'OTHER'. We have endevoured to present the likelihood of a minor, unnamed soil series occuring in your site in Table 3.

Schematic diagrams of the vertical soil profile of the major constituent soil series are provided in Section D to allow easier identification of the particular soil series at your site.

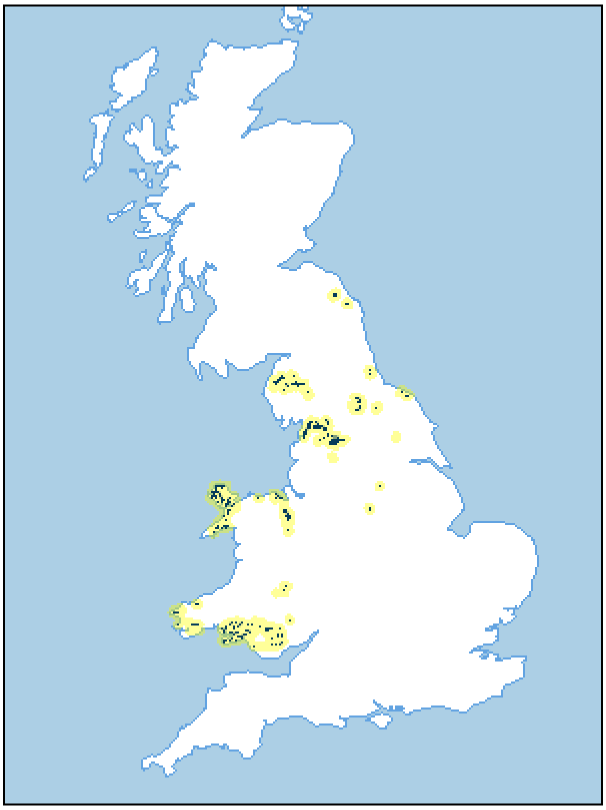


Figure 27. Association Distribution

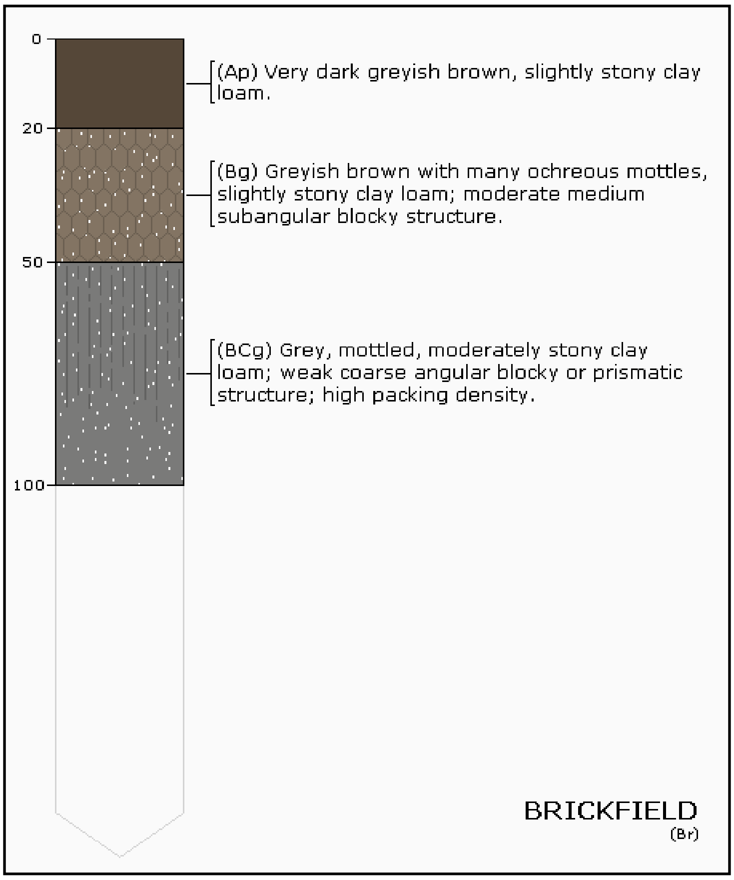
| Soil Series | Description | Area % |
|---|---|---|
| BRICKFIELD (Br) | medium loamy drift with siliceous stones | 40% |
| NERCWYS (Nc) | medium loamy drift with siliceous stones | 20% |
| EAST KESWICK (Ew) | medium loamy drift with siliceous stones | 15% |
| OTHER | other minor soils | 25% |

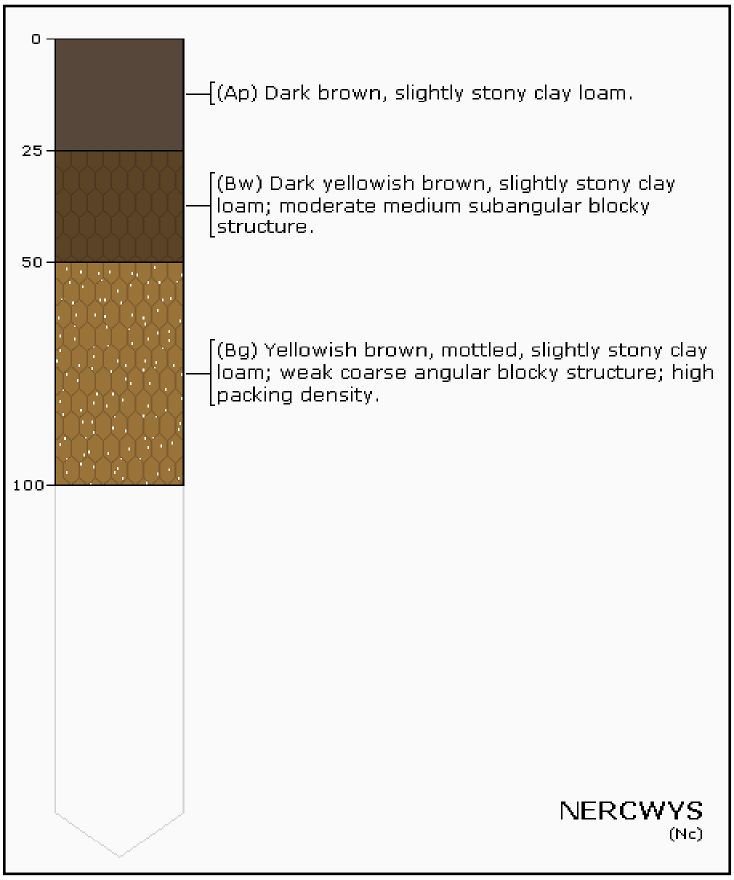
Table 3. The component soil series of the BRICKFIELD 2 soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

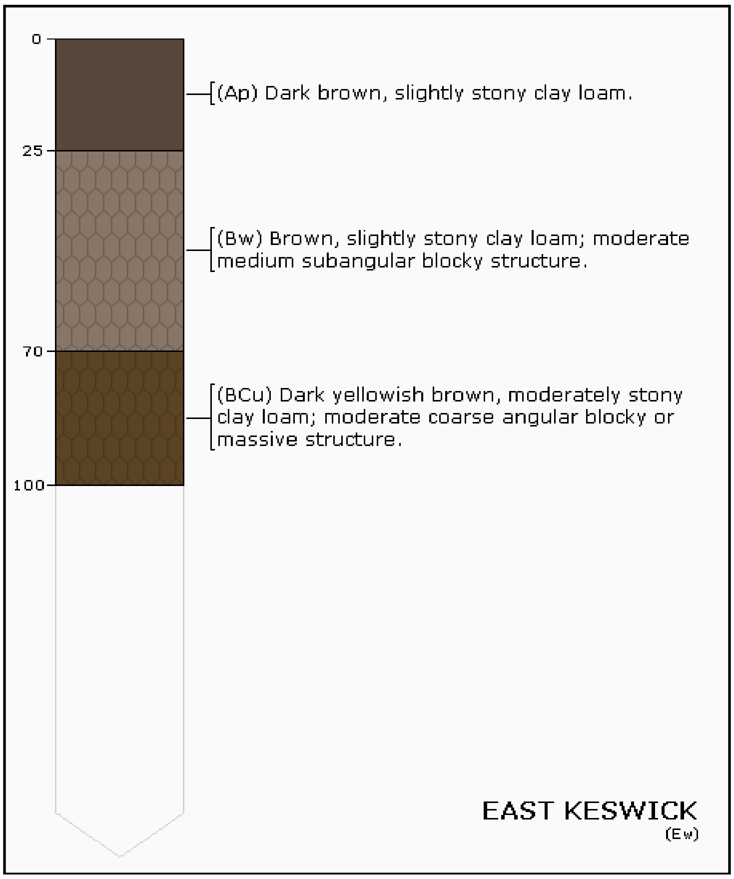
# BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

## d. BRICKFIELD 2 Component Series Profiles



# BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

## e. Soil Properties

This section provides graphical summaries of selected attribute data available for the component series in this association. The blue bars of the graphs presented in this section describe the range of property values for all soils across England and Wales. Superimposed on these graphs are the values for the component soil series in this association. This has been done to provide the reader with an understanding of where each property for each series sits within the national context.

| Soil Series | Description | Area % |
|---|---|---|
| BRICKFIELD (Br) | medium loamy drift with siliceous stones | 40% |
| NERCWYS (Nc) | medium loamy drift with siliceous stones | 20% |
| EAST KESWICK (Ew) | medium loamy drift with siliceous stones | 15% |
| OTHER | other minor soils | 25% |

Table 3. The component soil series of the BRICKFIELD 2 soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

## e(i). Soil Depth Information and Depths to Important Layers

*Depth to rock* A mean depth to bedrock or very stony rubble which has been assigned to each soil series based on observed and recorded soil profiles.

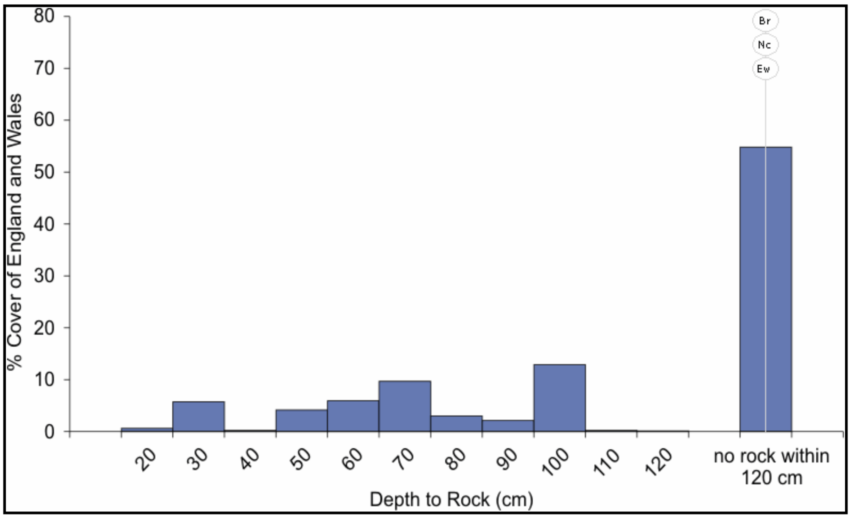



Figure 28. Depth of soil to Rock

*Depth to gleying*, the presence of grey and ochreous mottles within the soil, is caused by intermittent waterlogging. A mean depth to gleying has been assigned to each soil series based on observed and recorded soil profiles. The definition of a gleyed layer is designed to equate with saturation for at least 30 days in each year or the presence of artificial drainage.

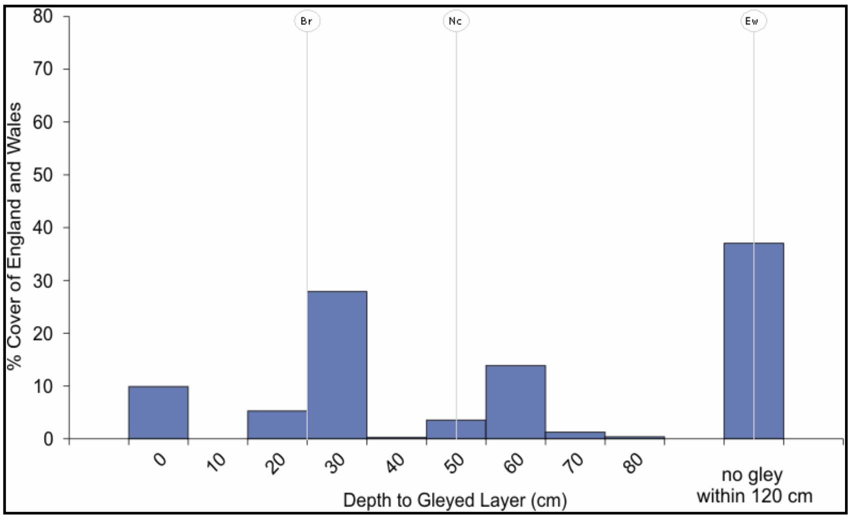



Figure 29. Depth of Soil to Gleying

# BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

## e(i). Soil Depth Information and Depths to Important Layers continued

*Depth to slowly permeable layer (downward percolation)* A mean depth to a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede downward percolation of excess soil water. This causes periodic saturation in the overlying soil, reduced storage capacity and therefore increased hydrological response to rainfall events.

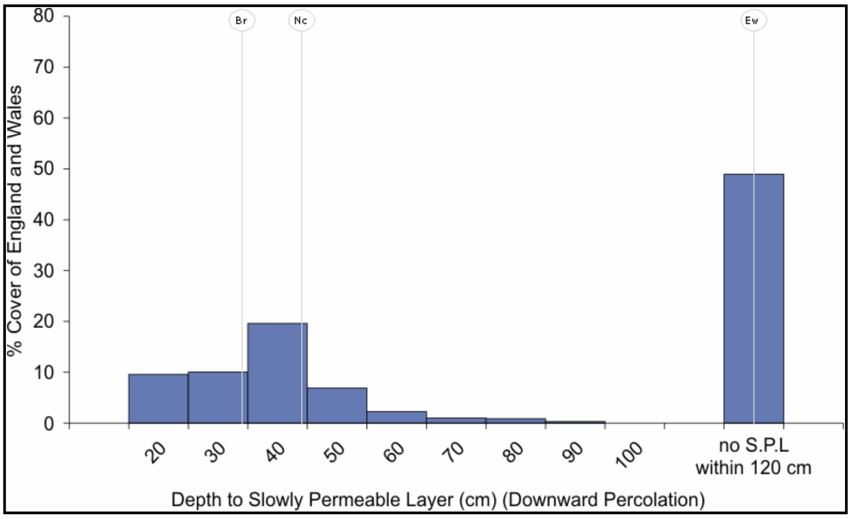



Figure 30. Depth to slowly permeable layer (downward percolation)

*Depth to Slowly Permeable Layer (upward diffusion)* A mean depth to the bottom of a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede upward diffusion of water and gasses.

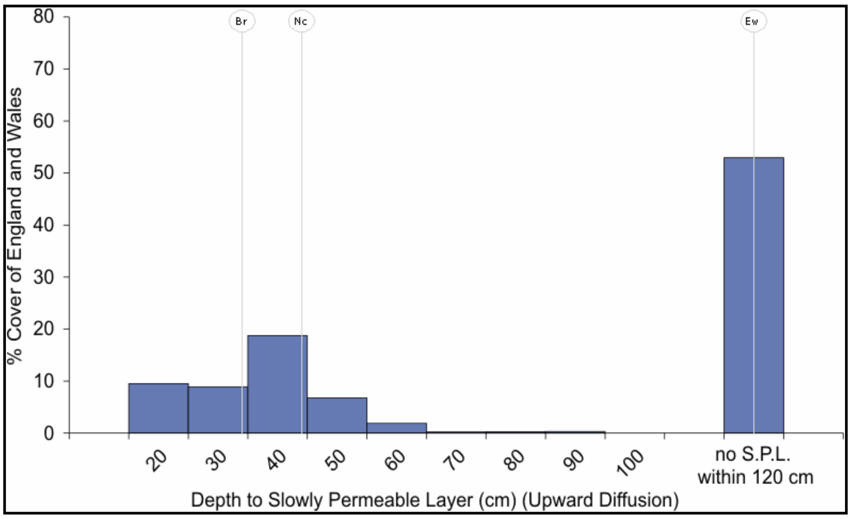



Figure 31. Depth to Slowly Permeable Layer (upward diffusion)

## BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

### e(ii). Soil Hydrological Information

*Integrated air capacity (IAC)* is the total coarse pore space (>60 $\mu$m diameter) to 1 m depth. This size of pore would normally be air-filled when the soil is fully moist but not waterlogged. A large IAC means that the soil is well aerated. This will encourage root development and, provided near surface soil structure is well developed, will allow rainfall to percolate into the ground thus mitigating against localised flooding.

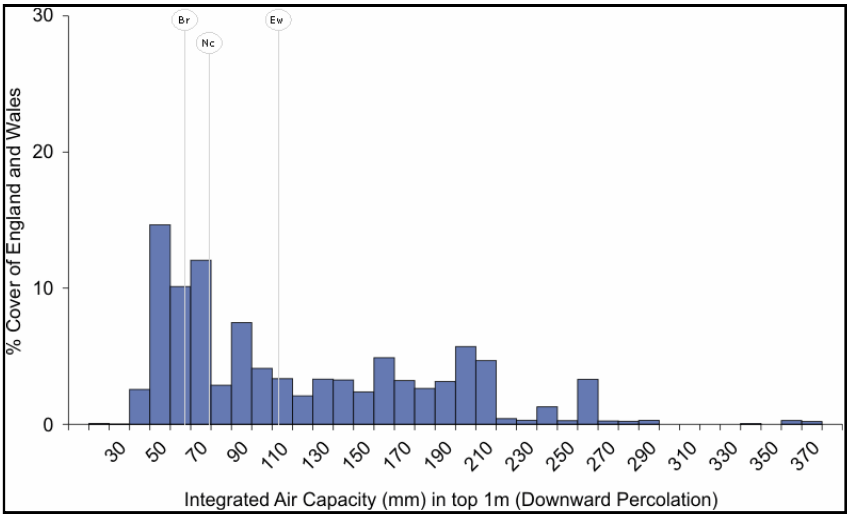



Figure 32. Integrated Air Capacity

*Standard Percentage Runoff (SPR)* is the percentage of rainfall that causes the short-term increase in flow seen at a catchment outlet following a storm event. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

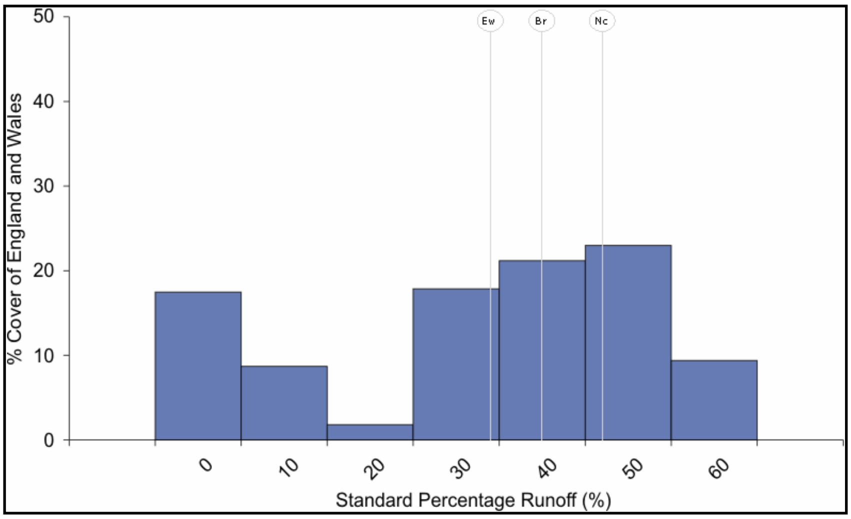



Figure 33. Standard Percentage Runoff

*Base flow index* is calculated from daily river flow data and expresses the volume of base flow of a river as a fraction of the total flow volume. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

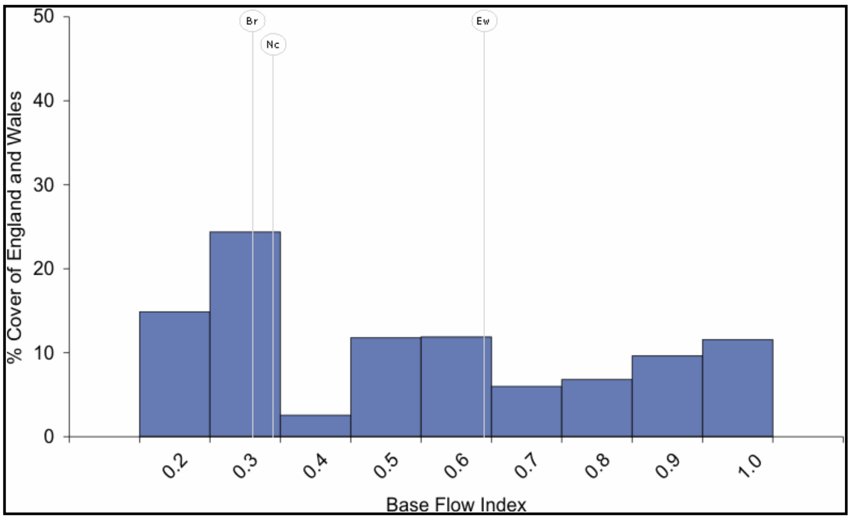



Figure 34. Base Flow Index

# BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

## e(iii). Available Water Content

*Available water content* for plants varies depending on a number of factors, including the rooting depth of the plants. Described below are differing available water contents for cereals, sugar beet, grass and potato crops, as well as a generic available water value to 1 m depth.

*Available water (by crop)* Available water content to 1 m for the specified soil series between suctions of 5 and 1500kPa.

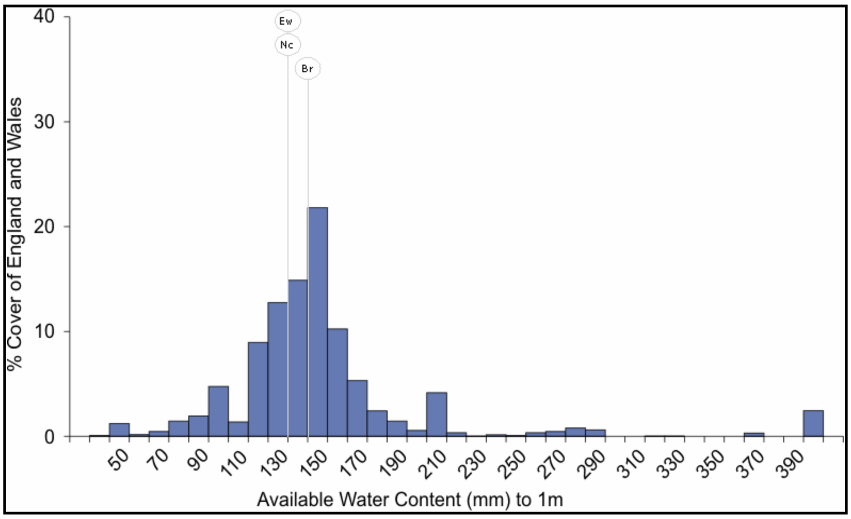



Figure 35. Available Water (by crop)

*Available water for grass* represents the water that is available to a permanent grass sward that is able to root to 100cm depth.

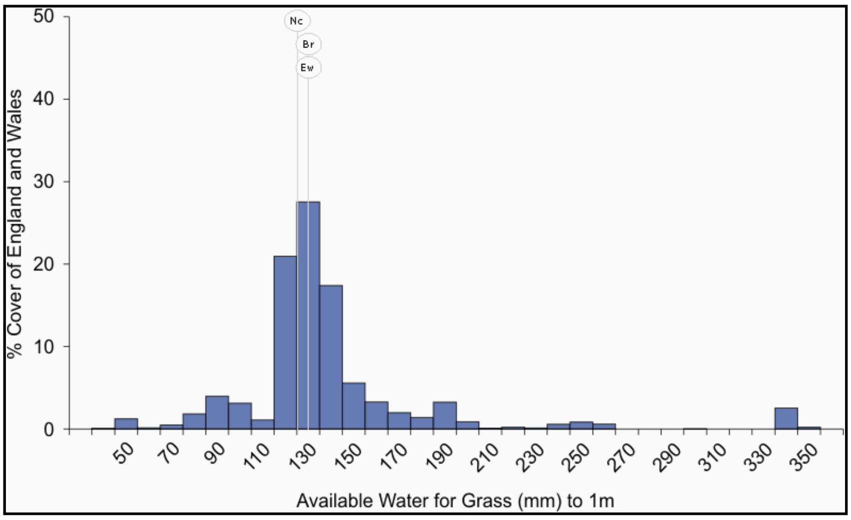



Figure 36. Available Water for Grass

## BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

### e(iii). Available Water Content continued

*Available water for cereal* represents the water that is available to a cereal crop that is able to root to 120cm depth.

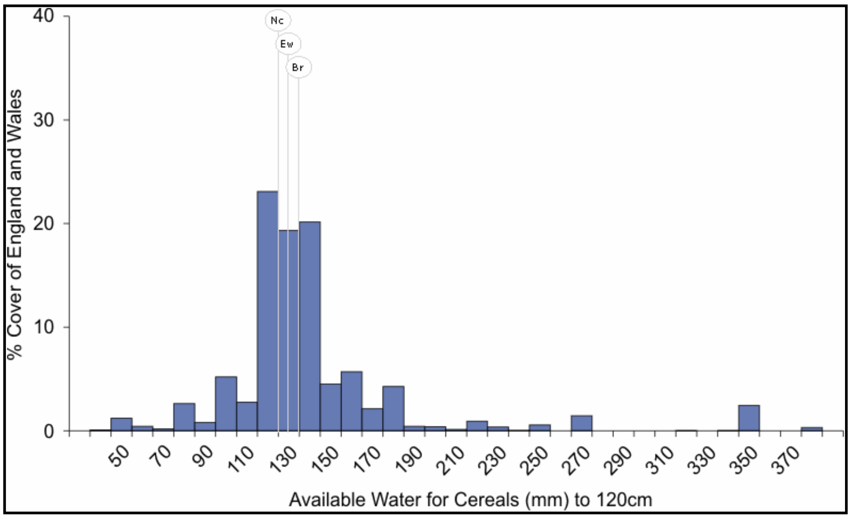



Figure 37. Available Water for Cereal

*Available water for Sugar Beet* represents the water that is available to a sugar beet crop that is able to root to 140cm depth.

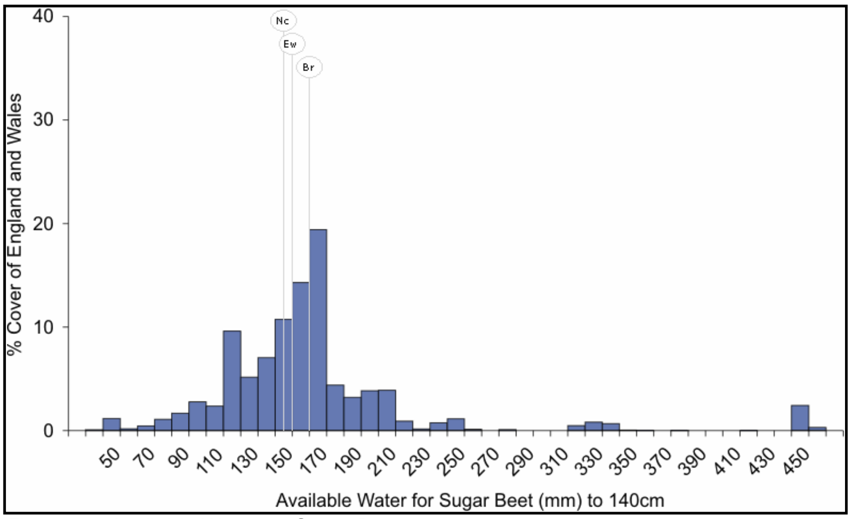



Figure 38. Available Water for Sugar Beet

*Available water for Potatoes* represents the water that is available to a potato crop that is able to root to 70cm depth.

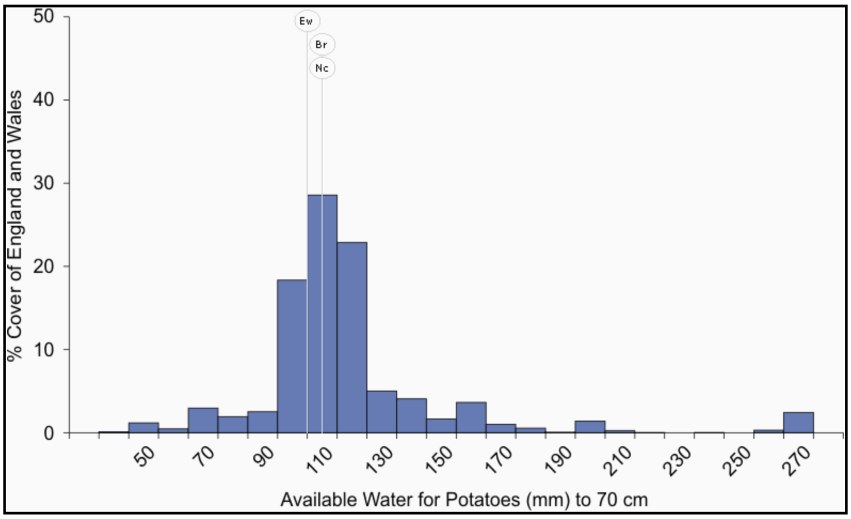
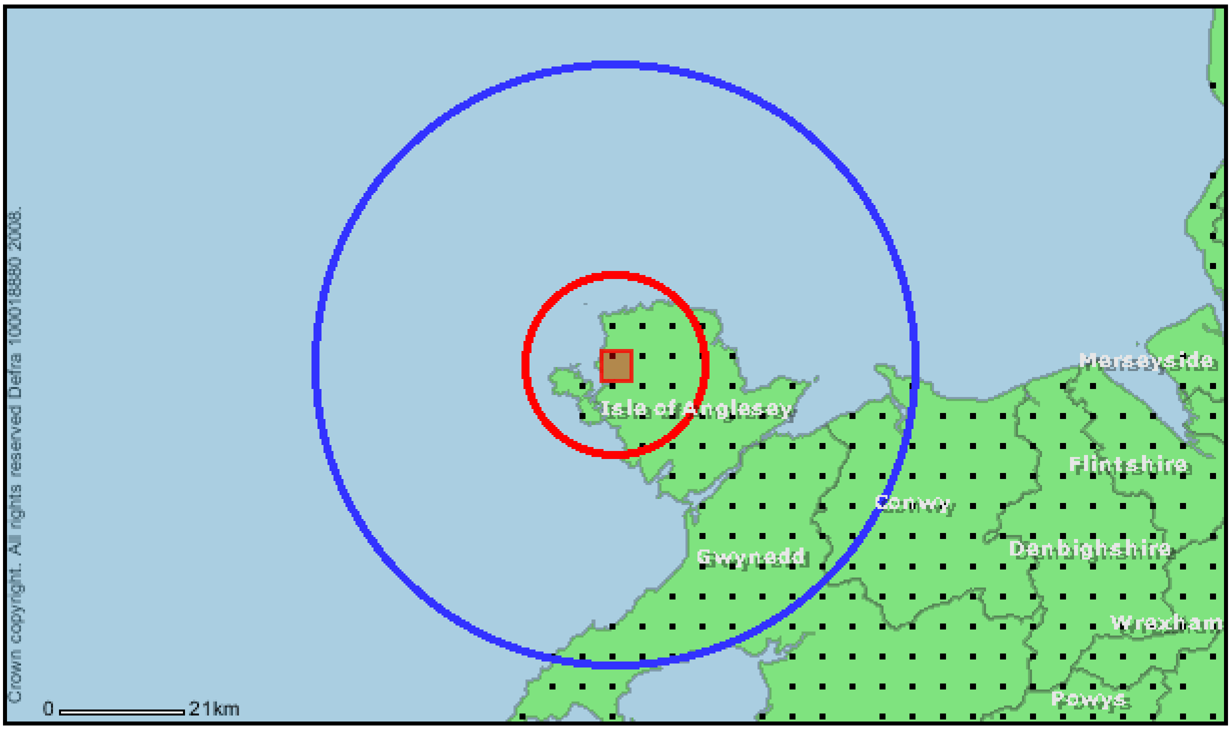
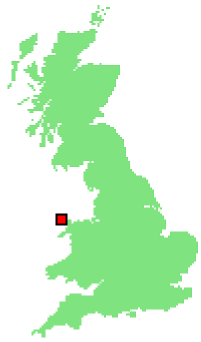



Figure 39. Available Water for Potatoes

# 3. TOPSOIL ELEMENT BACKGROUND LEVELS



## TOPSOIL ELEMENT BACKGROUND LEVELS KEY

- NSI sample points
- Report area
- 15 km radius - local area
- 50 km radius - regional area

TOPSOIL ELEMENT BACKGROUND LEVELS DESCRIPTION

The National Soil Inventory (NSI) covers England and Wales on a 5 km grid and provides detailed information for each intersect of the grid. Collectively NSI data are statistically representative of England and Wales soils. The original sampling was undertaken around 1980 and there were partial resamplings in the mid-1990s. The most up-to-date data is presented here.

Analysis of the NSI samples provides detailed measurements of over 20 elements from the soils, in addition to pH. This data is summarised over three areas to provide you with an understanding of how your site, and your data for it, sits within the local, regional and national context.

Where available, the soil element levels are compared with the Soil Guideline Values and where a soil sample we have analysed has been found in excess of the SGV guidelines for "residential with plant uptake" land, this is displayed in red in the tables which follow.

SGV levels are provided for the following elements: lead, selenium, nickel, mercury, chromium, cadmium and arsenic.

In the following pages, a number of analyses of the topsoil are provided. The majority of analyses have been performed on the full compliment of sample points, however, in some areas, for some elements, only a few samples were analysed as part of subsequent programmes. In order to present the full suite of possible datasets, and accurately convey the validity of the data, the number of actual measured samples is stated for each analysis. Care should be taken where the number of samples is disproportionately low.

## 3a. Analyses Within a 15 km Radius (16 Sample Points)

| ANALYSES | SAMPLES | MEAN | MIN | MAX | ST. DEV |
|---|---|---|---|---|---|
| pH (PH) | 16 | 5.1 | 4.2 | 5.7 | 0.4 |
| Carbon (CARBON) | 16 | 4.9 | 2.2 | 13.5 | 3.0 |
| Aluminium (AL_ACID) | 16 | 30,759.1 | 13,802.0 | 53,950.0 | 10,452.6 |
| Arsenic (AS_ACID) | 14 | 3.5 | 2.0 | 9.6 | 1.9 |
| Barium (BA_ACID) | 16 | 202.6 | 76.0 | 372.0 | 102.6 |
| Calcium (CA_ACID) | 16 | 2,460.7 | 353.0 | 4,696.0 | 1,528.9 |
| Cadmium (CD_ACID) | 16 | 0.5 | 0.1 | 1.3 | 0.4 |
| Cadmium (Extractable) (CD_EDTA) | 16 | 0.2 | 0.1 | 0.4 | 0.1 |
| Cobalt (CO_ACID) | 16 | 11.3 | 3.6 | 26.1 | 6.7 |
| Cobalt (Extractable) (CO_EDTA) | 16 | 0.7 | 0.1 | 2.1 | 0.6 |
| Chromium (CR_ACID) | 16 | 49.0 | 31.2 | 88.4 | 16.3 |
| Copper (CU_ACID) | 16 | 21.3 | 5.8 | 49.1 | 10.1 |
| Copper (Extractable) (CU_EDTA) | 16 | 5.6 | 1.2 | 9.8 | 2.2 |
| Flouride (F_ACID) | 15 | 41.8 | 0.0 | 137.0 | 37.3 |
| Iron (FE_ACID) | 16 | 33,047.6 | 17,114.0 | 53,860.0 | 10,564.5 |
| Mercury (HG_ACID) | 14 | 0.0 | 0.0 | 0.1 | 0.0 |
| Potassium (K_ACID) | 16 | 4,750.7 | 1,717.0 | 8,269.0 | 1,992.1 |
| Potassium (Extractable) (K_NITRATE) | 16 | 106.9 | 25.0 | 247.0 | 56.5 |
| Magnesium (MG_ACID) | 16 | 3,661.3 | 2,133.0 | 5,459.0 | 996.4 |
| Magnesium (Extractable) (MG_NITRATE) | 16 | 135.8 | 66.0 | 307.0 | 58.3 |
| Manganese (MN_ACID) | 16 | 1,050.6 | 231.0 | 2,707.0 | 843.5 |
| Manganese (Extractable) (MN_EDTA) | 16 | 146.9 | 9.0 | 589.0 | 152.4 |
| Molybdenum (MO_ACID) | 15 | 1.1 | 0.0 | 2.9 | 0.8 |
| Sodium (NA_ACID) | 16 | 583.3 | 193.0 | 1,176.0 | 347.0 |
| Nickel (NI_ACID) | 16 | 22.0 | 13.5 | 33.0 | 7.3 |
| Nickel (Extractable) (NI_EDTA) | 16 | 0.8 | 0.3 | 2.9 | 0.6 |
| Phosphorus (P_ACID) | 16 | 899.9 | 358.0 | 2,016.0 | 429.3 |
| Phosphorus (Extractable) (P_OLSEN) | 16 | 23.1 | 6.0 | 58.0 | 14.0 |
| Lead (PB_ACID) | 16 | 42.3 | 15.0 | 118.0 | 25.0 |
| Lead (Extractable) (PB_EDTA) | 16 | 12.3 | 3.6 | 53.7 | 12.9 |
| Selenium (SE_ACID) | 14 | 0.6 | 0.2 | 1.0 | 0.2 |
| Strontium (SR_ACID) | 16 | 24.5 | 1.0 | 45.0 | 13.9 |
| Vanadium (V_ACID) | 15 | 40.3 | 6.7 | 70.2 | 16.0 |
| Zinc (ZN_ACID) | 16 | 71.7 | 25.0 | 158.0 | 32.2 |
| Zinc (Extractable) (ZN_EDTA) | 16 | 3.4 | 1.1 | 10.2 | 2.2 |

for units, see Analyses Definitions (p50)

## 3b. Analyses Within a 50 km Radius (75 Sample Points)

| ANALYSES | SAMPLES | MEAN | MIN | MAX | ST. DEV |
|---|---|---|---|---|---|
| pH (PH) | 75 | 4.8 | 3.5 | 6.2 | 0.6 |
| Carbon (CARBON) | 75 | 10.7 | 0.2 | 44.1 | 11.5 |
| Aluminium (AL_ACID) | 75 | 24,417.3 | 3,269.0 | 53,950.0 | 11,163.2 |
| Arsenic (AS_ACID) | 47 | 5.2 | 0.4 | 25.2 | 4.0 |
| Barium (BA_ACID) | 75 | 141.9 | 11.0 | 393.0 | 85.0 |
| Calcium (CA_ACID) | 75 | 1,884.4 | 100.0 | 5,800.0 | 1,452.4 |
| Cadmium (CD_ACID) | 75 | 0.6 | 0.0 | 4.5 | 0.6 |
| Cadmium (Extractable) (CD_EDTA) | 74 | 1.2 | 0.0 | 75.0 | 8.7 |
| Cobalt (CO_ACID) | 75 | 15.5 | 0.7 | 321.8 | 40.6 |
| Cobalt (Extractable) (CO_EDTA) | 74 | 0.9 | 0.0 | 10.8 | 1.7 |
| Chromium (CR_ACID) | 75 | 35.9 | 4.3 | 95.4 | 20.3 |
| Copper (CU_ACID) | 75 | 21.7 | 2.4 | 103.7 | 16.7 |
| Copper (Extractable) (CU_EDTA) | 74 | 5.3 | 1.2 | 39.2 | 4.8 |
| Flouride (F_ACID) | 64 | 46.7 | 0.0 | 340.7 | 64.5 |
| Iron (FE_ACID) | 75 | 27,518.8 | 3,538.0 | 83,515.0 | 14,630.6 |
| Mercury (HG_ACID) | 47 | 0.1 | 0.0 | 1.2 | 0.2 |
| Potassium (K_ACID) | 75 | 3,781.8 | 581.0 | 8,269.0 | 1,761.4 |
| Potassium (Extractable) (K_NITRATE) | 75 | 109.1 | 13.0 | 256.0 | 49.8 |
| Magnesium (MG_ACID) | 75 | 2,980.4 | 322.0 | 8,008.0 | 1,836.6 |
| Magnesium (Extractable) (MG_NITRATE) | 75 | 105.7 | 24.0 | 307.0 | 50.1 |
| Manganese (MN_ACID) | 75 | 1,294.9 | 26.0 | 13,613.0 | 1,767.4 |
| Manganese (Extractable) (MN_EDTA) | 74 | 171.8 | 1.0 | 2,347.0 | 287.6 |
| Molybdenum (MO_ACID) | 63 | 1.3 | 0.0 | 5.9 | 1.3 |
| Sodium (NA_ACID) | 75 | 458.2 | 137.0 | 2,209.0 | 348.1 |
| Nickel (NI_ACID) | 75 | 16.9 | 2.9 | 46.8 | 10.1 |
| Nickel (Extractable) (NI_EDTA) | 74 | 0.7 | 0.1 | 2.9 | 0.5 |
| Phosphorus (P_ACID) | 75 | 946.2 | 175.0 | 2,214.0 | 390.9 |
| Phosphorus (Extractable) (P_OLSEN) | 75 | 20.2 | 3.0 | 88.0 | 13.9 |
| Lead (PB_ACID) | 75 | 75.7 | 6.0 | 795.0 | 94.8 |
| Lead (Extractable) (PB_EDTA) | 74 | 18.7 | 3.6 | 108.0 | 17.8 |
| Selenium (SE_ACID) | 47 | 1.2 | 0.0 | 6.4 | 1.3 |
| Strontium (SR_ACID) | 75 | 18.8 | 0.0 | 54.0 | 11.4 |
| Vanadium (V_ACID) | 64 | 34.2 | 0.0 | 96.1 | 25.3 |
| Zinc (ZN_ACID) | 75 | 69.6 | 21.0 | 237.0 | 40.7 |
| Zinc (Extractable) (ZN_EDTA) | 74 | 5.4 | 1.1 | 31.2 | 4.8 |

for units, see Analyses Definitions (p50)

## 3c. National Analyses (5686 Sample Points)

| ANALYSES | SAMPLES | MEAN | MIN | MAX | ST. DEV |
|---|---|---|---|---|---|
| pH (PH) | 5,630 | 6.0 | 3.1 | 9.2 | 1.3 |
| Carbon (CARBON) | 5,672 | 6.1 | 0.1 | 61.5 | 8.9 |
| Aluminium (AL_ACID) | 5,677 | 26,775.3 | 491.0 | 79,355.0 | 12,772.2 |
| Arsenic (AS_ACID) | 2,729 | 4.6 | 0.0 | 110.0 | 5.7 |
| Barium (BA_ACID) | 5,677 | 150.0 | 7.0 | 3,840.0 | 159.5 |
| Calcium (CA_ACID) | 5,677 | 13,768.7 | 0.0 | 339,630.0 | 37,785.0 |
| Cadmium (CD_ACID) | 5,677 | 0.7 | 0.0 | 40.9 | 1.0 |
| Cadmium (Extractable) (CD_EDTA) | 5,655 | 0.5 | 0.0 | 85.0 | 3.0 |
| Cobalt (CO_ACID) | 5,677 | 10.6 | 0.0 | 567.0 | 13.7 |
| Cobalt (Extractable) (CO_EDTA) | 5,655 | 1.1 | 0.0 | 26.5 | 1.2 |
| Chromium (CR_ACID) | 5,677 | 38.9 | 0.0 | 2,339.8 | 43.7 |
| Copper (CU_ACID) | 5,677 | 22.6 | 0.0 | 1,507.7 | 36.8 |
| Copper (Extractable) (CU_EDTA) | 5,655 | 6.4 | 0.3 | 431.4 | 11.1 |
| Flouride (F_ACID) | 3,320 | 58.5 | 0.0 | 6,307.9 | 186.2 |
| Iron (FE_ACID) | 5,677 | 28,147.8 | 395.0 | 264,405.0 | 16,510.5 |
| Mercury (HG_ACID) | 2,159 | 0.1 | 0.0 | 2.4 | 0.2 |
| Potassium (K_ACID) | 5,677 | 4,727.7 | 60.0 | 23,905.0 | 2,700.2 |
| Potassium (Extractable) (K_NITRATE) | 5,609 | 182.0 | 6.0 | 2,776.0 | 151.6 |
| Magnesium (MG_ACID) | 5,677 | 3,648.1 | 0.0 | 62,690.0 | 3,284.1 |
| Magnesium (Extractable) (MG_NITRATE) | 5,609 | 146.0 | 1.0 | 1,601.0 | 147.5 |
| Manganese (MN_ACID) | 5,677 | 777.0 | 3.0 | 42,603.0 | 1,068.8 |
| Manganese (Extractable) (MN_EDTA) | 5,654 | 159.4 | 0.0 | 3,108.0 | 188.6 |
| Molybdenum (MO_ACID) | 4,417 | 0.9 | 0.0 | 56.3 | 2.0 |
| Sodium (NA_ACID) | 5,677 | 323.3 | 17.0 | 25,152.0 | 572.3 |
| Nickel (NI_ACID) | 5,677 | 25.4 | 0.0 | 1,350.2 | 29.2 |
| Nickel (Extractable) (NI_EDTA) | 5,655 | 1.6 | 0.1 | 73.2 | 2.0 |
| Phosphorus (P_ACID) | 5,677 | 792.1 | 41.0 | 6,273.0 | 433.9 |
| Phosphorus (Extractable) (P_OLSEN) | 5,604 | 27.4 | 0.0 | 534.0 | 25.5 |
| Lead (PB_ACID) | 5,677 | 73.3 | 0.0 | 17,365.0 | 280.6 |
| Lead (Extractable) (PB_EDTA) | 5,655 | 27.8 | 1.2 | 6,056.5 | 119.7 |
| Selenium (SE_ACID) | 2,729 | 0.6 | 0.0 | 22.8 | 0.8 |
| Strontium (SR_ACID) | 5,677 | 42.3 | 0.0 | 1,445.0 | 67.8 |
| Vanadium (V_ACID) | 4,428 | 41.0 | 0.0 | 854.4 | 33.9 |
| Zinc (ZN_ACID) | 5,677 | 90.2 | 0.0 | 3,648.0 | 104.4 |
| Zinc (Extractable) (ZN_EDTA) | 5,655 | 9.6 | 0.5 | 712.0 | 24.6 |

for units, see Analyses Definitions (p50)

## SOIL GUIDELINE VALUES (SGV)

Defra and the Environment Agency have produced soil guideline values (SGVs) as an aid to preliminary assessment of potential risk to human health from land that may be contaminated. SGVs represent ‘intervention values’, which, if exceeded, act as indicators of potential unacceptable risk to humans, so that more detailed risk assessment is needed.

The SGVs were derived using the Contaminated Land Exposure Assessment (CLEA) model for four land uses:

1. residential (with plant uptake / vegetable growing)
2. residential (without vegetable growing)
3. allotments
4. commercial / industrial

SGVs are only designed to indicate whether further site-specific investigation is needed. Where a soil guideline value is exceeded, it does not mean that there is necessarily a chronic or acute risk to human health.

The values presented in this report represent those from a number of sample points ( given in the "Samples" column in each table) providing local, regional and national background levels. Figures which appear in red indicate that a bulked sample from 20m surrounding a sample point, has at a past date, exceeded the SGV for the ‘residential with plant uptake’ land use.

It is always advisable to perform site specific investigations.

More details on all the SGVs can be found on the Environment Agency Website.

All units are mg/kg which is equivalent to parts per million (ppm)

| SUBSTANCE | RESIDENTIAL WITH PLANT UPTAKE | RESIDENTIAL WITHOUT PLANT UPTAKE | ALLOTMENTS | COMMERCIAL / INDUSTRIAL |
|---|---|---|---|---|
| LEAD | 450 | 450 | 450 | 750 |
| SELENIUM | 35 | 260 | 35 | 8000 |
| NICKEL | 50 | 75 | 50 | 5000 |
| MERCURY | 8 | 15 | 8 | 480 |
| CHROMIUM | 130 | 200 | 130 | 5000 |
| CADMIUM (pH 6) | 1 | 30 | 1 | 1400 |
| CADMIUM (pH 7) | 2 | 30 | 2 | 1400 |
| CADMIUM (pH 8) | 8 | 30 | 8 | 1400 |
| ARSENIC | 20 | 20 | 20 | 500 |

## ANALYSES DEFINITIONS

### PH (pH)
pH of soil measure after shaking 10ml of soil for 15 minutes with 25ml of water

### CARBON (Carbon)
Organic Carbon (% by wt) measured either by loss-on-ignition for soils estimated to contain more than about 20% organic carbon or by dichromate digestion.

### AL_ACID (Aluminium)
Total Aluminium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### AS_ACID (Arsenic)
Total Arsenic concentration (mg/kg) determined by Hydride Atomic Absorption Spectrometry (AAS), extracted into hydrochloric acid after digestion with nitric acid and ashing with magnesium nitrate

### BA_ACID (Barium)
Total Barium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### CA_ACID (Calcium)
Total Calcium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### CD_ACID (Cadmium)
Total Cadmium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### CD_EDTA (Cadmium Extractable)
Extractable Cadmium concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### CO_ACID (Cobalt)
Total Cobalt concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### CO_EDTA (Cobalt Extractable)
Extractable Cobalt concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### CR_ACID (Chromium)
Total Chromium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### CU_ACID (Copper)
Total Copper concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### CU_EDTA (Copper Extractable)
Extractable Copper concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### F_ACID (Flouride)
Flouride extracted with 1mol / l sulphuric acid and determined by Ion Selective Electrode (ISE)

### FE_ACID (Iron)
Total Iron concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### HG_ACID (Mercury)
Total Mercury concentration (mg/kg) determined by Hydride Atomic Absorption Spectrometry (AAS), digested in a nitric/sulphuric acid mixture

### K_ACID (Potassium)
Total Potassium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### K_NITRATE (Potassium Extractable)
Extractable Potassium concentration (mg/l) determined by shaking 10ml of air dry soil with 50ml of 1.0M ammonium nitrate for 30mins, filtering and then measuring the concentration by flame photometry

## ANALYSES DEFINITIONS continued

### MG_ACID (Magnesium)
Total Magnesium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### MG_NITRATE (Magnesium Extractable)
Extractable Magnesium concentration (mg/l) determined by shaking 10ml of air dry soil with 50ml of 1.0M ammonium nitrate for 30mins, filtering and then measuring the concentration by flame photometry

### MN_ACID (Manganese)
Total Manganese concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### MN_EDTA (Manganese Extractable)
Extractable Manganese concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### MO_ACID (Molybdenum)
Total Molybdenum concentration (mg/kg) determined by Atomic Adsorption Spectrometyr (AAS) in an aqua regia digest

### MO_EDTA (Molybdenum Extractable)
Extractable Molybdenum concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### NA_ACID (Sodium)
Total Sodium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### NI_ACID (Nickel)
Total Nickel concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### NI_EDTA (Nickel Extractable)
Extractable Nickel concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### P_ACID (Phosphorus)
Total Phosphorus concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### P_OLSON (Phosphorous Extractable)
Extractable Phosphorus concentration (mg/l) determined by shaking 5ml of air dry soil with 100ml of 0.5M sodium bicarbonate for 30mins at 20 deg.C, filtering and then measuring the absorbance at 880 nm colorimetrically with acid ammonium molybdate solution

### PB_ACID (Lead)
Total Lead concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### PB_EDTA (Lead Extractable)
Extractable Lead concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

### SE_ACID (Selenium)
Total Selenium concentration (mg/kg) determined by Hydride Atomic Absorption Spectrometry (AAS), extracted into hydrochloric acid after digestion with nitric acid and ashing with magnesium nitrate

### SR_ACID (Strontium)
Total Strontium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### V_ACID (Vanadium)
Total Vanadium concentration (mg/kg) determined by Atomic Adsorption Spectrometyr (AAS) in an aqua regia digest

### ZN_ACID (Zinc)
Total Zinc concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

### ZN_EDTA (Zinc Extractable)
Extractable Zinc concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

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To view the glossary visit: www.landis.org.uk/sitereporter/GLOSSARY.pdf

For a list of further reading visit: www.landis.org.uk/sitereporter/FURTHER_READING.pdf

For more information visit: www.landis.org.uk/reports

**GIS DATASETS:**
The GIS data used in the creation of this report is available to lease for use in projects.
To learn more about, or acquire the GIS datasets used in the creation of this report, please contact the National Soil Resources Institute:

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# Appendix A4 NSRI Soil Report – Section 7

# National Soil Resources Institute

## Soils Site Report

Full Soil Report

National Grid Reference: SH3591792942
Easting: 235917
Northing: 392942
Site Area: 5km x 5km

Prepared by
authorised user:
**Joanne Jeffreys**
Jacobs

2 March 2015

# Citations

Citations to this report should be made as follows:

National Soil Resources Institute (2015) Full Soils Site Report for location 235917E, 392942N, 5km x 5km, National Soil Resources Institute, Cranfield University. Accessed via https://www.landis.org.uk/sitereporter/.

# Disclaimer

# About this report

This Soils Site Report identifies and describes the properties and capacities of the soil at your specified location as recorded in the 1:250,000 scale National Soil Map for England and Wales. It has been produced by Cranfield University's National Soil Resources Institute.

The National Soil Map represents the most accurate comprehensive source of information about the soil at the national coverage in England and Wales. It maps the distribution of soil mapping units (termed soil associations) which are defined in terms of the main soil types (or soil series) that were recorded for each soil association during field soil survey. Each soil association is named after its principal soil series and these bear the location name from where they were first described (e.g. Windsor). Each of these soil associations have differing environmental characteristics (physical, chemical and biological) and it is by mapping these properties that the range of thematic maps in this report have been produced.

Soil types and properties vary locally, as well as at the landscape scale. It is not possible to identify precisely the soil conditions at a specific location without first making a site visit. We have therefore provided you with information about the range of soil types we have identified at and around your selected location. Schematic diagrams are also provided to aid accurate identification of the soil series at your site.

Whilst an eight-figure national grid reference should be accurate to within 100m, a single rural Postcode can cover a relatively large geographical area. Postcodes can therefore be a less precise basis for specifying a location. The maps indicate the bounded area the reports relate to.

Your Soils Site Report will enable you to:

- identify the soils most likely to be present at and immediately around your specified location;
- understand the patterns of soil variation around your location and how these correlate with changes in landscape;
- identify the nature and properties of each soil type present within the area;
- understand the relevant capacities and limitations of each of the soils and how these might impact on a range of factors such as surface water quality.

Provided that this Soils Site Report is not modified in any way, you may reproduce it for a third-party.

For more information visit [www.landis.org.uk/reports](http://www.landis.org.uk/reports)

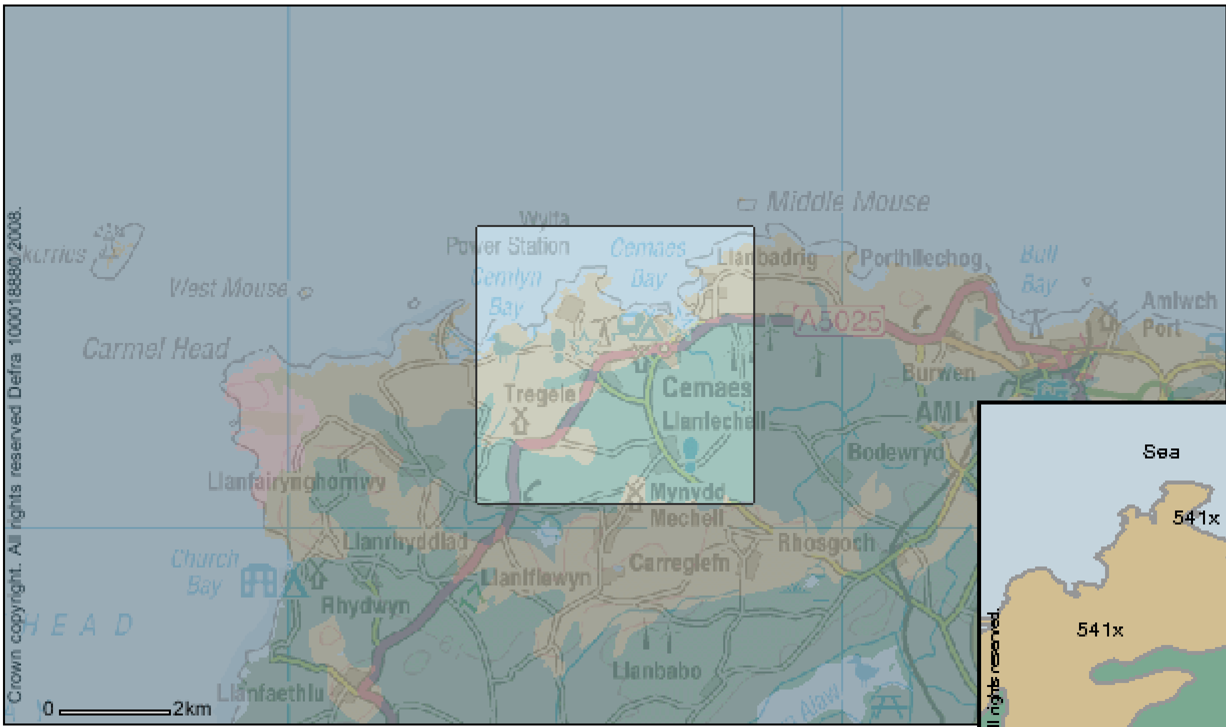
# Table of Contents

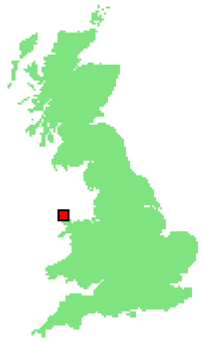
# 1. SOIL THEMATIC MAPS

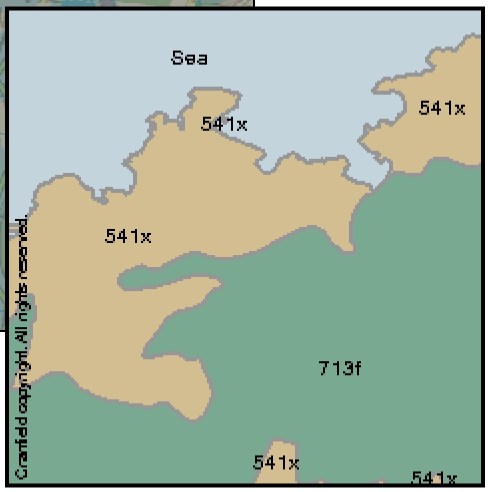
This section contains a series of maps of the area surrounding your selected location, based on the 1:250,000 scale National Soil Map, presenting a number of thematic maps relating to the characteristics of the soils. These provide an overview of the nature and condition of the local soil conditions. It is these conditions that may be used to infer the response of an area to certain events (with the soil as a receptor), such as pollution contamination from a chemical spill, or an inappropriate pesticide application and the likelihood of these materials passing though the soil to groundwater. Other assessments provide an insight into the way a location may impact, by corrosive attack or ground movement, upon structures or assets within the ground, for example building or engineering foundations or pipes and street furniture.

Soil is a dynamic environment with many intersecting processes, chemical, physical and biological at play. Even soils 'sealed' over by concrete and bitumen are not completely dormant. The way soils respond to events and actions can vary considerably according to the properties of the soil as well as other related factors such as land-use, vegetation, topography and climate. There are many threats facing our national soil resource today and forthcoming legislation such as the proposed Soil Framework Directive (SFD) (COM(2006) 232) will seek to identify measures aimed towards soil protection and ensuring the usage of soils in the most sustainable way. This report is therefore a useful snapshot of the soil properties for your given area, providing a summary of a broad range of ground conditions.

## 1a. SOILS - SPATIAL DISTRIBUTION





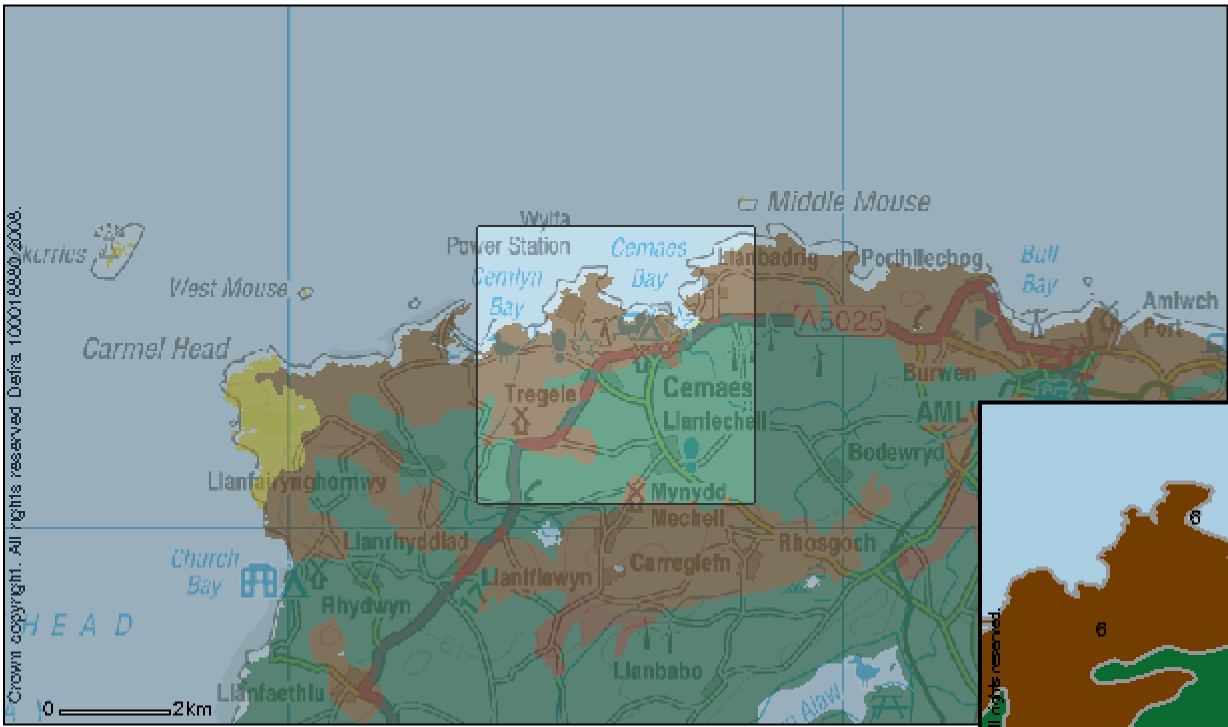

### SOIL ASSOCIATION MAP UNIT KEY

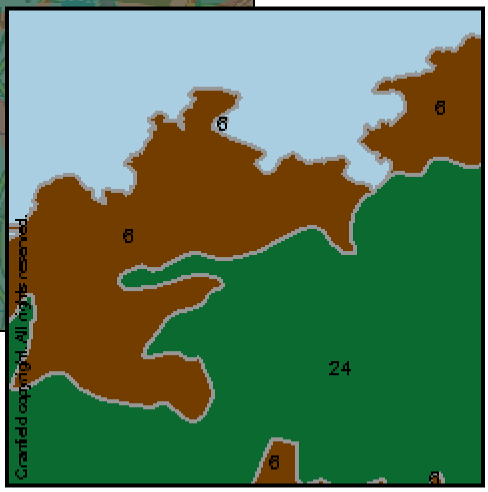
**EAST KESWICK 1** 541x
*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

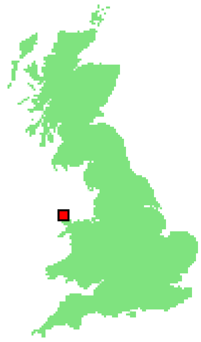
**BRICKFIELD 2** 713f
*Slowly permeable seasonally waterlogged fine loamy soils.*

Soil associations represent a group of soil series (soil types) which are typically found occurring together, associated in the landscape (Avery, 1973; 1980; Clayden and Hollis, 1984). Soil associations may occur in many geographical locations around the country where the environmental conditions are comparable. For each of these soil associations, a collection of soil types (or soil series) are recorded together with their approximate proportions within the association. Soil associations have codes as well as textual names, thus code '554a' refers to the 'Frilford' association. Where a code is prefixed with 'U', the area is predominantly urbanised (e.g. 'U571v'). The soil associations for your location, as mapped above, are described in more detail in Section 2: Soil Association Descriptions.

## 1b. HYDROLOGY OF SOIL TYPE (HOST)



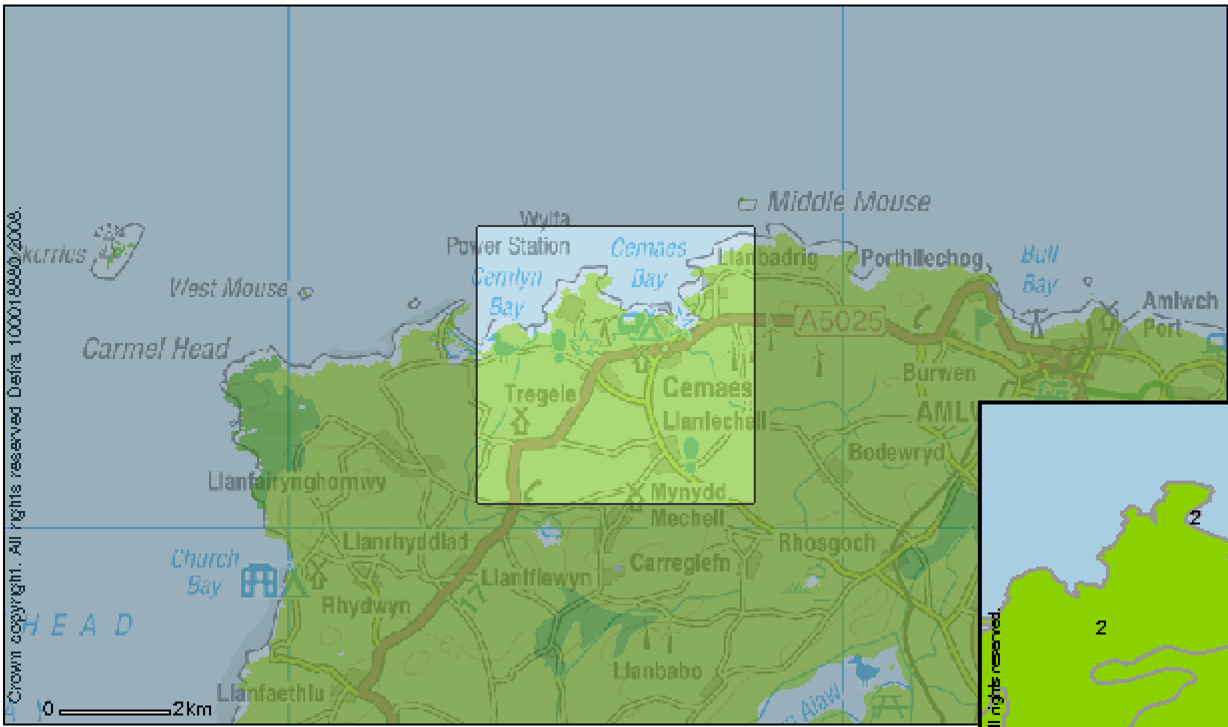
### HYDROLOGY OF SOIL TYPE KEY

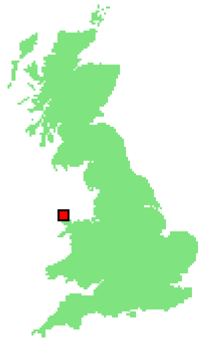
- 24 - *Slowly permeable, seasonally waterlogged soils over slowly permeable substrates with negligible storage capacity*
- 6 - *Free draining permeable soils in unconsolidated loams or clays with low permeability and storage capacity*

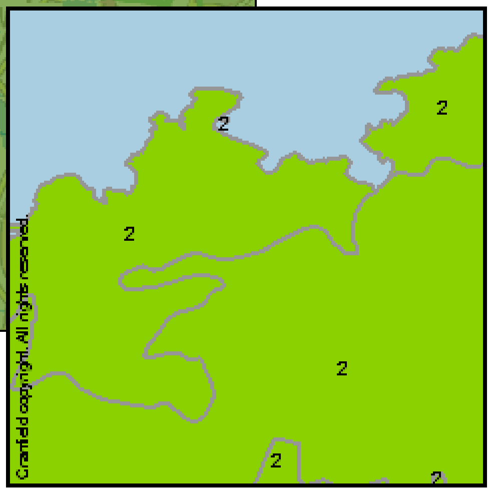
HOST CLASS DESCRIPTION

The Hydrology of Soil Types (HOST) classification describes the dominant pathways of water movement through the soil and, where appropriate, the underlying substrate. Eleven drainage models are defined according to the permeability of the soil and its substrate and the depth to a groundwater table, where one is present (Boorman et al,1995). These are further subdivided into 29 HOST classes to which all soil series have been assigned. These classes identify the way soil water flows are partitioned, with water passing over, laterally through, or vertically down the soil column. Analysis of the river hydrograph and the extent of soil series for several hundred gauged catchments allowed mean values for catchment hydrological variables to be identified for each HOST class, The HOST classification is widely used to predict river flows and the frequency and severity of flood events and also to model the behaviour of diffuse pollutants (Hollis et al, 1995).

## 1c. GROUND MOVEMENT POTENTIAL






## GROUND MOVEMENT POTENTIAL KEY

- 1 - *Very low*
- 2 - *Low*
- 3 - *Moderate*
- 4 - *High*
- 5 - *Very high*

* If a High class is starred, a 'Very High' ground movement potential is likely to be achieved if these soils are drained to an effective depth of at least two metres.

### GROUND MOVEMENT POTENTIAL DESCRIPTION

Clay-related ground movement is the most widespread cause of foundation failure in the UK and is linked to seasonal swelling and shrinkage of the clay. The content of clay within the soils of your selected area has therefore a direct bearing upon the likelihood of ground movement.

Among the inorganic particles that constitute the solid component of any soil, clay particles are the smallest and defined as being <0.002 mm - equivalent spherical diameter (esd) in size. Clay particles occur in most kinds of soil but they only begin to exert a predominant influence on the behaviour of the whole soil where there is more than 35 per cent (by weight) of clay-sized material present.

Because clay particles are very small and commonly platy in shape they have an immense surface area onto which water can be attracted, relative to the total volume of the soil material. In addition to surface attraction or inter-crystalline absorption of water, some clay minerals, those with three layers of atoms (most other kinds of clay have only two layers of atoms) are able to absorb and hold additional water between these layers. It is these types of clay mineral, which are widespread in British soils and commonly known as *smectites* that have the greatest capacity to shrink and swell.

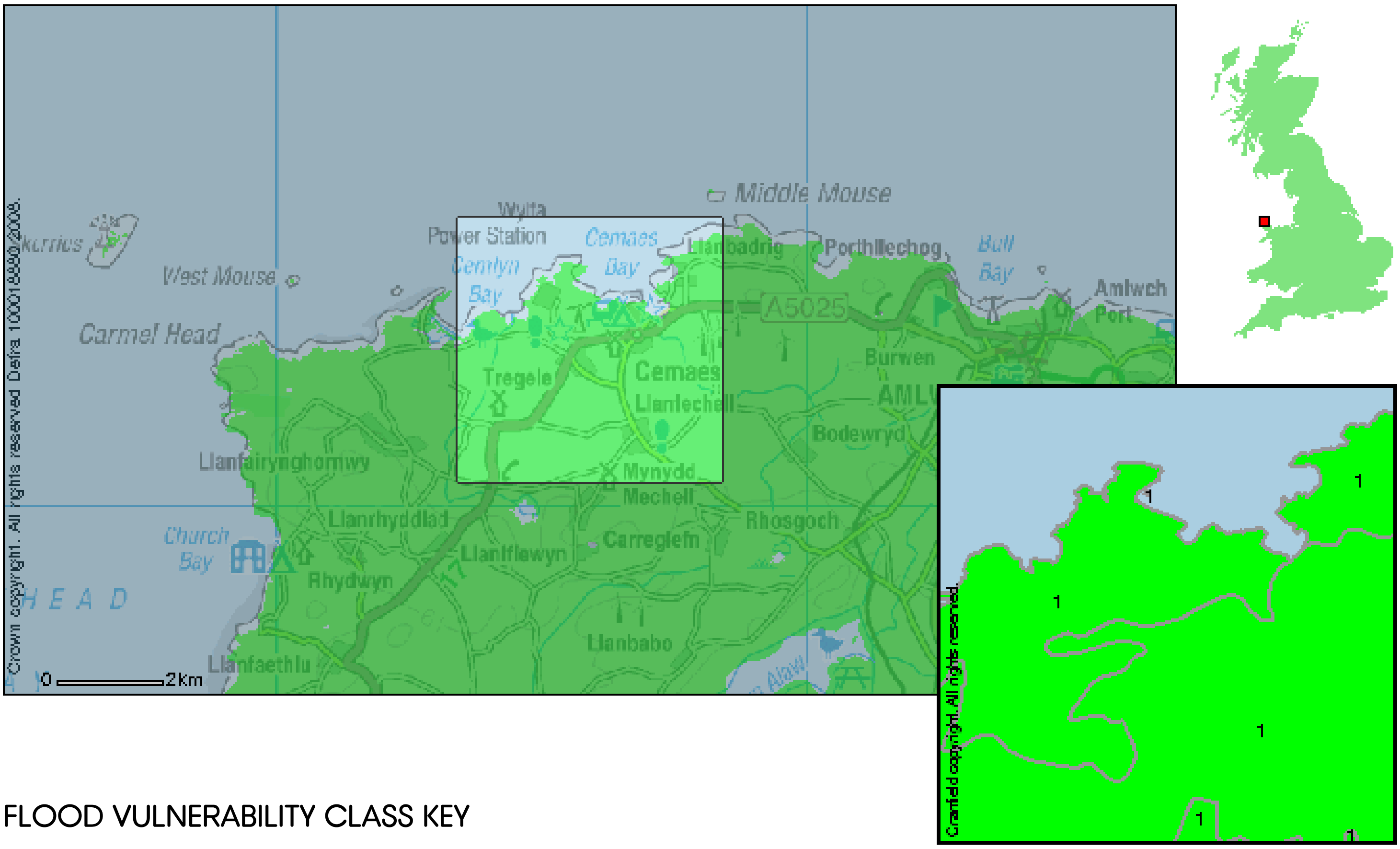
In a natural undisturbed condition, the moisture content of deep subsoil clay does not change greatly through the year and consequently there are no changes in volume leading to shrinkage and swelling. However, when clays are exposed at or near the ground surface and especially when vegetation is rooting in them seasonal moisture and volume changes can be dramatic. Plants and trees transpire moisture from the soil to support their growth and transfer necessary nutrients into their structures. Surface evaporation

also takes place from soil and plant structures, and the combination of evaporation from surfaces and transpiration by plants and trees is termed *evapotranspiration*. Thus, the layer of soil material down to 2m depth into which plants will root is critical when assessing the vulnerability of land to subsidence.

Whenever soil moisture is continuously being replenished by rainfall, the soil moisture reserves will be unaffected by the removal of moisture by plants as there is no net loss. However, in many parts of Britain, particularly in the south and east, summer rainfall is small and is exceeded by evapotranspiration. Water reserves are then not sufficiently replenished by rainfall and so a soil moisture deficit develops. The water removed from a clayey soil by evapotranspiration leads to a reduction in soil volume and the consequent shrinkage causes stress in the soil materials leading in turn to stress on building foundations that are resting in the soil (Hallett, et al, 1994).

The foundations themselves may then move and thus cause damage to building structures. This problem can be exacerbated by the fact that the soil beneath the structure may not dry out uniformly, so that any lateral pressure exerted on the building foundation is made effectively greater. This assessment identifies the likelihood of soil conditions being prone to ground movement given these other factors.

## 1d. FLOOD VULNERABILITY




## FLOOD VULNERABILITY CLASS KEY

0 - *Major risk*

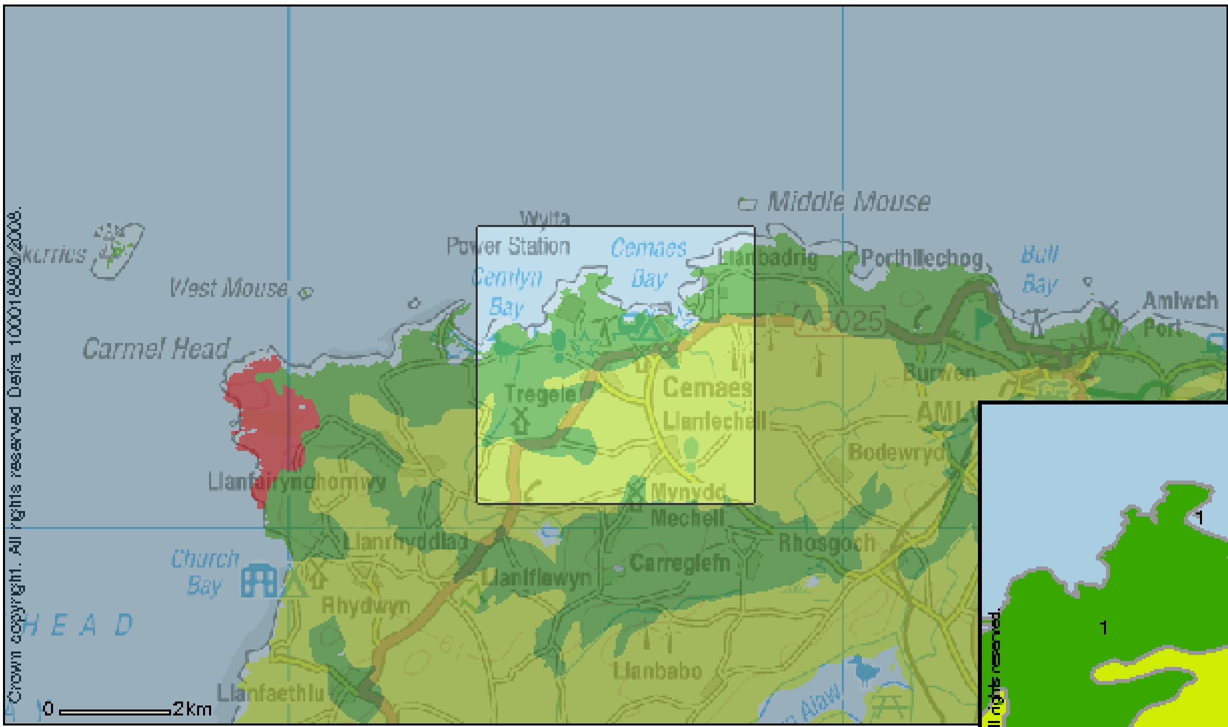
1 - *Minor risk*

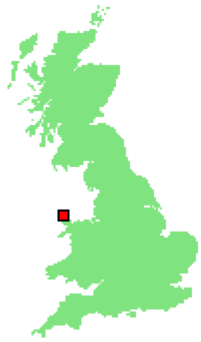
FLOOD VULNERABILITY DESCRIPTION

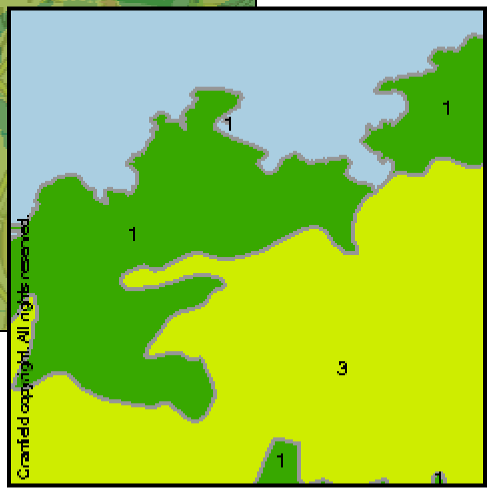
The inundation of properties by flood water can occur in a number of circumstances. Surface run-off can collect on low-lying land from upslope following heavy rainfall. More commonly rivers, lakes and/or the sea extend beyond their normal limits as a result of prolonged or intense rainfall, unusually high tides and/or extreme wind events. Water damage to properties and their contents is compounded by the deposition of sediment suspended in the flood waters. The spatial distribution of such waterborne sediment (or alluvium as defined in soil science) is one basis upon which land that has been subject to historical flooding can be mapped, and this forms a basis for present-day flooding risk assessment.

Both riverine and marine alluvium are identified as distinct soil parent materials within the British soil classifications. Combining soil map units that are dominated by soil series developed in alluvium across Great Britain identifies most of the land that is vulnerable to flooding. This assessment does not account for man-made flood defence measures, showing instead the areas where once water has stood.

## 1e. RISK OF CORROSION TO FERROUS IRON






### RISK OF CORROSION TO FERROUS IRON KEY

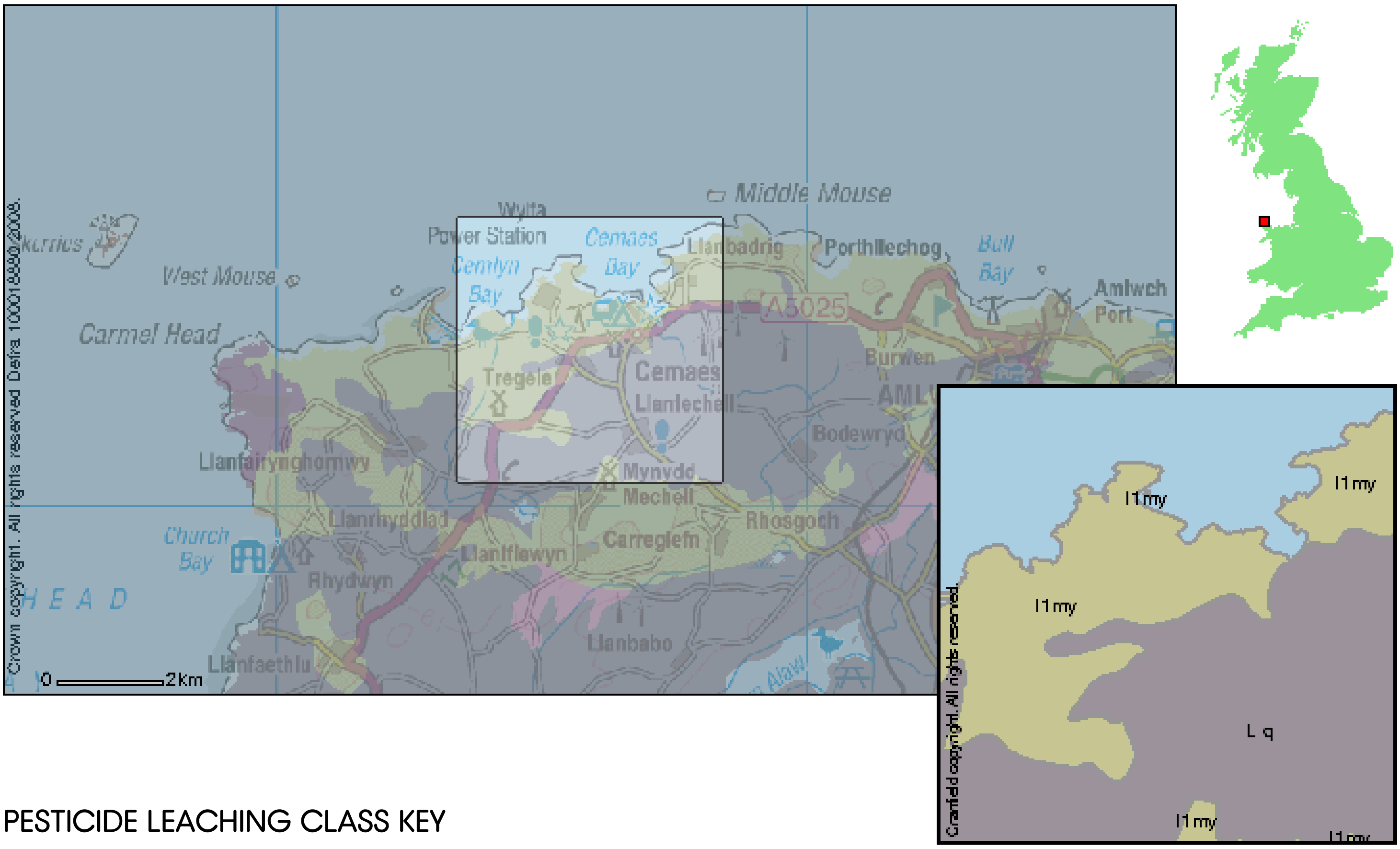
- 1 - *Non-aggressive*
- 2 - *Slightly Aggressive*
- 3 - *Moderately Aggressive*
- 4 - *Highly Aggressive*
- 5 - *Very highly Aggressive*
- 6 - *Impermeable Rock*

* If a class is starred, it is assumed that there are moderate amounts of sulphate in the soil. If there is abundant sulphate present, the soil may be one class more aggressive. Conversely, if there is very little sulphate, the soil may be one class less aggressive to buried ferrous iron.

### RISK OF CORROSION TO FERROUS IRON DESCRIPTION

Buried iron pipes and other infrastructure corrode at rates that are influenced by soil conditions (Jarvis and Hedges, 1994). Soil acidity, sulphide content, aeration and wetness all influence the corrosivity of the soil. These factors are used to map 5 major classes of relative corrosivity.

## 1f. PESTICIDE LEACHING RISK




## PESTICIDE LEACHING CLASS KEY

I1my - *Deep loamy soil; groundwater at moderate depth*

L q - *Impermeable soils over soft substrates of low or negligible storage capacity that sometimes conceal groundwater bearing rocks at depth*

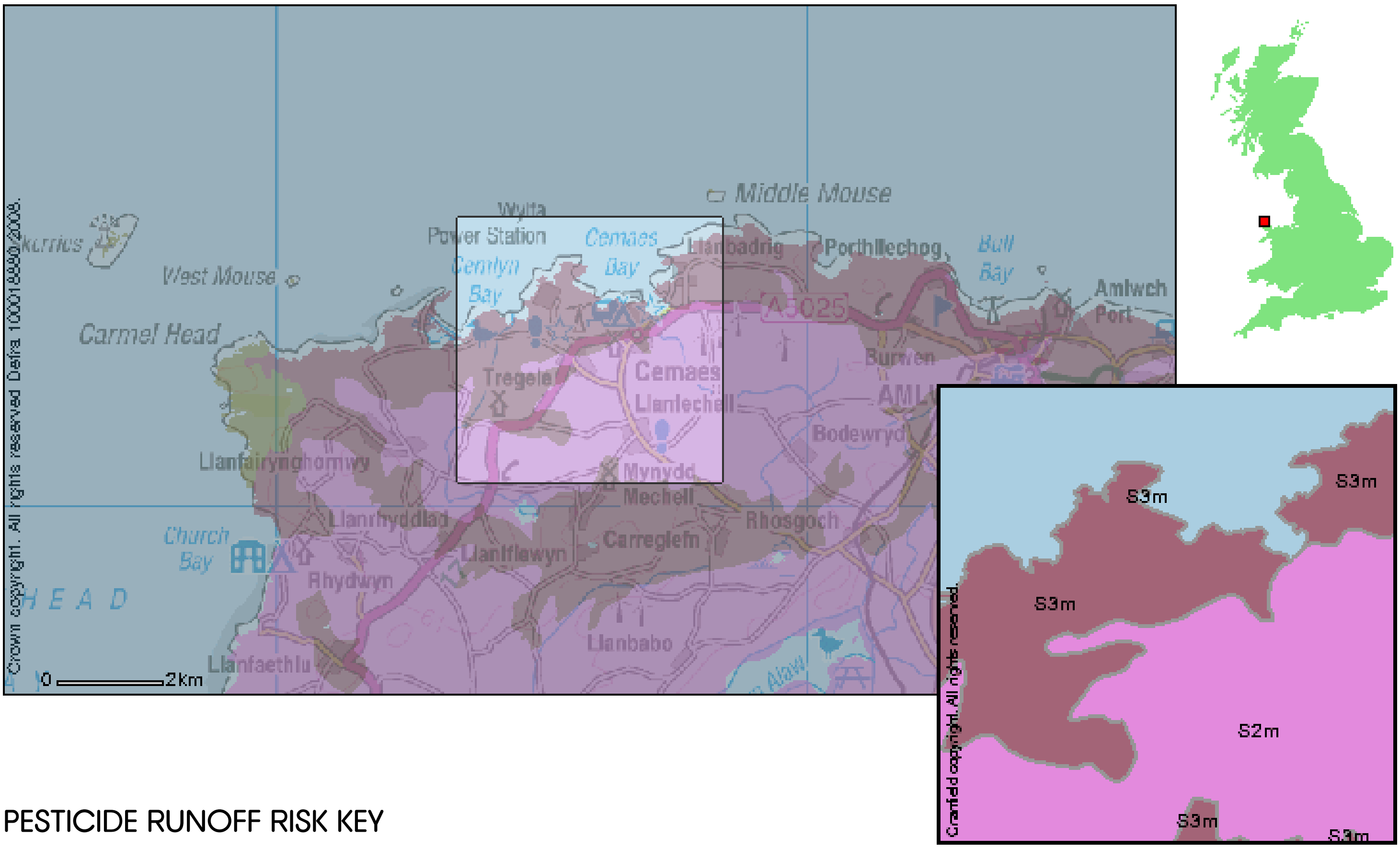
### PESTICIDE LEACHING CLASS DESCRIPTION

The natural permeability and water regime of soils are influential in determining the fate and behaviour of pesticides applied to the crop and soil surface (Hollis et al, 1995). A system of vulnerability assessment was devised as part of the national system for Policy and Practice for the Protection of Groundwater. This divided soils into three primary vulnerability classes.

H - Soils of high leaching capacity with little ability to attenuate non-adsorbed pesticide leaching which leave underlying groundwater vulnerable to pesticide contamination.
I – Soils of intermediate leaching capacity with a moderate ability to attenuate pesticide leaching.
L - Soils of low leaching capacity through which pesticides are unlikely to leach.

The primary classes have been further subdivided into nearly forty subclasses. These subclasses, with their descriptions, are mapped above. These classes do not account for differences in land cultivation, which can also have a significant impact on pesticide behaviour.

## 1g. PESTICIDE RUNOFF RISK



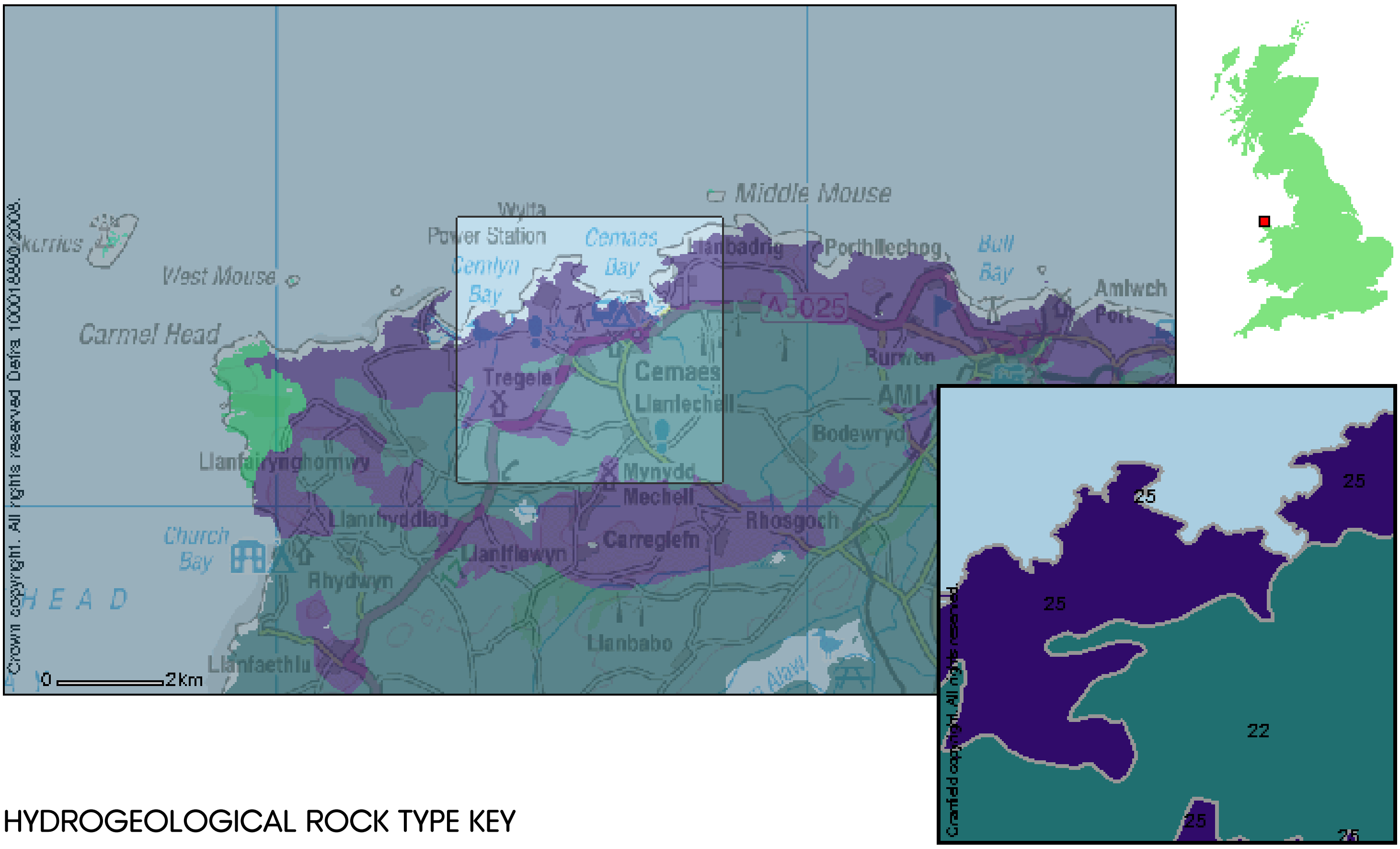

### PESTICIDE RUNOFF RISK KEY

- S2m - *Soils with high run-off potential but moderate adsorption potential*
- S3m - *Soils with moderate run-off potential and moderate adsorption potential*

PESTICIDE RUNOFF RISK DESCRIPTION

The physical properties and natural water regime of soils influence the speed and extent of lateral water movement over and through the soil at different depths (Hollis et al, 1995). At as result, soils can be classed according to the potential for pesticide run-off. Five runoff potential classes are identified for mineral soils and a further two for peat soils. The mineral soil classes are further subdivided according to the potential for pesticide adsorption.

## 1h. HYDROGEOLOGICAL ROCK TYPE




### HYDROGEOLOGICAL ROCK TYPE KEY

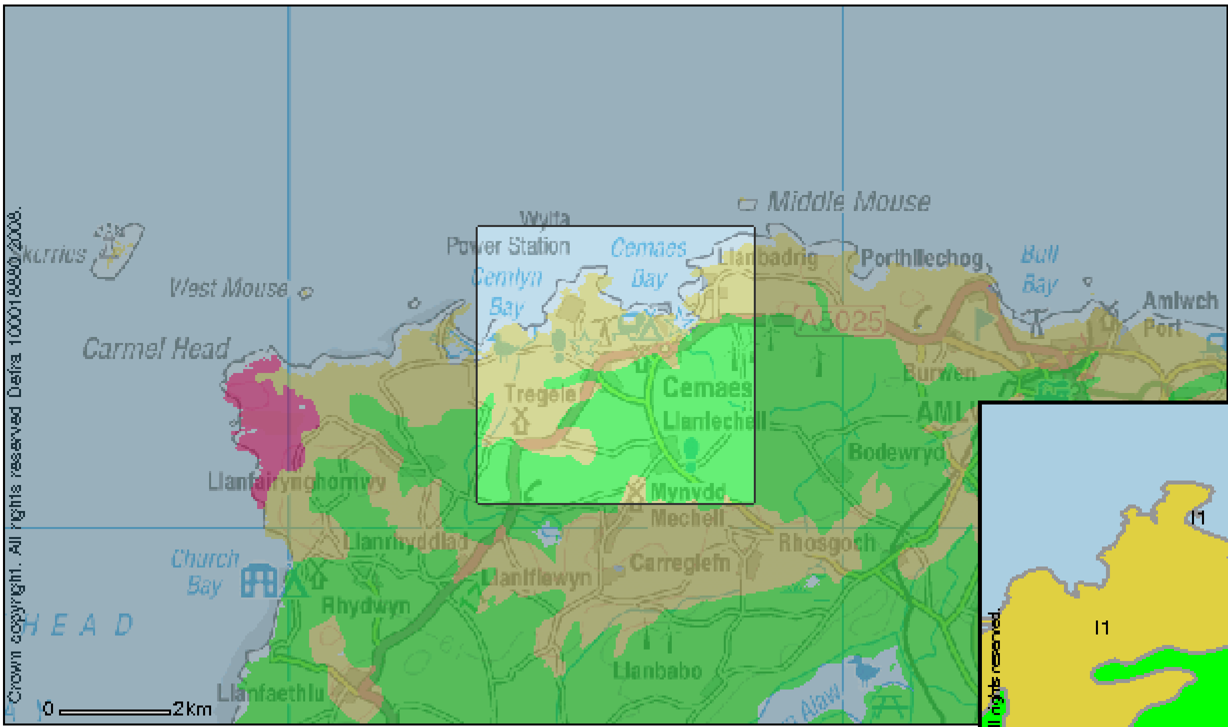
22 - *till and compact Head*

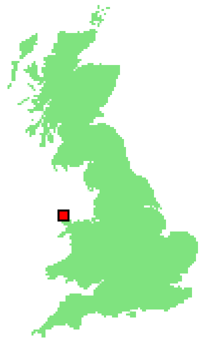
25 - *loamy drift*

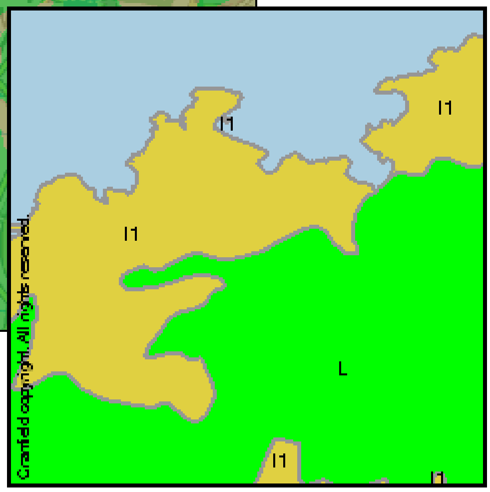
### HYDROGEOLOGICAL ROCK TYPE DESCRIPTION

The hydrogeological classification of the soil parent materials provides a framework for distinguishing between soil substrates according to their general permeability and whether they are likely to overlie an aquifer. Every soil series has been assigned one of the 32 substrate classes and each of these is characterised according to its permeability (being characterised as permeable, slowly permeable or impermeable). For further information, see Boorman et al (1995).

## 1i. GROUND WATER PROTECTION POLICY (GWPP) LEACHING





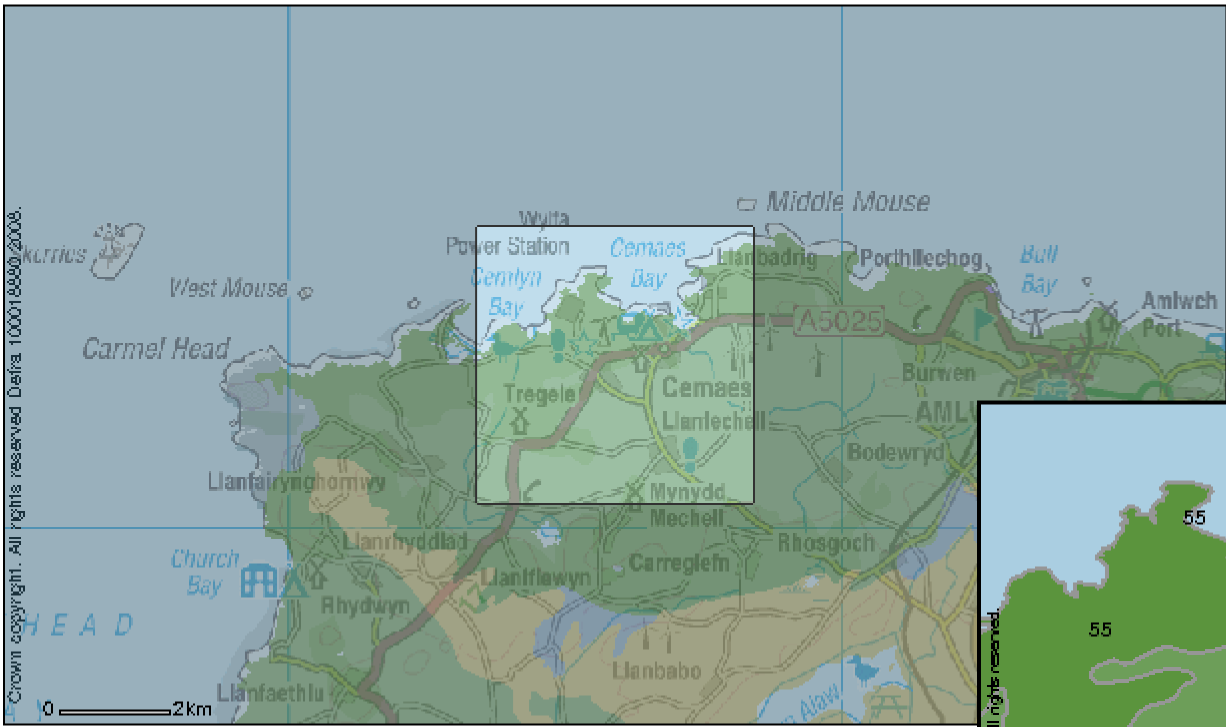

### GWPP LEACHING CLASS KEY

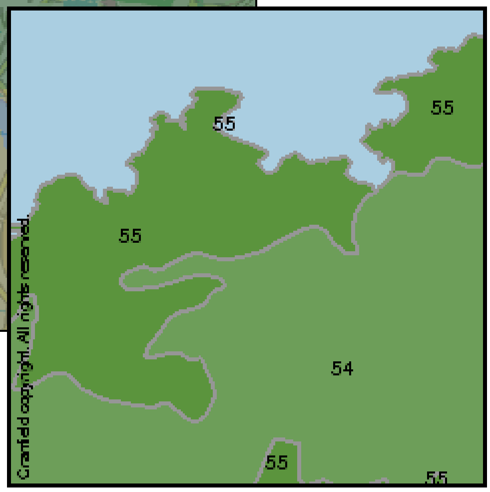
- I1 - *Soils of intermediate leaching potential which have a moderate ability to attenuate a wide range of diffuse source pollutants but in which it is possible that some non-adsorbed diffuse source pollutants and liquid discharges could penetrate the soil layer*
- L - *Soils in which pollutants are unlikely to penetrate the soil layer either because water movement is largely horizontal or because they have a large ability to attenuate diffuse source pollutants*

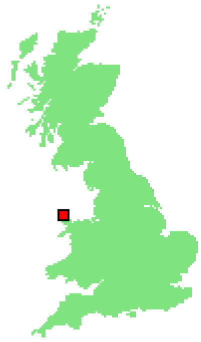
GWPP LEACHING CLASS DESCRIPTION

The Ground Water Protection Policy classes describe the leaching potential of pollutants through the soil (Hollis, 1991; Palmer et al, 1995). The likelihood of pollutants reaching ground water is described. Different classes of pollutants are described, including liquid discharges adsorbed and non-adsorbed pollutants.

## 1j. SOIL PARENT MATERIAL



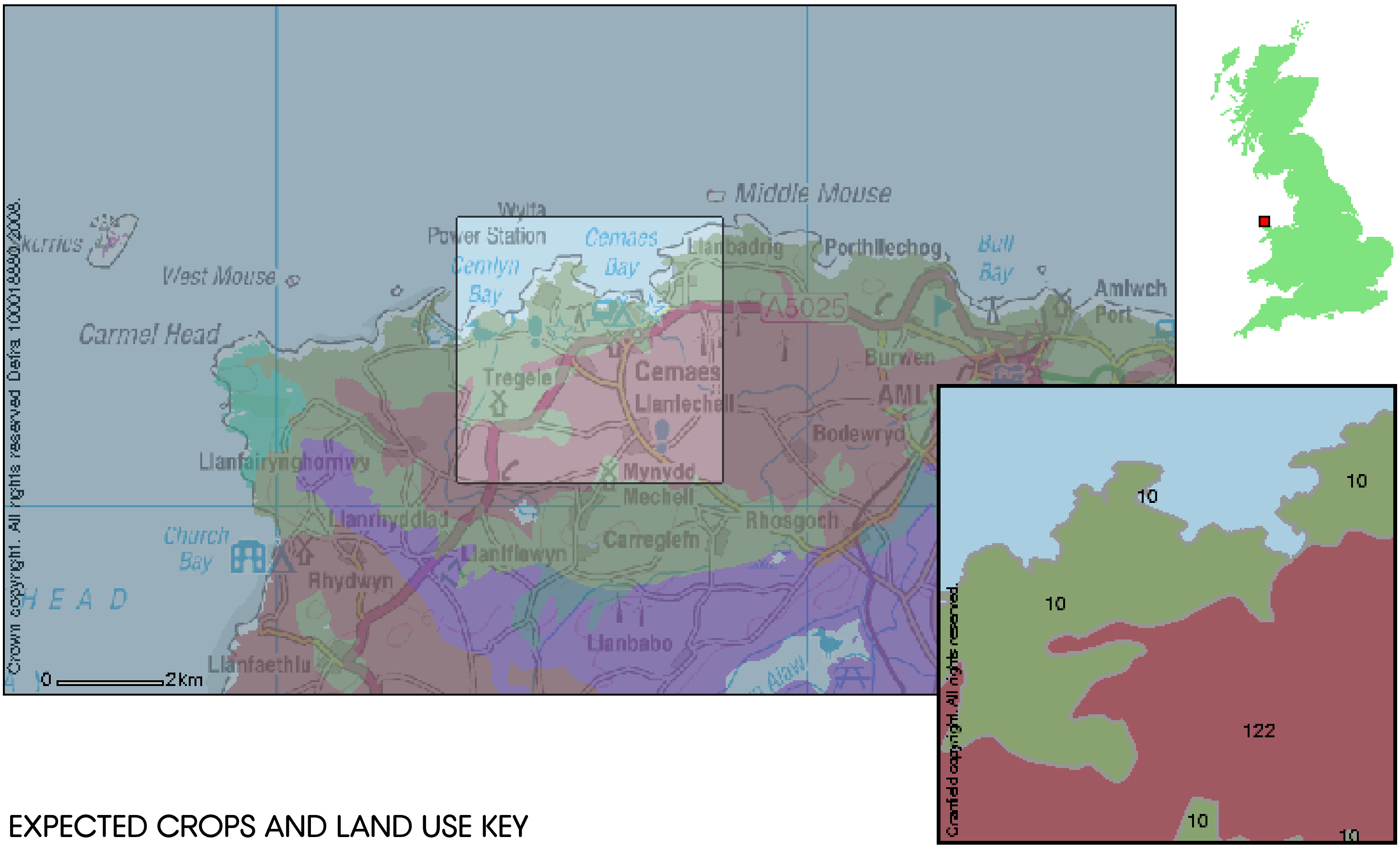
### SOIL PARENT MATERIAL KEY

- 54 - *Drift from Palaeozoic and Mesozoic sandstone and shale*
- 55 - *Drift from Palaeozoic sandstone and shale*

SOIL PARENT MATERIAL DESCRIPTION

Along with the effects of climate, relief, organisms and time, the underlying geology or 'parent material' has a very strong influence on the development of the soils of England and Wales. Through weathering, rocks contribute inorganic mineral grains to the soils and thus exhibit control on the soil texture. During the course of the creation of the national soil map, soil surveyors noted the parent material underlying each soil in England and Wales. It is these general descriptions of the regional geology which is provided in this map.

## 1k. EXPECTED CROPS AND LAND USE




## EXPECTED CROPS AND LAND USE KEY

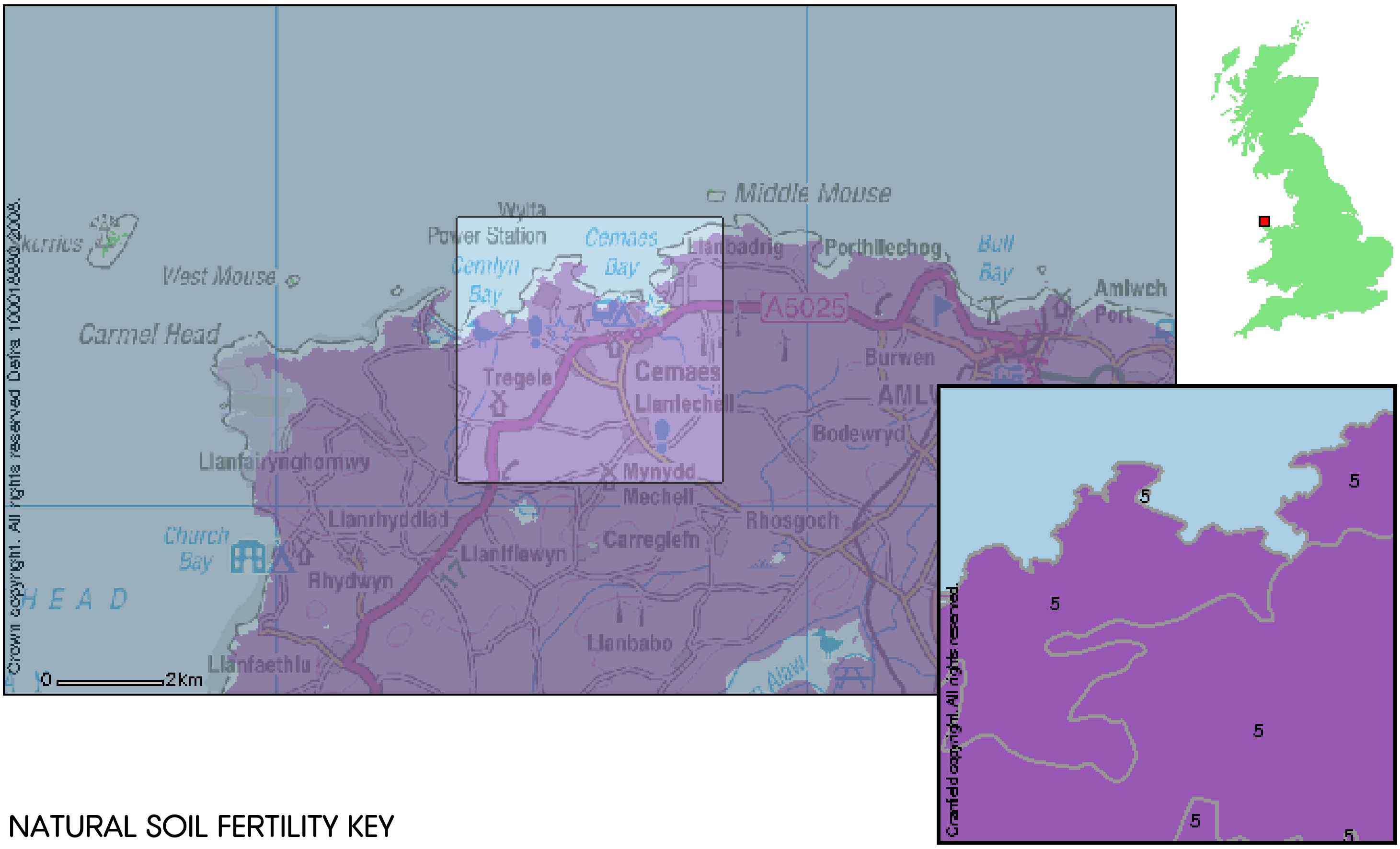
10 - *Cereals and grassland in the Northern Region; stock rearing on permanent grassland in Wales.*

122 - *Dairying and stock rearing on permanent or short term grassland; some cereals in drier areas.*

EXPECTED CROPS AND LAND USE DESCRIPTION

Individual soils are commonly associated with particular forms of land cover and land use. Whilst the soil surveyors were mapping the whole of England and Wales, they took careful note of the range of use to which the land was being put. This map shows the most common forms of land use found on each soil unit.

## 11. NATURAL SOIL FERTILITY



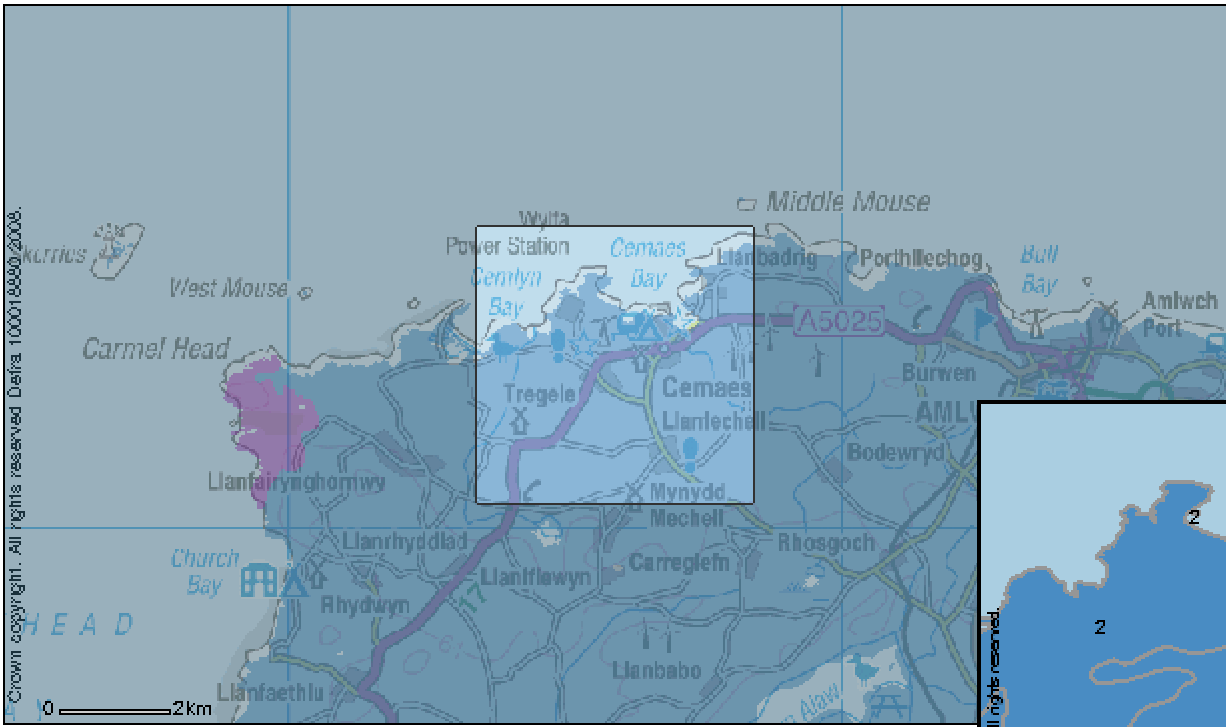

### NATURAL SOIL FERTILITY KEY

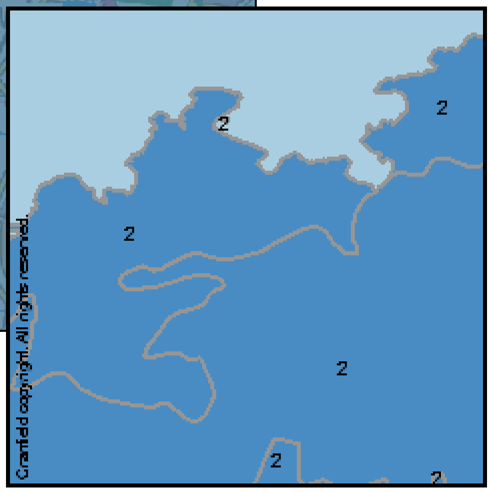
5 - *Low*

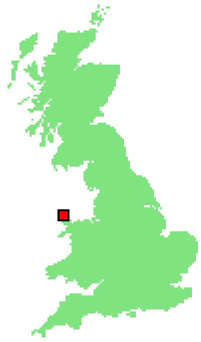
NATURAL SOIL FERTILITY DESCRIPTION

Soil fertility can be greatly altered by land management especially through the application of manures, lime and mineral fertilisers. What is shown in this map, however, is the likely natural fertility of each soil type. Soils that are very acid have low numbers of soil-living organisms and support heathland and acid woodland habitats. These are shown as of very low natural fertility. Soils identified as of low natural fertility are usually acid in reaction and are associated with a wide range of habitat types. The moderate class contains neutral to slightly acid soils, again with a wide range of potential habitats. Soil of high natural fertility are both naturally productive and able to support the base-rich pastures and woodlands that are now rarely encountered. Lime-rich soils contain chalk and limestone in excess, and are associated with downland, herb-rich pastures and chalk and limestone woodlands.

## 1m. SIMPLE TOPSOIL TEXTURE



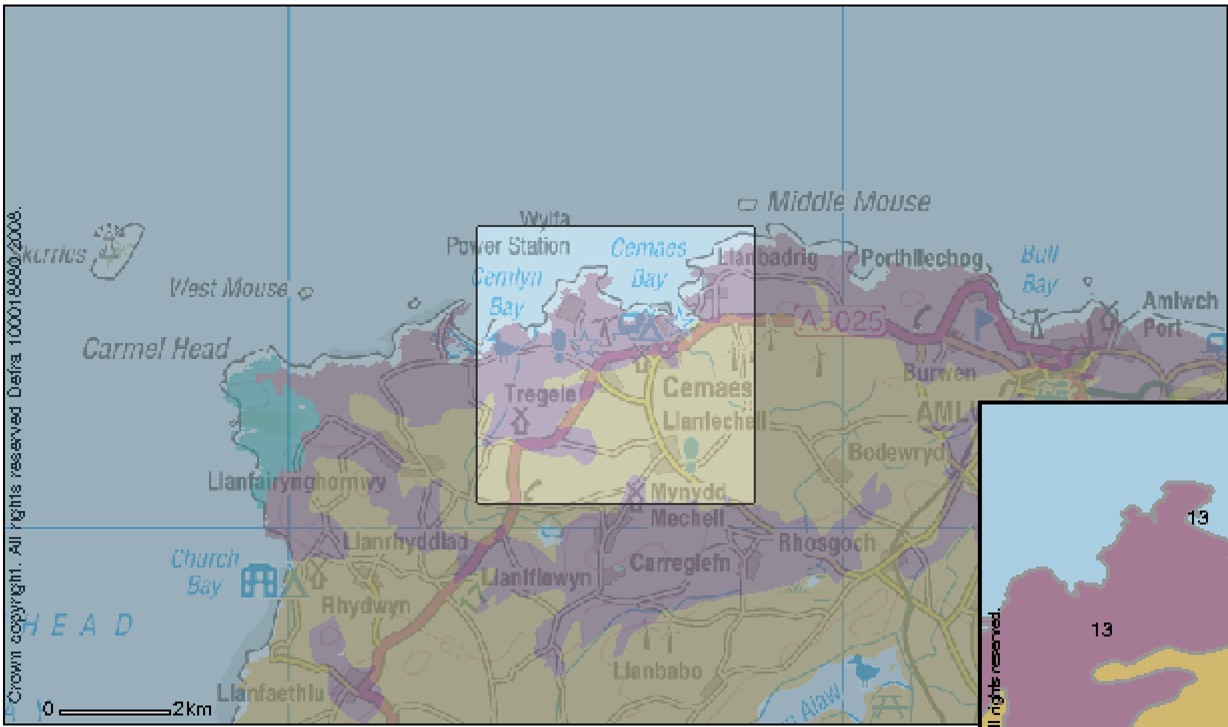
### SIMPLE TOPSOIL TEXTURE KEY

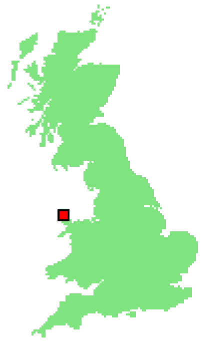
- 1 - *Clayey*
- 2 - *Loamy*
- 3 - *Peaty*
- 4 - *Sandy*

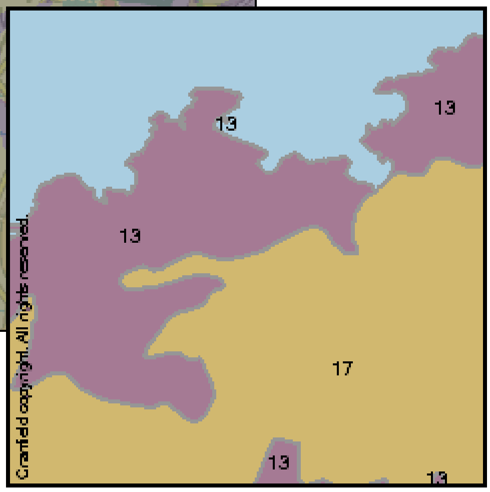
SIMPLE TOPSOIL TEXTURE DESCRIPTION

Soil texture is a term used in soil science to describe the physical composition of the soil in terms of the size of mineral particles in the soil. Specifically, we are concerned with the relative proportions of sand, silt and clay. Soil texture can vary between each soil layer or horizon as one moves down the profile. This map indicates the soil texture group of the upper 30 cm of the soil. 'Light' soils have more sand grains and are described as sandy, while 'heavy' soils have few sand grains but a lot of extremely small particles and are described as clayey. Loamy soils have a mix of sand, silt and clay-sized particles and are intermediate in character. Soils with a surface layer that is dominantly organic are described as Peaty. A good understanding of soil texture can enable better land management.

## 1n. TYPICAL HABITATS






## TYPICAL HABITATS KEY

- 13 - *Neutral and acid pastures and deciduous woodlands; acid communities such as bracken and gorse in the uplands*
- 17 - *Seasonally wet pastures and woodlands*

TYPICAL HABITATS DESCRIPTION

There is a close relationship between vegetation and the underlying soil. Information about the types of broad habitat associated with each soil type is provided in this map. Soil fertility, pH, drainage and texture are important factors in determining the types of habitats which can be established. Elevation above sea level and sometimes even the aspect - the orientation of a hillslope - can affect the species present. This map does not take into account the recent land management or any urban development, but provides the likely natural habitats assuming good management has been carried out.

## 2. SOIL ASSOCIATION DESCRIPTIONS

The following pages describe the following soil map units, (soil associations), in more detail.

**EAST KESWICK 1** 541x

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

**BRICKFIELD 2** 713f

*Slowly permeable seasonally waterlogged fine loamy soils.*

The soil associations are described in terms of their texture and drainage properties and potential risks may be identified. The distribution of the soils across England and Wales are provided. Further to this, properties of each association's component soil series are described in relation to each other. Lastly, schematic diagrams of each component series are provided for greater understanding and in-field verification purposes.

# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

**a. General Description**
Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging. Some coarse loamy soils affected by groundwater.
The major landuse on this association is defined as cereals and grassland in the northern region; stock rearing on permanent grassland in wales.

**b. Distribution (England & Wales)**
The EAST KESWICK 1 association covers 804km² of England and Wales which accounts for 0.53% of the landmass. The distribution of this association is shown in Figure 1. Note that the yellow shading represents a buffer to highlight the location of very small areas of the association.

**c. Comprising Soil Series**
Multiple soil series comprise a soil association. The soil series of the EAST KESWICK 1 association are outlined in Table 1 below. In some cases other minor soil series are present at a particular site, and these have been grouped together under the heading 'OTHER'. We have endevoured to present the likelihood of a minor, unnamed soil series occuring in your site in Table 1.

Schematic diagrams of the vertical soil profile of the major constituent soil series are provided in Section D to allow easier identification of the particular soil series at your site.

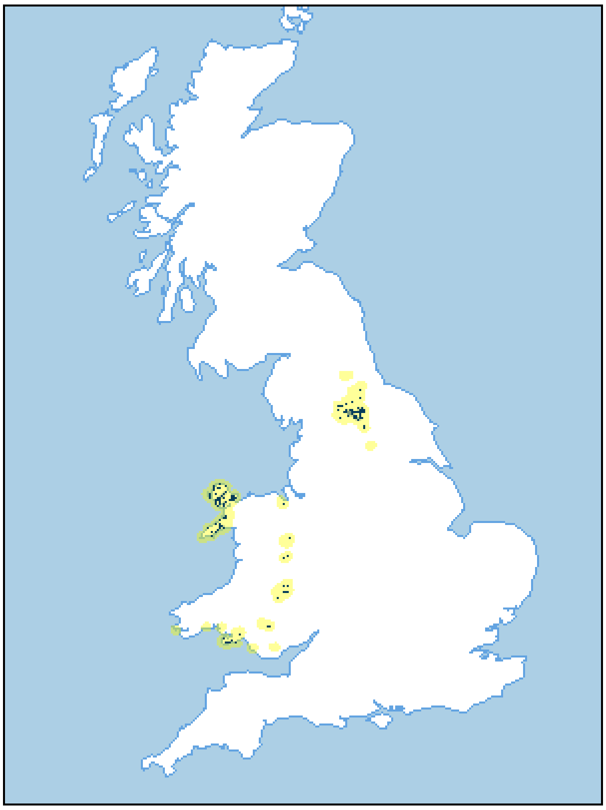


Figure 1. Association Distribution

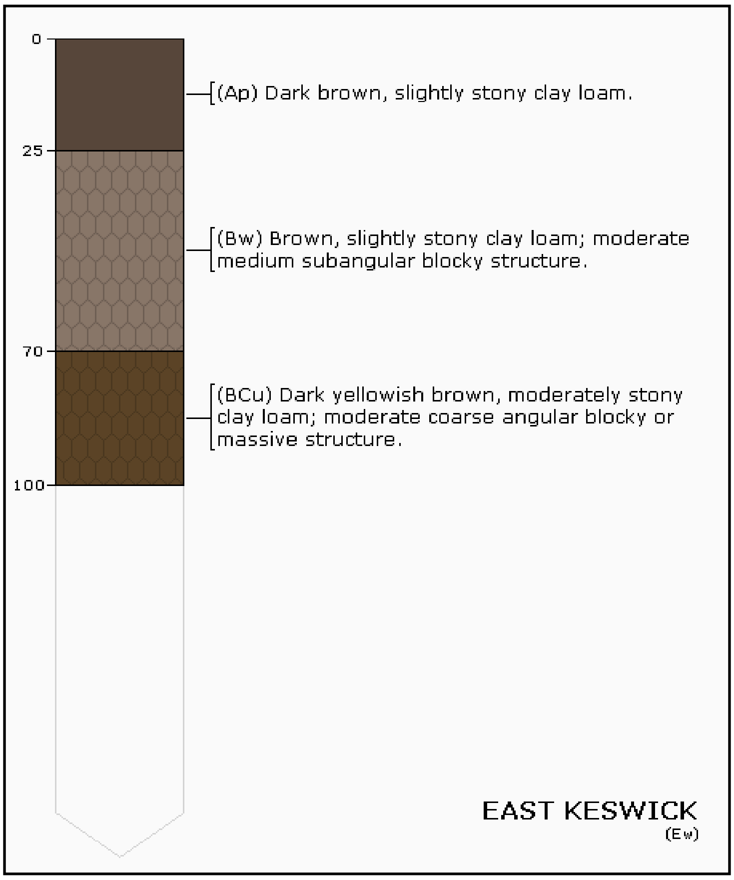
| Soil Series | Description | Area % |
|---|---|---|
| EAST KESWICK (Ew) | medium loamy drift with siliceous stones | 45% |
| NERCWYS (Nc) | medium loamy drift with siliceous stones | 30% |
| ARROW (aO) | light loamy drift with siliceous stones | 10% |
| OTHER | other minor soils | 15% |

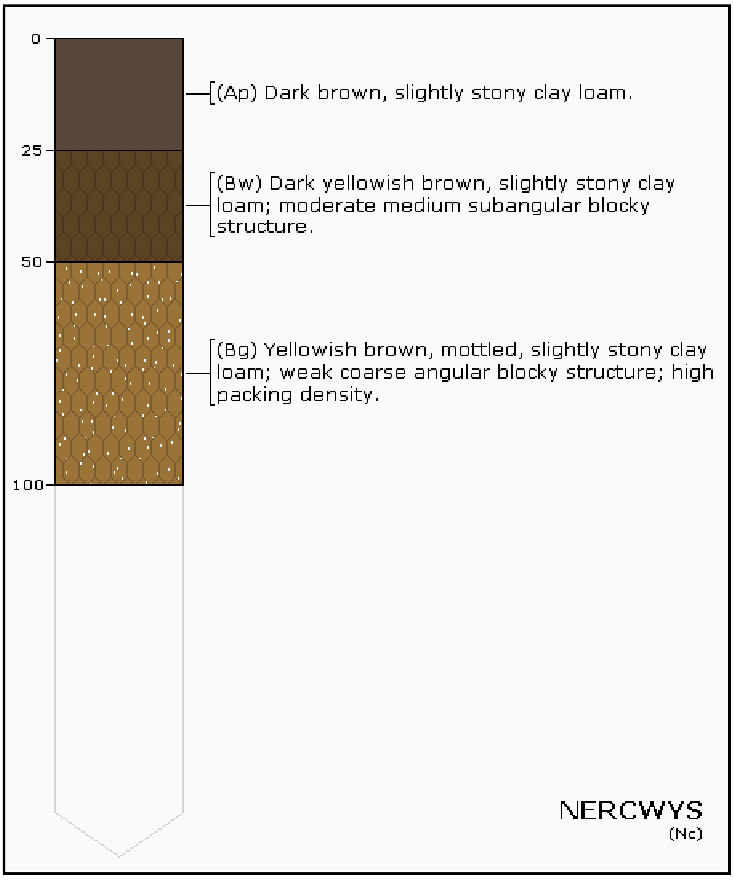
Table 1. The component soil series of the EAST KESWICK 1 soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

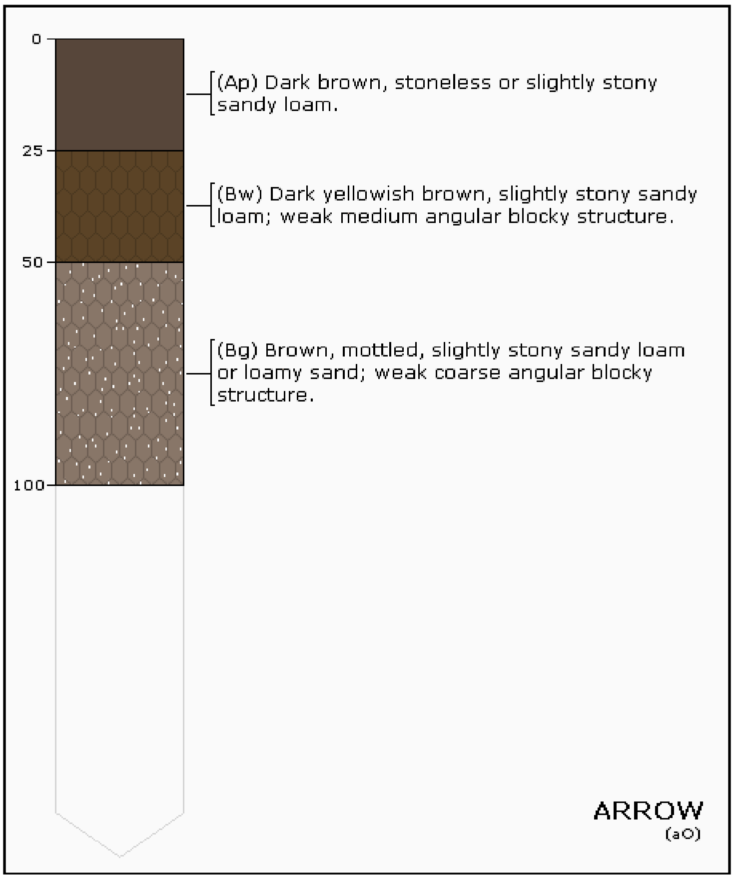
# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

## d. EAST KESWICK 1 Component Series Profiles



# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

## e. Soil Properties

This section provides graphical summaries of selected attribute data available for the component series in this association. The blue bars of the graphs presented in this section describe the range of property values for all soils across England and Wales. Superimposed on these graphs are the values for the component soil series in this association. This has been done to provide the reader with an understanding of where each property for each series sits within the national context.

| Soil Series | Description | Area % |
|---|---|---|
| EAST KESWICK (Ew) | medium loamy drift with siliceous stones | 45% |
| NERCWYS (Nc) | medium loamy drift with siliceous stones | 30% |
| ARROW (aO) | light loamy drift with siliceous stones | 10% |
| OTHER | other minor soils | 15% |

Table 1. The component soil series of the EAST KESWICK 1 soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

## e(i). Soil Depth Information and Depths to Important Layers

*Depth to rock* A mean depth to bedrock or very stony rubble which has been assigned to each soil series based on observed and recorded soil profiles.

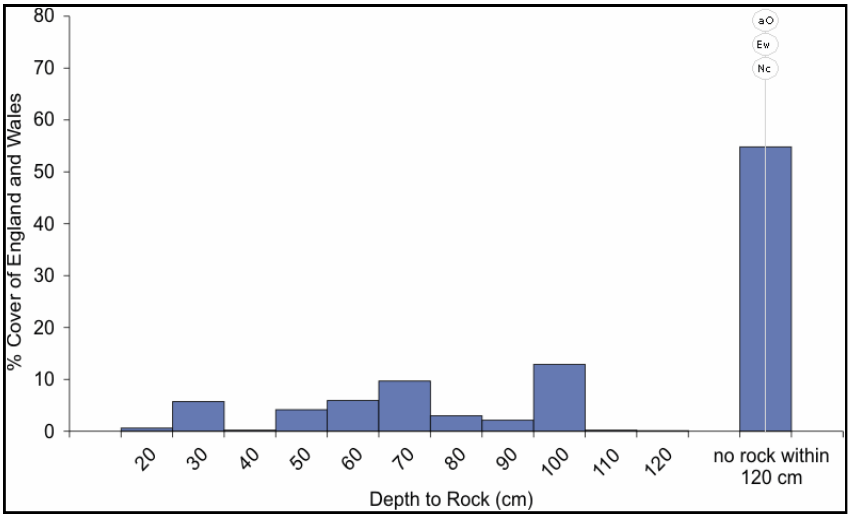



Figure 2. Depth of soil to Rock

*Depth to gleying*, the presence of grey and ochreous mottles within the soil, is caused by intermittent waterlogging. A mean depth to gleying has been assigned to each soil series based on observed and recorded soil profiles. The definition of a gleyed layer is designed to equate with saturation for at least 30 days in each year or the presence of artificial drainage.

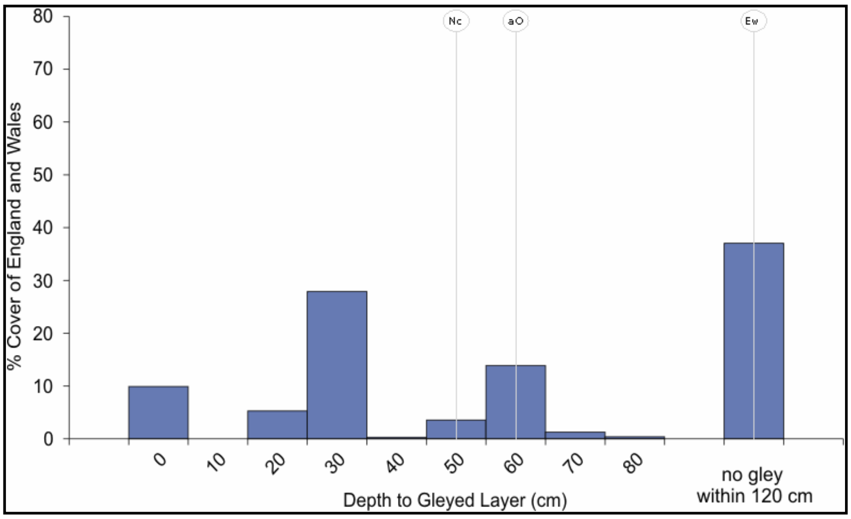



Figure 3. Depth of Soil to Gleying

# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

## e(i). Soil Depth Information and Depths to Important Layers continued

*Depth to slowly permeable layer (downward percolation)* A mean depth to a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede downward percolation of excess soil water. This causes periodic saturation in the overlying soil, reduced storage capacity and therefore increased hydrological response to rainfall events.

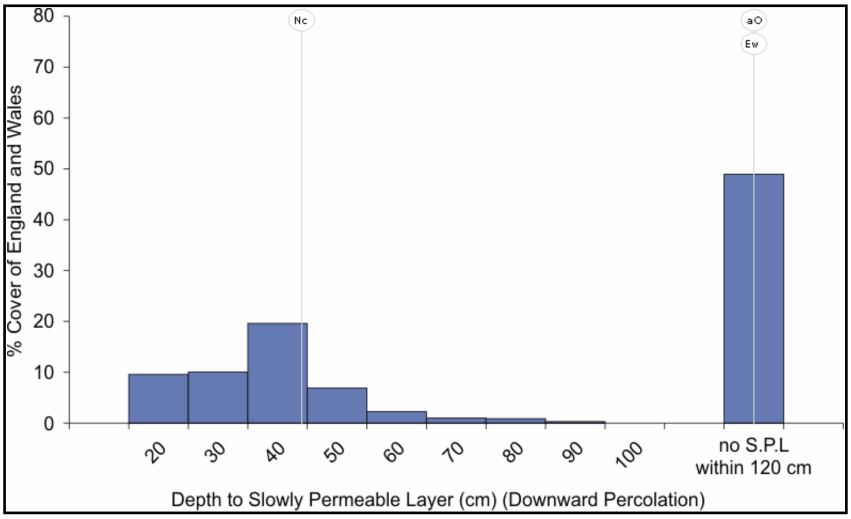



Figure 4. Depth to slowly permeable layer (downward percolation)

*Depth to Slowly Permeable Layer (upward diffusion)* A mean depth to the bottom of a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede upward diffusion of water and gasses.

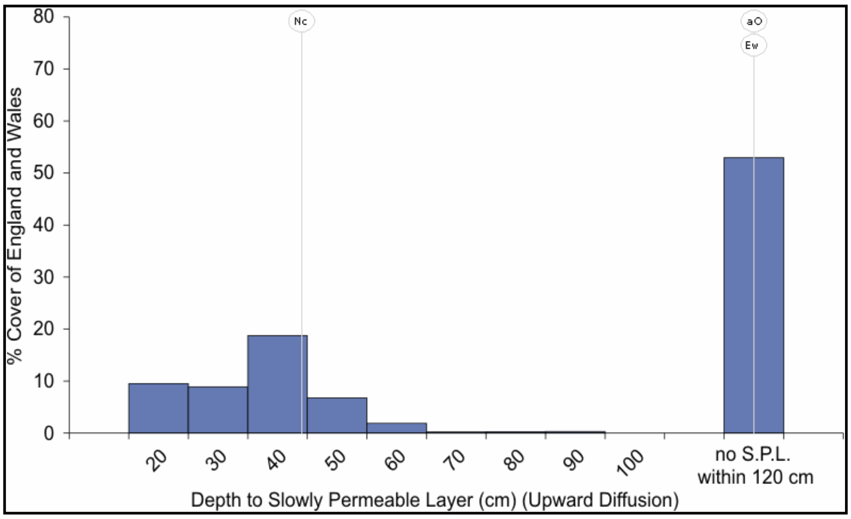



Figure 5. Depth to Slowly Permeable Layer (upward diffusion)

# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

## e(ii). Soil Hydrological Information

*Integrated air capacity (IAC)* is the total coarse pore space (>60 $\mu$m diameter) to 1 m depth. This size of pore would normally be air-filled when the soil is fully moist but not waterlogged. A large IAC means that the soil is well aerated. This will encourage root development and, provided near surface soil structure is well developed, will allow rainfall to percolate into the ground thus mitigating against localised flooding.

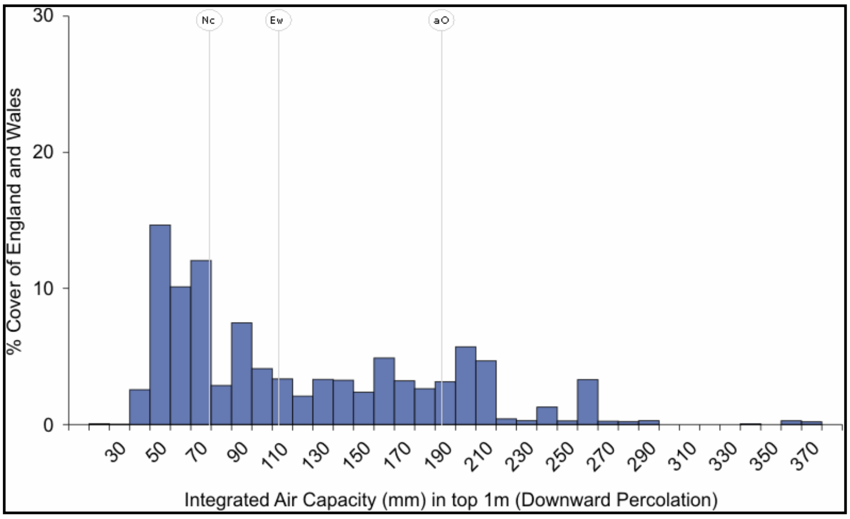



Figure 6. Integrated Air Capacity

*Standard Percentage Runoff (SPR)* is the percentage of rainfall that causes the short-term increase in flow seen at a catchment outlet following a storm event. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

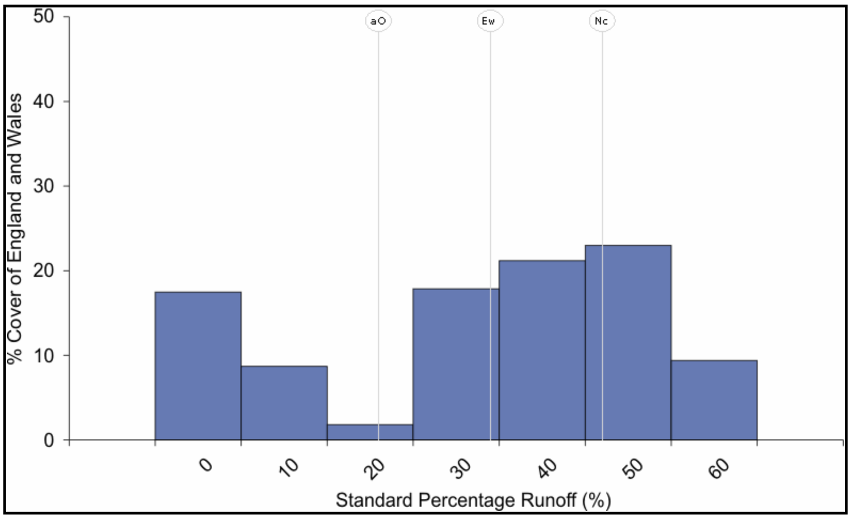



Figure 7. Standard Percentage Runoff

*Base flow index* is calculated from daily river flow data and expresses the volume of base flow of a river as a fraction of the total flow volume. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

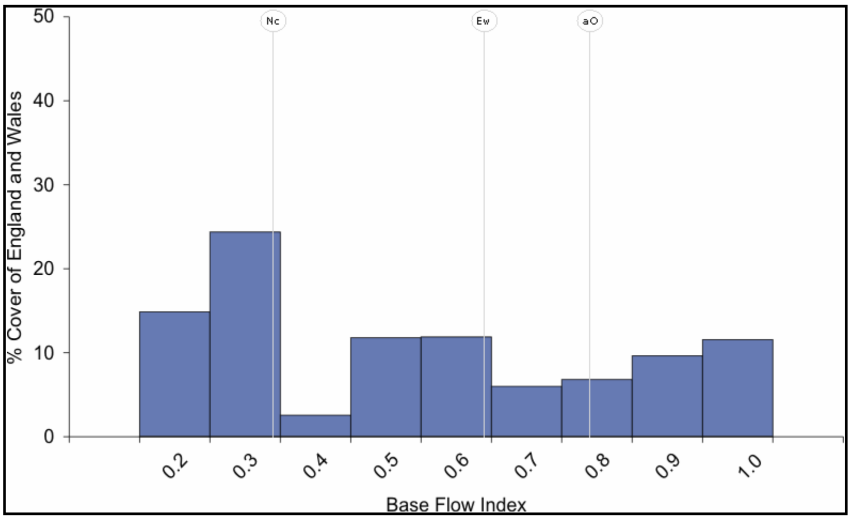



Figure 8. Base Flow Index

# EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

## e(iii). Available Water Content

*Available water content* for plants varies depending on a number of factors, including the rooting depth of the plants. Described below are differing available water contents for cereals, sugar beet, grass and potato crops, as well as a generic available water value to 1 m depth.

*Available water (by crop)* Available water content to 1 m for the specified soil series between suctions of 5 and 1500kPa.

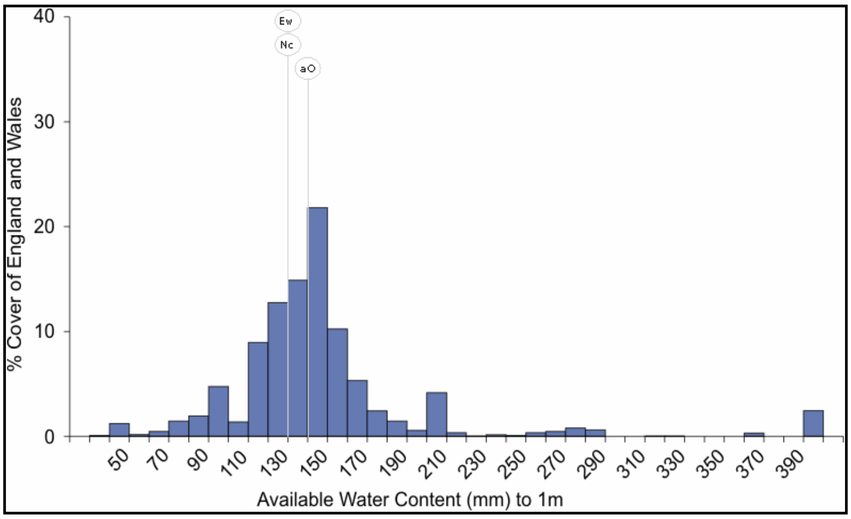



Figure 9. Available Water (by crop)

*Available water for grass* represents the water that is available to a permanent grass sward that is able to root to 100cm depth.

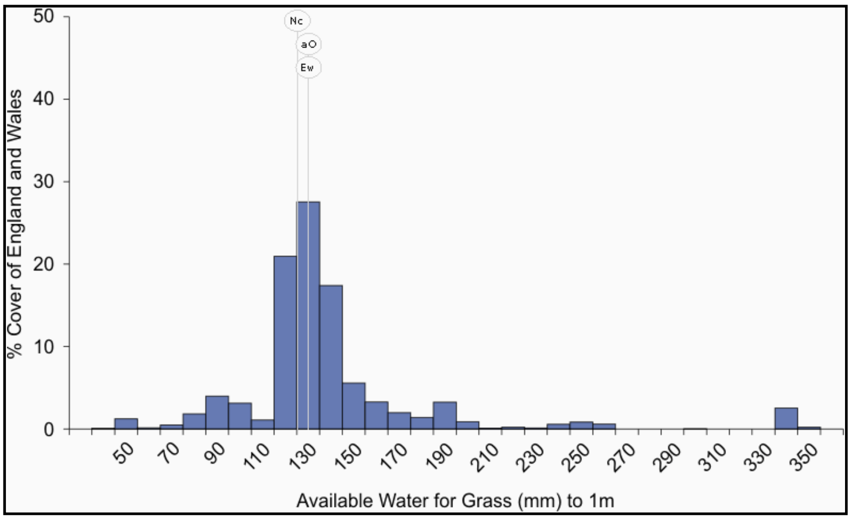



Figure 10. Available Water for Grass

## EAST KESWICK 1 (541x)

*Deep well drained fine loamy soils and similar soils with slowly permeable subsoils and slight seasonal waterlogging.*

### e(iii). Available Water Content continued

*Available water for cereal* represents the water that is available to a cereal crop that is able to root to 120cm depth.

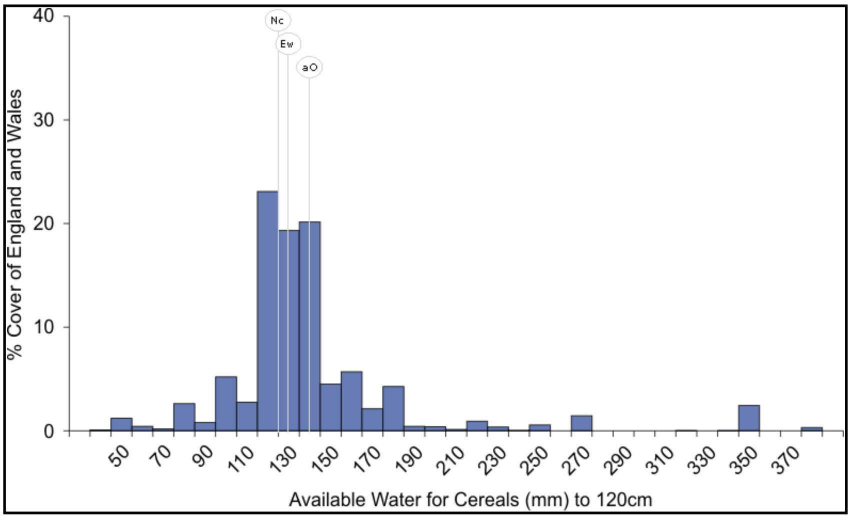



Figure 11. Available Water for Cereal

*Available water for Sugar Beet* represents the water that is available to a sugar beet crop that is able to root to 140cm depth.

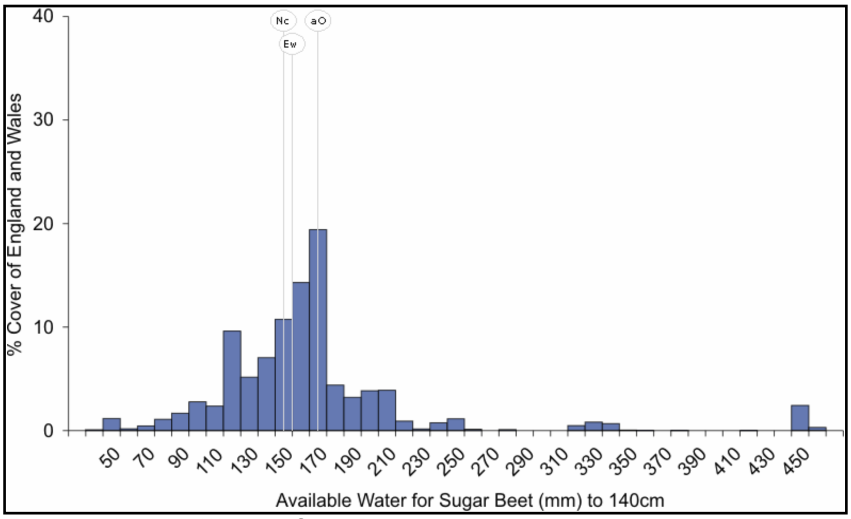



Figure 12. Available Water for Sugar Beet

*Available water for Potatoes* represents the water that is available to a potato crop that is able to root to 70cm depth.

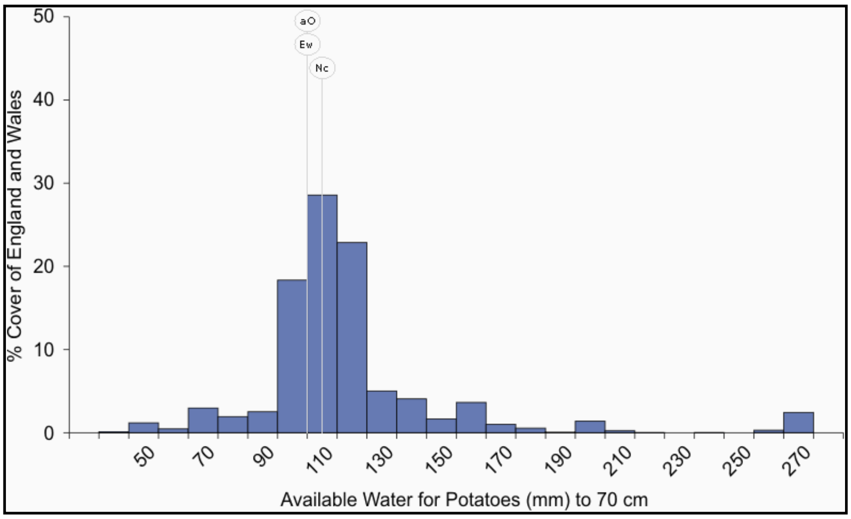



Figure 13. Available Water for Potatoes

# BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

**a. General Description**

Slowly permeable seasonally waterlogged fine loamy soils. Associated with fine loamy soils with only slight waterlogging and some deep well drained fine loamy soils.
The major landuse on this association is defined as dairying and stock rearing on permanent or short term grassland; some cereals in drier areas.

**b. Distribution (England & Wales)**

The BRICKFIELD 2 association covers 1596km² of England and Wales which accounts for 1.06% of the landmass. The distribution of this association is shown in Figure 14. Note that the yellow shading represents a buffer to highlight the location of very small areas of the association.

**c. Comprising Soil Series**

Multiple soil series comprise a soil association. The soil series of the BRICKFIELD 2 association are outlined in Table 2 below. In some cases other minor soil series are present at a particular site, and these have been grouped together under the heading 'OTHER'. We have endevoured to present the likelihood of a minor, unnamed soil series occuring in your site in Table 2.

Schematic diagrams of the vertical soil profile of the major constituent soil series are provided in Section D to allow easier identification of the particular soil series at your site.

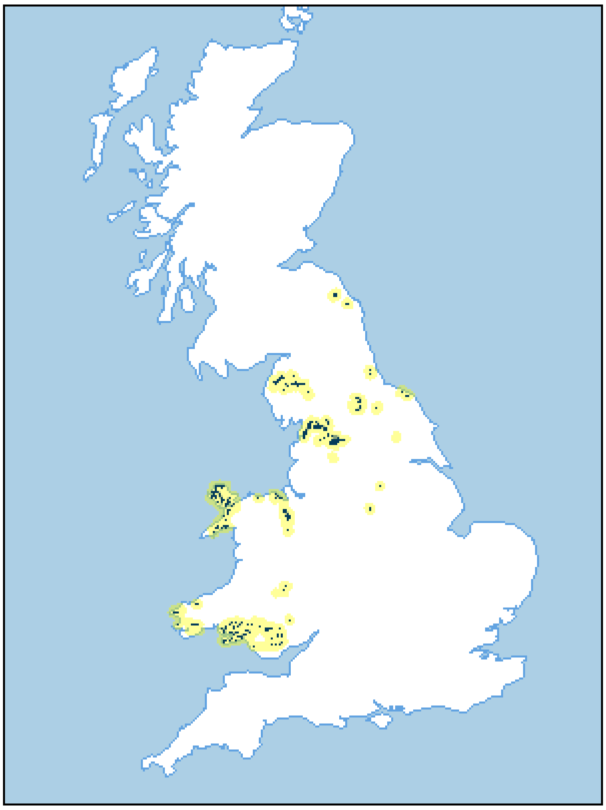


Figure 14. Association Distribution

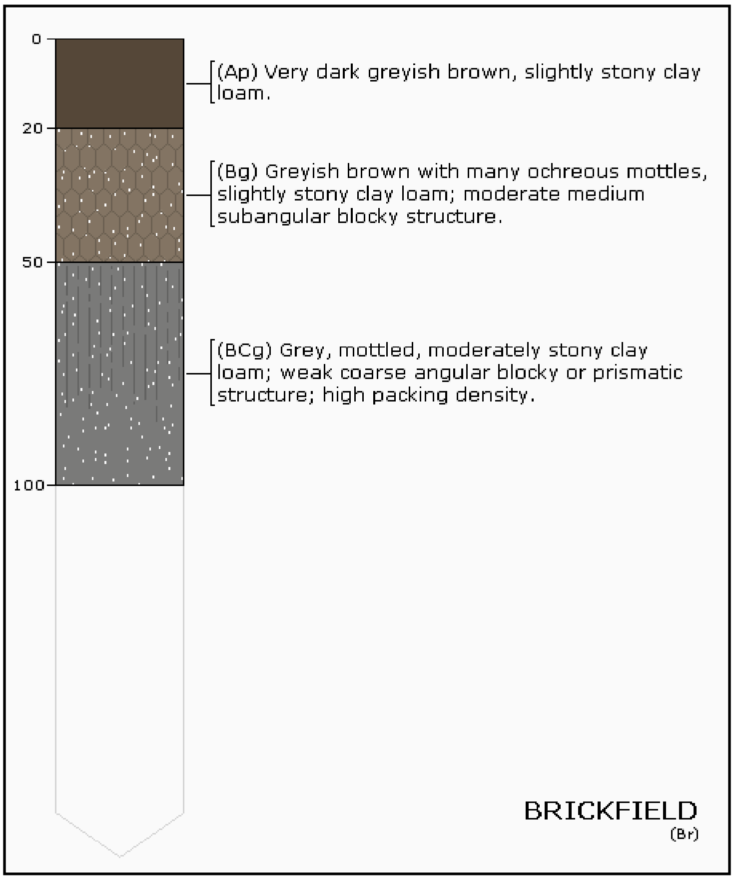
| Soil Series | Description | Area % |
|---|---|---|
| BRICKFIELD (Br) | medium loamy drift with siliceous stones | 40% |
| NERCWYS (Nc) | medium loamy drift with siliceous stones | 20% |
| EAST KESWICK (Ew) | medium loamy drift with siliceous stones | 15% |
| OTHER | other minor soils | 25% |

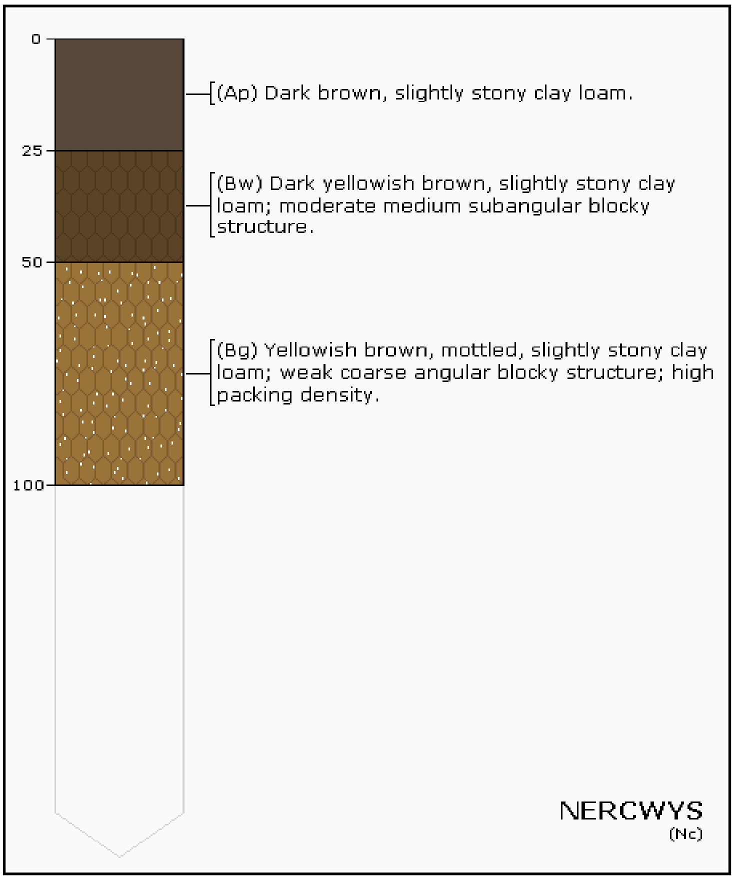
Table 2. The component soil series of the BRICKFIELD 2 soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

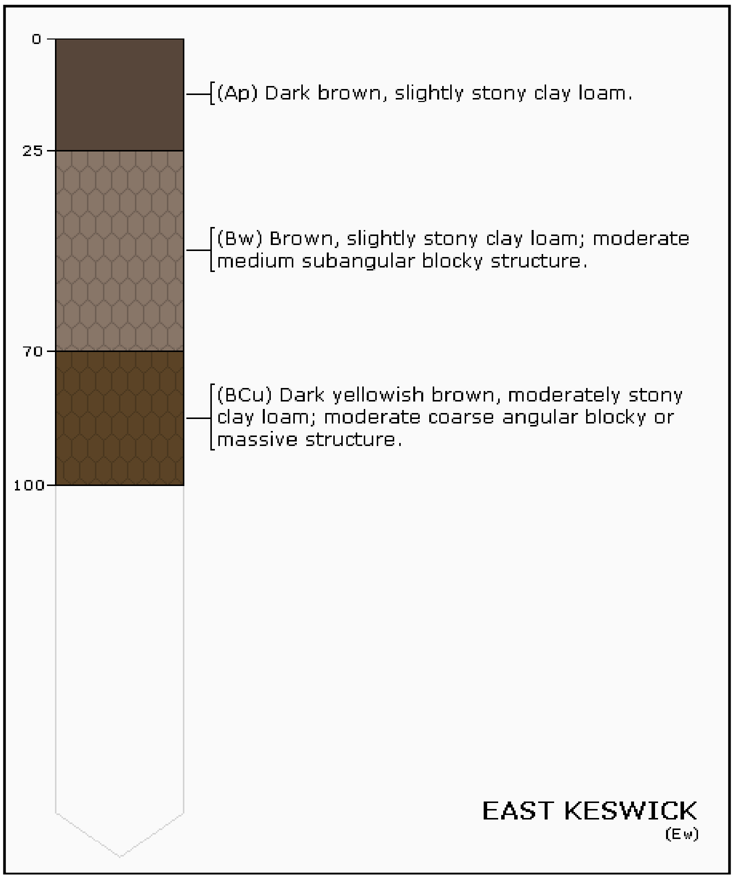
# BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

## d. BRICKFIELD 2 Component Series Profiles



# BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

## e. Soil Properties

This section provides graphical summaries of selected attribute data available for the component series in this association. The blue bars of the graphs presented in this section describe the range of property values for all soils across England and Wales. Superimposed on these graphs are the values for the component soil series in this association. This has been done to provide the reader with an understanding of where each property for each series sits within the national context.

| Soil Series | Description | Area % |
|---|---|---|
| BRICKFIELD (Br) | medium loamy drift with siliceous stones | 40% |
| NERCWYS (Nc) | medium loamy drift with siliceous stones | 20% |
| EAST KESWICK (Ew) | medium loamy drift with siliceous stones | 15% |
| OTHER | other minor soils | 25% |

Table 2. The component soil series of the BRICKFIELD 2 soil association. Because absolute proportions of the comprising series in this association vary from location to location, the national proportions are provided.

## e(i). Soil Depth Information and Depths to Important Layers

*Depth to rock* A mean depth to bedrock or very stony rubble which has been assigned to each soil series based on observed and recorded soil profiles.

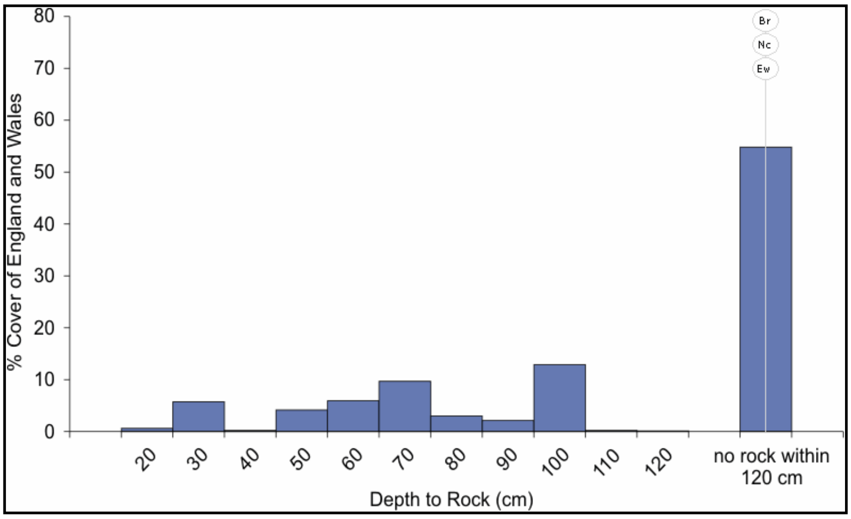



Figure 15. Depth of soil to Rock

*Depth to gleying*, the presence of grey and ochreous mottles within the soil, is caused by intermittent waterlogging. A mean depth to gleying has been assigned to each soil series based on observed and recorded soil profiles. The definition of a gleyed layer is designed to equate with saturation for at least 30 days in each year or the presence of artificial drainage.

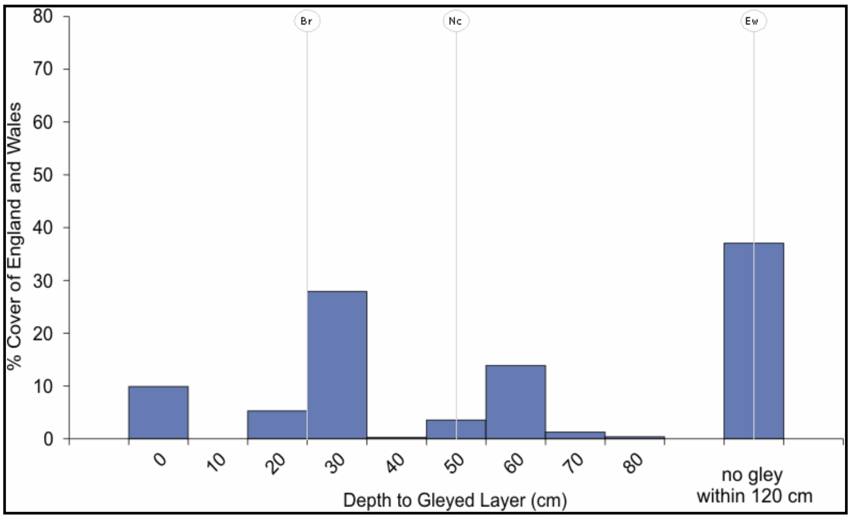



Figure 16. Depth of Soil to Gleying

# BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

## e(i). Soil Depth Information and Depths to Important Layers continued

*Depth to slowly permeable layer (downward percolation)* A mean depth to a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede downward percolation of excess soil water. This causes periodic saturation in the overlying soil, reduced storage capacity and therefore increased hydrological response to rainfall events.

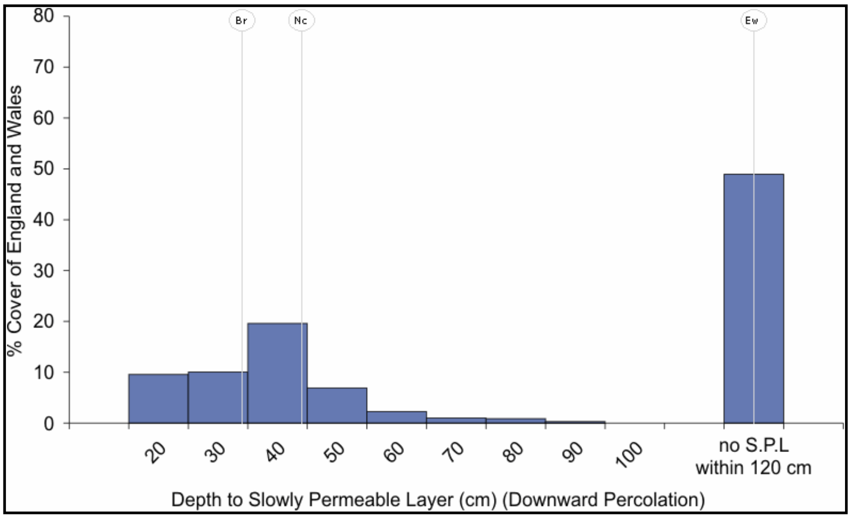



Figure 17. Depth to slowly permeable layer (downward percolation)

*Depth to Slowly Permeable Layer (upward diffusion)* A mean depth to the bottom of a layer with lateral hydraulic conductivity of <10 cm per day has been assigned to each soil series based on observed and recorded soil profiles. Such layers can be defined in terms of their particular soil textural and structural conditions and impede upward diffusion of water and gasses.

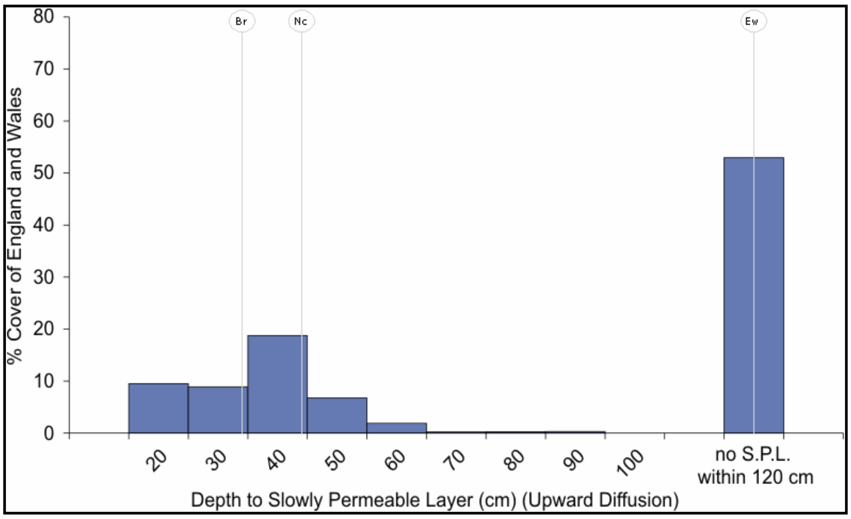



Figure 18. Depth to Slowly Permeable Layer (upward diffusion)

# BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

## e(ii). Soil Hydrological Information

*Integrated air capacity (IAC)* is the total coarse pore space (>60 $\mu$m diameter) to 1 m depth. This size of pore would normally be air-filled when the soil is fully moist but not waterlogged. A large IAC means that the soil is well aerated. This will encourage root development and, provided near surface soil structure is well developed, will allow rainfall to percolate into the ground thus mitigating against localised flooding.

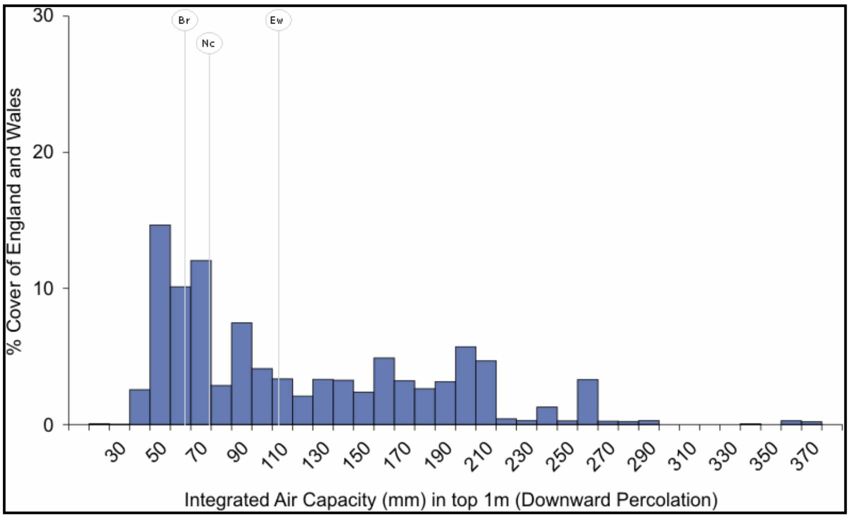



Figure 19. Integrated Air Capacity

*Standard Percentage Runoff (SPR)* is the percentage of rainfall that causes the short-term increase in flow seen at a catchment outlet following a storm event. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

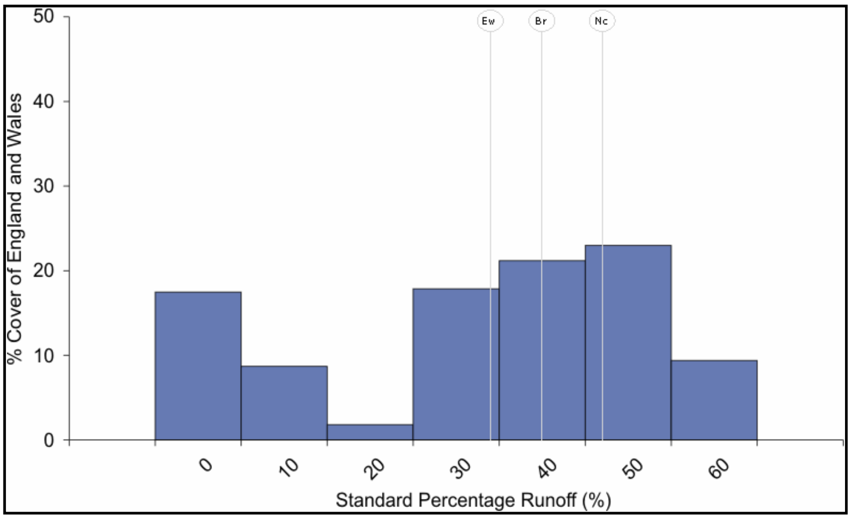



Figure 20. Standard Percentage Runoff

*Base flow index* is calculated from daily river flow data and expresses the volume of base flow of a river as a fraction of the total flow volume. The values associated with individual soil series have been calculated from an analysis of the relationships between flow data and the soils present within the catchment for several hundred gauged catchments.

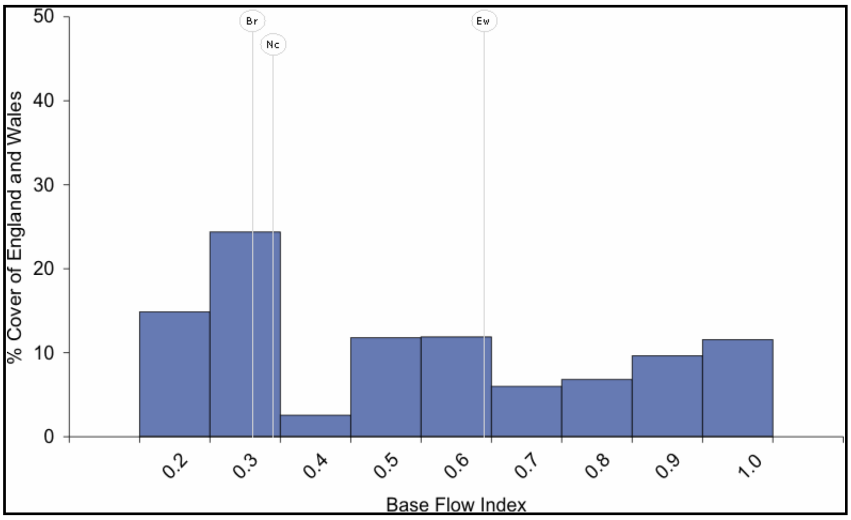



Figure 21. Base Flow Index

## BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

### e(iii). Available Water Content

*Available water content* for plants varies depending on a number of factors, including the rooting depth of the plants. Described below are differing available water contents for cereals, sugar beet, grass and potato crops, as well as a generic available water value to 1 m depth.

*Available water (by crop)* Available water content to 1 m for the specified soil series between suctions of 5 and 1500kPa.

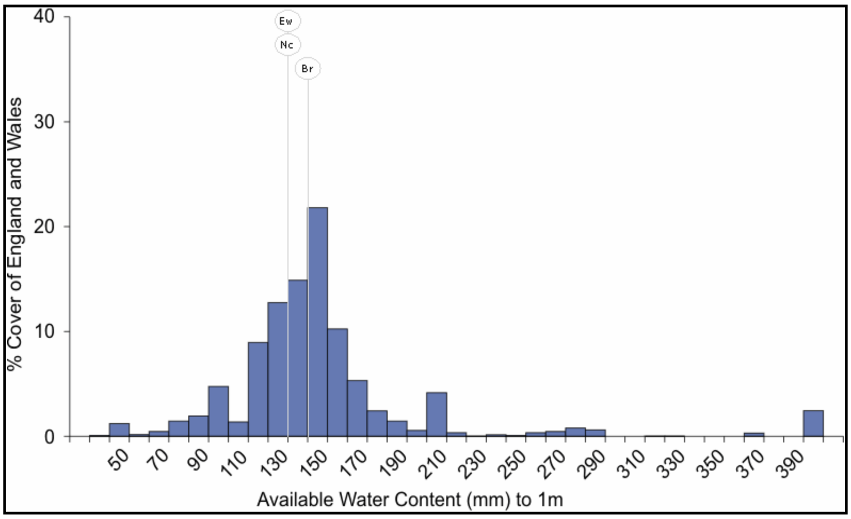



Figure 22. Available Water (by crop)

*Available water for grass* represents the water that is available to a permanent grass sward that is able to root to 100cm depth.

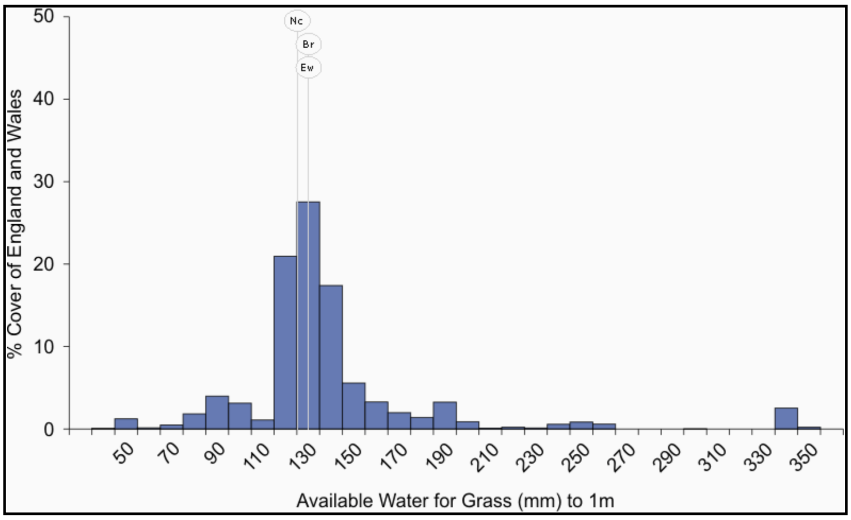



Figure 23. Available Water for Grass

## BRICKFIELD 2 (713f)

*Slowly permeable seasonally waterlogged fine loamy soils.*

### e(iii). Available Water Content continued

*Available water for cereal* represents the water that is available to a cereal crop that is able to root to 120cm depth.

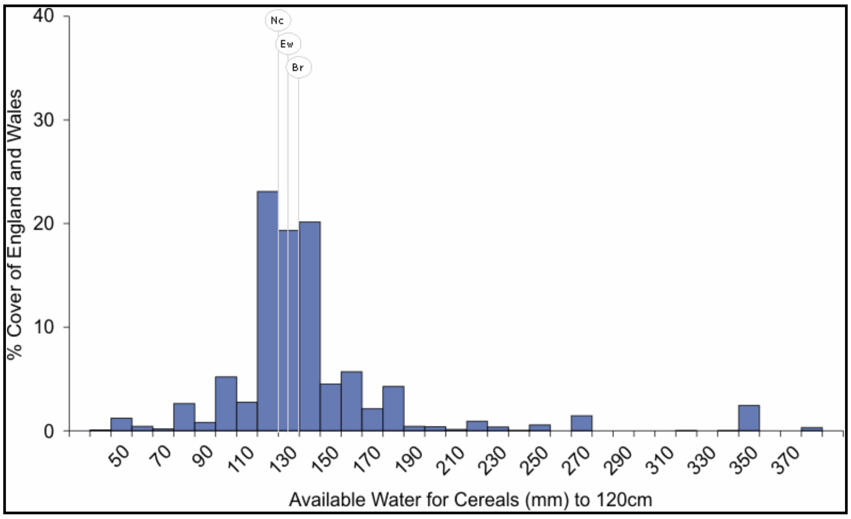



Figure 24. Available Water for Cereal

*Available water for Sugar Beet* represents the water that is available to a sugar beet crop that is able to root to 140cm depth.

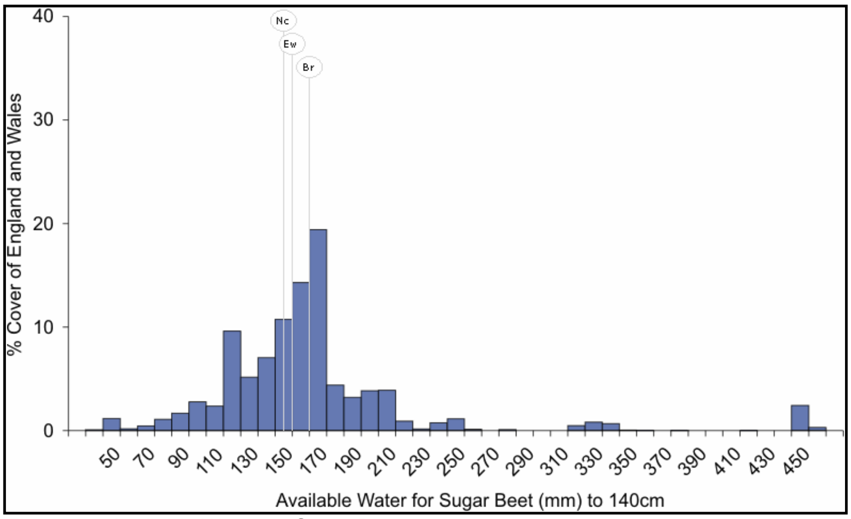



Figure 25. Available Water for Sugar Beet

*Available water for Potatoes* represents the water that is available to a potato crop that is able to root to 70cm depth.

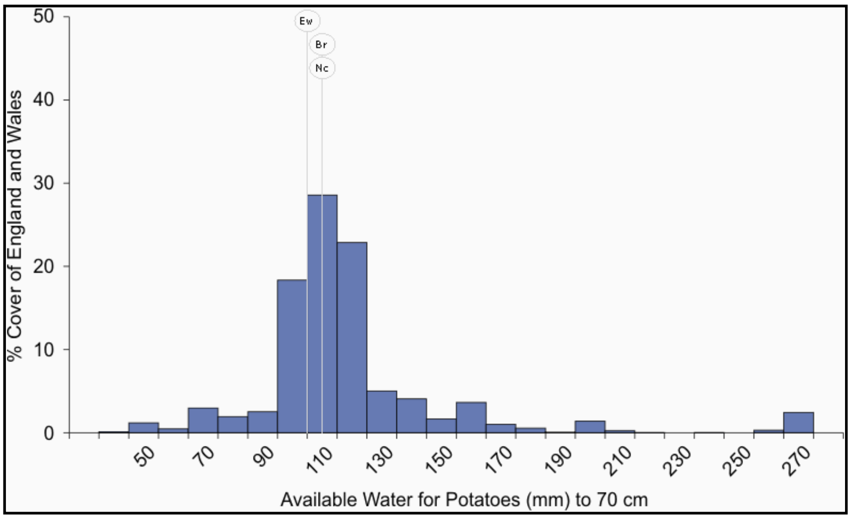
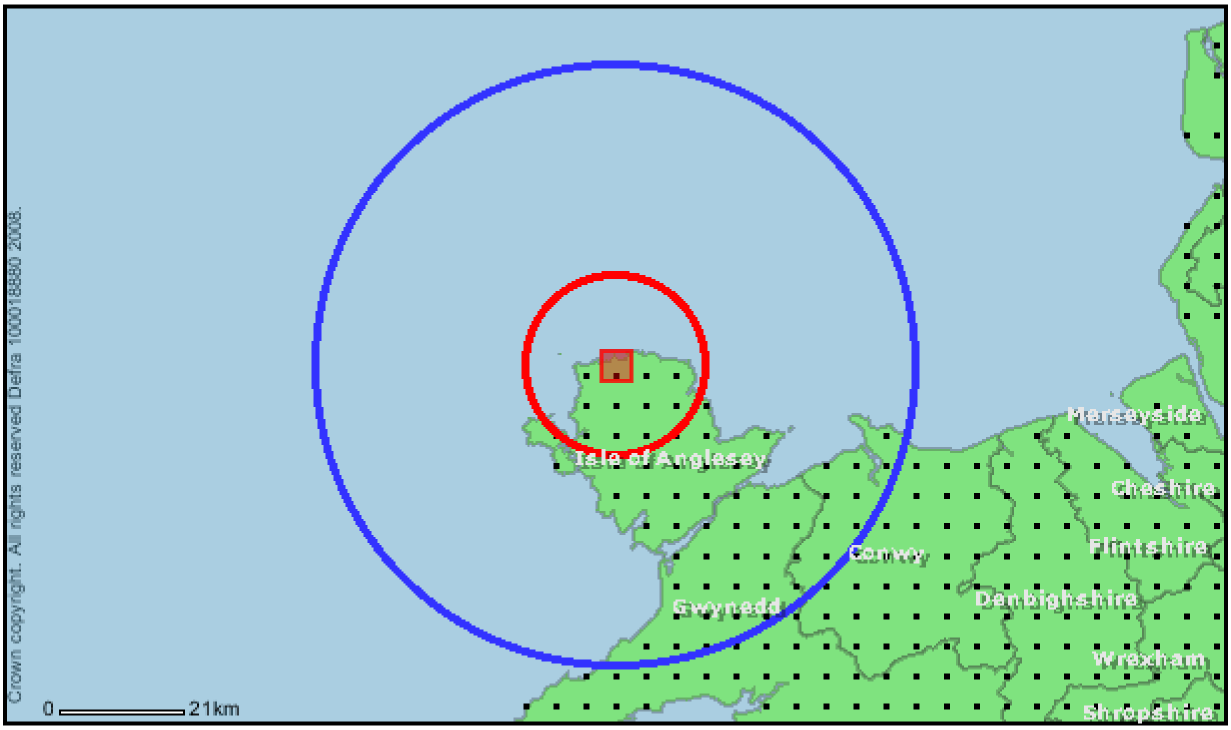
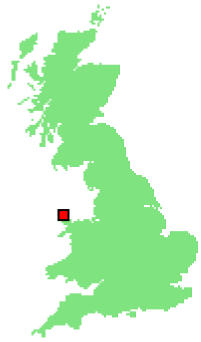



Figure 26. Available Water for Potatoes

## 3. TOPSOIL ELEMENT BACKGROUND LEVELS



### TOPSOIL ELEMENT BACKGROUND LEVELS KEY

- NSI sample points
- Report area
- 15 km radius - local area
- 50 km radius - regional area

TOPSOIL ELEMENT BACKGROUND LEVELS DESCRIPTION

The National Soil Inventory (NSI) covers England and Wales on a 5 km grid and provides detailed information for each intersect of the grid. Collectively NSI data are statistically representative of England and Wales soils. The original sampling was undertaken around 1980 and there were partial resamplings in the mid-1990s. The most up-to-date data is presented here.

Analysis of the NSI samples provides detailed measurements of over 20 elements from the soils, in addition to pH. This data is summarised over three areas to provide you with an understanding of how your site, and your data for it, sits within the local, regional and national context.

Where available, the soil element levels are compared with the Soil Guideline Values and where a soil sample we have analysed has been found in excess of the SGV guidelines for "residential with plant uptake" land, this is displayed in red in the tables which follow.

SGV levels are provided for the following elements: lead, selenium, nickel, mercury, chromium, cadmium and arsenic.

In the following pages, a number of analyses of the topsoil are provided. The majority of analyses have been performed on the full compliment of sample points, however, in some areas, for some elements, only a few samples were analysed as part of subsequent programmes. In order to present the full suite of possible datasets, and accurately convey the validity of the data, the number of actual measured samples is stated for each analysis. Care should be taken where the number of samples is disproportionately low.

## 3a. Analyses Within a 15 km Radius (11 Sample Points)

| ANALYSES | SAMPLES | MEAN | MIN | MAX | ST. DEV |
|---|---|---|---|---|---|
| pH (PH) | 11 | 5.1 | 4.6 | 5.6 | 0.3 |
| Carbon (CARBON) | 11 | 5.0 | 3.1 | 13.5 | 3.2 |
| Aluminium (AL_ACID) | 11 | 36,216.3 | 26,063.0 | 53,950.0 | 8,191.9 |
| Arsenic (AS_ACID) | 9 | 4.2 | 2.4 | 9.6 | 2.2 |
| Barium (BA_ACID) | 11 | 208.3 | 120.0 | 372.0 | 91.3 |
| Calcium (CA_ACID) | 11 | 2,836.8 | 353.0 | 4,631.0 | 1,438.6 |
| Cadmium (CD_ACID) | 11 | 0.6 | 0.1 | 1.3 | 0.4 |
| Cadmium (Extractable) (CD_EDTA) | 11 | 0.2 | 0.1 | 0.4 | 0.1 |
| Cobalt (CO_ACID) | 11 | 13.1 | 6.4 | 26.1 | 7.3 |
| Cobalt (Extractable) (CO_EDTA) | 11 | 0.8 | 0.1 | 2.1 | 0.7 |
| Chromium (CR_ACID) | 11 | 48.8 | 34.8 | 83.6 | 13.6 |
| Copper (CU_ACID) | 11 | 31.6 | 8.0 | 103.7 | 26.0 |
| Copper (Extractable) (CU_EDTA) | 11 | 8.9 | 4.2 | 39.2 | 10.2 |
| Flouride (F_ACID) | 10 | 52.5 | 0.0 | 137.0 | 41.2 |
| Iron (FE_ACID) | 11 | 35,948.2 | 24,232.0 | 53,860.0 | 10,080.5 |
| Mercury (HG_ACID) | 9 | 0.0 | 0.0 | 0.1 | 0.0 |
| Potassium (K_ACID) | 11 | 5,516.5 | 2,280.0 | 8,269.0 | 1,838.8 |
| Potassium (Extractable) (K_NITRATE) | 11 | 114.5 | 45.0 | 247.0 | 58.8 |
| Magnesium (MG_ACID) | 11 | 3,876.0 | 2,138.0 | 4,811.0 | 893.9 |
| Magnesium (Extractable) (MG_NITRATE) | 11 | 123.5 | 55.0 | 185.0 | 44.4 |
| Manganese (MN_ACID) | 11 | 1,211.7 | 231.0 | 2,707.0 | 933.9 |
| Manganese (Extractable) (MN_EDTA) | 11 | 175.8 | 9.0 | 589.0 | 174.0 |
| Molybdenum (MO_ACID) | 10 | 1.0 | 0.0 | 2.9 | 0.8 |
| Sodium (NA_ACID) | 11 | 676.0 | 193.0 | 1,176.0 | 384.4 |
| Nickel (NI_ACID) | 11 | 22.2 | 10.0 | 33.0 | 8.2 |
| Nickel (Extractable) (NI_EDTA) | 11 | 0.9 | 0.3 | 2.9 | 0.7 |
| Phosphorus (P_ACID) | 11 | 928.2 | 175.0 | 2,016.0 | 525.1 |
| Phosphorus (Extractable) (P_OLSEN) | 11 | 24.4 | 6.0 | 58.0 | 15.1 |
| Lead (PB_ACID) | 11 | 49.7 | 24.0 | 151.0 | 36.3 |
| Lead (Extractable) (PB_EDTA) | 11 | 13.3 | 3.8 | 56.7 | 14.8 |
| Selenium (SE_ACID) | 9 | 0.6 | 0.4 | 1.0 | 0.2 |
| Strontium (SR_ACID) | 11 | 30.2 | 2.0 | 54.0 | 13.1 |
| Vanadium (V_ACID) | 10 | 38.0 | 6.7 | 52.3 | 13.7 |
| Zinc (ZN_ACID) | 11 | 98.6 | 50.0 | 237.0 | 54.9 |
| Zinc (Extractable) (ZN_EDTA) | 11 | 3.8 | 1.1 | 10.2 | 2.6 |

for units, see Analyses Definitions (p41)

## 3b. Analyses Within a 50 km Radius (61 Sample Points)

| ANALYSES | SAMPLES | MEAN | MIN | MAX | ST. DEV |
|---|---|---|---|---|---|
| pH (PH) | 61 | 4.8 | 3.5 | 6.2 | 0.6 |
| Carbon (CARBON) | 61 | 10.1 | 0.2 | 44.1 | 11.3 |
| Aluminium (AL_ACID) | 61 | 24,829.1 | 3,269.0 | 53,950.0 | 11,502.9 |
| Arsenic (AS_ACID) | 39 | 5.1 | 0.4 | 25.2 | 4.3 |
| Barium (BA_ACID) | 61 | 152.3 | 11.0 | 393.0 | 88.7 |
| Calcium (CA_ACID) | 61 | 2,025.8 | 100.0 | 5,800.0 | 1,540.3 |
| Cadmium (CD_ACID) | 61 | 0.6 | 0.0 | 4.5 | 0.6 |
| Cadmium (Extractable) (CD_EDTA) | 60 | 0.2 | 0.0 | 0.8 | 0.1 |
| Cobalt (CO_ACID) | 61 | 17.2 | 0.7 | 321.8 | 44.7 |
| Cobalt (Extractable) (CO_EDTA) | 60 | 0.9 | 0.0 | 10.8 | 1.9 |
| Chromium (CR_ACID) | 61 | 36.9 | 4.3 | 95.4 | 21.6 |
| Copper (CU_ACID) | 61 | 22.9 | 2.4 | 103.7 | 18.0 |
| Copper (Extractable) (CU_EDTA) | 60 | 5.7 | 1.2 | 39.2 | 5.2 |
| Flouride (F_ACID) | 50 | 46.3 | 0.0 | 340.7 | 68.0 |
| Iron (FE_ACID) | 61 | 28,477.3 | 4,223.0 | 83,515.0 | 14,672.6 |
| Mercury (HG_ACID) | 39 | 0.0 | 0.0 | 0.3 | 0.1 |
| Potassium (K_ACID) | 61 | 3,963.6 | 581.0 | 8,269.0 | 1,969.9 |
| Potassium (Extractable) (K_NITRATE) | 61 | 105.6 | 13.0 | 256.0 | 51.4 |
| Magnesium (MG_ACID) | 61 | 3,282.2 | 322.0 | 11,264.0 | 2,177.8 |
| Magnesium (Extractable) (MG_NITRATE) | 61 | 109.3 | 24.0 | 307.0 | 52.6 |
| Manganese (MN_ACID) | 61 | 1,320.2 | 32.0 | 13,613.0 | 1,863.0 |
| Manganese (Extractable) (MN_EDTA) | 60 | 181.7 | 1.0 | 2,347.0 | 311.6 |
| Molybdenum (MO_ACID) | 50 | 1.3 | 0.0 | 5.9 | 1.4 |
| Sodium (NA_ACID) | 61 | 459.4 | 137.0 | 2,209.0 | 363.1 |
| Nickel (NI_ACID) | 61 | 18.2 | 2.9 | 61.0 | 11.5 |
| Nickel (Extractable) (NI_EDTA) | 60 | 0.7 | 0.1 | 2.9 | 0.5 |
| Phosphorus (P_ACID) | 61 | 929.3 | 175.0 | 2,214.0 | 395.5 |
| Phosphorus (Extractable) (P_OLSEN) | 61 | 21.0 | 3.0 | 88.0 | 14.6 |
| Lead (PB_ACID) | 61 | 77.8 | 6.0 | 795.0 | 102.6 |
| Lead (Extractable) (PB_EDTA) | 60 | 19.0 | 3.6 | 108.0 | 18.4 |
| Selenium (SE_ACID) | 39 | 0.9 | 0.0 | 6.4 | 1.1 |
| Strontium (SR_ACID) | 61 | 19.7 | 0.0 | 54.0 | 12.0 |
| Vanadium (V_ACID) | 51 | 34.5 | 0.0 | 91.5 | 25.6 |
| Zinc (ZN_ACID) | 61 | 72.1 | 21.0 | 237.0 | 42.0 |
| Zinc (Extractable) (ZN_EDTA) | 60 | 5.1 | 1.1 | 21.1 | 3.7 |

for units, see Analyses Definitions (p41)

## 3c. National Analyses (5686 Sample Points)

| ANALYSES | SAMPLES | MEAN | MIN | MAX | ST. DEV |
|---|---|---|---|---|---|
| pH (PH) | 5,630 | 6.0 | 3.1 | 9.2 | 1.3 |
| Carbon (CARBON) | 5,672 | 6.1 | 0.1 | 61.5 | 8.9 |
| Aluminium (AL_ACID) | 5,677 | 26,775.3 | 491.0 | 79,355.0 | 12,772.2 |
| Arsenic (AS_ACID) | 2,729 | 4.6 | 0.0 | 110.0 | 5.7 |
| Barium (BA_ACID) | 5,677 | 150.0 | 7.0 | 3,840.0 | 159.5 |
| Calcium (CA_ACID) | 5,677 | 13,768.7 | 0.0 | 339,630.0 | 37,785.0 |
| Cadmium (CD_ACID) | 5,677 | 0.7 | 0.0 | 40.9 | 1.0 |
| Cadmium (Extractable) (CD_EDTA) | 5,655 | 0.5 | 0.0 | 85.0 | 3.0 |
| Cobalt (CO_ACID) | 5,677 | 10.6 | 0.0 | 567.0 | 13.7 |
| Cobalt (Extractable) (CO_EDTA) | 5,655 | 1.1 | 0.0 | 26.5 | 1.2 |
| Chromium (CR_ACID) | 5,677 | 38.9 | 0.0 | 2,339.8 | 43.7 |
| Copper (CU_ACID) | 5,677 | 22.6 | 0.0 | 1,507.7 | 36.8 |
| Copper (Extractable) (CU_EDTA) | 5,655 | 6.4 | 0.3 | 431.4 | 11.1 |
| Flouride (F_ACID) | 3,320 | 58.5 | 0.0 | 6,307.9 | 186.2 |
| Iron (FE_ACID) | 5,677 | 28,147.8 | 395.0 | 264,405.0 | 16,510.5 |
| Mercury (HG_ACID) | 2,159 | 0.1 | 0.0 | 2.4 | 0.2 |
| Potassium (K_ACID) | 5,677 | 4,727.7 | 60.0 | 23,905.0 | 2,700.2 |
| Potassium (Extractable) (K_NITRATE) | 5,609 | 182.0 | 6.0 | 2,776.0 | 151.6 |
| Magnesium (MG_ACID) | 5,677 | 3,648.1 | 0.0 | 62,690.0 | 3,284.1 |
| Magnesium (Extractable) (MG_NITRATE) | 5,609 | 146.0 | 1.0 | 1,601.0 | 147.5 |
| Manganese (MN_ACID) | 5,677 | 777.0 | 3.0 | 42,603.0 | 1,068.8 |
| Manganese (Extractable) (MN_EDTA) | 5,654 | 159.4 | 0.0 | 3,108.0 | 188.6 |
| Molybdenum (MO_ACID) | 4,417 | 0.9 | 0.0 | 56.3 | 2.0 |
| Sodium (NA_ACID) | 5,677 | 323.3 | 17.0 | 25,152.0 | 572.3 |
| Nickel (NI_ACID) | 5,677 | 25.4 | 0.0 | 1,350.2 | 29.2 |
| Nickel (Extractable) (NI_EDTA) | 5,655 | 1.6 | 0.1 | 73.2 | 2.0 |
| Phosphorus (P_ACID) | 5,677 | 792.1 | 41.0 | 6,273.0 | 433.9 |
| Phosphorus (Extractable) (P_OLSEN) | 5,604 | 27.4 | 0.0 | 534.0 | 25.5 |
| Lead (PB_ACID) | 5,677 | 73.3 | 0.0 | 17,365.0 | 280.6 |
| Lead (Extractable) (PB_EDTA) | 5,655 | 27.8 | 1.2 | 6,056.5 | 119.7 |
| Selenium (SE_ACID) | 2,729 | 0.6 | 0.0 | 22.8 | 0.8 |
| Strontium (SR_ACID) | 5,677 | 42.3 | 0.0 | 1,445.0 | 67.8 |
| Vanadium (V_ACID) | 4,428 | 41.0 | 0.0 | 854.4 | 33.9 |
| Zinc (ZN_ACID) | 5,677 | 90.2 | 0.0 | 3,648.0 | 104.4 |
| Zinc (Extractable) (ZN_EDTA) | 5,655 | 9.6 | 0.5 | 712.0 | 24.6 |

for units, see Analyses Definitions (p41)

## SOIL GUIDELINE VALUES (SGV)

Defra and the Environment Agency have produced soil guideline values (SGVs) as an aid to preliminary assessment of potential risk to human health from land that may be contaminated. SGVs represent ‘intervention values’, which, if exceeded, act as indicators of potential unacceptable risk to humans, so that more detailed risk assessment is needed.

The SGVs were derived using the Contaminated Land Exposure Assessment (CLEA) model for four land uses:

1. residential (with plant uptake / vegetable growing)
2. residential (without vegetable growing)
3. allotments
4. commercial / industrial

SGVs are only designed to indicate whether further site-specific investigation is needed. Where a soil guideline value is exceeded, it does not mean that there is necessarily a chronic or acute risk to human health.

The values presented in this report represent those from a number of sample points ( given in the "Samples" column in each table) providing local, regional and national background levels. Figures which appear in red indicate that a bulked sample from 20m surrounding a sample point, has at a past date, exceeded the SGV for the ‘residential with plant uptake’ land use.

It is always advisable to perform site specific investigations.

More details on all the SGVs can be found on the Environment Agency Website.

All units are mg/kg which is equivalent to parts per million (ppm)

| SUBSTANCE | RESIDENTIAL WITH PLANT UPTAKE | RESIDENTIAL WITHOUT PLANT UPTAKE | ALLOTMENTS | COMMERCIAL / INDUSTRIAL |
|---|---|---|---|---|
| LEAD | 450 | 450 | 450 | 750 |
| SELENIUM | 35 | 260 | 35 | 8000 |
| NICKEL | 50 | 75 | 50 | 5000 |
| MERCURY | 8 | 15 | 8 | 480 |
| CHROMIUM | 130 | 200 | 130 | 5000 |
| CADMIUM (pH 6) | 1 | 30 | 1 | 1400 |
| CADMIUM (pH 7) | 2 | 30 | 2 | 1400 |
| CADMIUM (pH 8) | 8 | 30 | 8 | 1400 |
| ARSENIC | 20 | 20 | 20 | 500 |

# ANALYSES DEFINITIONS

PH (pH)
pH of soil measure after shaking 10ml of soil for 15 minutes with 25ml of water

CARBON (Carbon)
Organic Carbon (% by wt) measured either by loss-on-ignition for soils estimated to contain more than about 20% organic carbon or by dichromate digestion.

AL_ACID (Aluminium)
Total Aluminium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

AS_ACID (Arsenic)
Total Arsenic concentration (mg/kg) determined by Hydride Atomic Absorption Spectrometry (AAS), extracted into hydrochloric acid after digestion with nitric acid and ashing with magnesium nitrate

BA_ACID (Barium)
Total Barium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

CA_ACID (Calcium)
Total Calcium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

CD_ACID (Cadmium)
Total Cadmium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

CD_EDTA (Cadmium Extractable)
Extractable Cadmium concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

CO_ACID (Cobalt)
Total Cobalt concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

CO_EDTA (Cobalt Extractable)
Extractable Cobalt concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

CR_ACID (Chromium)
Total Chromium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

CU_ACID (Copper)
Total Copper concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

CU_EDTA (Copper Extractable)
Extractable Copper concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

F_ACID (Flouride)
Flouride extracted with 1mol / l sulphuric acid and determined by Ion Selective Electrode (ISE)

FE_ACID (Iron)
Total Iron concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

HG_ACID (Mercury)
Total Mercury concentration (mg/kg) determined by Hydride Atomic Absorption Spectrometry (AAS), digested in a nitric/sulphuric acid mixture

K_ACID (Potassium)
Total Potassium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

K_NITRATE (Potassium Extractable)
Extractable Potassium concentration (mg/l) determined by shaking 10ml of air dry soil with 50ml of 1.0M ammonium nitrate for 30mins, filtering and then measuring the concentration by flame photometry

## ANALYSES DEFINITIONS continued

MG_ACID (Magnesium)
Total Magnesium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

MG_NITRATE (Magnesium Extractable)
Extractable Magnesium concentration (mg/l) determined by shaking 10ml of air dry soil with 50ml of 1.0M ammonium nitrate for 30mins, filtering and then measuring the concentration by flame photometry

MN_ACID (Manganese)
Total Manganese concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

MN_EDTA (Manganese Extractable)
Extractable Manganese concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

MO_ACID (Molybdenum)
Total Molybdenum concentration (mg/kg) determined by Atomic Adsorption Spectrometyr (AAS) in an aqua regia digest

MO_EDTA (Molybdenum Extractable)
Extractable Molybdenum concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

NA_ACID (Sodium)
Total Sodium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

NI_ACID (Nickel)
Total Nickel concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

NI_EDTA (Nickel Extractable)
Extractable Nickel concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

P_ACID (Phosphorus)
Total Phosphorus concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

P_OLSON (Phosphorous Extractable)
Extractable Phosphorus concentration (mg/l) determined by shaking 5ml of air dry soil with 100ml of 0.5M sodium bicarbonate for 30mins at 20 deg.C, filtering and then measuring the absorbance at 880 nm colorimetrically with acid ammonium molybdate solution

PB_ACID (Lead)
Total Lead concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

PB_EDTA (Lead Extractable)
Extractable Lead concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

SE_ACID (Selenium)
Total Selenium concentration (mg/kg) determined by Hydride Atomic Absorption Spectrometry (AAS), extracted into hydrochloric acid after digestion with nitric acid and ashing with magnesium nitrate

SR_ACID (Strontium)
Total Strontium concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

V_ACID (Vanadium)
Total Vanadium concentration (mg/kg) determined by Atomic Adsorption Spectrometyr (AAS) in an aqua regia digest

ZN_ACID (Zinc)
Total Zinc concentration (mg/kg) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) in an aqua regia digest

ZN_EDTA (Zinc Extractable)
Extractable Zinc concentration (mg/l) determined by Inductively Coupled Plasma Emission Spectrometry (ICP) after shaking 10ml of soil with 50ml of 0.05M EDTA at pH 7.0 for 1h at 20 deg. C and then filtering

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To view the glossary visit: www.landis.org.uk/sitereporter/GLOSSARY.pdf

For a list of further reading visit: www.landis.org.uk/sitereporter/FURTHER_READING.pdf

For more information visit: www.landis.org.uk/reports

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The GIS data used in the creation of this report is available to lease for use in projects.
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# Appendix B ALC Report – A5025 Off-line Highway Improvements

**Jacobs UK Limited**

# Offline Improvements to the A5025, Anglesey

## Agricultural Land Classification and Soil Resources

May 2017

Reading Agricultural Consultants Ltd

www.readingagricultural.co.uk

# 1. Introduction

1.1.1. Reading Agricultural Consultants Ltd (RAC) is instructed by Jacobs UK Limited to investigate the Agricultural Land Classification (ALC) and soil resources of land at four locations along the A5025, Anglesey.

1.1.2. Guidance for assessing the quality of agricultural land in England and Wales is set out in the Ministry of Agriculture, Fisheries and Food (MAFF) revised guidelines and criteria for grading the quality of agricultural land (1988[1]).

1.1.3. Agricultural land in England and Wales is graded between 1 and 5, depending on the extent to which physical or chemical characteristics impose long-term limitations on agricultural use. The principal physical factors influencing grading are climate, site and soil which, together with interactions between them, form the basis for classifying land into one of the five grades.

1.1.4. Grade 1 land is excellent quality agricultural land with very minor or no limitations to agricultural use, and Grade 5 is very poor quality land, with severe limitations due to adverse soil, relief, climate or a combination of these. Grade 3 land is subdivided into Subgrade 3a (good quality land) and Subgrade 3b (moderate quality land). Land which is classified as Grades 1, 2 and 3a in the ALC system is defined as best and most versatile agricultural land.

# 2. Site and Climatic Conditions

## 2.1. General Features, Land Form and Drainage

2.1.1. The survey area extends along four sections of the A5025. From south to north, these sections are located at Valley, Llanfachraeth, Llanfaethlu and Cefn Coch, as outlined in Figures RAC6753-1a-d. The cumulative length of all sections is 5.1km.

2.1.2. Topography across the north, west and south of the site at Valley is level at around 5m above Ordnance Datum (AOD). There is an irregular slope up to a plateau at 14m AOD at the eastern boundary. At the time of survey most of this section was under grass and used for grazing sheep.

2.1.3. A small water course dissects the site at Llanfachraeth and runs westward, flowing out to Holyhead Bay. South of this water course, the land is largely level at 5m AOD and drained via a network of field ditches. North of the water course, the landform undulates between around 5m and 10m AOD, until the northernmost extent of this section which becomes largely level at around 10m AOD and is also drained via ditches. Most of the Llanfachraeth section was under grass at the time of survey but for two fields in the north which were cultivated.

[1] **MAFF (1988).** *Agricultural Land Classification of England and Wales. Revised guidelines and criteria for grading the quality of agricultural land.* MAFF Publications.

2.1.4. The section of the A5025 at Llanfaethlu has more variable topography. The village of Llanfaethlu in the north-west sits at the highest altitude of the section, at around 85m AOD. The proposed A5025 improvements to the north-east and east of the village are on lower slopes which have generally convex form falling to around 65m AOD. In the southern half of this section, slopes are shallower but more complex in form, with convex and concave features to around 55m AOD. All of the land in the Llanfaethlu section was under grass at the time of survey and grazed mostly by sheep, except in the north where cattle and ponies were present.

2.1.5. The northernmost section at Cefn Coch has the most complex topography of the four sections. There are two distinct hills to the east of the A5025. The proposed improvements are located along the lower slopes of these hills where landform is mixed, forming convex and concave slopes between 65m and 50m AOD in the south, and between around 50m and 35m AOD in the mid-section. There are rocky outcrops in the southern field. Slopes are shallower in the north with a westward fall from 35m to 30m AOD. In the very north, a narrow strip of land is largely level at 30m AOD. All of the land in this section is under grass but for the very north which is characterised by reeds and wetland vegetation.

## 2.2. Agro-climatic Conditions

2.2.1. Agro-climatic data for one point at each of the proposed sections of road improvements have been interpolated from the Meteorological Office's standard 5km grid point data set at representative altitudes, and are given in Table 1. Climate at the survey area is wet and warm to moderately warm. Crop moisture deficits are moderate to moderately small and the number of Field Capacity Days is considered relatively high.

**Table 1: Local agro-climatic conditions**

| | Valley | Llanfachraeth | Llanfaethlu | Cefn Coch |
|---|---|---|---|---|
| Grid Reference | SH 2297 3794 | SH 2316 3826 | SH 2317 3866 | SH 2342 3904 |
| Altitude (AOD) | 5m | 10m | 55m | 40m |
| Average Annual Rainfall | 884mm | 888mm | 930mm | 927mm |
| Accumulated Temperatures >0°C | 1,482 day° | 1,475 day° | 1,422 day° | 1,437 day° |
| Field Capacity Days | 187 days | 187 days | 194 days | 196 days |
| Average Moisture Deficit, wheat | 92mm | 91mm | 85mm | 88mm |
| Average Moisture Deficit, potatoes | 81mm | 80mm | 70mm | 75mm |

### 2.3. Soil Parent Material and Soil Type

2.3.1. The principal underlying geology of the sites at Valley, Llanfachraeth and the north of Cefn Coch as mapped by the British Geological Survey[2] comprises mica schist of the Harbour Group. The section at Llanfaethlu is underlain by schist of the Gwna Group which includes grit, quartzite, limestone, phyllite and jasper, and which is also found in the south of the Cefn Coch survey section.

2.3.2. Between the Gwna Group and Harbour Group at Cefn Coch is undifferentiated Church Bay Tuffs and Skerries Grits, comprising tuff and sandstone.

2.3.3. Most of the survey area is overlain by superficial deposits of glacial till, the content of which may include clay, sand, gravel and boulders. Alluvium is mapped in conjunction with watercourses and may contain clay, silt, sand and gravel.

2.3.4. The Soil Survey of England and Wales soil association mapping[3] (1:250,000 scale) shows the Brickfield 2 association to be present across Valley, the south of Llanfachraeth, Llanfaethlu and most of the Cefn Coch section of the A5025. The East Keswick 1 association is mapped across the north of Llanfachraeth and the south of Cefn Coch.

2.3.5. Brickfield 2 soils are characterised by fine loamy soils derived from shale and sandstone. The associated Brickfield series has slowly permeable subsurface horizons and is commonly of Wetness Class (WC) IV, although responds well to drainage. The East Keswick series of the Brickfield 2 association is contrastingly well drained, of WC I.

2.3.6. East Keswick association soils are more generally characterised by deep, fine loamy brown earths. Drift thickness is variable and rocky exposures may be observed. The soils are mostly permeable, of WC I although locally lower horizons may be seasonally waterlogged[4].

## 3. Agricultural Land Quality

### 3.1. Soil Survey Methods

3.1.1. Across the four sections, 63 soil profiles were examined using an Edelman (Dutch) auger at an observation density of one per hectare. Of the 63 observations, nine were made at Valley; 25 at Llanfachraeth; 13 at Llanfaethlu; and 16 at Cefn Coch. Observations at Valley were located according to a scheme layout which has since been realigned. As such, the observations made do not correlate entirely with the present proposed route.

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[2] **British Geological Survey (2016).** *Geology of Britain viewer, http://mapapps.bgs.ac.uk/geologyofbritain/home.html*

[3] **Soil Survey of England and Wales (1984).** *1:250,000 scale soil association mapping, Sheet 2 – Soils of Wales.*

[4] **Rudeforth *et al.* (1984).** *Soils and Their Use in Wales.* Soil Survey of England and Wales Bulletin 11, Harpenden.

3.1.2. One observation pit was also excavated per section to examine subsoil structures. The locations of observations are indicated on Figure RAC6753-1a-d. At each observation point the following characteristics were assessed for each soil horizon up to a maximum of 120cm or any impenetrable layer:

- soil texture;
- significant stoniness;
- colour (including local gley and mottle colours);
- consistency;
- structural condition;
- free carbonate; and
- depth.

3.1.3. Soil Wetness Class (WC) was inferred from the matrix colour, presence or absence of, and depth to, greyish and ochreous gley mottling and/or poorly permeable subsoil layers at least 15cm thick, in relation to the number of Field Capacity Days at the location.

3.1.4. Soil droughtiness was investigated by the calculation of moisture balance equations (given in Appendix 1). Crop-adjusted Available Profile Water (AP) is estimated from texture, stoniness and depth, and then compared to a calculated moisture deficit (MD) for the standard crops wheat and potatoes. The MD is a function of potential evapotranspiration and rainfall. Grading of the land can be affected if the AP is insufficient to balance the MD and droughtiness occurs. When a profile is found with significant stoniness, sufficient to prevent penetration of a hand auger, then it is assumed, for the purposes of calculating droughtiness, that similar levels of stoniness continues to the full 1.2m depth considered.

3.1.5. Representative topsoil samples were taken from within each of the four sections and sent to a laboratory for analysis of particle size distribution, organic matter content and major nutrients. The analysis was not able to be completed as the samples were damaged in transit to the laboratory.

## 3.2. Agricultural Land Classification and Site Limitations

3.2.1. Assessment of agricultural land quality has been carried out according to the MAFF revised guidelines (1988[1]). Soil profiles have been described according to the Soil Survey Field Handbook[5] which is the recognised source for describing soil profiles and characteristics according to the revised ALC guidelines.

[5] **Hodgson, J. M. (Ed.) (1997).** *Soil Survey Field Handbook*. Soil Survey Technical Monograph No. 5, Silsoe.

Valley

3.2.2. At the time of survey, the low-lying land at Valley was severely waterlogged, with standing water at the surface. The soil profiles predominantly comprise sandy loam topsoil, although clay loam and sandy clay loam are also occasionally present. The average depth is 32cm and the colour is dark grey or dark greyish brown (10YR4/1, 2.5Y4/2 or 5Y4/1 in the Munsell soil colour charts[6]). All of the topsoil is mottled to some extent, ranging from few distinct ochreous mottles to many prominent mottles, indicating recurrent periods of prolonged wetness in the topsoil. Stone content is slight at around 2-5%.

3.2.3. Subsoil at Valley is coarse textured, comprising loamy sand or sand which is grey, greyish brown or light brownish grey (10YR5/1, 5/2, 2.5Y6/2 or 5Y4/1). All of the subsoil is mottled with common or many ochreous stains and all is gleyed. Stone content continues to be slight, typically 1-2% by volume. The coarse textures of the subsoil ensure that surface water drains freely through the profiles. However, the site is severely affected by groundwater and inundated from below, as shown in Appendix 2, as well as receiving any excess water which drains from the slopes to the east.

3.2.4. Aerial photography shows a clear distinction between the flat survey area at Valley and the point at which the altitude changes in the east, suggesting that flooding is recurrent. According to the ALC guidelines, sites that experience frequent flooding (more than once in three years) of long duration (lasting more than four days) during winter months are limited to Grade 4. Based on the field survey data combined with historical aerial photography, Grade 4 is considered to be an appropriate classification for the low-lying land at Valley.

3.2.5. As the landform begins to slope upward, the flood risk decreases. However, some of the slopes are very irregular and are likely to present difficulties regarding access for some machinery. Additionally, aerial photography shows some patchiness in vegetation growth in these areas. Subgrade 3b is therefore considered an appropriate grade for areas bordering the flood zones and with irregular slopes.

Llanfachraeth

3.2.6. Topsoil at Llanfachraeth is predominantly of medium clay loam or medium silty clay loam with occasional sandy clay loam. The average depth is 36cm and the colour ranges from brown (7.5YR4/2, 5/2 and 10YR4/3) to greyish brown and grey (10YR3/2, 4/2 and 5/1). The topsoil contains up to around 5% stones by volume but is commonly stoneless. The topsoil structure is moderately well developed and forms fine angular blocky peds. There is ample pore space to allow for sufficient aeration and drainage, although only few fine roots grow through the topsoil.

[6] **Munsell Color (2009).** *Munsell Soil Color Book,* Grand Rapids, MI, USA

3.2.7. The subsoil is commonly of a similar texture to the topsoil although clay also occurs frequently. Subsoil stone content is assessed as moderate to high, between 10 and 20% by volume. The colour is highly variable and includes brown (7.5YR4/2 and 5/2), grey (10YR5/1), light olive brown (2.5Y5/3) and light brownish grey (2.5Y6/2). Other than in the north at Observations 28, 29 and 30, all of the subsoil contains ochreous mottles, ranging from few to many but mostly distinct, with most of the subsoil considered gleyed. A pit excavated at Observation 26 showed the subsoil to be slowly permeable, with a weakly developed, fine angular blocky structure.

3.2.8. Where the subsoil is not permeable, the profiles are of WC III or IV depending on the specific depths to gleyed and/or slowly permeable layers. Where there is no gleying present and/or the profiles are permeable, they are of WC II.

3.2.9. Under the climatic conditions of the site, profiles of WC II or III are limited by wetness and workability to Subgrade 3a when combined with medium loamy topsoil textures. Profiles of WC IV are limited more severely, to Subgrade 3b. In the mid-section of Llanfachraeth in the vicinity of the water courses, the risk of flooding is mapped by Natural Resources Wales as high (Appendix 2). As is applicable at Valley, this area is also classified as Grade 4.

<u>Llanfaethlu</u>

3.2.10. A large area in the centre of the site at Llanfaethlu, extending to around a 600m length of the proposed improvements and 2.8ha in area, could not be surveyed as access permission was not granted due to lambing. Several additional observations were made to the north and south of this area in order to assist with interpolation of results.

3.2.11. Soil profiles at Llanfaethlu comprise medium clay loam topsoil of 31cm average depth. The colour varies from brown (7.5YR4/2) to greyish or dark greyish brown (10YR4/2, 2.5Y4/2 and 5/2). Stone content is typically slight at around 2-5%. The topsoil structure is moderately to well developed and forms fine subangular blocky peds. Common fine roots are present in the topsoil which has ample pore space for aeration and drainage.

3.2.12. Subsoil is mostly of clay with some clay loam also present. Stone content is up to around 20%. The subsoil colour includes various shades of brown (7.5YR4/2, 4/3, 4/4 and 10YR5/3), greyish brown (10YR5/3) and light olive or yellowish brown (2.5Y5/3 or 6/3). In the south and north of the section, the subsoil is mottled with common or many ochreous mottles and is gleyed. A pit excavated at Observation 33 showed the subsoil to have a weakly developed fine angular blocky structure and be slowly permeable.

3.2.13. Profiles in this section with slowly permeable subsoils are of WC IV which, when combined with climatic factors and medium clay loam topsoil, results in a limitation to Subgrade 3b.

3.2.14. Profiles that were able to be surveyed closer to the middle of the section, at Observations 39, 39a and 40, included brown (but not pale) subsoil mostly of medium clay loam. This subsoil displayed no mottles and no signs of recurrent soil wetness and hence are assessed as WC I. The profiles are on a gentle south-facing slope which will further assist with drainage. Profiles of WC I with medium clay loam topsoils have a slight wetness and workability limitation to Grade 2. Furthermore, aerial photography shows the land to have been cultivated in the past, in addition to land to the immediate east of the applicable area which was not accessible for survey. The discrepancy between this grade and the provisional mapping which shows Grade 4 may have been influenced by the presence of rocky outcrops in neighbouring fields to the north and south.

3.2.15. The northernmost field of the section is limited by microrelief. Although the soil profile assessed is inherently of good quality, it is located on the periphery of a field otherwise characterised by rocky outcrops. The field edges could not practically be farmed as a separate unit to the centre of the field and therefore it is restricted to grazing and to Grade 5.

3.2.16. There is not considered to be a significant flood risk at Llanfaethlu.

Cefn Coch

3.2.17. Topsoil throughout the Cefn Coch section is of medium clay loam which has an average depth of 32cm. The colour is mostly dark greyish brown (10YR4/2) but varies from dark grey (5YR4/1) to dark greyish brown (10YR4/2). Stone content is slight, up to 5% by volume. The topsoil structure is well developed with medium to fine subangular blocky peds.

3.2.18. The subsoil is variable in texture, including medium and heavy clay loam, sandy clay loam and occasionally sandy loam or clay. Stone content is variable and ranges from around 2% to 20%. South of the crossroads the colour is mostly brown (7.5YR4/2 or 4/4, 10YR4/2) whilst north of the crossroads greyish brown and brown (10YR5/3 and 5/3) become more common, with other colours present to a lesser extent throughout the section. Most but not all of the subsoil is mottled with common and/or distinct ochreous mottles, and much is gleyed. The structure is weakly developed with medium subangular blocky peds which will enable percolation of water through the subsoil. Where gleyed but permeable, the profiles are of WC I or II. Those which are not gleyed are of WC I.

3.2.19. The southernmost section of the route (Observations 48 to 52) is most severely limited by microrelief. The area in which these observations were made is characterised by rocky outcrops which restrict this land to grazing and therefore to no better than Grade 5.

3.2.20. To the north of the crossroads, land quality is most severely limited by slope, with gradients of 7°, which limit the land to Subgrade 3b due to restrictions on the types of agricultural machinery that can be safely operated.

3.2.21. Further north at Cefn Coch, on the east side of the existing A5025 is a pony paddock. At the time of survey the soil in this area was exceptionally compacted such that it could not be penetrated by auger to depths greater than around 20cm. The ALC guidelines state that "*Where significant subsoil compaction occurs, root penetration is generally restricted and moisture reserves in the soil below a severely compacted, very poorly structured horizon will make a negligible contribution to plant growth. In such cases the calculation of AP should be limited to the soil horizons above the compacted layer.*" Following this guidance results in a droughtiness limitation to Grade 4 for a profile restricted to 20cm although if this were to increase by just 3cm, the limitation would be less severe to Subgrade 3b. Indeed, aerial photography shows a noticeable difference in established vegetation between the paddock and surrounding grassland.

3.2.22. To the west of the existing A5025 in the very northernmost field of the section, the land is low lying and characterised by trees, reeds and rushes, which are indicative of wetland environments. Natural Resources Wales classify the area as being at high risk of flooding from surface water and at medium risk of being flooded by rivers (shown in Appendix 2). Grade 4 is considered to be an appropriate grade for this area.

3.2.23. The areas of each ALC grade are given in Table 2 and are shown in Figures RAC6753-2a-d. Photographs taken at each of the sites are given in Appendix 3.

**Table 2: Agricultural Land Classification**

| Grade | Description | Valley | | Llanfachraeth | | Llanfaethlu | | Cefn Coch | |
|---|---|---|---|---|---|---|---|---|---|
| | | Area (ha) | % of agri. land | Area (ha) | % of agri. land | Area (ha) | % of agri. land | Area (ha) | % of agri. land |
| 2 | Very good quality | - | - | 1.3 | 10 | 1.1 | 15 | - | - |
| 3a | Good quality | - | - | 7.9 | 59 | 1.0 | 13 | 2.1 | 20 |
| 3b | Moderate quality | 4.6 | 38 | 3.5 | 26 | 3.9 | 53 | 3.3 | 31 |
| 4 | Poor quality | 7.5 | 62 | 0.7 | 5 | - | - | 3.1 | 29 |
| 5 | Very poor quality | - | - | - | - | 1.4 | 19 | 2.1 | 20 |
| | Total Agricultural | 12.1 | 100 | 13.4 | 100 | 7.4 | 100 | 10.6 | 100 |

## Appendix 1: Soil Profile Summaries and Droughtiness Calculations

## Valley

Droughtiness calculations are made according to the methodology given in Appendix 4 of the ALC guidelines, MAFF 1988.

MDw= 92 MDp= 81

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | Wheat Calculation: TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | Potato Calculation: TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VA1 | 0 | 40 | fSL | 10YR4/1 | ffd och | 2 | 1 | 18 | 70.6 | 1 | 18 | 70.6 | n | n | I | 4 |
| | 40 | 50 | LmS | 10YR5/1+5/2 | cmf och | 2 | 1 | 9 | 8.8 | 1 | 9 | 8.8 | y | n | | |
| | 50 | 70 | LmS | 10YR5/1+5/2 | cmf och | 2 | 0.5 | 6 | 11.8 | 1 | 9 | 17.7 | y | n | | |
| | 70 | 120 | LmS | 10YR5/1+5/2 | cmf och | 2 | 0.5 | 6 | 29.5 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 120.7 | | Total (mm) = | 97.2 | | | | |
| | | | | | | | | MBw= | 28.7 | | MBp= | 16.2 | | | | |
| | | | | | | | | Grade = | 2 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VA2 | 0 | 40 | fSL | 10YR4/1 | ffd och | 2 | 1 | 18 | 70.6 | 1 | 18 | 70.6 | n | n | I | 4 |
| | 40 | 50 | mS | 10YR5/1+5/2 | cmf och | 2 | 1 | 7 | 6.9 | 1 | 7 | 6.9 | y | n | | |
| | 50 | 70 | mS | 10YR5/1+5/2 | cmf och | 2 | 0.5 | 5 | 9.8 | 1 | 7 | 13.8 | y | n | | |
| | 70 | 120 | mS | 10YR5/1+5/2 | cmf och | 2 | 0.5 | 5 | 24.6 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 111.9 | | Total (mm) = | 91.3 | | | | |
| | | | | | | | | MBw= | 19.9 | | MBp= | 10.3 | | | | |
| | | | | | | | | Grade = | 2 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VA3 | 0 | 35 | fSL | 10YR4/1 | ffd och | 2 | 1 | 18 | 61.8 | 1 | 18 | 61.8 | n | n | I | 4 |
| | 35 | 50 | mS | 10YR5/1+5/2 | cmf och | 2 | 1 | 7 | 10.3 | 1 | 7 | 10.3 | y | n | | |
| | 50 | 70 | mS | 10YR5/1+5/2 | cmf och | 2 | 0.5 | 5 | 9.8 | 1 | 7 | 13.8 | y | n | | |
| | 70 | 120 | mS | 10YR5/1+5/2 | cmf och | 2 | 0.5 | 5 | 24.6 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 106.5 | | Total (mm) = | 85.9 | | | | |
| | | | | | | | | MBw= | 14.5 | | MBp= | 4.9 | | | | |

| | | | | | | | | Grade = | 2 | | Grade = | 2 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Wheat Calculation | | | Potato Calculation | | | | | | |
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
| VA 4 | 0 | 40 | HCL | 5Y4/1 | fmd och | 5 | 1 | 18 | 68.6 | 1 | 18 | 68.6 | y | n | I | 4 |
| | 40 | 50 | LS | 5Y4/1 | mcp och | 2 | 1 | 9 | 8.8 | 1 | 9 | 8.8 | y | n | | |
| | 50 | 70 | LS | 5Y4/1 | mcp och | 2 | 0.5 | 6 | 11.8 | 1 | 9 | 17.7 | y | n | | |
| | 70 | 120 | S | 5Y4/1 | mcp och | 2 | 0.5 | 5 | 24.6 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 113.8 | | Total (mm) = | 95.1 | | | | |
| | | | | | | | | MBw= | 21.8 | | MBp= | 14.1 | | | | |
| | | | | | | | | Grade = | 2 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VA 5 | 0 | 30 | MCL | 2.5Y4/2 | mcp och | 2 | 1 | 18 | 53.0 | 1 | 18 | 53.0 | y | n | I | 4 |
| | 30 | 50 | LS | 5Y4/1 | mcp och | 2 | 1 | 9 | 17.7 | 1 | 9 | 17.7 | y | n | | |
| | 50 | 70 | LS | 5Y4/1 | mcp och | 2 | 0.5 | 6 | 11.8 | 1 | 9 | 17.7 | y | n | | |
| | 70 | 120 | S | 5Y4/1 | mcp och | 2 | 0.5 | 5 | 24.6 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 107.0 | | Total (mm) = | 88.3 | | | | |
| | | | | | | | | MBw= | 15.0 | | MBp= | 7.3 | | | | |
| | | | | | | | | Grade = | 2 | | Grade = | 2 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VA 6 | 0 | 10 | SCL | 2.5Y4/2 | fmd och | 1 | 1 | 17 | 16.8 | 1 | 17 | 16.8 | n | n | I | 4 |
| | 10 | 50 | SL | 5Y4/1 | mcp och | 1 | 1 | 15 | 59.4 | 1 | 15 | 59.4 | y | n | | |
| | 50 | 70 | SL | 5Y4/1 | mcp och | 1 | 0.5 | 11 | 21.8 | 1 | 15 | 29.7 | y | n | | |
| | 70 | 120 | LS | 5Y4/1 | mcp och | 1 | 0.5 | 6 | 29.7 | | | 0.0 | y | n | | |
| | | | | | | | | Total (mm) = | 127.8 | | Total (mm) = | 106.0 | | | | |
| | | | | | | | | MBw= | 35.8 | | MBp= | 25.0 | | | | |

| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Wheat Calculation | | | Potato Calculation | | | | | | |
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
| VA7 | 0 | 30 | fSL | 10YR4/1 | ffd och | 2 | 1 | 18 | 53.0 | 1 | 18 | 53.0 | n | n | I | 4 |
| | 35 | 50 | LmS | 10YR5/1+5/2 | cmf och | 2 | 1 | 9 | 13.3 | 1 | 9 | 13.3 | y | n | | |
| | 50 | 70 | LfS | 10YR5/1 | | 2 | 0.5 | 13 | 25.5 | 1 | 15 | 29.4 | n | n | | |
| | 70 | 120 | LfS | 10YR5/1 | | 2 | 0.5 | 13 | 63.8 | | | | n | n | | |
| | | | | | | | | Total (mm) = | 155.5 | | Total (mm) = | 95.7 | | | | |
| | | | | | | | | MBw= | 63.5 | | MBp= | 14.7 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VA8 | 0 | 30 | fSL | 10YR4/1 | ffd och | 2 | 1 | 18 | 53.0 | 1 | 18 | 53.0 | n | n | I | 4 |
| | 35 | 50 | mS | 10YR5/1+5/2 | cmf och | 2 | 1 | 7 | 10.3 | 1 | 7 | 10.3 | y | n | | |
| | 50 | 70 | mS | 10YR5/1+5/2 | cmf och | 2 | 0.5 | 5 | 9.8 | 1 | 7 | 13.8 | n | n | | |
| | 70 | 120 | mS | 10YR5/1+5/2 | cmf och | 2 | 0.5 | 5 | 24.6 | | | | n | n | | |
| | | | | | | | | Total (mm) = | 97.7 | | Total (mm) = | 77.1 | | | | |
| | | | | | | | | MBw= | 5.7 | | MBp= | -3.9 | | | | |
| | | | | | | | | Grade = | 2 | | Grade = | 2 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VA9 | 0 | 30 | SL | 2.5Y4/2 | fmd och | 1 | 1 | 17 | 50.5 | 1 | 17 | 50.5 | n | n | I | 4 |
| | 30 | 50 | LS | 2.5Y6/2 | mmp och | 1 | 1 | 9 | 17.8 | 1 | 9 | 17.8 | y | n | | |
| | 50 | 70 | LS | 2.5Y6/2 | mmp och | 1 | 0.5 | 6 | 11.9 | 1 | 9 | 17.8 | y | n | | |
| | 70 | 120 | S | 2.5Y6/2 | mmp och | 1 | 0.5 | 5 | 24.8 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 105.0 | | Total (mm) = | 86.2 | | | | |
| | | | | | | | | MBw= | 13.0 | | MBp= | 5.2 | | | | |
| | | | | | | | | Grade = | 2 | | Grade = | 2 | | | | |

## Llanfachraeth

Droughtiness calculations are made according to the methodology given in Appendix 4 of the ALC guidelines, MAFF 1988.

MDw= 85 MDp= 70

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | Wheat Calculation: TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | Potato Calculation: TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFT10 | 0 | 30 | MZCL | 7.5YR4/2 | | 1 | 1 | 19 | 56.5 | 1 | 19 | 56.5 | n | n | II | 3a |
| | 30 | 50 | MCL | 10YR5/2+5/3 | cf-md och | 15 | 1 | 16 | 27.5 | 1 | 16 | 27.5 | y | n | | |
| | 50 | 60 | MCL | 10YR5/2+5/3 | cf-md och | 15 | 0.5 | 10 | 8.6 | 1 | 16 | 13.8 | y | n | | |
| | 60 | 70 | MCL | 10YR5/2+5/3 | cf-md och | 15 | 0.5 | 10 | 8.6 | 1 | 16 | 13.8 | y | n | | |
| | 70 | 120 | MCL | 10YR5/2+5/3 | cf-md och | 15 | 0.5 | 10 | 42.9 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 144.0 | | Total (mm) = | 111.5 | | | | |
| | | | | | | | | MBw= | 59.0 | | MBp= | 41.5 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFT11 | 0 | 27 | MCL | 2.5YR4/2 | | 1 | 1 | 18 | 48.1 | 1 | 18 | 48.1 | n | n | I | 2 |
| | 27 | 50 | C | 2.5Y5/3 | fmd och | 15 | 1 | 16 | 31.6 | 1 | 16 | 31.6 | n | n | | |
| | 50 | 68 | C | 2.5Y5/3 | mmd och | 15 | 0.5 | 8 | 12.4 | 1 | 16 | 24.8 | y | n | | |
| | 68 | 70 | C | 2.5Y5/3 | mmd och | 15 | 0.5 | 8 | 1.4 | 1 | 16 | 2.8 | y | n | | |
| | 70 | 120 | C | 2.5Y5/3 | mmd och | 15 | 0.5 | 8 | 34.4 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 127.9 | | Total (mm) = | 107.3 | | | | |
| | | | | | | | | MBw= | 42.9 | | MBp= | 37.3 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| | | | | | | | Wheat Calculation | | | Potato Calculation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
| LFT12 | 0 | 45 | MZCL | 10YR4/3 | | 1 | 1 | 19 | 84.7 | 1 | 19 | 84.7 | n | n | III | 3a |
| | 45 | 50 | SCL | 10YR5/3 | cfd och | 10 | 1 | 13 | 5.9 | 1 | 13 | 5.9 | y | y | | |
| | 50 | 70 | SCL | 10YR5/3 | cfd och | 10 | 0.5 | 8 | 14.5 | 1 | 13 | 23.6 | y | y | | |
| | 70 | 120 | SCL | 10YR5/3 | cfd och | 10 | 0.5 | 8 | 36.3 | | | | y | y | | |
| | | | | | | | | Total (mm) = | 141.3 | | Total (mm) = | 114.2 | | | | |
| | | | | | | | | MBw= | 56.3 | | MBp= | 44.2 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFT13 | 0 | 30 | MZCL | 10YR4/2 | | 1 | 1 | 19 | 56.5 | 1 | 19 | 56.5 | n | n | II | 3a |
| | 30 | 50 | C | 7.5YR4/2 | cmf och | 5 | 1 | 16 | 30.5 | 1 | 16 | 30.5 | y | n | | |
| | 50 | 70 | C | 7.5YR4/2 | cmf och | 5 | 0.5 | 8 | 15.3 | 1 | 16 | 30.5 | y | n | | |
| | 70 | 120 | C | 7.5YR4/2 | cmf och | 5 | 0.5 | 8 | 38.1 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 140.3 | | Total (mm) = | 117.5 | | | | |
| | | | | | | | | MBw= | 55.3 | | MBp= | 47.5 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFT 14 | 0 | 46 | MCL | 10YR4/2 | | 5 | 1 | 18 | 78.9 | 1 | 18 | 78.9 | n | n | II | 3a |
| | 46 | 50 | MZCL | 10YR5/3 | mmd och | 5 | 1 | 17 | 6.5 | 1 | 17 | 6.5 | y | n | | |
| | 50 | 70 | MZCL | 10YR5/3 | mmd och | 10 | 0.5 | 10 | 18.1 | 1 | 17 | 30.8 | y | n | | |
| | 70 | 120 | MZCL | 10YR5/3 | mmd och | 10 | 0.5 | 10 | 45.3 | | | 0.0 | y | n | | |
| | | | | | | | | Total (mm) = | 148.7 | | Total (mm) = | 116.2 | | | | |
| | | | | | | | | MBw= | 63.7 | | MBp= | 46.2 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| | | | | | | | Wheat Calculation | | | Potato Calculation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
| LFT15 | 0 | 50 | MCL | 7.5YR4/2 | | 0 | 1 | 18 | 90.0 | 1 | 18 | 90.0 | n | n | I | 2 |
| | 50 | 60 | MCL | 7.5YR4/2 | | 0 | 0.5 | 10 | 10.0 | 1 | 16 | 16.0 | n | n | | |
| | 60 | 70 | MCL | 7.5YR4/2 | | 0 | 0.5 | 10 | 10.0 | 1 | 16 | 16.0 | n | n | | |
| | 70 | 100 | MCL | 7.5YR4/2 | | 0 | 0.5 | 10 | 30.0 | | | | n | n | | |
| | 100 | 120 | MCL | 7.5YR4/3 | cmf och | 0 | 0.5 | 10 | 20.0 | | | | n | n | | |
| | | | | | | | | Total (mm) = | 160.0 | | Total (mm) = | 122.0 | | | | |
| | | | | | | | | MBw= | 75.0 | | MBp= | 52.0 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFT 16 | 0 | 27 | MCL | 2.5Y4/2 | | 5 | 1 | 18 | 46.3 | 1 | 18 | 46.3 | n | n | III | 3a |
| | 27 | 50 | C | 2.5Y6/2 | mmd och | 5 | 1 | 16 | 35.1 | 1 | 16 | 35.1 | y | n | | |
| | 50 | 70 | C | 10G5/1 | mmd och | 10 | 0.5 | 8 | 14.5 | 1 | 16 | 29.0 | y | n | | |
| | 70 | 78 | C | 10G5/1 | mmd och | 10 | 0.5 | 7 | 5.1 | 1 | | 0.1 | y | n | | |
| | 78 | 120 | C | 10G5/1 | mmp och | 10 | 0.5 | 7 | 26.7 | | | 0.0 | y | y | | |
| | | | | | | | | Total (mm) = | 127.6 | | Total (mm) = | 110.5 | | | | |
| | | | | | | | | MBw= | 42.6 | | MBp= | 40.5 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFT17 | 0 | 30 | MCL | 10YR4/2 | | 0 | 1 | 18 | 54.0 | 1 | 18 | 54.0 | n | n | IV | 3b |
| | 30 | 50 | C | 10YR5/3 | mmd och | 0 | 1 | 13 | 26.0 | 1 | 13 | 26.0 | y | y | | |
| | 50 | 65 | C | 10YR5/3 | mmd och | 0 | 0.5 | 7 | 10.5 | 1 | 13 | 19.5 | y | y | | |
| | 65 | 70 | C | N5 | | 10 | 0.5 | 7 | 3.2 | 1 | 13 | 5.9 | n | y | | |
| | 70 | 120 | C | N5 | | 10 | 0.5 | 7 | 31.8 | | | 0.0 | n | y | | |
| | | | | | | | | Total (mm) = | 125.4 | | Total (mm) = | 105.4 | | | | |
| | | | | | | | | MBw= | 40.4 | | MBp= | 35.4 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| | | | | | | | Wheat Calculation | | | Potato Calculation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
| LFT18 | 0 | 30 | MCL | 10YR3/2 | | 0 | 1 | 18 | 54.0 | 1 | 18 | 54.0 | n | n | IV | 3b |
| | 30 | 40 | MCL | 10YR4/2 | cfd-p och | 0 | 1 | 12 | 12.0 | 1 | 12 | 12.0 | y | y | | |
| | 40 | 50 | C | 10YR5/3 | cmd och | 0 | 0.5 | 13 | 13.0 | 1 | 13 | 13.0 | y | y | | |
| | 50 | 70 | C | 10YR5/3 | cmd och | 0 | 0.5 | 7 | 14.0 | 1 | 13 | 26.0 | y | y | | |
| | 70 | 120 | C | 10YR5/3 | cmd och | 0 | 0.5 | 7 | 35.0 | | | 0.0 | y | y | | |
| | | | | | | | | Total (mm) = | 128.0 | | Total (mm) = | 105.0 | | | | |
| | | | | | | | | MBw= | 43.0 | | MBp= | 35.0 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFT19 | 0 | 50 | MCL | 7.5YR5/2 | | 0 | 1 | 18 | 90.0 | 1 | 18 | 90.0 | n | n | III | 3a |
| | 50 | 55 | MCL | 7.5YR5/2 | | 0 | 1 | 16 | 8.0 | 1 | 16 | 8.0 | n | n | | |
| | 55 | 70 | MCL | 7.5YR5/2 | cff och | 20 | 0.5 | 7 | 8.6 | 1 | 12 | 14.7 | y | y | | |
| | 70 | 120 | MCL | 7.5YR5/2 | cff och | 20 | 0.5 | 7 | 28.5 | | | 0.0 | y | y | | |
| | | | | | | | | Total (mm) = | 135.1 | | Total (mm) = | 112.7 | | | | |
| | | | | | | | | MBw= | 50.1 | | MBp= | 42.7 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFT 20 | 0 | 40 | MCL | 2.5YR4/2 | | 5 | 1 | 18 | 68.6 | 1 | 18 | 68.6 | n | n | II | 3a |
| | 40 | 50 | HCL | 10YR4/2 | mmd och | 5 | 1 | 16 | 15.3 | 1 | 16 | 15.3 | y | n | | |
| | 50 | 60 | HCL | 10YR4/2 | mmd och | 10 | 0.5 | 10 | 9.1 | 1 | 16 | 14.5 | y | n | | |
| | 60 | 70 | HCL | 10YR4/2 | mmd och | 20 | 0.5 | 10 | 8.1 | 1 | 16 | 13.0 | y | n | | |
| | 70 | 120 | HCL | 10YR4/2 | mmp och | 20 | 0.5 | 10 | 40.5 | | | 0.0 | y | n | | |
| | | | | | | | | Total (mm) = | 141.5 | | Total (mm) = | 111.4 | | | | |
| | | | | | | | | MBw= | 56.5 | | MBp= | 41.4 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| | | | | | | | Wheat Calculation | | | Potato Calculation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
| LFT21 | 0 | 40 | SCL | 7.5YR5/2 | | 0 | 1 | 17 | 68.0 | 1 | 17 | 68.0 | n | n | II | 3a |
| | 40 | 50 | SCL | 7.5YR5/2 | cff och | 0 | 1 | 15 | 15.0 | 1 | 15 | 15.0 | y | n | | |
| | 50 | 70 | SCL | 7.5YR5/2 | cff och | 20 | 0.5 | 10 | 16.2 | 1 | 15 | 24.4 | y | n | | |
| | 70 | 120 | SCL | 7.5YR5/2 | cff och | 20 | 0.5 | 10 | 40.5 | | | 0.0 | y | n | | |
| | | | | | | | | Total (mm) = | 139.7 | | Total (mm) = | 107.4 | | | | |
| | | | | | | | | MBw= | 54.7 | | MBp= | 37.4 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFT22 | 0 | 20 | MCL | 2.5YR4/2 | | 5 | 1 | 18 | 34.3 | 1 | 18 | 34.3 | n | n | II | 3a |
| | 20 | 50 | C | 2.5Y6/2 | mmd och | 20 | 1 | 16 | 39.0 | 1 | 16 | 39.0 | y | n | | |
| | 50 | 70 | C | 2.5Y6/2 | mmd och | 20 | 0.5 | 10 | 16.2 | 1 | 16 | 26.0 | y | n | | |
| | 70 | 120 | C | 2.5Y6/2 | mmp och | 20 | 0.5 | 10 | 40.5 | | | 0.0 | y | n | | |
| | | | | | | | | Total (mm) = | 130.0 | | Total (mm) = | 99.3 | | | | |
| | | | | | | | | MBw= | 45.0 | | MBp= | 29.3 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFT23 | 0 | 30 | MZCL | 10YR4/2 | | 0 | 1 | 19 | 57.0 | 1 | 19 | 57.0 | n | n | II | 3a |
| | 30 | 50 | C | 7.5YR5/2 | cmf och | 0 | 1 | 16 | 32.0 | 1 | 16 | 32.0 | y | n | | |
| | 50 | 70 | C | 7.5YR5/2 | cmf och | 0 | 0.5 | 8 | 16.0 | 1 | 16 | 32.0 | y | n | | |
| | 70 | 75 | C | 7.5YR5/2 | cmf och | 0 | 0.5 | 8 | 4.0 | | | | y | n | | |
| | 75 | 120 | C | 7.5YR5/2 | cmf och | 0 | 0.5 | 8 | 36.0 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 145.0 | | Total (mm) = | 121.0 | | | | |
| | | | | | | | | MBw= | 60.0 | | MBp= | 51.0 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| | | | | | | | Wheat Calculation | | | Potato Calculation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
| LFT24 | 0 | 30 | MCL | 10YR4/2 | | 5 | 1 | 18 | 51.5 | 1 | 18 | 51.5 | n | n | II | 3a |
| | 30 | 50 | C | 2.5Y6/2 | mmd och | 20 | 1 | 16 | 26.0 | 1 | 16 | 26.0 | y | n | | |
| | 50 | 70 | C | 2.5Y6/2 | mmd och | 20 | 0.5 | 10 | 16.2 | 1 | 16 | 26.0 | y | n | | |
| | 70 | 120 | C | 2.5Y6/2 | mmp och | 20 | 0.5 | 10 | 40.5 | | | 0.0 | y | n | | |
| | | | | | | | | Total (mm) = | 134.2 | | Total (mm) = | 103.5 | | | | |
| | | | | | | | | MBw= | 49.2 | | MBp= | 33.5 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFT 25 | 0 | 40 | MCL | 10YR4/2 | | 5 | 1 | 18 | 68.6 | 1 | 18 | 68.6 | n | n | II | 3a |
| | 40 | 50 | HCL | 2.5Y6/2 | mmd och | 5 | 1 | 16 | 15.3 | 1 | 16 | 15.3 | y | n | | |
| | 50 | 60 | HCL | 2.5Y6/2 | mmd och | 5 | 0.5 | 10 | 9.5 | 1 | 16 | 15.3 | y | n | | |
| | 60 | 70 | HCL | 2.5Y6/2 | mmd och | 20 | 0.5 | 10 | 8.1 | 1 | 16 | 13.0 | y | n | | |
| | 70 | 120 | HCL | 2.5YR6/2 | mmp och | 20 | 0.5 | 10 | 40.5 | | | 0.0 | y | n | | |
| | | | | | | | | Total (mm) = | 142.0 | | Total (mm) = | 112.1 | | | | |
| | | | | | | | | MBw= | 57.0 | | MBp= | 42.1 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFT26 | 0 | 35 | SCL | 10YR4/3 | | 5 | 1 | 17 | 56.7 | 1 | 17 | 56.7 | n | n | II | 3a |
| | 35 | 50 | SCL | 10YR5/1+5/2 | cmd och | 20 | 1 | 15 | 18.3 | 1 | 15 | 18.3 | y | n | | |
| | 50 | 70 | SCL | 10YR5/1+5/2 | cmd och | 20 | 0.5 | 10 | 16.2 | 1 | 15 | 24.4 | y | n | | |
| | 70 | 75 | SCL | 10YR5/1+5/2 | cmd och | 20 | 0.5 | 10 | 4.1 | | | | y | n | | |
| | 75 | 120 | SCL | 10YR5/1+5/2 | cmd och | 20 | 0.5 | 10 | 36.5 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 131.7 | | Total (mm) = | 99.4 | | | | |
| | | | | | | | | MBw= | 46.7 | | MBp= | 29.4 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| | | | | | | | Wheat Calculation | | | Potato Calculation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
| LFT27 | 0 | 30 | MCL | 10YR5/1 | | 5 | 1 | 18 | 51.5 | 1 | 18 | 51.5 | n | n | II | 3a |
| | 30 | 50 | SCL | 10YR5/3 | cmf och | 5 | 1 | 15 | 28.6 | 1 | 15 | 28.6 | y | n | | |
| | 50 | 70 | SCL | 10YR5/3 | cmf och | 5 | 0.5 | 10 | 19.1 | 1 | 15 | 28.6 | y | n | | |
| | 70 | 75 | SCL | 10YR5/3 | cmf och | 5 | 0.5 | 10 | 4.8 | | | | y | n | | |
| | 75 | 120 | SCL | 10YR5/3 | cmf och | 5 | 0.5 | 10 | 42.9 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 146.7 | | Total (mm) = | 108.7 | | | | |
| | | | | | | | | MBw= | 61.7 | | MBp= | 38.7 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFT28 | 0 | 40 | MCL | 10YR4/3 | femns | 0 | 1 | 18 | 72.0 | 1 | 18 | 72.0 | n | n | I | 2 |
| | 40 | 50 | MCL | 10YR4/2 | | 15 | 1 | 16 | 13.8 | 1 | 16 | 13.8 | n | n | | |
| | 50 | 70 | MCL | 10YR4/2 | | 15 | 0.5 | 10 | 17.2 | 1 | 16 | 27.5 | n | n | | |
| | 70 | 120 | MCL | 10YR4/2 | | 15 | 0.5 | 10 | 42.9 | | | | n | n | | |
| | | | | | | | | Total (mm) = | 145.8 | | Total (mm) = | 113.3 | | | | |
| | | | | | | | | MBw= | 60.8 | | MBp= | 43.3 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFT29 | 0 | 40 | MZCL | 10YR4/2 | | 5 | 1 | 19 | 72.4 | 1 | 19 | 72.4 | n | n | I | 2 |
| | 40 | 50 | MCL | 10YR4/2 | | 15 | 1 | 16 | 13.8 | 1 | 16 | 13.8 | n | n | | |
| | 50 | 70 | MCL | 10YR4/2 | | 15 | 0.5 | 10 | 17.2 | 1 | 16 | 27.5 | n | n | | |
| | 70 | 120 | MCL | 10YR4/2 | | 15 | 0.5 | 10 | 42.9 | | | | n | n | | |
| | | | | | | | | Total (mm) = | 146.2 | | Total (mm) = | 113.7 | | | | |
| | | | | | | | | MBw= | 61.2 | | MBp= | 43.7 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | Wheat Calculation<br>TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | Potato Calculation<br>TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFT30 | 0 | 50 | MZCL | 7.5YR4/2 | | 0 | 1 | 19 | 95.0 | 1 | 19 | 95.0 | n | n | I | 2 |
| | 50 | 60 | MZCL | 7.5YR4/2 | | 0 | 1 | 10 | 10.0 | 1 | 17 | 17.0 | n | n | | |
| | 60 | 70 | MCL | 7.5YR4/3 | | 5 | 0.5 | 10 | 9.5 | 1 | 16 | 15.3 | n | n | | |
| | 70 | 120 | MCL | 7.5YR4/3 | | 5 | 0.5 | 10 | 47.6 | | | | n | n | | |
| | | | | | | | | Total (mm) = | 162.2 | | Total (mm) = | 127.3 | | | | |
| | | | | | | | | MBw= | 77.2 | | MBp= | 57.3 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFT31 | 0 | 30 | MCL | 10YR4/2 | | 5 | 1 | 18 | 51.5 | 1 | 18 | 51.5 | n | n | I | 2 |
| | 30 | 50 | SCL | 10YR5/3 | fmf och | 5 | 1 | 15 | 28.6 | 1 | 15 | 28.6 | n | n | | |
| | 50 | 60 | SCL | 10YR5/3 | fmf och | 5 | 0.5 | 10 | 9.5 | 1 | 15 | 14.3 | n | n | | |
| | 60 | 70 | SCL | 10YR5/3 | fmf och | 20 | 0.5 | 10 | 8.1 | 1 | 15 | 12.2 | n | n | | |
| | 70 | 120 | SCL | 10YR5/3 | fmf och | 20 | 0.5 | 10 | 40.5 | | | | n | n | | |
| | | | | | | | | Total (mm) = | 138.2 | | Total (mm) = | 106.6 | | | | |
| | | | | | | | | MBw= | 53.2 | | MBp= | 36.6 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFT63 | 0 | 42 | MCL | 2.5YR4/2 | fmd och | 0 | 1 | 18 | 75.6 | 1 | 18 | 75.6 | n | n | IV | 3b |
| | 42 | 50 | C | 2.5Y5/3 | mmd och | 0 | 1 | 13 | 10.4 | 1 | 13 | 10.4 | y | y | | |
| | 50 | 70 | C | 2.5Y5/3 | mmd och | 0 | 0.5 | 7 | 14.0 | 1 | 13 | 26.0 | y | y | | |
| | 70 | 120 | C | 2.5Y5/3 | mmd och | 0 | 0.5 | 7 | 35.0 | | | | y | y | | |
| | | | | | | | | Total (mm) = | 135.0 | | Total (mm) = | 112.0 | | | | |
| | | | | | | | | MBw= | 50.0 | | MBp= | 42.0 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| | | | | | | | Wheat Calculation | | | Potato Calculation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
| LFT 64 | 0 | 27 | MCL | 2.5YR4/2 | | 5 | 1 | 18 | 46.3 | 1 | 18 | 46.3 | n | n | I | 2 |
| | 27 | 40 | HCL | 2.5Y5/3 | fmd och | 10 | 1 | 16 | 18.9 | 1 | 16 | 18.9 | n | n | | |
| | 40 | 50 | HCL | 2.5Y5/3 | fmd och | 20 | 1 | 10 | 8.2 | 1 | 16 | 13.0 | n | n | | |
| | 50 | 70 | HCL | 2.5Y5/3 | fmd och | 20 | 0.5 | 10 | 16.2 | 1 | 16 | 26.0 | n | n | | |
| | 70 | 120 | HCL | 2.5Y5/3 | fmd och | 20 | 0.5 | 10 | 40.5 | | | | n | n | | |
| | | | | | | | | Total (mm) = | 130.1 | | Total (mm) = | 104.2 | | | | |
| | | | | | | | | MBw= | 45.1 | | MBp= | 34.2 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFT65 | 0 | 35 | MCL | 10YR5/1 | ffd ocg | 0 | 1 | 18 | 63.0 | 1 | 18 | 63.0 | n | n | IV | 3b |
| | 35 | 50 | C | 10YR5/3 | cfd och | 0 | 1 | 13 | 19.5 | 1 | 13 | 19.5 | y | y | | |
| | 50 | 70 | C | 10YR5/3 | cfd och | 0 | 0.5 | 7 | 14.0 | 1 | 13 | 26.0 | y | y | | |
| | 70 | 120 | C | 10YR5/3 | cfd och | 0 | 0.5 | 7 | 35.0 | | | | y | y | | |
| | | | | | | | | Total (mm) = | 131.5 | | Total (mm) = | 108.5 | | | | |
| | | | | | | | | MBw= | 46.5 | | MBp= | 38.5 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

# Llanfaethlu

Droughtiness calculations are made according to the methodology given in Appendix 4 of the ALC guidelines, MAFF 1988.

MDw= 85 | MDp= 70

| | | | | | | | Wheat Calculation | | | Potato Calculation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
| LFL32 | 0 | 30 | MCL | 2.5Y4/2 | ffd och | 2 | 1 | 18 | 53.0 | 1 | 18 | 53.0 | n | n | IV | 3b |
| | 30 | 50 | C | 2.5Y5/3 | cmd och | 20 | 1 | 13 | 21.2 | 1 | 13 | 21.2 | y | y | | |
| | 50 | 70 | C | 2.5Y5/3 | cmd och | 20 | 0.5 | 7 | 11.4 | 1 | 13 | 21.2 | y | y | | |
| | 70 | 120 | C | 2.5Y5/3 | cmd och | 20 | 0.5 | 7 | 22.8 | | | | y | y | | |
| | | | | | | | | Total (mm) = | 114.1 | | Total (mm) = | 95.4 | | | | |
| | | | | | | | | MBw= | 29.1 | | MBp= | 25.4 | | | | |
| | | | | | | | | Grade = | 2 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFL33 | 0 | 30 | MCL | 2.5Y4/2 | ffd och | 2 | 1 | 18 | 53.0 | 1 | 18 | 53.0 | n | n | IV | 3b |
| Pit | 30 | 50 | C | 2.5Y6/3 | cmd och | 20 | 1 | 13 | 21.2 | 1 | 13 | 21.2 | y | y | | |
| | 50 | 70 | C | 2.5Y6/3 | cmd och | 20 | 0.5 | 7 | 11.4 | 1 | 13 | 21.2 | y | y | | |
| | 70 | 80 | C | 2.5Y6/3 | cmd och | 20 | 0.5 | 7 | 5.7 | | | | y | y | | |
| | 80 | 120 | C | 2.5Y6/3 | cmd och | 20 | 0.5 | 7 | 22.8 | | | | y | y | | |
| | | | | | | | | Total (mm) = | 114.1 | | Total (mm) = | 95.4 | | | | |
| | | | | | | | | MBw= | 29.1 | | MBp= | 25.4 | | | | |
| | | | | | | | | Grade = | 2 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFL33a | 0 | 30 | MCL | 2.5YR4/2 | | 5 | 1 | 18 | 51.5 | 1 | 18 | 51.5 | n | n | IV | 3b |
| | 30 | 50 | HCL | 2.5Y5/3 | mcp och | 20 | 1 | 12 | 19.6 | 1 | 12 | 19.6 | y | y | | |
| | 50 | 70 | HCL | 2.5Y5/3 | mcp och | 20 | 0.5 | 8 | 13.0 | 1 | 12 | 19.6 | y | y | | |
| | 70 | 120 | HCL | 2.5Y5/3 | mcp och | 20 | 0.5 | 8 | 32.5 | | | 0.0 | y | y | | |
| | | | | | | | | Total (mm) = | 116.6 | | Total (mm) = | 90.7 | | | | |
| | | | | | | | | MBw= | 31.6 | | MBp= | 20.7 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| | | | | | | | Wheat Calculation | | | Potato Calculation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
| LFL34 | 0 | 25 | MCL | 2.5Y5/2 | | 2 | 1 | 18 | 44.2 | 1 | 18 | 44.2 | n | n | IV | 3b |
| | 25 | 50 | C | 2.5Y6/3 | cmd och | 20 | 1 | 13 | 26.5 | 1 | 13 | 26.5 | y | y | | |
| | 50 | 70 | C | 2.5Y6/3 | cmd och | 20 | 0.5 | 7 | 11.4 | 1 | 13 | 21.2 | y | y | | |
| | 70 | 120 | C | 2.5Y6/3 | cmd och | 20 | 0.5 | 7 | 28.5 | | | | y | y | | |
| | | | | | | | | Total (mm) = | 110.6 | | Total (mm) = | 91.9 | | | | |
| | | | | | | | | MBw= | 25.6 | | MBp= | 21.9 | | | | |
| | | | | | | | | Grade = | 2 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFL34a | 0 | 30 | MCL | 2.5YR4/2 | | 5 | 1 | 18 | 51.5 | 1 | 18 | 51.5 | n | n | IV | 3b |
| | 30 | 50 | C | 2.5Y6/3 | mmp och | 20 | 1 | 13 | 21.2 | 1 | 13 | 21.2 | y | y | | |
| | 50 | 70 | C | 2.5Y6/3 | mmp och | 20 | 0.5 | 7 | 11.4 | 1 | 13 | 21.2 | y | y | | |
| | 70 | 120 | C | 2.5Y6/3 | mmp och | 20 | 0.5 | 7 | 28.5 | | | | y | y | | |
| | | | | | | | | Total (mm) = | 112.6 | | Total (mm) = | 93.9 | | | | |
| | | | | | | | | MBw= | 27.6 | | MBp= | 23.9 | | | | |
| | | | | | | | | Grade = | 2 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFL39a | 0 | 30 | MCL | 7.5YR4/2 | | 5 | 1 | 18 | 51.5 | 1 | 18 | 51.5 | n | n | I | 2 |
| | 30 | 50 | SCL | 7.5YR4/3 | | 5 | 1 | 15 | 28.6 | 1 | 15 | 28.6 | n | n | | |
| | 50 | 55 | SCL | 7.5YR4/3 | | 5 | 0.5 | 10 | 4.8 | 1 | 15 | 7.2 | n | n | | |
| | 55 | 65 | C | 7.5YR4/4 | | 20 | 0.5 | 10 | 8.1 | 1 | 15 | 12.2 | n | n | | |
| | 65 | 70 | C | 7.5YR4/4 | | 20 | 0.5 | 10 | 4.1 | 1 | 15 | 6.1 | n | n | | |
| | 70 | 120 | C | 7.5YR4/4 | | 20 | 0.5 | 10 | 40.5 | | | | n | n | | |
| | | | | | | | | Total (mm) = | 137.5 | | Total (mm) = | 105.5 | | | | |
| | | | | | | | | MBw= | 52.5 | | MBp= | 35.5 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| | | | | | | | Wheat Calculation | | | Potato Calculation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
| LFL39 | 0 | 40 | MCL | 7.5YR4/2 | | 5 | 1 | 18 | 68.6 | 1 | 18 | 68.6 | n | n | I | 2 |
| | 40 | 50 | MCL | 7.5YR4/2 | | 5 | 1 | 16 | 15.3 | 1 | 16 | 15.3 | n | n | | |
| | 50 | 70 | MCL | 7.5YR4/2 | | 5 | 0.5 | 10 | 19.1 | 1 | 16 | 30.5 | n | n | | |
| | 70 | 80 | MCL | 7.5YR4/2 | | 10 | 0.5 | 10 | 9.1 | | | | n | n | | |
| | 80 | 120 | MCL | 7.5YR4/2 | | 10 | 0.5 | 10 | 36.2 | | | | n | n | | |
| | | | | | | | | Total (mm) = | 148.2 | | Total (mm) = | 114.4 | | | | |
| | | | | | | | | MBw= | 63.2 | | MBp= | 44.4 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFL 40 | 0 | 30 | MCL | 2.5Y4/3 | | 5 | 1 | 18 | 51.5 | 1 | 18 | 51.5 | n | n | I | 2 |
| | 30 | 50 | MCL | 7.5YR4/2 | | 20 | 1 | 16 | 26.0 | 1 | 16 | 26.0 | n | n | | |
| | 50 | 70 | MCL | 7.5YR4/2 | | 20 | 0.5 | 10 | 16.2 | 1 | 16 | 26.0 | n | n | | |
| | 70 | 120 | MCL | 7.5YR4/2 | | 20 | 0.5 | 10 | 40.5 | | | 0.0 | n | n | | |
| | | | | | | | | Total (mm) = | 134.2 | | Total (mm) = | 103.5 | | | | |
| | | | | | | | | MBw= | 49.2 | | MBp= | 33.5 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFL41 | 0 | 30 | MCL | 2.5Y4/3 | | 2 | 1 | 18 | 53.0 | 1 | 18 | 53.0 | n | n | IV | 3b |
| | 30 | 50 | C | 2.5Y5/3 | cmf och | 5 | 1 | 13 | 24.8 | 1 | 13 | 24.8 | y | y | | |
| | 50 | 60 | C | 2.5Y5/3 | cmf och | 5 | 0.5 | 7 | 6.7 | 1 | 13 | 12.4 | y | y | | |
| | 60 | 70 | C | 2.5Y5/3 | cmf och | 10 | 0.5 | 7 | 6.4 | | | | y | y | | |
| | 70 | 120 | C | 2.5Y5/3 | cmf och | 10 | 0.5 | 7 | 31.8 | | | | y | y | | |
| | | | | | | | | Total (mm) = | 122.6 | | Total (mm) = | 90.2 | | | | |
| | | | | | | | | MBw= | 37.6 | | MBp= | 20.2 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| | | | | | | | Wheat Calculation | | | Potato Calculation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
| LFL 42 | 0 | 30 | MCL | 10YR4/2 | | 5 | 1 | 18 | 51.5 | 1 | 18 | 51.5 | n | n | II | 3a |
| | 30 | 50 | C | 2.5Y5/3 | mmd och | 20 | 1 | 16 | 26.0 | 1 | 16 | 26.0 | y | n | | |
| | 50 | 70 | C | 2.5Y5/3 | mmd och | 20 | 0.5 | 8 | 13.0 | 1 | 16 | 26.0 | y | n | | |
| | 70 | 120 | C | 2.5Y5/3 | mmd och | 20 | 0.5 | 8 | 32.5 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 123.0 | | Total (mm) = | 103.5 | | | | |
| | | | | | | | | MBw= | 38.0 | | MBp= | 33.5 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFL43 | 0 | 25 | MCL | 7.5YR4/2 | | 2 | 1 | 18 | 44.2 | 1 | 18 | 44.2 | n | n | II | 3a |
| | 25 | 50 | MCL | 10YR5/3 + 2.5Y5/3 | cff och | 10 | 1 | 16 | 36.3 | 1 | 16 | 36.3 | y | n | | |
| | 50 | 55 | MCL | 10YR5/3 + 2.5Y5/3 | cff och | 10 | 0.5 | 10 | 4.5 | 1 | 16 | 7.3 | y | n | | |
| | 55 | 70 | MCL | 10YR5/3 + 2.5Y5/3 | cff och | 10 | 0.5 | 10 | 13.6 | 1 | 16 | 21.8 | y | n | | |
| | 70 | 120 | MCL | 10YR5/3 + 2.5Y5/3 | cff och | 10 | 0.5 | 10 | 45.3 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 143.8 | | Total (mm) = | 109.4 | | | | |
| | | | | | | | | MBw= | 58.8 | | MBp= | 39.4 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFL 44 | 0 | 30 | MCL | 10YR4/2 | | 5 | 1 | 18 | 51.5 | 1 | 18 | 51.5 | n | n | I | 5 |
| | 30 | 50 | SCL | 10YR5/2 | FEMNS | 20 | 1 | 15 | 24.4 | 1 | 15 | 24.4 | n | n | | |
| | 50 | 70 | SCL | 10YR5/2 | FEMNS | 20 | 0.5 | 15 | 24.2 | 1 | 15 | 24.4 | n | n | | |
| | 70 | 90 | SCL | 10YR5/3 | FEMNS | 20 | 0.5 | 15 | 24.2 | | | | n | n | | |
| | 90 | 120 | SCL | 10YR5/2 | FEMNS | 20 | 0.5 | 10 | 24.3 | | | | n | n | | |
| | | | | | | | | Total (mm) = | 148.6 | | Total (mm) = | 100.3 | | | | |
| | | | | | | | | MBw= | 63.6 | | MBp= | 30.3 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| | | | | | | | Wheat Calculation | | | Potato Calculation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
| LFL47 | 0 | 42 | MCL | 7.5YR4/2 | | 2 | 1 | 18 | 74.2 | 1 | 18 | 74.2 | n | n | IV | 3b |
| | 42 | 50 | C | 10YR5/3 + 2.5Y5/3 | cff och | 10 | 1 | 13 | 9.4 | 1 | 13 | 9.4 | y | y | | |
| | 50 | 70 | C | 10YR5/3 + 2.5Y5/3 | cff och | 10 | 0.5 | 7 | 12.7 | 1 | 13 | 23.6 | y | y | | |
| | 70 | 120 | C | 10YR5/3 + 2.5Y5/3 | cff och | 10 | 0.5 | 7 | 31.8 | | | | y | y | | |
| | | | | | | | | Total (mm) = | 128.1 | | Total (mm) = | 107.2 | | | | |
| | | | | | | | | MBw= | 43.1 | | MBp= | 37.2 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

## Cefn Coch

Droughtiness calculations are made according to the methodology given in Appendix 4 of the ALC guidelines, MAFF 1988.

MDw= 88 MDp= 75

| | | | | | | | Wheat Calculation | | | Potato Calculation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
| CC48 | 0 | 45 | MCL | 7.5YR4/2 | | 5 | 1 | 18 | 77.2 | 1 | 18 | 77.2 | n | n | I | 5 |
| | 45 | 50 | MCL | 7.5YR4/2 + 5YR4/2 | mmd och | 5 | 1 | 16 | 7.6 | 1 | 16 | 7.6 | y | n | | |
| | 50 | 70 | MCL | 7.5YR4/2 + 5YR4/2 | mmd och | 5 | 0.5 | 10 | 19.1 | 1 | 16 | 30.5 | y | n | | |
| | 70 | 80 | MCL | 7.5YR4/2 + 5YR4/2 | mmd och | 5 | 0.5 | 10 | 9.5 | | | | y | n | | |
| | 80 | 120 | MCL | 7.5YR4/2 + 5YR4/2 | mmd och | 5 | 0.5 | 10 | 38.1 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 151.5 | | Total (mm) = | 115.3 | | | | |
| | | | | | | | | MBw= | 63.5 | | MBp= | 40.3 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| | | | | | | | Wheat Calculation | | | Potato Calculation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
| CC 49 | 0 | 25 | MCL | 10YR4/2 | | 5 | 1 | 18 | 42.9 | 1 | 18 | 42.9 | n | n | I | 5 |
| | 25 | 50 | MCL | 7.5YR4/2 | fmd och | 10 | 1 | 16 | 36.3 | 1 | 16 | 36.3 | n | n | | |
| | 50 | 70 | MCL | 7.5YR4/2 | fmd och | 10 | 0.5 | 10 | 18.1 | 1 | 16 | 29.0 | n | n | | |
| | 70 | 120 | MCL | 7.5YR4/2 | fmd och | 10 | 0.5 | 10 | 45.3 | | | 0.0 | n | n | | |
| | | | | | | | | Total (mm) = | 142.5 | | Total (mm) = | 108.1 | | | | |
| | | | | | | | | MBw= | 54.5 | | MBp= | 33.1 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CC 50 | 0 | 40 | MCL | 10YR4/2 | | 5 | 1 | 18 | 68.6 | 1 | 18 | 68.6 | n | n | I | 5 |
| | | | | | | | | Total (mm) = | 68.6 | | Total (mm) = | 68.6 | | | | |
| | | | | | | | | MBw= | -19.4 | | MBp= | -6.4 | | | | |
| | | | | | | | | Grade = | 3a | | Grade = | 2 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CC51 | 0 | 45 | MCL | 7.5YR4/2 | | 2 | 1 | 18 | 79.5 | 1 | 18 | 79.5 | n | n | I | 5 |
| | 45 | 50 | MCL | 7.5YR4/4 | | 2 | 1 | 16 | 7.9 | 1 | 16 | 7.9 | n | n | | |
| | 50 | 70 | MCL | 7.5YR4/4 | | 2 | 0.5 | 10 | 19.6 | 1 | 16 | 31.4 | n | n | | |
| | 70 | 85 | MCL | 7.5YR4/4 | | 2 | 0.5 | 10 | 14.7 | | | | n | n | | |
| | 85 | 120 | MCL | 7.5YR4/4 | | 2 | 0.5 | 10 | 34.3 | | | | n | n | | |
| | | | | | | | | Total (mm) = | 156.0 | | Total (mm) = | 118.7 | | | | |
| | | | | | | | | MBw= | 68.0 | | MBp= | 43.7 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| | | | | | | | Wheat Calculation | | | Potato Calculation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
| CC 52 | 0 | 40 | MCL | 10YR4/2 | | 5 | 1 | 18 | 68.6 | 1 | 18 | 68.6 | n | n | I | 5 |
| | 40 | 50 | SCL | 10YR4/2 | | 20 | 1 | 15 | 12.2 | 1 | 15 | 12.2 | n | n | | |
| | 50 | 70 | SCL | 10YR4/2 | | 20 | 0.5 | 10 | 16.2 | 1 | 15 | 24.4 | n | n | | |
| | 70 | 120 | SCL | 10YR4/2 | | 20 | 0.5 | 10 | 40.5 | | | | n | n | | |
| | | | | | | | | Total (mm) = | 137.5 | | Total (mm) = | 105.2 | | | | |
| | | | | | | | | MBw= | 49.5 | | MBp= | 30.2 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CC66 | 0 | 24 | MCL | 10YR3/2 | | 0 | 1 | 18 | 43.2 | 1 | 18 | 43.2 | n | n | IV | 3b |
| | 24 | 50 | C | N4 | cff och | 0 | 1 | 13 | 33.8 | 1 | 13 | 33.8 | y | y | | |
| | 50 | 70 | C | N4 | cff och | 0 | 0.5 | 7 | 14.0 | 1 | 13 | 26.0 | y | y | | |
| | 70 | 120 | C | N4 | cff och | 0 | 0.5 | 7 | 35.0 | | | | y | y | | |
| | | | | | | | | Total (mm) = | 126.0 | | Total (mm) = | 103.0 | | | | |
| | | | | | | | | MBw= | 38.0 | | MBp= | 28.0 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CC54 | 0 | 20 | MCL | 10YR4/2 | | 2 | 1 | 18 | 35.3 | 1 | 18 | 35.3 | n | n | I/II | 2/3a |
| | 20 | 40 | SCL | 10YR5/2+5/3 | cfd och | 0 | 1 | 15 | 30.0 | 1 | 15 | 30.0 | y | n | | |
| | 40 | 50 | cSL | 10YR5/1 | f-cmf och | 0 | 1 | 16 | 16.0 | 1 | 16 | 16.0 | y | n | | |
| | 50 | 70 | cSL | 10YR5/1 | f-cmf och | 0 | 0.5 | 11 | 22.0 | 1 | 16 | 32.0 | y | n | | |
| | 70 | 90 | cSL | 10YR5/1 | f-cmf och | 0 | 0.5 | 11 | 22.0 | | | | y | n | | |
| | 90 | 120 | cSL | 10YR5/1 | f-cmf och | 0 | 0.5 | 11 | 33.0 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 158.3 | | Total (mm) = | 113.3 | | | | |
| | | | | | | | | MBw= | 70.3 | | MBp= | 38.3 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| | | | | | | | Wheat Calculation | | | Potato Calculation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
| CC56 | 0 | 30 | MCL | 10YR3/2 | ffd och | 2 | 1 | 18 | 53.0 | 1 | 18 | 53.0 | n | n | II | 3b |
| | 30 | 40 | SCL | 10YR5/2 | cmf och | 10 | 1 | 15 | 13.6 | 1 | 15 | 13.6 | y | n | | |
| | 40 | 50 | SCL | 10YR5/2 | cmf och | 10 | 1 | 15 | 13.6 | 1 | 15 | 13.6 | y | n | | |
| | 50 | 70 | SCL | 10YR5/2 | cmf och | 10 | 0.5 | 10 | 18.1 | 1 | 15 | 27.2 | y | n | | |
| | 70 | 120 | SCL | 10YR5/2 | cmf och | 10 | 0.5 | 10 | 45.3 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 143.5 | | Total (mm) = | 107.4 | | | | |
| | | | | | | | | MBw= | 55.5 | | MBp= | 32.4 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CC57 | 0 | 30 | MCL | 10YR3/2 | ffd och | 2 | 1 | 18 | 53.0 | 1 | 18 | 53.0 | n | n | II | 3b |
| | 30 | 40 | SCL | 10YR5/2 | cmf och | 10 | 1 | 15 | 13.6 | 1 | 15 | 13.6 | y | n | | |
| | 40 | 50 | SCL | 10YR5/2 | cmf och | 10 | 1 | 15 | 13.6 | 1 | 15 | 13.6 | y | n | | |
| | 50 | 70 | SCL | 10YR5/2 | cmf och | 10 | 0.5 | 10 | 18.1 | 1 | 15 | 27.2 | y | n | | |
| | 70 | 120 | SCL | 10YR5/2 | cmf och | 10 | 0.5 | 10 | 45.3 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 143.5 | | Total (mm) = | 107.4 | | | | |
| | | | | | | | | MBw= | 55.5 | | MBp= | 32.4 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CC67 | 0 | 40 | MCL | 10YR3/2 | | 2 | 1 | 18 | 70.6 | 1 | 18 | 70.6 | n | n | II | 3b |
| | 40 | 50 | C | 10YR5/3 | cmf och | 10 | 1 | 16 | 14.5 | 1 | 16 | 14.5 | y | n | | |
| | 50 | 70 | C | 10YR5/3 | cmf och | 10 | 0.5 | 8 | 14.5 | 1 | 16 | 29.0 | y | n | | |
| | 70 | 120 | C | 10YR5/3 | cmf och | 10 | 0.5 | 8 | 36.3 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 135.9 | | Total (mm) = | 114.1 | | | | |
| | | | | | | | | MBw= | 47.9 | | MBp= | 39.1 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| | | | | | | | Wheat Calculation | | | Potato Calculation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
| CC 58 | 0 | 30 | MCL | 10YR4/2 | | 5 | 1 | 18 | 51.5 | 1 | 18 | 51.5 | n | n | II | 3a |
| | 30 | 50 | HCL | 10YR5/2 | mmd och | 20 | 1 | 16 | 26.0 | 1 | 16 | 26.0 | y | n | | |
| | 50 | 70 | HCL | 10YR5/3 | mmd och | 20 | 0.5 | 10 | 16.2 | 1 | 16 | 26.0 | y | n | | |
| | 70 | 120 | HCL | 10YR5/3 | mmd och | 20 | 0.5 | 10 | 40.5 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 134.2 | | Total (mm) = | 103.5 | | | | |
| | | | | | | | | MBw= | 46.2 | | MBp= | 28.5 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CC59 | 0 | 20 | MCL | 10YR4/2 | | 2 | 1 | 18 | 35.3 | 1 | 18 | 35.3 | n | n | II | 3a |
| | 20 | 50 | MCL | 7.5YR4/2 | cff och | 10 | 1 | 16 | 43.5 | 1 | 16 | 43.5 | y | n | | |
| | 50 | 70 | MCL | 7.5YR4/2 | cff och | 10 | 0.5 | 10 | 18.1 | 1 | 16 | 29.0 | y | n | | |
| | 70 | 120 | MCL | 7.5YR4/2 | cff och | 10 | 0.5 | 10 | 45.3 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 142.2 | | Total (mm) = | 107.8 | | | | |
| | | | | | | | | MBw= | 54.2 | | MBp= | 32.8 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CC 60 | 0 | 28 | MCL | 10YR4/2 | | 5 | 1 | 18 | 48.0 | 1 | 18 | 48.0 | n | n | III | 3a |
| | 28 | 50 | HCL | 10YR5/3 | mmd och | 20 | 1 | 16 | 28.6 | 1 | 16 | 28.6 | y | n | | |
| | 50 | 70 | HCL | 10YR5/3 | mmd och | 20 | 0.5 | 10 | 16.2 | 1 | 16 | 26.0 | y | n | | |
| | 70 | 120 | HCL | 10YR5/3 | mmd och | 20 | 0.5 | 10 | 40.5 | | | | y | n | | |
| | | | | | | | | Total (mm) = | 133.3 | | Total (mm) = | 102.6 | | | | |
| | | | | | | | | MBw= | 45.3 | | MBp= | 27.6 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

| | | | | | | | Wheat Calculation | | | Potato Calculation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
| CC68 | 0 | 50 | MCL | 10YR4/2 | | 5 | 1 | 18 | 85.8 | 1 | 18 | 85.8 | n | n | I | 3a |
| | 50 | 70 | MCL | 10YR4/2 | | 5 | 1 | 16 | 30.5 | 1 | 16 | 30.5 | n | n | | |
| | 70 | 120 | MCL | 10YR4/2 | | 10 | 0.5 | 10 | 45.3 | | | | n | n | | |
| | | | | | | | | Total (mm) = | 161.5 | | Total (mm) = | 116.3 | | | | |
| | | | | | | | | MBw= | 73.5 | | MBp= | 41.3 | | | | |
| | | | | | | | | Grade = | 1 | | Grade = | 1 | | | | |

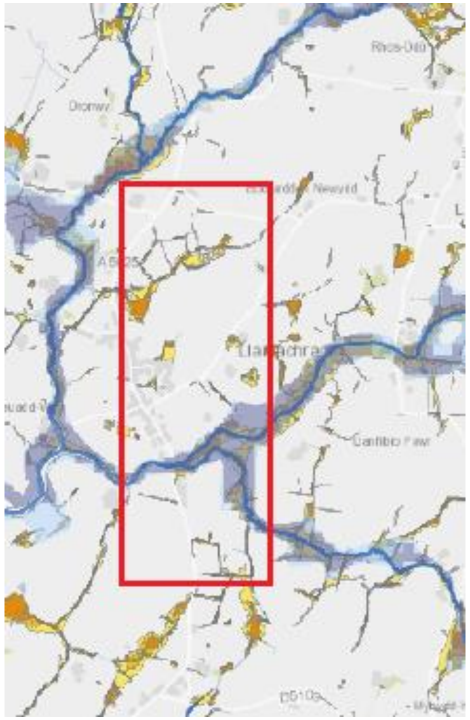
| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CC61 | 0 | 20 | MCL | 7.5YR4/2 | | 5 | 1 | 18 | 34.3 | 1 | 18 | 34.3 | n | n | I | 3b/4 |
| Paddock | 20 | 50 | MCL | 7.5YR4/2 | | 5 | 1 | 16 | 45.8 | 1 | 16 | 45.8 | n | n | | |
| | 50 | 70 | MCL | 7.5YR4/2 | | 5 | 1 | 16 | 30.5 | 1 | 16 | 30.5 | n | n | | |
| | 70 | 120 | MCL | 7.5YR4/2 | | 5 | 0.5 | 10 | 47.6 | | | | n | n | | |
| | | | | | | | | Total (mm) = | 34.3 | | Total (mm) = | 110.6 | | | | |
| | | | | | | | | MBw= | -53.7 | | MBp= | 35.6 | | | | |
| | | | | | | | | Grade = | 4 | | Grade = | 1 | | | | |

| Site No. | Depth (cm) | | Texture | Colour | Mottle | stones % | TAv or EAv (stones) % | TAv or EAv (soil) % | AP (wheat) mm | TAv (stones) % | TAv (soil) % | AP (potatoes) mm | Gley | SP | WC | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CC 62 | 0 | 20 | M/HCL | 10YR4/2 | fmf och | 5 | 1 | 18 | 34.3 | 1 | 18 | 34.3 | n | n | IV | 3b |
| | 20 | 50 | HCL | 10YR5/3 | mmd och | 5 | 1 | 12 | 34.4 | 1 | 12 | 34.4 | y | y | | |
| | 50 | 70 | HCL | 10YR5/3 | mmd och | 5 | 0.5 | 7 | 13.4 | 1 | 12 | 22.9 | y | y | | |
| | 70 | 120 | HCL | 10YR5/3 | mmd och | 5 | 0.5 | 7 | 33.4 | | | | y | y | | |
| | | | | | | | | Total (mm) = | 115.4 | | Total (mm) = | 34.3 | | | | |
| | | | | | | | | MBw= | 27.4 | | MBp= | -40.7 | | | | |
| | | | | | | | | Grade = | 2 | | Grade = | 3b | | | | |

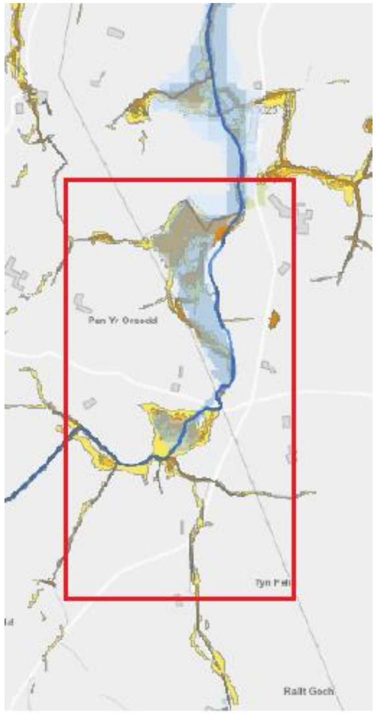
## **Appendix 2: Flood Risk (***"Contains Natural Resources Wales information © Natural Resources Wales and database right"*)

- Main rivers
- Risk of Flooding from Rivers and the Sea
  - High
  - Medium
  - Low
  - Very Low
- Risk of flooding from surface water - High
- Risk of flooding from surface water - Medium
- Risk of flooding from surface water - Low

Valley



Llanfachraeth



Cefn Coch

## Appendix 3 - Site Photographs

Attempted Pit at Valley

Pit at Llanfachraeth

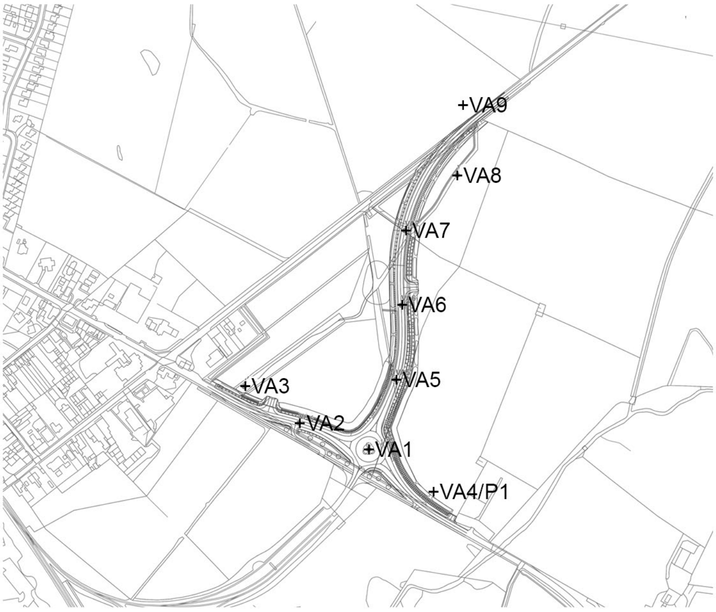
Topsoil at Llanfachraeth

Pit at Llanfaethlu

Topsoil and Subsoil at Llanfaethlu

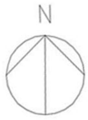
Pit at Cefn Coch

Topsoil Cefn Coch




VA1 Observation

/P1 Pit Observation





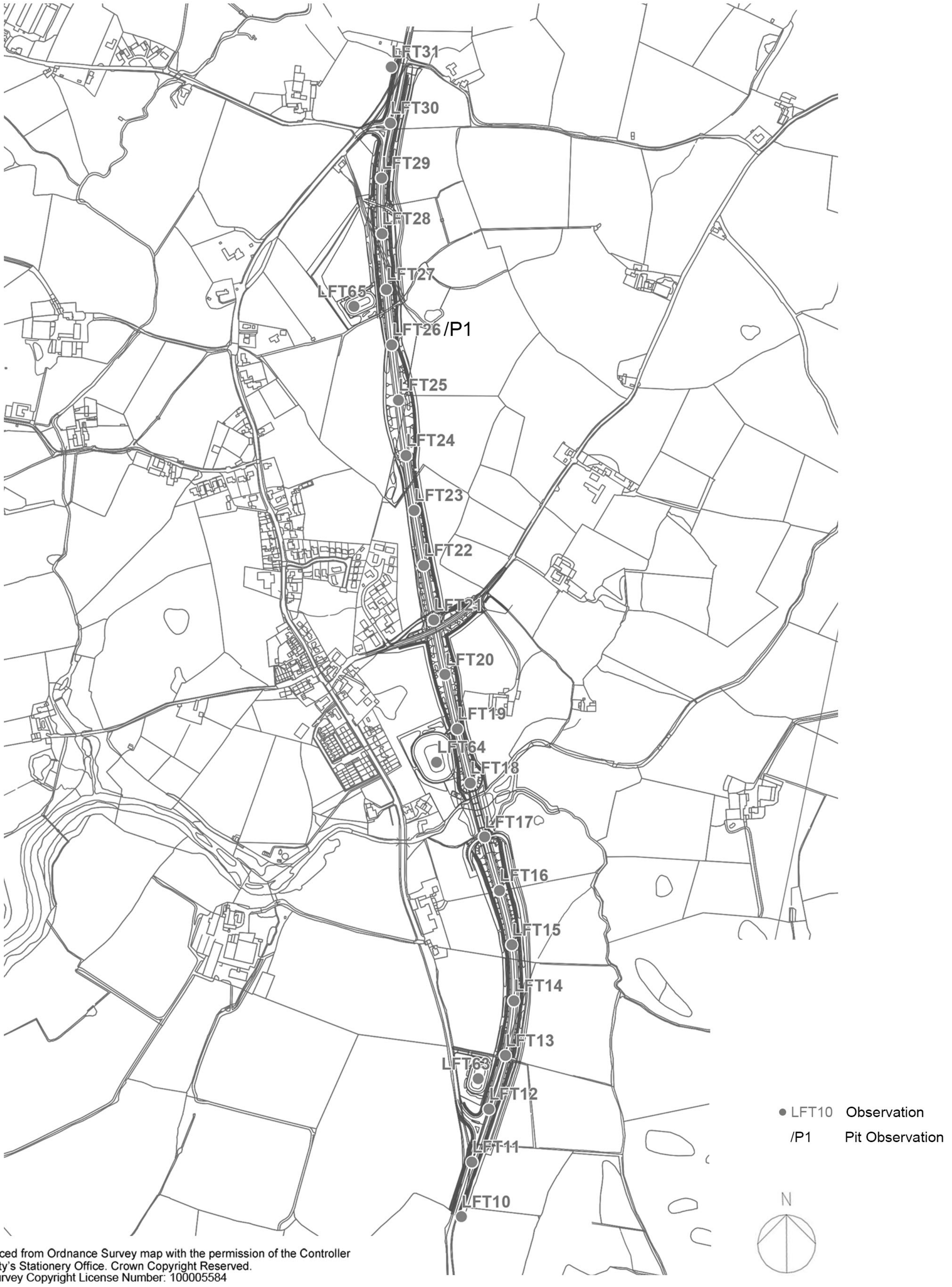

Scale 1:10,000@A4 Apr/2016

Figure RAC6753-1a: Observations

Site: Valley

Client: Jacobs UK Ltd

Reading Agricultural Consultants






Scale 1:10,000@A4 Apr/2016

Figure RAC6753-1b: Observations

Site: Llanfachraeth

Client: Jacobs UK Ltd

Reading Agricultural Consultants


● LFL46 Observation

/P1 Pit Observation

N



Scale 1:10,000@A4 Apr/2016

Figure RAC6753-1c: Observations

Site: Llanfaethlu

Client: Jacobs UK Ltd

Reading Agricultural Consultants


CC48 Observation

/P1 Pit Observation

N



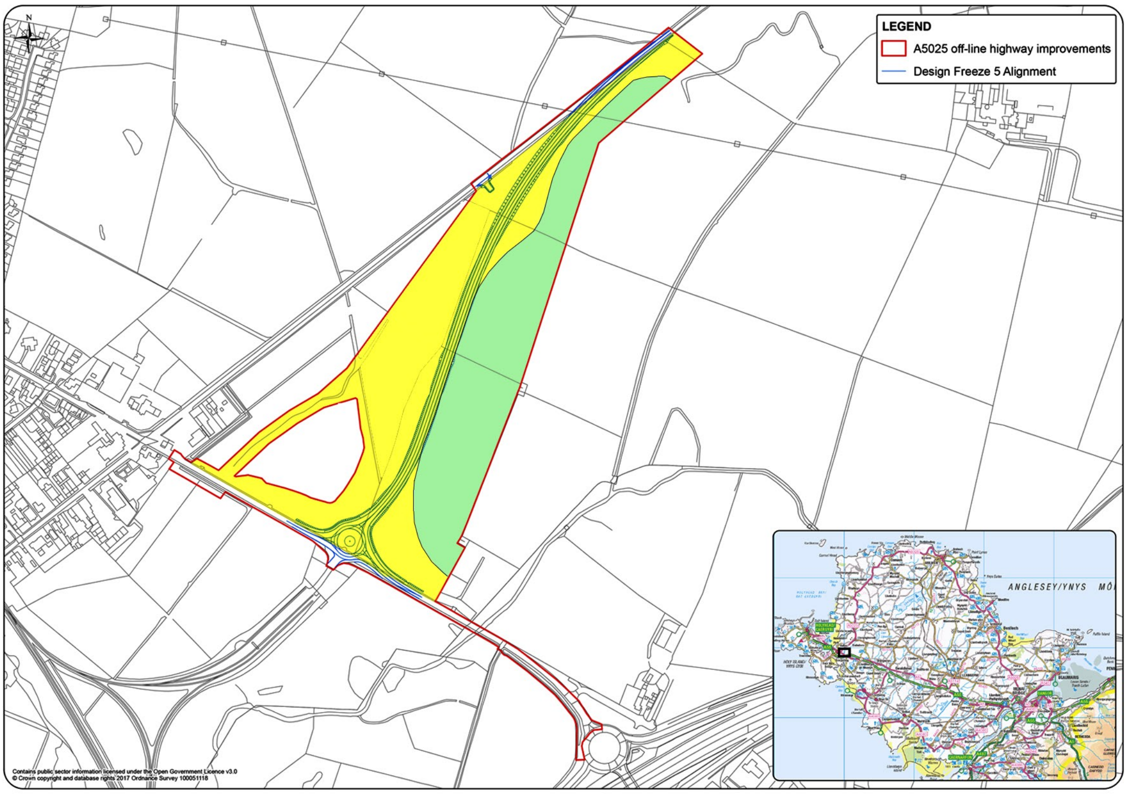
Scale 1:10,000@A4 Apr/2016

Figure RAC6753-1d: Observations

Site: Cefn Coch

Client: Jacobs UK Ltd

Reading Agricultural Consultants




- * Grade 1 - excellent quality
- * Grade 2 - very good quality
- * Subgrade 3a - good quality

(Grades 1, 2 and 3a: Best and most versatile land)

- Subgrade 3b - moderate quality
- Grade 4 - poor quality
- * Grade 5 - very poor quality

* Not Present



N

Scale 1:10,000@A4 May/2017

| | |
|---|---|
| Figure | RAC6753-2a: Agricultural Land Classification |
| Site: | Valley |
| Client: | Jacobs UK Ltd |

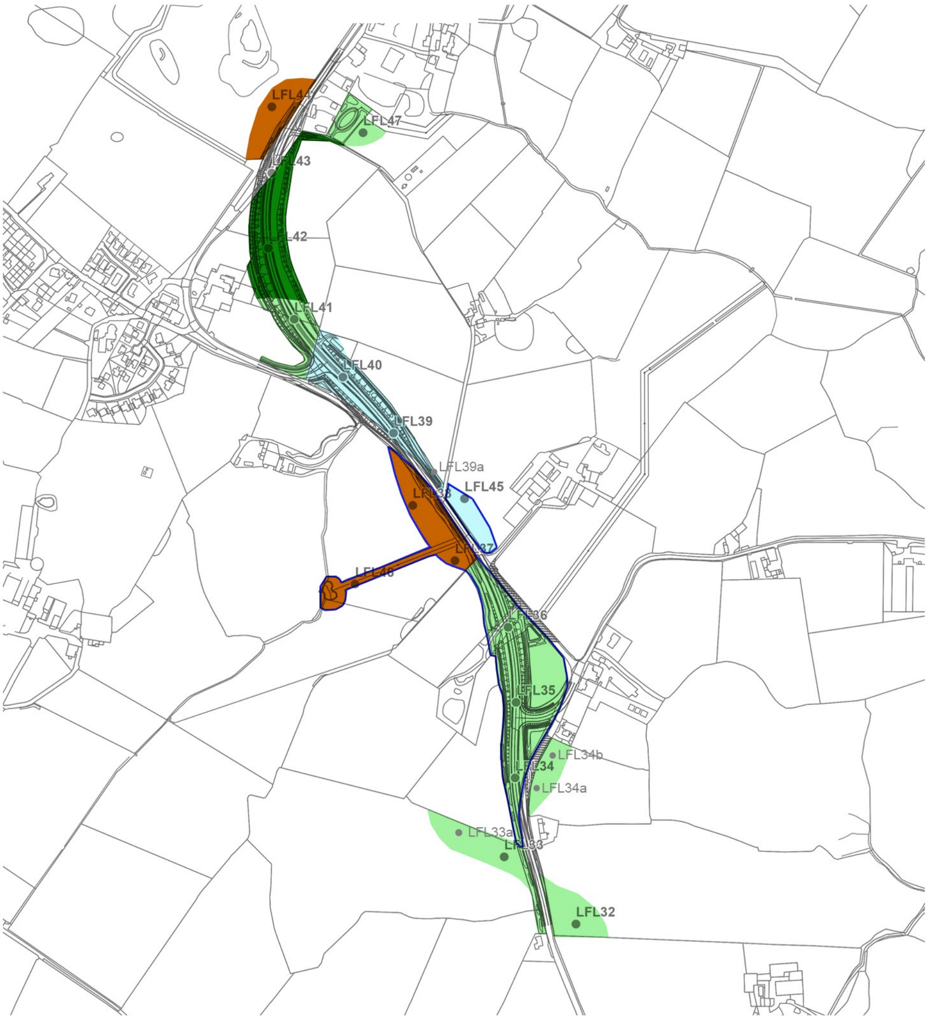
Reading Agricultural Consultants




Scale 1:10,000@A4 Apr/2016

| | |
|---|---|
| Figure | RAC6753-2b: Agricultural Land Classification |
| Site: | Llanfachraeth |
| Client: | Jacobs UK Ltd |

Reading Agricultural Consultants




- Grade 1 - excellent quality *
- Grade 2 - very good quality
- Subgrade 3a - good quality

} Best and most versatile land

- Subgrade 3b - moderate quality
- Grade 4 - poor quality *
- Grade 5 - very poor quality
- Not Surveyed

* Not Present

N



Scale 1:10,000@A4 Apr/2016

Figure RAC6753-2c: Agricultural Land Classification

Site: Llanfaethlu

Client: Jacobs UK Ltd

Reading Agricultural Consultants


| | | | |
|---|---|---|---|
| * Grade 1 - excellent quality | Best and most versatile land | | Subgrade 3b - moderate quality |
| * Grade 2 - very good quality | | | Grade 4 - poor quality |
| Subgrade 3a - good quality | | | Grade 5 - very poor quality |

* Not Present

N



Scale 1:10,000@A4 Apr/2016

Figure RAC6753-2d: Agricultural Land Classification

Site: Cefn Coch

Client: Jacobs UK Ltd

Reading Agricultural Consultants

## Appendix C1 Consultation response - *Environmental search enquiry: A5025 from Valley to Wylfa*

Available on request.

## Appendix C2 Consultation response - *The Animal Health Act 1981 – Notifiable Disease Burial Sites RE: Wylfa Newydd Development Area & A5025 Improvement Scheme*

Available on request.

## Appendix C3 Consultation response - National Resources Wales (NRW) Letter response to Environmental Search Enquiry ref: ATI-05562a dated 16 October 2014 (NRW, 2014)

Available on request.

## Appendix D1 RSK Preliminary Source Study Report – Section 1

Available on request.

## Appendix D2 RSK Preliminary Source Study Report – Section 3

Available on request.

## Appendix D3 RSK Preliminary Source Study Report – Section 5

Available on request.

## Appendix D4 RSK Preliminary Source Study Report – Section 7

Available on request.

## Appendix E1 Structural Soils Ltd factual Ground Investigation report – Section 1

Available on request.

## Appendix E2 Structural Soils Ltd factual Ground Investigation report – Section 3

Available on request.

## Appendix E3 Structural Soils Ltd factual Ground Investigation report – Section 5

Available on request.

## Appendix E4 Structural Soils Ltd factual Ground Investigation report – Section 7

Available on request.

## Appendix F1 AECOM Geotechnical Interpretive Report – Section 1

Available on request.

## Appendix F2 AECOM Geotechnical Interpretive Report – Section 3

Available on request.

## Appendix F3 AECOM Geotechnical Interpretive Report – Section 5

Available on request.

## Appendix F4 AECOM Geotechnical Interpretive Report – Section 7

Available on request.

## Appendix G Photographs of site walkover from 30 March 2015

Photograph 1: Section 5, view towards garage and depot

Photograph 2: Section 5, garage and depot

Photograph 3: Section 5, sewage treatment works tanks

Photograph 4: Section 5, sewage treatment works

Photograph 5: Section 5, view to landfill area

Photograph 6: Section 5, view towards landfill area

Photograph 7: Section 5, view towards lime kiln

Photograph 8: Section 7, view from crossroads towards mill site

Photograph 9: Section 7, mill site near crossroads

Photograph 10: Section 7, former mill pond

Photograph 11: Section 7, former mill pond

Photograph 12: Section 7, view across area identified as gravel pit in PSSR

# Appendix H1 Preliminary UXO risk assessment – Section 1, previous alignment

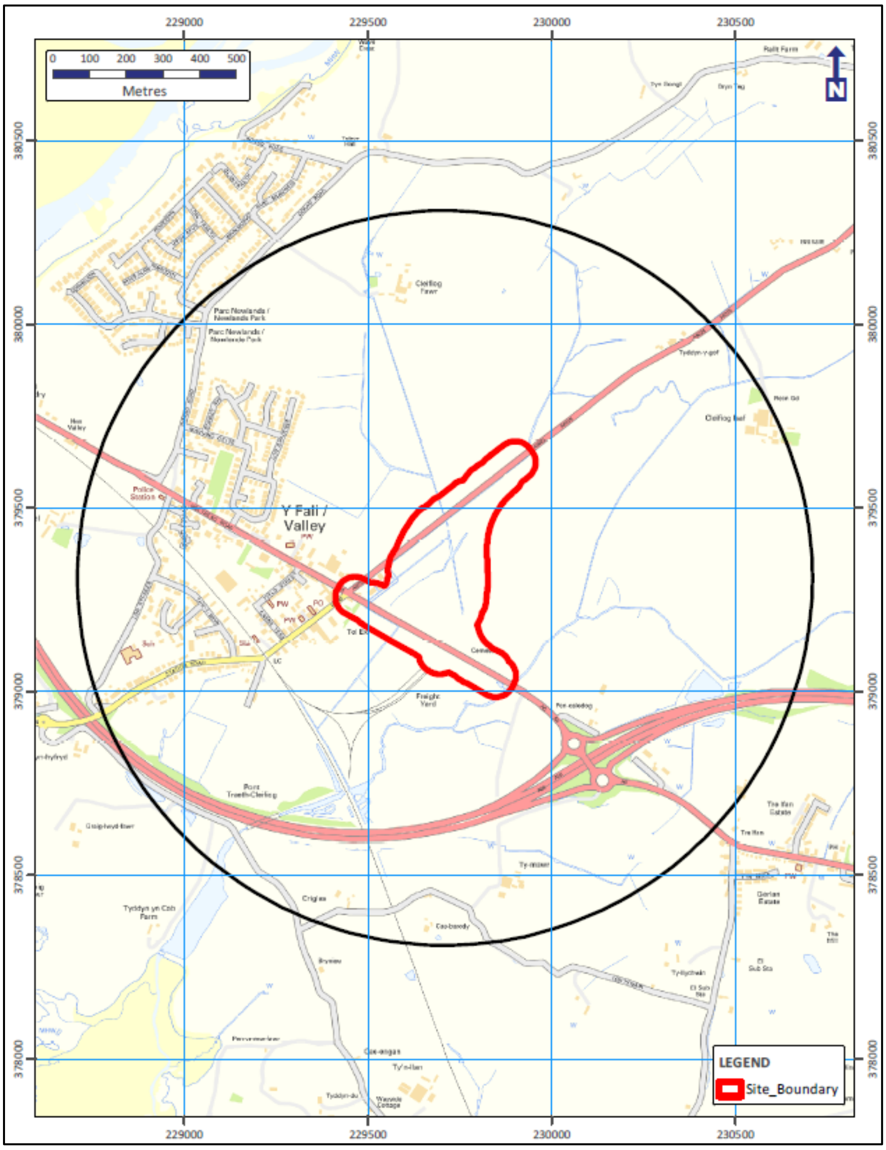
6 Alpha Associates Ltd
Quatro House
Frimley Road
Camberley
Surrey GU16 7ER
United Kingdom

T: +44 (0)2033 713 900
W: www.6alpha.com

BOMB SEARCH

# Preliminary Unexploded Ordnance (UXO) Risk Assessment

Meeting the requirements of CIRIA C681 "Unexploded Ordnance (UXO) – A guide for the Construction Industry" Risk Management Framework




**6 Alpha Project Number:** P4614

**Client:** RSK

**Site:** Valley – Wylfa off Line Highways

**Originator:** Jennifer Russell (22nd June 2015)

**Released By:** Lisa Askham (24th June 2015)

Delivered By

alpha ASSOCIATES
special risks consultancy

## Study Site

The Study Site is described as "Valley – Wylfa off Line Highways", and it is centred on National Grid Reference 229710, 379310.

## Threat Potential

UXO PROBABILITY ASSESSMENT = 2 RATING, INDICATING A

LOW/MEDIUM PROBABILITY OF UXO ENCOUNTER

The rating scale can be seen on *Figure 2* (Probability of UXO Encounter). In accordance with current guidelines (CIRIA C681 Chapter 5), the highest risk rating has been determined at this specific site for UXO risk consideration and has been used for the final assessment and recommendations.

## Summary

During WWII the Study Site was situated within *Valley Rural District*, which recorded less than 50 HE bomb strikes per 1,000 acres; a low level of bombing.

*Luftwaffe* aerial reconnaissance photography could not be found, however a railway station and a foundry located in the vicinity of the Site may have been considered secondary bombing targets.

Neither *Air Raid Precaution* (ARP) HE bomb strike records nor bomb damage mapping could be located. Nonetheless, there is no evidence to suggest that the Site or immediate area was subjected to bombing.

Given that there is no evidence to suggest that bombing took place in the vicinity of the Site, nor any military activity, it has been concluded that no further action is warranted.

## Recommendations

In accordance with CIRIA C681 Chapter 5 on managing UXO risks, 6 Alpha recommends that no further action is required to address the UXO risk at this Study Site. Should you have any queries, please contact 6 Alpha.

## Using This Report

This Preliminary Assessment is designed to inform environmental and construction professionals of the potential threat of military related explosives and/or ordnance on, or in, the vicinity of the Study Site.

This assessment is designed to be employed as a site-screening tool to meet with the requirement of Phase One of the CIRIA UXO Risk Management Framework; there are two broad prospective outcomes; either the threat level requires a detailed threat & risk assessment; or no further action is required. In the former instance we can provide a report within 14 working days (or more quickly upon application).

Two figures accompany the report, the *Second World War* (WWII) High Explosive (HE) Bomb Density and the final Probability of UXO Encounter. The purpose of this approach is to demonstrate that whilst bomb density statistics give an indication for WWII bombing, they should not be relied upon exclusively to generate a holistic assessment.

For further information, please contact 6 Alpha:
Telephone: +44 (0)2033 713 900
Website: http://www.6alpha.com
Email: enquiry@6alpha.com

## Data Findings

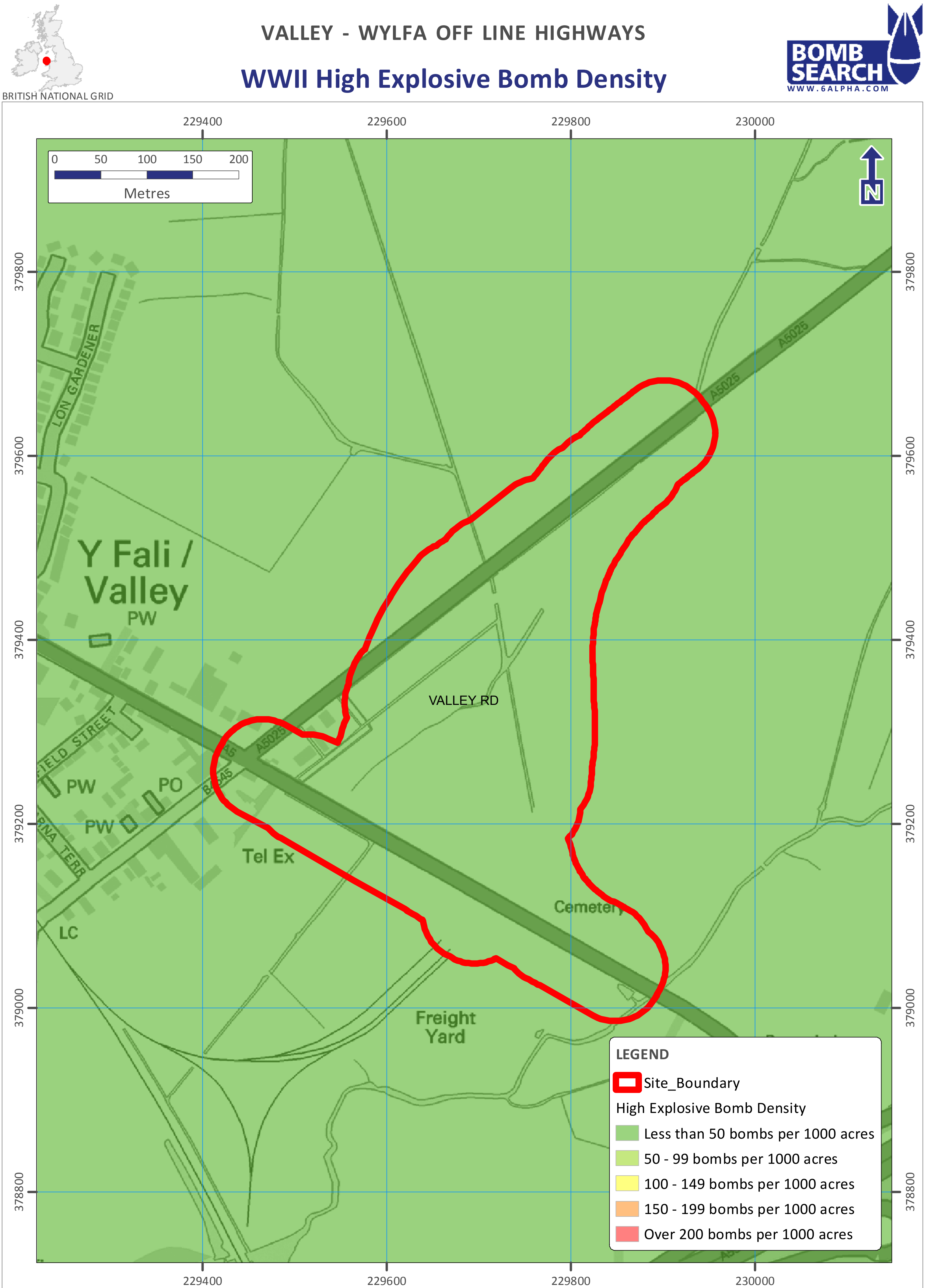
| Threat Source (Within 1,000m) | | Detail | |
|---|---|---|---|
| | | Identified | Comments |
| | Airfields/Military Facilities | ✗ | None recorded within 1,000m. |
| | Ordnance Manufacture/Storage | ✗ | None recorded within 1,000m. |
| | WWII Decoy Bombing Sites | ✗ | None recorded within 1,000m. |
| | WWII Defensive Features | ✗ | None recorded within 1,000m. |
| | WWII *Luftwaffe* Designated Bombing Targets | ✗ | *Luftwaffe* aerial photography could not be located. |
| | Secondary Bombing Targets | ✓ | A railway station (235m to the southwest) and a foundry (950m to the northwest). |
| | WWII Bomb Strikes Within Site Boundary | ✗ | ARP HE bomb strike records could not be located. |
| | WWII Bomb Strikes Near Site Boundary | ✗ | ARP HE bomb strike records could not be located. |
| | WWII Bomb Damage | ✗ | Bomb damage mapping could not be located. |
| | Abandoned Bomb Register | ✗ | None recorded within 1,000m. |
| | WWII Bombing Density | ✓ | The Site was located within *Valley Rural District* which recorded less than 50 HE bomb strikes per 1,000 acres. |

## Important Notes

1. The term 'Preliminary UXO Risk Assessment' has been used to describe this report, to fall inline with the CIRIA C681 guidelines. Whilst the term 'Risk' can be justifiably used at this stage, the reader should note that the 'Consequence' function of 'Risk' is not considered. Should it be required, this would be addressed in the 'Detailed UXO Threat & Risk Assessment' (Stages 2 and 3).
2. This report is accurate and up to date at the time of writing.
3. The assessment levels have been generated from historical data and third party sources. Where possible 6 Alpha have sought to verify the accuracy of such data, but cannot be held accountable for inherent errors that may be in third party data sets (e.g. National Archive or library sources).
4. 6 Alpha have exercised all reasonable care, skill and due diligence in producing this service.
5. Whilst every effort has been used to identify all potential UXO/explosive threats, there were a number of private facilities, which may not have released privately recorded information concerning UXO/explosive threats into the public domain. It is therefore possible that some of the aforementioned sites may not be included within the database.

VALLEY - WYLFA OFF LINE HIGHWAYS

# WWII High Explosive Bomb Density



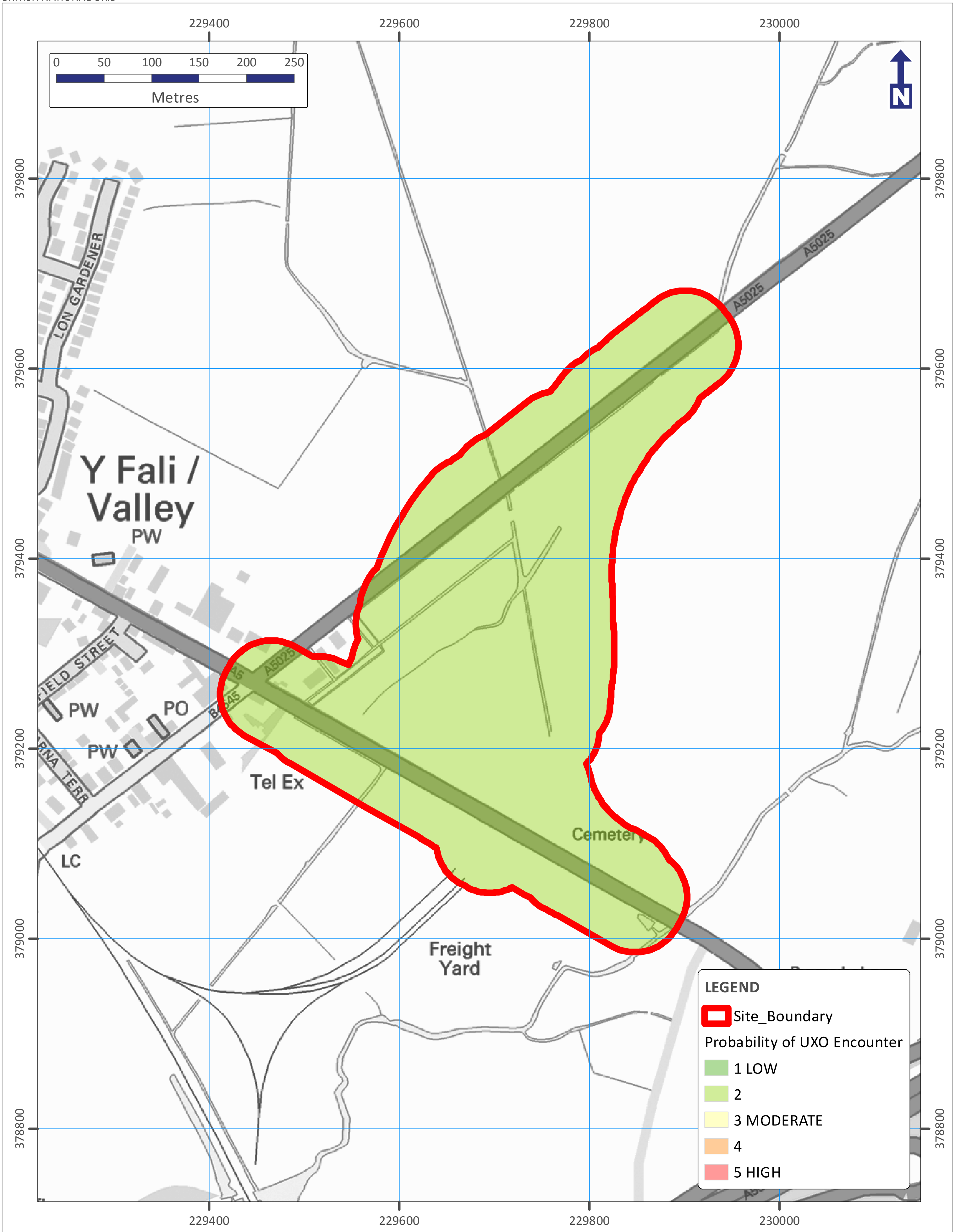

| PROJECT NO. | FIGURE NO. | DRAWN BY | CHECKED BY | DATE |
|---|---|---|---|---|
| P4615 | 1 | DR | RB | 22 June 2015 |

# VALLEY - WYLFA OFF LINE HIGHWAYS

## Probability of UXO Encounter

BRITISH NATIONAL GRID

BOMB SEARCH
WWW.6ALPHA.COM



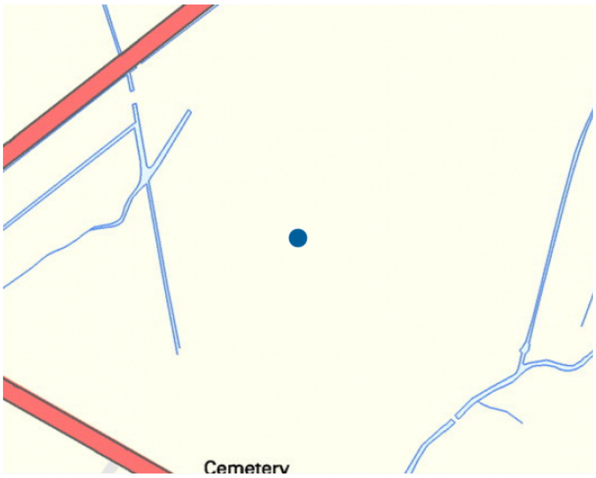

| PROJECT NO. | FIGURE NO. | DRAWN BY | CHECKED BY | DATE | | |
|---|---|---|---|---|---|---|
| P4615 | 2 | DR | RB | 22 June 2015 | Contains Ordnance Survey data © Crown copyright and database right 2015 | Produced by and Copyright to 6 Alpha Associates Ltd. Users noting any errors please notify 6 Alpha. |

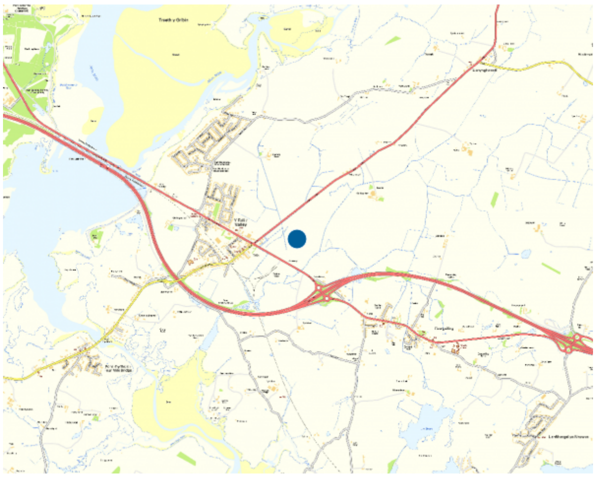
## Appendix H2 Preliminary UXO risk assessment – Section 1, current alignment

Groundsure
LOCATION INTELLIGENCE

BombRisk.com

# Preliminary Unexploded Ordnance Risk Assessment



Project: 229867.2405563787, 379317.0323393802

Groundsure Ref: GS-4000028

*Report prepared by Dynasafe BACTEC Limited and FIND Mapping Limited*

*Report reference: 502282*

**SAFE**
**RELIABLE**
**PROFESSIONAL**

The established
market leader in
**UXO RISK MITIGATION**

**www.bombrisk.com**

DYNASAFE Area Clearance

Dynasafe BACTEC Limited

FIND PROFESSIONAL MAPPING INTELLIGENCE

# Preliminary Unexploded Ordnance Threat Assessment

## 229867.2405563787, 379317.0323393802

*Contents* | *Page*

# 1 Executive Summary

1 **Has a potential unexploded ordnance (UXO) risk been identified at the site in question?**

**NO**

| | |
|---|---|
| **Indicative British / Allied UXO Risk** | **NEGLIGIBLE** |
| **Indicative German UXO Risk** | **NEGLIGIBLE** |

2 **Does the site in question require further research to clarify the unexploded ordnance (UXO) risk to future ground works?**

**NO**

3 **Dynasafe BACTEC's recommendation:**

**Dynasafe BACTEC recommend no further action on this site, however, it would be prudent to consider an Explosive Ordnance Safety Awareness briefing provided by a suitably experienced UXO Specialist.**

# 2 Introduction

## About Dynasafe BACTEC Limited

Since 1991, Dynasafe BACTEC Limited has supported the UK construction industry by assessing the risk of encountering items of unexploded ordnance (UXO) during intrusive works. Dynasafe BACTEC's specialist advice provides essential information for threat assessments, improving safety and enhancing reputations, helping contractors avoid costly delays.

Dynasafe BACTEC holds the following accreditations: Occupational Health & Safety Management Systems (OHAS 18001:2007), Environmental Management Systems (ISO 14001:2004) and Quality Management Systems (ISO 9001:2008).

The risk of encountering UXO on most sites in the UK is low. However, where a site is at increased risk it is necessary to take measures to mitigate that risk. The factors affecting UXO threat assessment are based upon the history and previous usage of a site and its surroundings.

In 2009, the Construction Industry Research and Information Association (CIRIA) established a set of guidelines to assist industry professionals.

CIRIA recommends a four stage risk management process:

- **Preliminary threat assessment**
- **Detailed threat assessment**
- **Risk mitigation**
- **Implementation**

The preliminary threat assessment enables a non-UXO specialist to place a site in context and to identify whether a more detailed assessment is necessary. The assessment is based upon data obtained from desktop reviews of the site's history and its proximity to potential indicators of UXO contamination.

There are two principal groups of onshore UXO in the UK:

- **British / Allied Army, Air Force and Navy activities – domestic military activity**
- **Enemy bombing during WWI and WWII – aerial bombing and naval bombardment**

These two groups comprise many potential UXO risk contributing sources within the UK, the most significant of which are listed below. Georeferenced databases containing this information are used by BombRisk.com to identify areas of potentially elevated UXO risk.

- **Historic army, navy and air-force facilities**
- **Explosives / ammunition factories**
- **Munitions storage depots**
- **Historic military training areas and firing ranges**

- **British army explosive ordnance clearance tasks / recces**
- **WWII heavy anti-aircraft batteries**
- **WWII anti-invasion defensive fortifications**
- **Miscellaneous WWII pipe mined locations**
- **WWII prisoner of war camps**
- **WWII German bombing density statistics**
- **WWII bombing decoy sites**
- **Press articles regarding UXO finds**
- **Locations of Dynasafe BACTEC UXO finds**
- **Locations of Dynasafe BACTEC desktop threat assessments**
- **Locations of Dynasafe BACTEC on-site support services**

## About FIND Mapping Limited

Established in 2006, FIND Mapping Limited is a pioneering web mapping and spatial data technology company offering online mapping and consultancy services. FIND technology powers the generation of this report.

www.findmaps.co.uk provides detailed mapping and a wealth of data sets to hundreds of the UK's top property, environmental and design/build companies.

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While working closely with a wide range of reputable data providers including Ordnance Survey and the Environment Agency, FIND works independently of these organisations. A similar arm's-length relationship is maintained in terms of software and hardware providers. This enables the team at FIND to offer truly independent advice.

# 3 Methodology

**Dynasafe BACTEC Limited and FIND have compiled a geo-referenced database of potential sources of UXO risk within the UK. From this information a range of risk zones have been defined.**

The weighting of these zones is based upon the influence of all relevant factors. A WWII-era RAF airfield, for example, has a far greater zone of influence than a single WWII-era Anti-Aircraft Battery, as it would have covered a larger area, housed a much greater quantity / variety of munitions, seen more domestic troop training activities and would have been a more likely target for enemy bombers.

An online Preliminary Automated UXO Threat Assessment will determine an indicative level of UXO risk relating to a site. Note that these risk levels could be subject to change following the completion of any Detailed Desktop Threat Assessment for the same site.

The assessment will list all factors contributing to this weighting and will also give appropriate recommendations for further action, if considered necessary.

# 4 Search Results

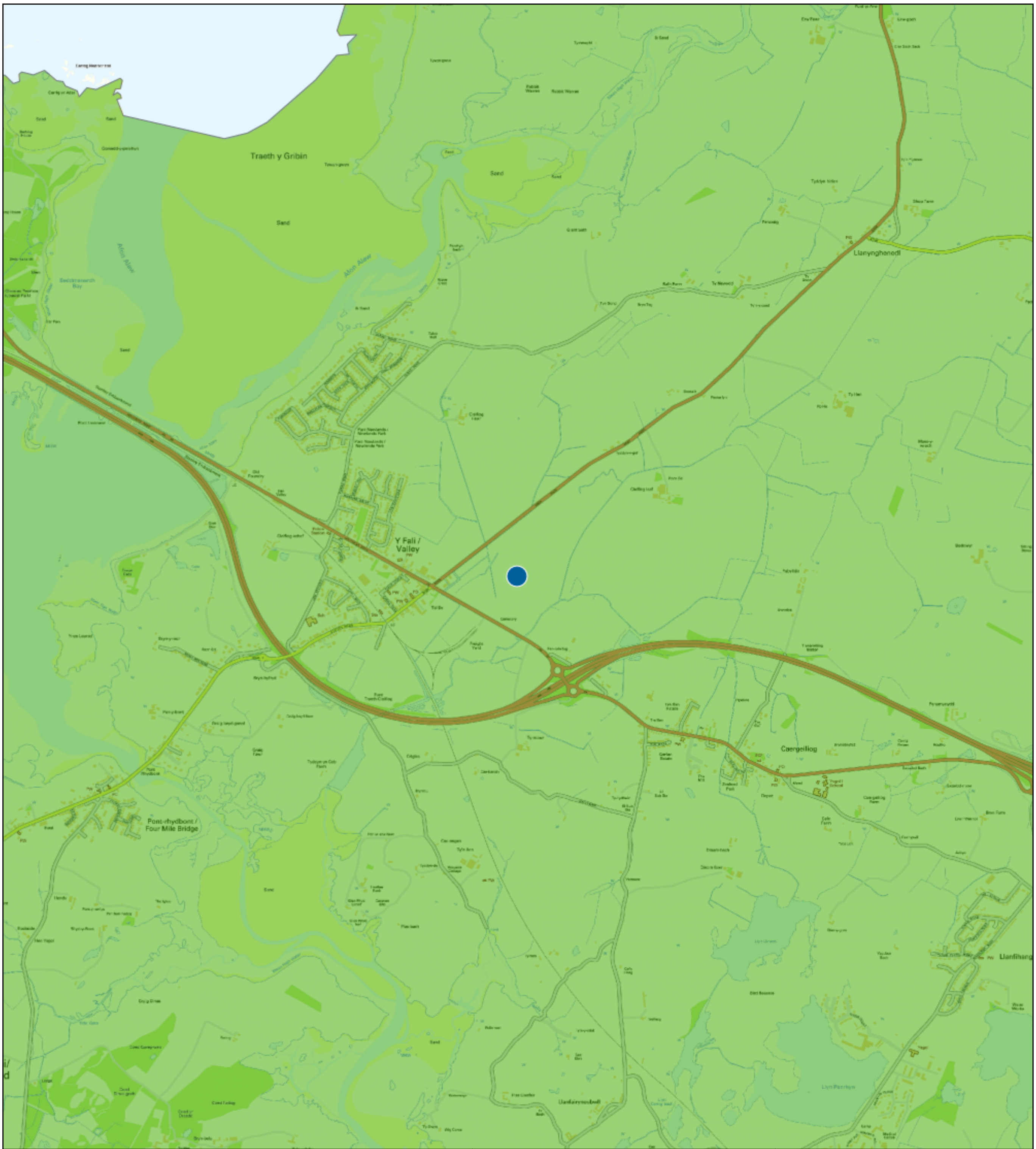
## Dynasafe BACTEC Limited's UXO Source Database

Within 10km of the site the following potential sources of explosive ordnance have been recorded:

| *Source* | *Number within 10km* |
|---|---|
| Military Airfield Sites | 1 |
| WWII Defence Related Positions & Pillboxes | 20 |
| Historic Army Camps | 1 |
| Military Training Areas and Firing Ranges | 1 |
| Army Explosive Ordnance Clearance Tasks/Recces | 1 |
| Bombing Decoy Sites | None recorded |
| Abandoned Bombs | None recorded |
| Press Articles regarding UXO Finds | None recorded |
| Prisoner of War Camps | None recorded |
| Heavy Anti-Aircraft Batteries | None recorded |
| Pipe Mined WWII Airfields | None recorded |
| Miscellaneous WWII Pipe Mined Locations | None recorded |
| Sites Related to the Manufacture of Explosives and Explosive Ordnance | None recorded |
| Dynasafe BACTEC Unexploded Ordnance Finds | None recorded |
| Dynasafe BACTEC Desk-top Threat Assessments | None recorded |
| Dynasafe BACTEC On-Site Support Services | None recorded |

None of these sources are deemed significant enough to be a risk and therefore do not warrant further research.

# 5 Risk of UXO based on WWII German bombing density






**BombRisk.com**

**Dynasafe BACTEC Limited**

DYNASAFE Area Clearance · F!ND PROFESSIONAL MAPPING INTELLIGENCE · OS Map data

NEGLIGIBLE
LOW
MEDIUM
HIGH

1:20000

N
W E
S

0 400 800
Metres

# 6 Conclusions

## Risk Levels and Recommendation

### Indicative British / Allied UXO Risk

**NEGLIGIBLE**

There are no potential sources of British / Allied UXO recorded in Dynasafe BACTEC's historical database in close proximity to the site. If there is any empirical evidence of actual or potential contamination, Dynasafe BACTEC should be contacted for advice. Otherwise, the risk on site from UXO is considered to be Negligible.

### Indicative German UXO Risk

**NEGLIGIBLE**

Historical records indicate a negligible level of bombing density from WWII. If there is empirical evidence of UXB risk (i.e. anecdotal evidence) then please contact Dynasafe BACTEC for further advice.

This preliminary assessment has identified a Negligible risk from German unexploded bombs at this site.

## Conclusion

This preliminary assessment has resulted in an overall Negligible risk from UXO. Unless any empirical evidence of actual or potential UXO contamination is available, Dynasafe BACTEC recommend no further action on this site, however, it would be prudent to consider an Explosive Ordnance Safety Awareness briefing provided by a suitably experienced UXO Specialist.

www.bombrisk.com

Dynasafe Area Clearance

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Tel: +44 (0) 1322 284 550
Email: support@bombrisk.com

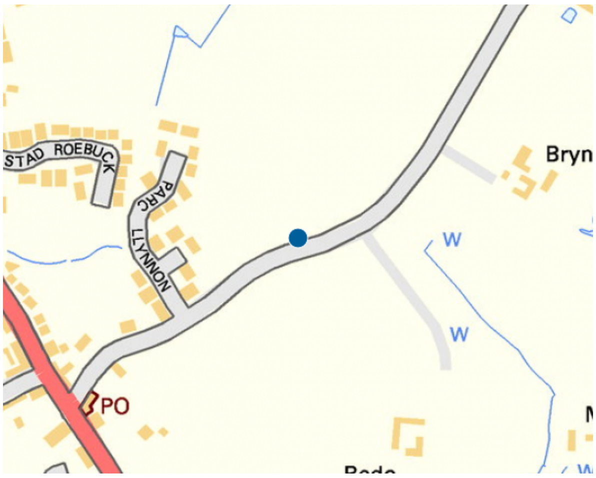
www.bactecuxo.com | www.dynasafe.com

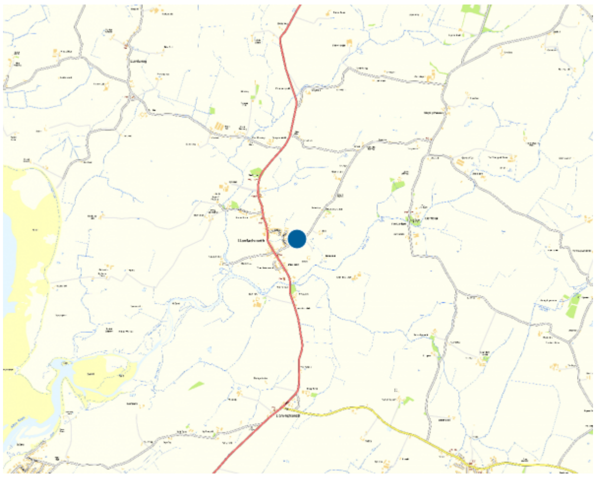
# Appendix H3 Preliminary UXO risk assessment – Section 3

Groundsure
LOCATION INTELLIGENCE

BombRisk.com

# Preliminary Unexploded Ordnance Risk Assessment



Project: 231751.14665483386, 382398.85028510046

Groundsure Ref: GS-4000034

*Report prepared by Dynasafe BACTEC Limited and FIND Mapping Limited*

*Report reference: 502283*



DYNASAFE Area Clearance

Dynasafe BACTEC Limited

F!ND PROFESSIONAL MAPPING INTELLIGENCE

# Preliminary Unexploded Ordnance Threat Assessment

## 231751.14665483386, 382398.85028510046

*Contents* *Page*

# 1 Executive Summary

**1 Has a potential unexploded ordnance (UXO) risk been identified at the site in question?**

**NO**

| | |
|---|---|
| Indicative British / Allied UXO Risk | NEGLIGIBLE |
| Indicative German UXO Risk | NEGLIGIBLE |

**2 Does the site in question require further research to clarify the unexploded ordnance (UXO) risk to future ground works?**

**NO**

**3 Dynasafe BACTEC's recommendation:**

**Dynasafe BACTEC recommend no further action on this site, however, it would be prudent to consider an Explosive Ordnance Safety Awareness briefing provided by a suitably experienced UXO Specialist.**

# 2 Introduction

## About Dynasafe BACTEC Limited

Since 1991, Dynasafe BACTEC Limited has supported the UK construction industry by assessing the risk of encountering items of unexploded ordnance (UXO) during intrusive works. Dynasafe BACTEC's specialist advice provides essential information for threat assessments, improving safety and enhancing reputations, helping contractors avoid costly delays.

Dynasafe BACTEC holds the following accreditations: Occupational Health & Safety Management Systems (OHAS 18001:2007), Environmental Management Systems (ISO 14001:2004) and Quality Management Systems (ISO 9001:2008).

The risk of encountering UXO on most sites in the UK is low. However, where a site is at increased risk it is necessary to take measures to mitigate that risk. The factors affecting UXO threat assessment are based upon the history and previous usage of a site and its surroundings.

In 2009, the Construction Industry Research and Information Association (CIRIA) established a set of guidelines to assist industry professionals.

CIRIA recommends a four stage risk management process:

- **Preliminary threat assessment**
- **Detailed threat assessment**
- **Risk mitigation**
- **Implementation**

The preliminary threat assessment enables a non-UXO specialist to place a site in context and to identify whether a more detailed assessment is necessary. The assessment is based upon data obtained from desktop reviews of the site's history and its proximity to potential indicators of UXO contamination.

There are two principal groups of onshore UXO in the UK:

- **British / Allied Army, Air Force and Navy activities – domestic military activity**
- **Enemy bombing during WWI and WWII – aerial bombing and naval bombardment**

These two groups comprise many potential UXO risk contributing sources within the UK, the most significant of which are listed below. Georeferenced databases containing this information are used by BombRisk.com to identify areas of potentially elevated UXO risk.

- **Historic army, navy and air-force facilities**
- **Explosives / ammunition factories**
- **Munitions storage depots**
- **Historic military training areas and firing ranges**

- **British army explosive ordnance clearance tasks / recces**
- **WWII heavy anti-aircraft batteries**
- **WWII anti-invasion defensive fortifications**
- **Miscellaneous WWII pipe mined locations**
- **WWII prisoner of war camps**
- **WWII German bombing density statistics**
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# 4 Search Results

## Dynasafe BACTEC Limited's UXO Source Database

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| ***Source*** | ***Number within 10km*** |
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| WWII Defence Related Positions & Pillboxes | 19 |
| Military Training Areas and Firing Ranges | 1 |
| Bombing Decoy Sites | None recorded |
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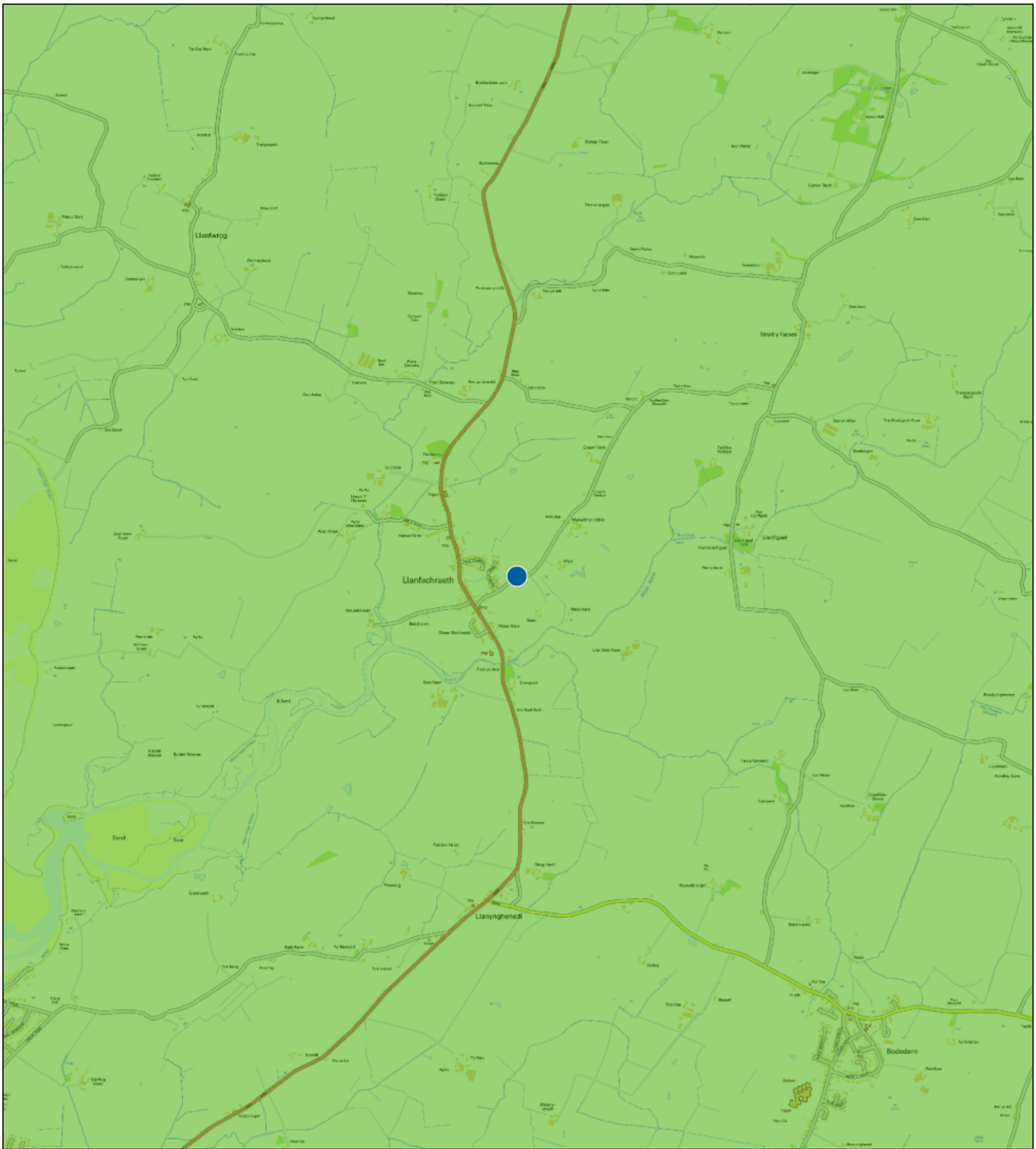




**BombRisk.com**

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www.bombrisk.com

Dynasafe Area Clearance

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Dartford, Kent, DA2 6NX
United Kingdom
Tel: +44 (0) 1322 284 550
Email: support@bombrisk.com

www.bactecuxo.com | www.dynasafe.com

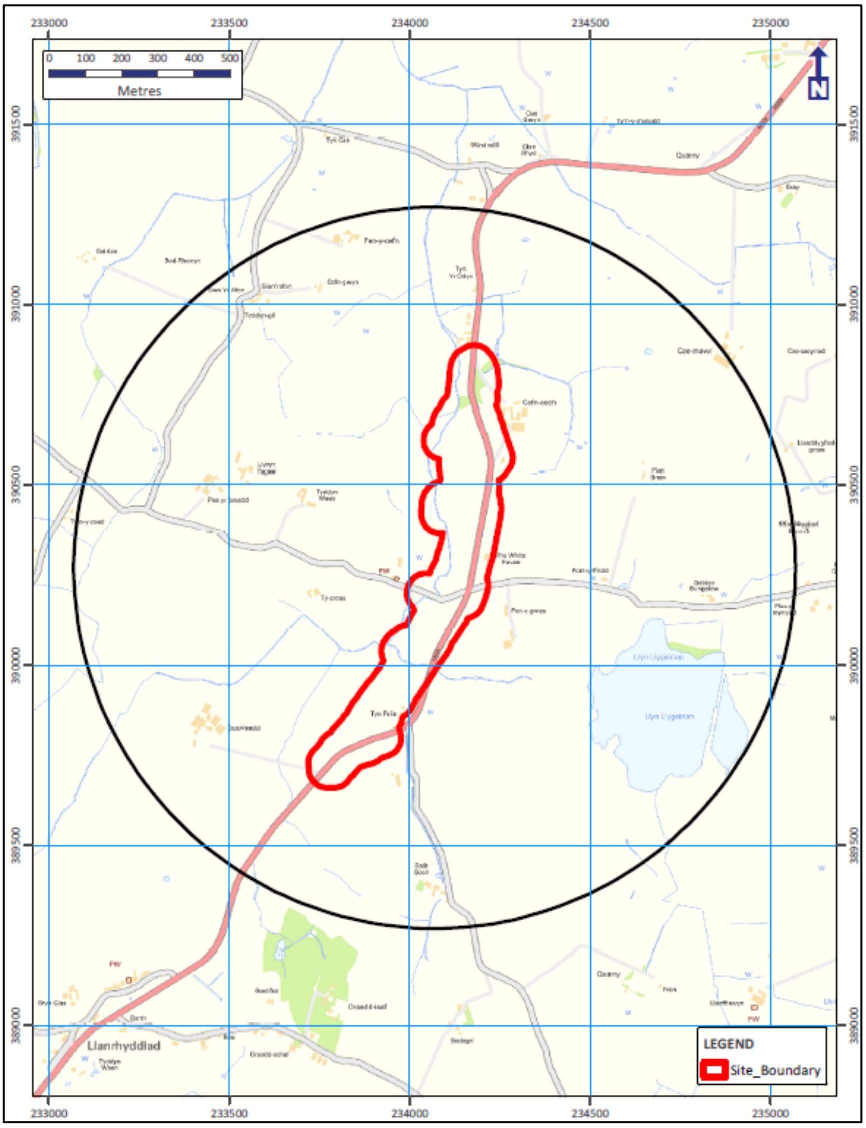
## Appendix H4 Preliminary UXO risk assessment – Section 7

6 Alpha Associates Ltd
Quatro House
Frimley Road
Camberley
Surrey GU16 7ER
United Kingdom

T: +44 (0)2033 713 900
W: www.6alpha.com

# Preliminary Unexploded Ordnance (UXO) Risk Assessment

Meeting the requirements of CIRIA C681 "Unexploded Ordnance (UXO) – A guide for the Construction Industry" Risk Management Framework




**6 Alpha Project Number:** P4612
**Client:** RSK
**Site:** Llanrhyddlad – Wylfa Off Line Highways

**Originator:** Jennifer Russell (22nd June 2015)
**Released By:** Lisa Askham (24th June 2015)

Delivered By

special risks consultancy

# Unexploded Ordnance Probability Assessment

## Study Site

The Study Site is described as "Llanrhyddlad – Wylfa off Line Highways", and it is centred on National Grid Reference 234070, 390270.

## Threat Potential

UXO PROBABILITY ASSESSMENT = 1 RATING, INDICATING A

LOW/MEDIUM PROBABILITY OF UXO ENCOUNTER

The rating scale can be seen on *Figure 2* (Probability of UXO Encounter). In accordance with current guidelines (CIRIA C681 Chapter 5), the highest risk rating has been determined at this specific site for UXO risk consideration and has been used for the final assessment and recommendations.

## Summary

During WWII the Study Site was situated within *Valley Rural District* and *Twrcelyn Rural District*, both of which recorded less than 50 HE bomb strikes per 1,000 acres; a low level of bombing.

*Luftwaffe* aerial reconnaissance photography could not be found, nor were any secondary bombing targets identified within the area.

Neither *Air Raid Precaution* (ARP) HE bomb strike records nor bomb damage mapping could be located. Nonetheless, there is no evidence to suggest that the Site or immediate area was subjected to bombing.

Given that there is no evidence to suggest that bombing took place in the vicinity of the Site, nor any military activity, it has been concluded that no further action is warranted.

## Recommendations

In accordance with CIRIA C681 Chapter 5 on managing UXO risks, 6 Alpha recommends that no further action is required to address the UXO risk at this Study Site. Should you have any queries, please contact 6 Alpha.

## Using This Report

This Preliminary Assessment is designed to inform environmental and construction professionals of the potential threat of military related explosives and/or ordnance on, or in, the vicinity of the Study Site.

This assessment is designed to be employed as a site-screening tool to meet with the requirement of Phase One of the CIRIA UXO Risk Management Framework; there are two broad prospective outcomes; either the threat level requires a detailed threat & risk assessment; or no further action is required. In the former instance we can provide a report within 14 working days (or more quickly upon application).

Two figures accompany the report, the *Second World War* (WWII) High Explosive (HE) Bomb Density and the final Probability of UXO Encounter. The purpose of this approach is to demonstrate that whilst bomb density statistics give an indication for WWII bombing, they should not be relied upon exclusively to generate a holistic assessment.

For further information, please contact 6 Alpha:

Telephone: +44 (0)2033 713 900

Website: http://www.6alpha.com

Email: enquiry@6alpha.com

## Data Findings

| Threat Source (Within 1,000m) | Detail: Identified | Detail: Comments |
|---|---|---|
| Airfields/Military Facilities | ✗ | None recorded within 1,000m. |
| Ordnance Manufacture/Storage | ✗ | None recorded within 1,000m. |
| WWII Decoy Bombing Sites | ✗ | None recorded within 1,000m. |
| WWII Defensive Features | ✗ | None recorded within 1,000m. |
| WWII *Luftwaffe* Designated Bombing Targets | ✗ | *Luftwaffe* aerial photography could not be located. |
| Secondary Bombing Targets | ✗ | None recorded within 1,000m. |
| WWII Bomb Strikes Within Site Boundary | ✗ | ARP HE bomb strike records could not be located. |
| WWII Bomb Strikes Near Site Boundary | ✗ | ARP HE bomb strike records could not be located. |
| WWII Bomb Damage | ✗ | Bomb damage mapping could not be located. |
| Abandoned Bomb Register | ✗ | None recorded within 1,000m. |
| WWII Bombing Density | ✓ | The Site was located within *Valley Rural District* and *Twrcelyn Rural District*, which recorded less than 50 HE bomb strikes per 1,000 acres. |

## Important Notes

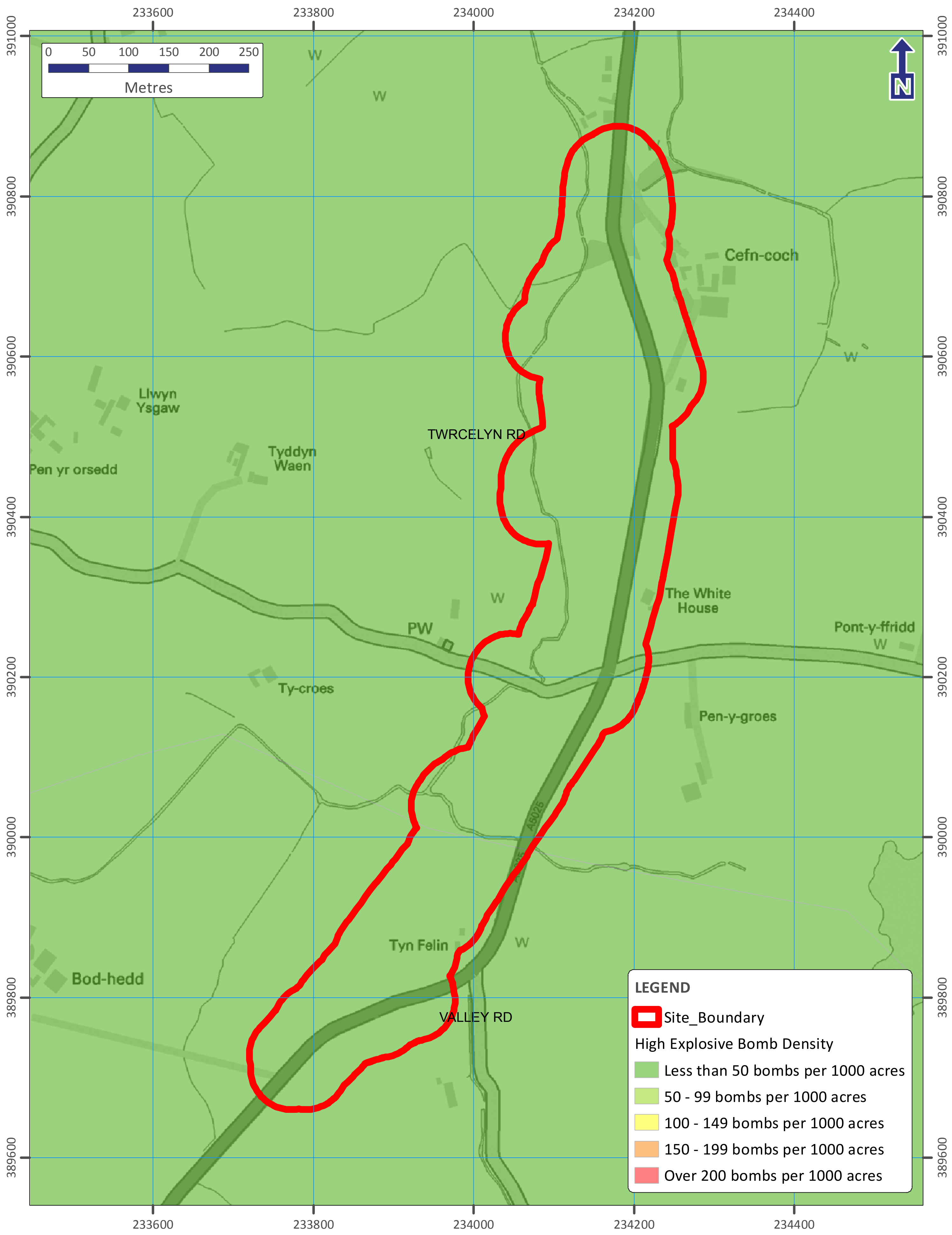
1. The term 'Preliminary UXO Risk Assessment' has been used to describe this report, to fall inline with the CIRIA C681 guidelines. Whilst the term 'Risk' can be justifiably used at this stage, the reader should note that the 'Consequence' function of 'Risk' is not considered. Should it be required, this would be addressed in the 'Detailed UXO Threat & Risk Assessment' (Stages 2 and 3).
2. This report is accurate and up to date at the time of writing.
3. The assessment levels have been generated from historical data and third party sources. Where possible 6 Alpha have sought to verify the accuracy of such data, but cannot be held accountable for inherent errors that may be in third party data sets (e.g. National Archive or library sources).
4. 6 Alpha have exercised all reasonable care, skill and due diligence in producing this service.
5. Whilst every effort has been used to identify all potential UXO/explosive threats, there were a number of private facilities, which may not have released privately recorded information concerning UXO/explosive threats into the public domain. It is therefore possible that some of the aforementioned sites may not be included within the database.

BRITISH NATIONAL GRID

# LLANRHYDDLAD - WYLFA OFF LINE HIGHWAYS

## WWII High Explosive Bomb Density

BOMB SEARCH
WWW.6ALPHA.COM

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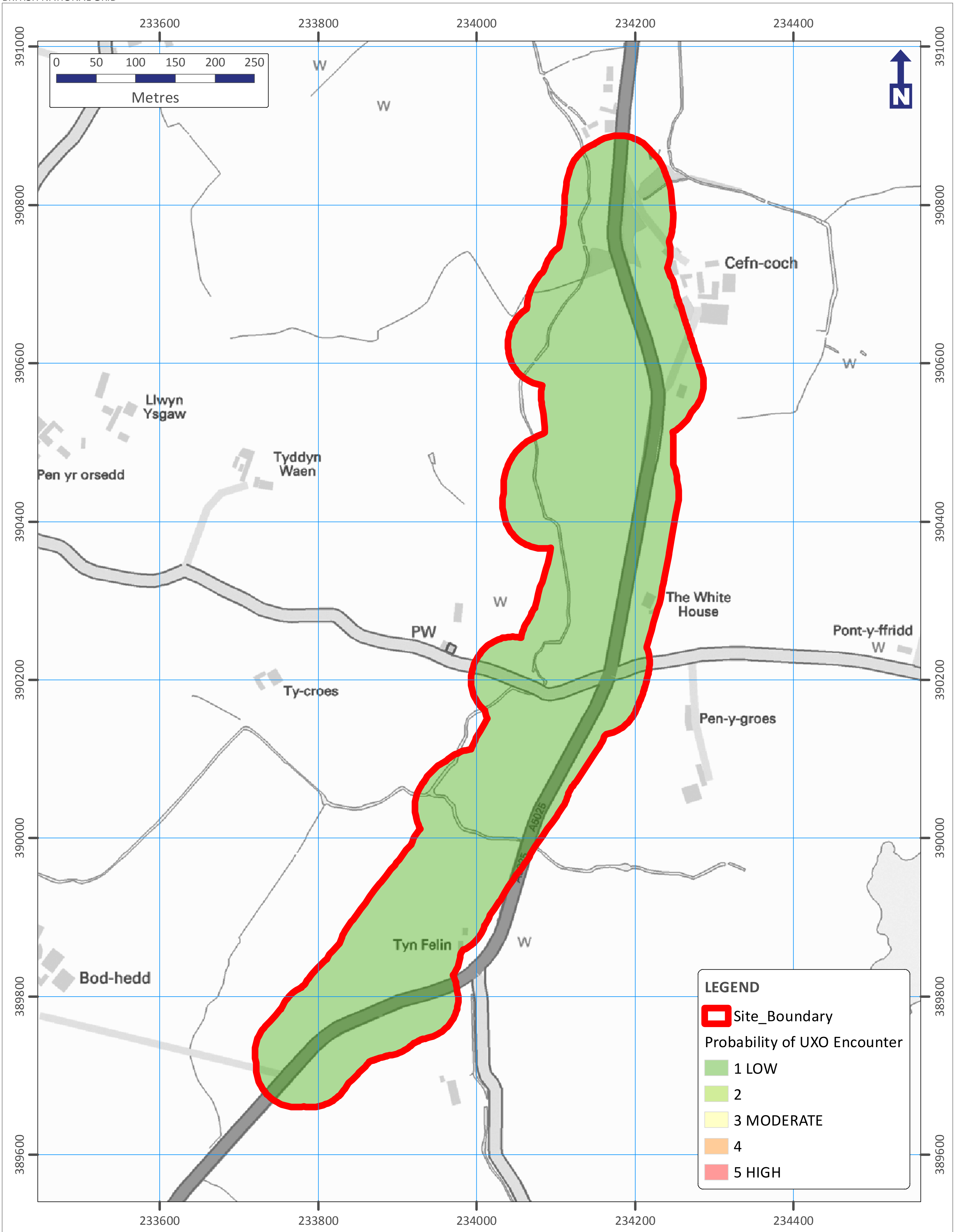
| P4612 | 1 | DR | RB | 18 June 2015 | Contains Ordnance Survey data © Crown copyright and database right 2015 | Produced by and Copyright to 6 Alpha Associates Ltd. Users noting any errors please notify 6 Alpha. |


# LLANRHYDDLAD - WYLFA OFF LINE HIGHWAYS

## Probability of UXO Encounter

BOMB SEARCH
WWW.6ALPHA.COM

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