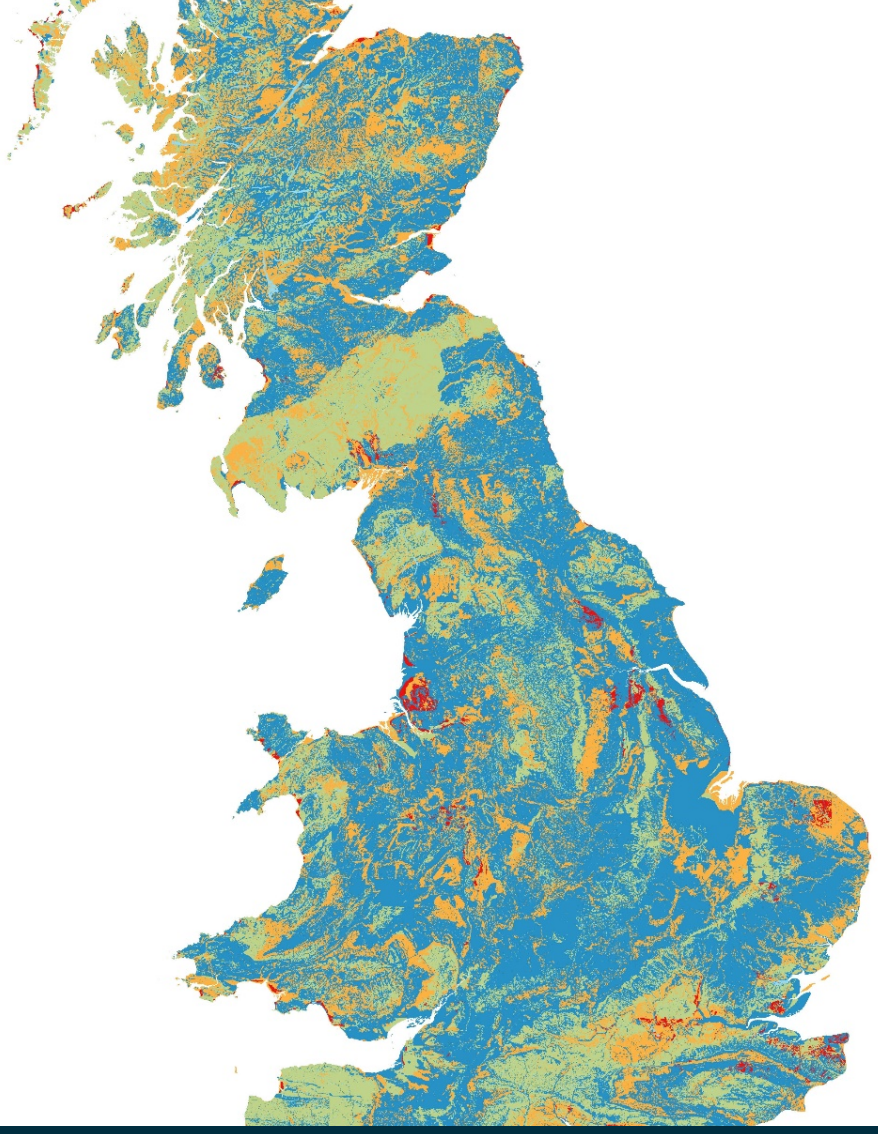

BGS DIGITAL

User guide: Soil Parent Material Dataset

Open report OR/21/064

British Geological Survey

BRITISH GEOLOGICAL SURVEY

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The British Geological Survey is a component body of UK Research and Innovation.

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Foreword

The British Geological Survey (BGS) is a world-leading geological survey, focusing on public-good science for government, and research to understand earth and environmental processes.

We are the UK's premier provider of objective and authoritative geoscientific data, information and knowledge to help society to:

- use its natural resources responsibly
- manage environmental change
- be resilient to environmental hazards

We provide expert services and impartial advice in all areas of geoscience. As a public sector organisation, we are responsible for advising the UK Government on all aspects of geoscience as well as providing impartial geological advice to industry, academia and the public. Our client base is drawn from the public and private sectors both in the UK and internationally.

The BGS is a component body of the Natural Environment Research Council (NERC), part of UK Research and Innovation (UKRI).

DATA PRODUCTS

The BGS produces a wide range of data products that align to government policy and stakeholder needs. These include baseline geological data, soils, geochemistry, engineering properties and geohazards datasets. These products are developed using in-house scientific and digital expertise, and are based on the outputs of our research programmes and substantial national data holdings.

Our products are supported by stakeholder focus groups, identification of gaps in current knowledge and policy assessments. They help to improve understanding and communication of the impact of geo-environmental properties and hazards in Great Britain, thereby improving society's resilience and enabling people, businesses, and the government to make better-informed decisions.

Acknowledgements

This report is the published product of a study by the British Geological Survey (BGS) to produce a digital dataset depicting the soil parent materials of Great Britain. The method used to derive the data was critically assessed at the time of creation and its fitness for purpose determined by R. Lawley, B. Smith and B. Rawlins (Version6) and R. Lawley, S. Cornillon and H. Holbrook Version 6.1).

A large number of individuals in BGS have contributed to the project. This assistance has been received at all stages of the study. In addition to the collection of data, many individuals have freely given their advice, and provided expert knowledge.

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Summary

Developed by the British Geological Survey (BGS), the soil parent material dataset informs users about the likely soil and sub-soil characteristics found across Great Britain. The data provides information about ground conditions relating to agricultural soils.

This product was developed from studies examining ways of utilising geology and landscape data to build digital soil models at medium scale. The dataset combines Geology (at 1: 50 000 scale) and terrain information (Ordnance Survey Terrain 50). The output provides an overview of common soil and subsoil characteristics.

The information provided in this User Guide is intended to provide a quick-start guide to using and understanding this BGS data product.

1 Introduction

This document provides information for users of the Soil Parent Material dataset.

The British Geological Survey provides digital 'parent material' maps as part of its 'BGS Geology' product line. The dataset has been developed over several years and is the result of a series of high-resolution mapping activities at BGS, including:

- Original geological survey
- Compilation & generalisation
- Digital capture & re-publication

The Soil Parent Material dataset is designed to help environmental scientists and consultants assess the characteristics of the 'near-surface' weathered zone. In particular, the data focuses upon the material from which top soils and subsoils (A and B horizons) develop (i.e. from the base of pedological soil down to c. 2-3m).

1.1 BACKGROUND

In 2005 the British Geological Survey initiated a development programme to produce thematic data that identified and portrayed a variety of parent material and soil properties in Great Britain.

A 'parent material' is a geological deposit over, and within which, a soil develops. Typically, the parent material is the first recognisably geological deposit encountered when excavating beneath the soil layer. It represents the very-near-surface geology. In general, the geological deposits closest to the ground surface are the most weathered, whilst the deeper deposits are less so. The interface between soil and parent (geology) can vary from a sharp, clearly defined boundary, to a diffuse continuum with no distinctive point of transition.

"The major soil groups [in the UK]… are distinguished by broad differences in the composition or origin of the soil material" (Avery, 1980). A soil's parent materials play a vital role in determining soil-type. Typically, parent material characteristics control three primary characteristics of their overlying soils:

- Texture
- Gross soil Chemistry (geo-genic component)
- Permeability-Porosity (drainage)

A range of material characteristics (physical and chemical) are implicitly defined in the typical geological rock/deposit descriptions provided in many BGS products, and most geologists are able to interpret the information from their own experience and knowledge. However, these characteristics are easier to use by non-geologists when explicitly defined, as they are in the Soil Parent Material dataset.

The following characteristics are available from the dataset:

- European Soil Bureau Parent Material type
- Soil Texture
- Soil Group (a generalised soil texture)
- Parent Material texture
- Parent Material Carbonate Content
- Soil Layer thickness
- Soil susceptibility to water erosion
- Soil susceptibility for soil-wash
- Soil susceptibility to wind erosion.

1.2 WHO WOULD BENEFIT FROM THE DATASET?

It is envisaged that the Soil Parent Material dataset is of interest to a wide range of users working in the field of environmental science (from ground engineering and landscape modelling to climate change impact assessment). The dataset has been designed for a diverse user-base and simply presents BGS' geological and pedological spatial data in a manner that is more flexible for GIS-aware environmental scientists. A basic understanding of geology and soils is recommended so that users can fully utilise the dataset but any user with a grasp of physical geography should be able to work with the dataset. The database sets out simplified, qualitative descriptions of parent materials and soil characteristics available from the www.UKSO.org website. More experienced users may want to use this high resolution 1:50 000 scale dataset to integrate with climate, land use and terrain data to create high-resolution digital soil models.

2 Methodology

Data was collated and interpreted from a number of different sources currently held by BGS.

The primary datasets used for the Soil Parent Material dataset V6.1 are:

- BGS Soil Parent Material Map V6 dataset (The main spatial framework)
- BGS Civils 'Excavatability' dataset
- G-BASE (Geochemical and related observational data)
- Single Onshore Borehole Index (SOBI)
- BGS National Geotechnical Properties Database (NGPD)
- Industrial Minerals Assessment Unit (IMAU) Sand and Gravel dataset
- Ordnance Survey Terrain 50

Table 1 Sources of data used in this dataset

	Lithology	ESB type	$CaCO_3$ Content	Grain size	Soil Group	Soil texture	Soil Depth	Water Erosion	Run-off	Wind erosion
BGS SPMv6	Y	Y	Y	Y	Y	Y		Y		Y
BGS Civils							Y			
BGS G-BASE			Y		Y	Y	Y			
BGS SOBI			Y	Y	Y	Y	Y			
BGS NGPD				Y	Y	Y	Y			
BGS IMAU			Y	Y	Y	Y	Y	Y		Y
Ordnance Survey Terrain 50								Y	Y	

The Soil Parent Material dataset V6.1 content is created from a simple sequential workflow for each main soil attribute component. The bare-soil water erosion and bare soil 'run off' attributes utilise an integrated slope model derived from Ordnance Survey Terrain 50 elevation data.

General soil and subsoil attributes are assessed as follows:

1. Identify measurements and observations from archive sample records and rock descriptions that relate to the selected attributes (e.g. carbonate chemistry).
2. Categorise the observations into classes/groups of similar behaviours (e.g. High, Low), where possible using published standards of classification such as BS 5930, Eurocode 7 or similar.
3. Assess whether the range of available evidence statistically supports the range of possible classes (such as using ANOVA tests for mean texture classes from particle-size distributions derived from boreholes), or whether expert judgement is required to

subdivide/combine categories (e.g. it is not viable to predict an accurate $CaCO_3$ content (as %) across Great Britain, but generic classes of High, Medium, Low can be delineated/estimated).

4. Assess the range of lithostratigraphic variation of geological materials across Great Britain, in terms of the categories and classes identified in steps 2 & 3. Using combined expert-judgement and spatial analyses create a 'lookup' dataset of expected attributes (material characteristics and behaviours) per lithostratigraphic unit.
5. Combine the spatial (map) components of the Soil Parent Material v6 datasets with the 'lookup' dataset created in step 4 (using standard GIS 'spatial and/or attribution join' techniques to create new 'map' of fill characteristics.

The bare soil water erosion and run off attributes are then created with the following processes:

6. The OS Terrain 50 dataset is processed using a default ESRI ARCGIS slope algorithm.

The slope model is converted to a vector contoured model, with contour classes defining the bare soil erosion and run off factors for slope (see Table 9 and Table 10).

7. The slope contour model is geo-processed (union) with the BGS Soil Parent Material dataset.
8. For appropriate combinations of soil textures and slope factors the bare soil erosion class is calculated (see Table 8 and Table 9).

The bare soil run-off classes are derived directly from the slope factors (see Table 10).

All data have been subjected to standard BGS digital-data checking procedures (to assess completeness and cleanliness of content).

Categorisation of the data and assignment of classes have been mostly made by expert judgement in order to create 'look up tables' of lithostratigraphic rock type and associated engineering properties. The methods used are similar to those described in the methodology report for the underpinning Soil Parent Material v6 dataset (Lawley, 2009). Assignments of characteristics have been made at the 'formation' level of lithostratigraphic classification of rock/deposit type.

Spatial data-creation and attribution has been completed using standard ESRI ARCGIS 10.3 (EDITOR Version) software.

3 Technical Information

This section provides more detailed information on the data product, its content and advice on best use as well as highlighting some important considerations.

3.1 SCALE

The Soil Parent Material dataset is intended for use at 1:50 000 scale. All spatial searches of the maps should be undertaken using a minimum 50 m buffer. This is because the smallest detectable feature at this scale is 50 m.

3.2 COVERAGE

The dataset covers Great Britain i.e. England, Scotland and Wales (see Figure 1).

Figure 1 Soil Parent Material dataset coverage

3.3 ATTRIBUTE DESCRIPTIONS

The data attributes in the Soil Parent Material dataset are shown in **Error! Reference source not found.**.

Table 2 Attribute fields for the Soil Parent Material dataset

	GEN_PMLITH	ESB_DESC	GEN_GRAIN	SOIL_GROUP	SOIL_DEPTH	$CaCO_3$_RANK	SIMPLE_TEX	WATER_ERZ	WIND_ERZ	SOIL_WASH	UID
Example text	DIAMICTON-SAND-GRAVEL	GLACIAL TILL	MIXED (ARGILLIC-RUDACEOUS)	MEDIUM TO LIGHT(SILTY) TO HEAVY	DEEP	LOW	LOAM TO CLAYEY LOAM	Moderate. Rills may form during very wet periods. Sediment seen in run-off	Soil is not prone to wind erosion	Run off seen in some years during wet periods	Unique Identifier

Each field comprises a text description or classification which follows a basic definition of its characteristics as described in the following tables:

3.3.1 Generalised parent material lithology (GEN_PMLITH)

The generalised parent material lithology is a simple text description describing the geological parent material beneath any natural soil layer. It uses standard, commonly used terminology to describe lithologies that can be further explored via BGS webpages or internet searches.

3.3.2 European Soil Bureau definition of Parent Material type (ESB_DESC)

The European Soil Bureau (ESB) definition of Parent Material type provides the 'most applicable' European definition of parent material type for each map unit. The ESB description for a parent material is defined in the Georeferenced Soil database for Europe (Finke et al, 2001) and is summarised in Appendix 1. Multi-lithic parent materials (e.g. layered units of two or more contrasting lithologies) are represented by two or more concatenated descriptions. The ESB description is useful for users considering integration of this database into European soil/geology databases.

3.3.3 Parent Material Grain Size (GEN_GRAIN)

This is a generalised textural description of the Parent Material. The grain-size values are derived from analyses of samples taken from the parent material and also expert judgement (based on field survey and description of the deposits). Where a parent material comprises more than one type of deposit, a range of classes is recorded. Deposits that are known to be heterolithic are identified by the term 'mixed'. Note that geologists use different grain-size terminology for rocks originating from sedimentary and igneous lithologies (however, both are based on the phi scale) and that peat is not attributed with a grain-size term (peat is used to denote areas of peatland deposit, for these areas we often hold no alternative grain-size information). The terms are given in Table 3, as follows:

Table 3 Parent Material Grainsize

	GEN_GRAIN	GEN_GRAIN_DESCRIPTION	typical particle size (mm)
Grain size class (non-igneous parent –Wentworth scale)	RUDACEOUS	A gritty or gravel-rich subsoil.	2.0 +
	ARENACEOUS - RUDACEOUS	A layered subsoil of sand and gravel.	0.06 - 2.0+
	ARENACEOUS	A sand-rich subsoil.	0.06 - 2.0
	ARGILLIC - ARENACEOUS	A layered subsoil of clay, silt and sand.	< 2.0
	ARGILLIC or ARGILLACEOUS	A clay and silt-rich subsoil.	< 0.06
	MIXED (ARENACEOUS-RUDACEOUS)	A sand and gravel-rich subsoil.	0.06 - 2.0+
	MIXED (ARGILLIC-ARENACEOUS)	A variable clay, silt, and sand subsoil.	< 2.0
	MIXED (ARGILLIC-RUDACEOUS)	A variable clay, silt, sand and gravel subsoil.	> 0
	NA	No data applicable (typically inland water bodies).	na
	PEAT	Organic peaty subsoil.	na
Grain size class (igneous parent BGS RCS)	COARSE	A sand-rich subsoil, with fragmented hard rock at shallow depth.	2.0 +
	MEDIUM	A silt and sand-rich subsoil, with fragmented hard rock at shallow depth.	0.25 > 2
	FINE	A clay or silt subsoil, with fragmented hard rock at shallow depth.	< 0.25

3.3.4 Soil Group (SOIL_GROUP)

This is a generalised description of soil texture found over different parent material types, in terms of Heavy, Medium or Light soils as broadly indicated in the Defra Cross Compliance Guidance for Soil Management (Defra, 2006).

These generalised soil texture groupings are derived by comparing samples of measured soil textures (%clay, %silt and %sand) against a simplified grain-size ternary plot. Note that this map uses terms that refer to light soils (i.e. sand/silt rich), medium soils (i.e. loams) and heavy soils (i.e. clay-rich). The classifications are based on analyses of archived BGS G-BASE and geotechnical samples as well as expert judgment (where sample data is not available). Many parent materials are heterolithic and so can generate a broad range of particle sizes that may exhibit bimodal soil textures (i.e. a parent comprising sand beds and clay beds can locally generate soils of sand-dominant or clay-dominant textures, as well as a mixed sand/clay texture group) so these groupings should be regarded as 'indicative'. The 'Mixed or Organic' classification denotes highly variably textured soils or the presence of peat (no texture data is available for peaty soils).

The following values are present within the database:

Table 4 Soil Group descriptions

SOIL_GROUP	SOIL_GROUP_DESCRIPTION
HEAVY	Heavy, clay-rich soil and subsoil.
HEAVY AND MEDIUM	Heavy, clay-rich and medium, clay-loam soils and subsoils.
HEAVY AND MEDIUM TO LIGHT(SILTY)	Heavy clay-rich and medium, silty clay-loam, or sometimes light, silt-rich soils and subsoils.
HEAVY TO MEDIUM	Heavy, clay-rich but locally medium, clay-loam soil and subsoil.
HEAVY TO MEDIUM TO LIGHT(SILTY)	Heavy clay-rich but locally medium, silty clay-loam, or sometimes light, silt-rich soils and subsoils.
HEAVY TO MEDIUM(SANDY) TO LIGHT(SANDY)	Heavy clay-rich but locally medium, sandy clay-loam, or sometimes light, sand-rich soils and subsoils.
MEDIUM	Medium, loamy soil and subsoil.
MEDIUM TO HEAVY	Medium, clay-loam but locally heavy, clay-rich soil and subsoil.
MEDIUM TO LIGHT	Medium, loamy but locally light, sand or silt-rich soil and subsoil.
MEDIUM TO LIGHT(SILTY)	Medium, loamy but locally light, silt-rich soil and subsoil.
MEDIUM TO LIGHT(SILTY) TO HEAVY	Medium, loamy but locally light, silt-rich, or sometimes heavy clay-rich soil and subsoil.
MEDIUM(SILTY)	Medium, silt-loam soil and subsoil.
MEDIUM(SILTY) TO HEAVY	Medium, silt-loam but locally heavy, clay-rich soil and subsoil.
MEDIUM(SILTY) TO LIGHT(SILTY)	Medium, silt -loam but locally light, silt-rich soil and subsoil.
MEDIUM(SILTY) TO LIGHT(SILTY) TO HEAVY	Medium, silt-loam but locally light, silt-rich, or sometimes heavy clay-rich soils and subsoils.
LIGHT	Light, sand or silt-rich soil and subsoil.
LIGHT AND MEDIUM	Light, sand or silt-rich, and medium, loamy soil and subsoil.
LIGHT TO MEDIUM	Light, sand or silt-rich, but locally medium, loamy soil and subsoil.
LIGHT(SANDY)	Light, sand-rich soil and subsoil.
LIGHT(SANDY) TO MEDIUM(SANDY)	Light sand-rich, and medium sandy-loam soils and subsoils.
LIGHT(SANDY) TO MEDIUM(SANDY) TO HEAVY	Light sand-rich, but locally medium sandy-loam, or sometimes heavier, sandy clay-rich soils and subsoils.
LIGHT(SILTY)	Light, silt-rich soil and subsoil.
LIGHT(SILTY) TO MEDIUM(SILTY)	Light silt-rich, and medium silty-loam soils and subsoils.
LIGHT(SILTY) TO MEDIUM(SILTY) TO HEAVY	Light silt-rich, but locally medium silt-loam, or sometimes heavier, silty clay-rich soils and subsoils.
ALL	A variable soil and subsoil typically Peat or layered clay, sand and silt (riverine).
NA	No data applicable (typically inland water bodies).

3.3.5 Soil layer thickness (SOIL_DEPTH)

This is a general classification of soil thickness (soil depth) typically found on different Parent Material types. These soil thickness classifications are derived by using expert judgement to compare records of measured soil depth observed from borehole records with engineering

strength characteristics of the underlying Parent Materials. Five categories of soil thickness are provided ranging from deep to shallow. As a rule of thumb, these categories are based on the ability to manually dig (with a spade) without being hindered by a substrate that is too strong to excavate (i.e. layers of solid rock, dense gravel, or very stiff clays). An example of a deep soil would be one developed over unconsolidated, clayey Quaternary deposits, and an example of a shallow soil would be one found in areas underlain by chalk or limestone. Users should note that land management practices and natural weathering and accumulation (or erosion) processes of soil materials play a significant role in controlling field-scale soil depth (it has not been possible to factor in these influences within the scope of this dataset). The Soil depth descriptions (broad trends in soil thickness) are defined as follows:

Table 5 Soil layer thickness classes

SOIL_DEPTH	SOIL_DEPTH_DESCRIPTION
Deep	The soil and subsoil can be easily dug to a depth of more than 1 metre.
Deep-intermediate	The soil and subsoil can be easily dug to a depth of 1 metre, sometimes more in places.
Intermediate	The soil and subsoil can be easily dug to a depth of 1 metre, but not more.
Intermediate-shallow	The soil and subsoil can be dug to depths of more than half a metre, but less than 1 metre.
Shallow	The soil and subsoil can be dug to depths of only half a metre, sometimes less.
Not applicable	No data applicable (typically inland water bodies)

3.3.6 Carbonate Content ($CaCO_3$_RANK)

This field classifies all forms of carbonate (calcite, dolomite, and siderite) content in each parent material as a simple ranking of: none, low, moderate or high (with unknown or variable for heterolithic and multilithic parent units). As a very general rule, soils that have formed over carbonate-rich parent material are more likely to have a higher carbonate content which means they can buffer acidity from agricultural or atmospheric sources. The Parent Material Carbonate Content classification is based on expert judgment of the likely content of carbonate ($Mg/CaCO_3$) in the total rock-mass of each parent material. For example, High carbonate content would be expected for a chalk or limestone parent material type; Low carbonate content would be representative of weakly, calcite-cemented sandstone. The term variable is used where the parent material comprises two or more distinct lithologies e.g. interbedded limestone and mudstone where it is not possible to clearly identify the precise parent type at any given location. Users should note that land management practices and natural weathering processes of parent materials play a significant role in controlling carbonate content in surface deposits (it has not been possible to factor in these influences within the scope of this dataset) and so the classes shown in this dataset should be regarded as ‘indicative’.

Table 6 Carbonate content

Term used	Definition
High	Parent type has a high $CaCO_3$ content due to its primary mineralogy e.g. Chalk.
Variable(high)	Parent type has a variable but possibly high $CaCO_3$ content due to lithological variation e.g. Interbedded limestone and calcareous mudstone beds.
Mod	Parent type has a moderate $CaCO_3$ content due to its primary mineralogy e.g. dolomite.
Variable	Parent type has a variable (high to low) CaCO3 content due to heterolithic distribution of carbonate e.g. Till with chalk-gravel.
Low	Parent type has a low $CaCO_3$ content due to its primary mineralogy e.g. weakly calcareous-cemented mudstone.
Variable(low)	Parent type has a variable but typically low $CaCO_3$ content e.g. mudstone with intermittent, weakly-calcareous, sandstone beds.
None	Parent type has a no primary $CaCO_3$ content.

Unknown	Parent materials whose precise lithology is unclear (generally highly variable at short scales) or from a location that no mineralogical/geochemical data is available to confirm primary mineralogical content.
Not applicable	No data applicable (typically inland water bodies).

3.3.7 Soil Texture (SIMPLE_TEX)

This is a general classification of soil texture derived from measured samples of soils overlying different parent materials. Soil texture classes are based on a UK classification of soil texture. These soil texture classifications are derived by comparing samples of measured soil textures (%clay, %silt and %sand) against the soil grain-size ternary plot designed by The National Soil Resources Institute (Hodgson, 1997). The classifications are based on analyses of archive G-BASE and geotechnical samples held by BGS, as well as expert judgment (where sample data is not available). Note that the map uses terms that refer to: Sandy soils, Silty soils, Clayey soils and Loamy soils with additional indicators for the presence of Chalk fragments (Chalky) and Peat (Peaty). Many parent materials are heterolithic and so can generate a broad range of particle sizes that may exhibit bimodal soil textures (i.e. a parent comprising sand beds and clay beds can locally generate soils of sand-dominant or clay-dominant textures, as well as a mixed sand/clay texture group) so these groupings should be regarded as 'indicative'. The 'Varied, Locally Peaty' classification denotes variably textured soils that are typically found in alluvial systems. The Soil texture descriptions are defined as follows:

Table 7 Soil texture

	Definition
Clay	Soil is generally dominated by clay grade particles (< 0.002mm dia)
Silt	Soil is generally dominated by silt grade particles (0.002mm < 0.06mm dia)
Sand	Soil is generally dominated by sand grade particles (0.06mm <2.0mm dia)
Loam	Loam soils are soils with a distributed/even mix of particle sizes
Peat	**Not** a texture term, but defines areas dominated by Peat materials
Moderators	
Clayey-	This terms indicates that the dominant/ typical texture is moderated by a component of clay particles
Silty-	This terms indicates that the dominant/ typical texture is moderated by a component of clay particles
Sandy-	This terms indicates that the dominant/ typical texture is moderated by a component of clay particles
Peaty-	This terms indicates that the dominant/ typical texture includes a component of Peat
Chalky-	This terms indicates that the dominant/ typical texture includes a component of Chalk (as sand grade or gravel-grade fragments)

3.3.8 Soil susceptibility to erosion (WATER_ERZ)

This is a general classification ***indicative*** of the susceptibility of soils to suffer from water erosion, caused by rainfall running off bare soil in sloping terrain and mechanically removing soil particles (see also soil wash below, which is simply the effect of water running off soil, rather than infiltrating). It is derived from the soil texture data in BGS Parent Material V6 and a calculation of slope from the Ordnance Survey Terrain 50 dataset. Soil erosion is a natural phenomenon. The risk of erosion by water occurs wherever heavy or prolonged rainfall falls on bare soils. The resistance of soil to erosion is largely determined by soil texture. Soils with a high sand or silt content are the most vulnerable. Soils with a higher clay content generally have more stable soil aggregates. Soil organic matter also influences aggregate stability by binding soil particles together. Rainfall that runs off across bare soils on slopes can detach and transport soil particles and begin to scour the soil surface. This scouring results in shallow channels, or 'rills', developing down the slope. They very often form in tramlines or wheelings, where soil infiltration rates are reduced by compaction. The categories used in this data reflect those previously published in Rural Development Service guidance on managing soil erosion risk (DEFRA 2005) and are based on the factor-matrix given in Table 8.

Please note that current DEFRA guidance for erosion uses a more empirical approach to defining potential soil erosion features (rather than previous attempts to categorise slope and texture combinations). Users should refer to the latest documentation (e.g. DEFRA 2019) and only use UKSO maps as indicative of previous models/findings.

Table 8 Factors influencing bare-soil erosion

Texture	Steep slopes >7°	Moderate slopes 7°- 3°	Gentle slopes 3°- 1°	Level <1°
Sand rich	Very high	High	Moderate	Low-moderate
Silt rich	Very high	High	Moderate	Low-moderate
Sand/Silt 'loams'	Very high	High	Moderate	Low
Sand/Silt 'loams' **with** clay components	High	Moderate	Low	Low
Other mineral soils	Low	Low	Low	Low

These factors create the following categories:

Table 9 Bare soil erosion classes

WATER_ERZ	Description
Very high	Very high. Rills likely to form most seasons and gullies form in very wet periods
High	High. Rills likely to form during very wet periods. Sediment seen in run-off
Moderate	Moderate. Rills may form during very wet periods. Sediment seen in run-off
Low-moderate	Low-moderate. Rarely rills may form during very wet periods. Sediment seen in run-off
Low	Low. Sediment rarely seen to move, but be aware of soil run-off
NA	Not applicable

3.3.9 Soil susceptibility to soil-wash (SOIL_WASH)

This is a general classification of the susceptibility of rainfall to run-off soils (also known as soil wash), caused by rainfall running off bare soil in sloping terrain (soil wash may pick up chemical contaminants, but is not soil erosion, see above for soil erosion). It is derived from a calculation of slope from the Ordnance Survey Terrain 50 dataset. Soil run-off/wash is a natural phenomenon that occurs wherever heavy or prolonged rainfall falls on bare soils on slopes. Rainfall that runs off across bare soils on slopes can detach and transport soil particles and begin to scour the soil surface or transport residues from pesticides or fertilisers. Run-off will exploit areas of tramlines or wheelings, where soil infiltration rates are reduced by compaction. The factors used in this data are shown in

, and reflect those previously published in DEFRA guidance on managing soil erosion risk (DEFRA 2005). *Please note that current DEFRA guidance for issues concerning run-off uses a more holistic approach to defining potential run-off zones (rather than previous attempts to categorise slope). Users should refer to the latest documentation (e.g. DEFRA 2019) and only use UKSO maps as indicative of previous models/findings.*

Table 10 Factors influencing bare-soil run off

Soil textures	Steep slopes >7°	Moderate slopes 7°- 3°	Gentle slopes 3°- 1°	Level <1°
ANY	HIGH	MEDIUM	LOW	LOW

These factors create the following classes used in the Soil Parent Material dataset:

Table 11 Bare soil run off classes

SOIL_WASH	Description
High	Run off seen in most years during wet periods
Moderate	Run off seen in some years during wet periods
Low	Run off seen in some years during VERY wet periods

3.3.10 Soil susceptibility to wind erosion (WIND_ERZ)

This is a general classification of the susceptibility of soils to suffer from wind blow (wind-erosion or deflation), caused by moderate wind speeds lifting soil particles of certain grainsizes (generally fine sand and silt). The determination of whether a soil is susceptible to wind erosion is made from expert judgment of the soil texture data in the BGS Parent Material V6 (e.g. identifying soils with susceptible grain size components, and/or soils whose parent origin may have included an aeolian component in their formation). Soil wind erosion is a natural phenomenon. The risk of erosion by wind occurs wherever persistent wind speed (and generally dry surface conditions) interact with bare soils (particularly in exposed areas). The resistance of soil to wind erosion is largely determined by soil texture. Soils with a high fine-sand or silt content are the most vulnerable. Soils with a higher clay content generally have more stable soil aggregates. Soils with very-high organic components (e.g. Peat) are also susceptible to wind erosion if they become desiccated. Wind erosion can be seen as low level dust clouds and whilst generally a summer/autumn issue, can also occur during cold periods (where soil-surface desiccation has occurred due to evapotranspiration). The classes used in this data reflect the particulate nature and origin of the underlying parent materials. *Users should refer to the latest documentation for countryside stewardship when assessing their farms and identifying soils at risk of wind erosion* (e.g. DEFRA 2019) and only use this UKSO map as indicative of wind erosion susceptibility.

Table 12 Bare soil wind erosion classes

WIND_ERZ	Definition
Soil is very prone to wind erosion	Silt and sand dominant soils with substrates of Aeolian origin
Soil is prone to wind erosion	Silt and Sand dominant soils
Soil may be prone to wind erosion	Generally soils with minor silt or sand (e.g loams)
Soil is not prone to wind erosion	Generally clayey soils
Not applicable	Areas of non susceptible bedrock or water

3.3.11 PMM_UID

This field uniquely identifies each object in the map. It is used for auditing and identification purposes.

3.4 DATA FORMAT

The Parent Material dataset has been created as vector polygons and are available in ESRI shapefile (.shp) format. More specialised formats may be available but may incur additional processing costs. Please email BGS the digital data team (digitadata@bgs.ac.uk) to request further information.

3.5 DATASET HISTORY

This is version 6.1 of the BGS Soil Parent Material Dataset. It includes a subset of information created for the original Soil Parent Material Dataset (V6), and was released in order to provide corrections and limited new information up to December 2018. This version of the dataset also includes a ‘slope classified’ model of the Ordnance Survey Terrain 50 elevation dataset. The

slope data enables the bare-soil water-erosion, soil run-off and bare-soil wind-erosion susceptibility information to be portrayed within the dataset.

This version was released to update the Soil Parent Material Web Map Services available on www.ukso.org .

This release (2019): BGS Parent Material Map V6.1.

First release (2010): BGS Parent Material Map V6.

3.6 DISPLAYING THE DATA

The data can be displayed in most geographic information systems as a coverage of polygons. The dataset is supplied with an excel spreadsheet (and CSV file), with recommended styling options. The recommended colouration (as applied to the layers visible on the www.UKSO.org portal) is also shown in Appendix 2.

3.7 CITING THE DATA

If using extracts of the dataset in reports (e.g. as images), all content should be acknowledged as follows:

"Contains British Geological Survey materials © UKRI 2021."

If the extracts of the dataset include the bare-soil water erosion, or bare-soil run-off attributes, then the acknowledgements should include the following additional text:

"All OS Terrain 50 images are derived from Ordnance Survey data © Crown Copyright and database right 2021".

4 Limitations

4.1 DATA CONTENT

The Soil Parent Material has been developed to be used at a scale of 1:50 000 scale (i.e. 50 m). All spatial searches against the data should consider the limitations of making spatial comparison at the working scale in use at the time.

Local conditions may vary and this dataset should not replace detailed site investigations. Further detail of the geology or parent material may be available on more detailed 1:10 000 scale geological maps.

The spatial distribution of the data is limited by the spatial accuracy and resolution of the underpinning digital geological map data (DiGMapGB-50 V6). Spatial mismatches of parent material related to mismatches in lithology type (i.e. variation in LEX_RCS across map-sheet boundaries) are unavoidable, and require resolution by reference to higher resolution map information. Further detail of the geology or parent material may be available on more detailed 1:10 000 scale or 1:50 000 scale geological maps.

The Soil Parent Material dataset is concerned with the properties and potential use of NATURAL geological deposits and conditions only. It does NOT cover any man-made constructions or materials.

The Soil Parent Material dataset is based on, and limited to, an interpretation of the records in the possession of The British Geological Survey at the time the dataset was created.

An indication of the typical characteristics of a rock or soil does not necessarily mean that the properties are consistent throughout the material. Such an assessment can only be made by inspection of the area by a qualified professional.

4.2 SCALE

The data is delivered at 1: 50 000 scale, where 1 map unit equates to 50 equivalent units on the ground (e.g. 1mm on the map face = 50 000 mm on the ground).

4.3 ACCURACY AND UNCERTAINTY

The mapping accuracy associated with the soil parent material dataset is nominally 1 mm which equates to 50 m on the ground at 1:50 000 map scale. This is only a measure of how faithfully the lines have been captured from the underpinning source datasets, and are not a measure of the accuracy/uncertainty of the physical boundaries between soils and parent material types (who boundaries are likely to be diffuse over real scales). Consequently, users are advised not use this dataset at viewing scales finer than 1:50 000. All susceptibility classifications are based on interpretation (of previous government guidance for managing soils) for which no explicit uncertainty is provided.

4.4 ARTEFACTS

The dataset represents data acquired from surveys of geology and terrain from different times and origins. Furthermore, the data have been combined using arrange of expert judgement and standard methods available within GIS software. This can result in some spatial artefacts being present within the data. Users should regards the dataset to be representing indicative information, rather than absolute values/statements of processes or metrics.

4.5 DISCLAIMER

The use of any information provided by the British Geological Survey ('BGS') is at your own risk. Neither BGS nor the Natural Environment Research Council or UK Research and Innovation (UKRI) gives any warranty, condition or representation as to the quality, accuracy or completeness of the information or its suitability for any use or purpose. All implied conditions relating to the quality or suitability of the information, and all liabilities arising from the supply of the information (including any liability arising in negligence) are excluded to the fullest extent permitted by law. No advice or information given by BGS, NERC or their respective employees or authorised agents shall create a warranty, condition or representation as to the quality, accuracy or completeness of the information or its suitability for any use or purpose.

5 Frequently Asked Questions

The questions and answers below have been provided to address any potential issues relating to how the product can be used or how it can be interpreted. If you have any additional questions, please contact digitadata@bgs.ac.uk

Q: What does this dataset show?

A: A digital representation of soil and subsoil characteristics suitable for use within mapping software (such as GIS).

Q: What scale are these data provided at?

A: The data are provided for use at approximately 1:50 000 scale

Q: How accurate is this dataset?

A: The data has been captured from paper mapping at 1:50 000 scale. The quality of capture is estimated to provide +/- 1mm of cartographic accuracy (which represents +/- 50m of accuracy at true scale).

Users should be aware that parent-material maps are a compilation of observed and inferred features found on geology maps. It is not possible to provide a consistent level of accuracy for all objects in a soil/parent material map.

Q: How often will this dataset be updated?

A: The dataset is subject to ongoing continuous revision, whereby parts of the map are updated as and when further information becomes available to require a map alteration. There is not a specific timetable for all parts of the map. Users can contact digitadata@bgs.ac.uk if they wish to confirm if any new information is available for specific locations since publication date of the digital dataset.

Q: In what formats can these data be provided?

A: The data are provided in a range of vector formats suitable for geographic information systems. Typically, BGS provides this data in ESRI 'shp' and MapInfo 'tab' formats, with additional supporting files to enable use in QGIS and other GIS platforms. Additionally some original paper maps are available separately as raster scanned images.

Q: What is the difference between this data and that shown in the www.ukso.org web portal and mySoil app?

A: The UKSO and mySoil platforms show a facsimile of this dataset (as a Web Map Service). The online services provide an open licence alternative service to this licenced vector-download dataset.

Q: What do I do if I think I have spotted an error in the data?

A: Please contact digitaldata@bgs.ac.uk to let us know and discuss the issue with you.

Q: Can I use this dataset as part of a commercial application?

A: This dataset is licenced from BGS, please refer to the terms of your licence or contact digitadata@bgs.ac.uk for further information.

Glossary

Jargon Term	Description
ArcGIS	Geographic information system (GIS) software for working with maps and geographic information maintained by the Environmental Systems Research Institute (ESRI).
ESRI	Environmental Systems Research Institute (ESRI) is an international supplier of geographic information system (GIS) software, web GIS and geodatabase management applications.
soil	A weathered layer of materials, comprising a mixture of organic matter, minerals, gases, liquids, and organisms. An active layer that is used to grow food and fibre.
Parent Material	The mineral substrate to soils. A weathered layer of geological materials from which soil form
Polygon	Polygons are a representation of areas. A polygon is defined as a closed line or perimeter completely enclosing a contiguous space and is made up of one or more links.
Scale	The relation between the dimensions of features on a map and the geographic objects they represent on the earth, commonly expressed as a fraction or a ratio. A map scale of 1/100,000 or 1:100,000 means that one unit of measure on the map equals 100,000 on the earth.
Shapefile	The shapefile format is a geospatial vector data format for geographic information system software. It is developed and regulated by ESRI as a mostly open specification for data interoperability among ESRI and other GIS software products.
Source data	Source data is raw data (sometimes called atomic data) that has not been processed for meaningful use to become Information.
Spatial data	Data describing anything with spatial extent; i.e. size, shape or position. In addition to describing things that are positioned relative to the Earth, spatial data may also describe things using other coordinate systems that are not related to position on the Earth, such as the size, shape and positions of cellular and sub-cellular Spatial Things described using the 2D or 3D Cartesian coordinate system of a specific tissue sample.

References

British Geological Survey holds most of the references listed below, and copies may be obtained via the library service subject to copyright legislation (contact libuser@bgs.ac.uk for details). The library catalogue is available at: http://geolib.bgs.ac.uk.

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Appendix 1

European Soil Bureau Descriptions of Parent Materials

Major Class	Group		Type		Subtype	
100 Consolidated clastic sedimentary rocks	110	psephite or rudite	111	conglomerate	1111	pudding stone
			112	breccia		
	120	psammite	121	sandstone	1211	calcareous sandstone
		arenite				
					1212	ferruginous sandstone
					1213	clayey sandstone
					1214	quartzitic sandstone / orthoquartzite
					1215	micaceous sandstone
					1216	feldspathic sandstone
			122	arkose		
			123	greywacke	1231	feldspathic greywacke
	130	pelite, agillite lutite	131 132	claystone/ mudstone siltstone	1311 1312	kaolinite bentonite
	140	facies rocks bound	141 142	flysch molasse	1411 1412 1413	sandy flysch clayey and silty flysch conglomeratic flysch
200 Sedimentary rocks (chemically precipitated, evaporated, or of organogenic or biogenic origin)	210	calcareous rocks	211	limestone	2111 2112 2113 2114 2115 2116	hard limestone soft limestone marly limestone chalky limestone detrital limestone carbonaceous limestone
					2117	lacustrine or
						freshwater limestone
					2118	travertine / calcareous sinter
					2119	cavernous limestone
			212	dolomite	2121	cavernous dolomite
					2122	calcareous dolomite
			213	marlstone		
			214	marl	2141 2142	chalk marl gypsiferous marl
			215	chalk		
	220	evaporites	221 222 223	gypsum anhydrite halite		
	230	siliceous rocks	231	chert, hornstone,		
				flint		
			232	diatomite / radiolarite		
300 Igneous rocks	310	acid to intermediate plutonic rocks	311 312 313 314	granite granodiorite diorite syenite	3131 3132	quartz diorite gabbro diorite
	320	basic plutonic rocks	321	gabbro		

	330	ultrabasic plutonic rocks	331 332	peridotite pyroxenite		
	340	acid to intermediate volcanic rocks	341 342	rhyolite dacite	3411 3412	obsidian quartz porphyrite
			343 344 345	andesite phonolite trachyte	3431 3441	porphyrite (interm.) tephritic phonolite
	350	basic to ultrabasic	351	basalt		
		volcanic rocks	352	diabase		
			353	pikrite		
	360	dike rocks	361 362 363	aplite pegmatite lamprophyre		
	370	pyroclastic rocks (tephra)	371	tuff / tuffstone	3711 3712 3713	agglomoratic tuff block tuff lapilli tuff
			372 373 374	tuffite volcanic scoria volcanic breccia	3721 3722 3723	sandy tuffite silty tuffite clayey tuffite
			375	volcanic ash		
			376	ignimbrite pumice		
400 Metamorphic rocks	410	weakly metamorphic rocks	411 412	(meta-)shale / argillite slate	4121	graphitic slate
	420	acid regional metamorphic rocks	421 422 423	(meta-)quartzite phyllite mica schist	4211	quartzite schist
			424 425 426	gneiss granulite (sensu stricto) migmatite		
	430	basic regional metamorphic rocks	431	greenschist	4311 4312 4313	prasinite chlorite schist talc schist
			432 433	amphibolite eclogite		
	440	ultrabasic regional metamorphic rocks	441	serpentinite	4411	greenstone
	450	calcareous	451	marble		
		regional metamorphic rocks	452	calcschist, skarn		
	460	rocks formed by contact	461 462	contact slate hornfels	4611	nodular slate
		metamorphism	463	calcsilicate rocks		
	470	tectogenetic metamorphic rocks or cataclastic	471 472 473	tectonic breccia cataclasite mylonite		
		metamorphism				
500 Unconsolidated deposits (alluvium, weathering residuum and	510	marine and estuarine sands	511 512	pre-Quaternary sand Quaternary sand	5111 5121 5122	Tertiary sand Holocene coastal sand with shells delta sand

Slope deposits)	520	marine and estuarine clays and silts	521 522	pre-Quaternary clay and silt Quaternary clay and silt	5211 5212 5221 5222	Tertiary clay Tertiary silt Holocene clay Holocene silt
	530	fluvial sands and	531	river terrace sand	5311	river terrace sand
		gravels	532	or gravel flood plain sand or gravel	5312 5321 5322	river terrace gravel flood plain sand flood plain gravel
	540	fluvial clays, silts and loams	541	river clay and silt	5411 5412	terrace clay and silt terrace loam
					5413	floodplain clay and silt
			542	river loam		
			543	overbank deposits	5431	floodplain clay and silt
					5432	floodplain loam
	550	lake deposits	551	lake sand and		
				delta sand		
			552	lake marl, bog		
				lime		
			553	lake silt		
	560	residual and	561	residual loam	5611	stony loam
		redeposited loams			5612	clayey loam
		from silicate	562	redeposited loam	5621	running-ground
		rocks				
	570	residual and	571	residual clay	5711	clay with flints
		redeposited clays			5712	ferruginous residual
		from calcareous				clay
		rocks			5713	calcareous clay
					5714	non-calcareous clay
					5715	marly clay
			572	redeposited clay	5721	stony clay
	580	slope deposits	581	slope-wash		
				alluvium		
			582	colluvial deposits		
			583	talus scree	5831	stratified slope
						deposit
600 Unconsolidated glacial deposits / glacial drift	610	morainic deposits	611	glacial till	6111	boulder clay
			612	glacial debris		
	620	glaciofluvial	621	outwash sand,		
		deposits		glacial sand		
			622	outwash gravel,		
				glacial gravel		
	630	glacio-lacustrine	631	varves		
		deposits				
700 Eolian deposits	710	loess	711	loamy loess		
			712	sandy loess		

	720	Aeolian sands	721	dune sand		
			722	cover sand		
800 Organic materials	810	peat (mires)	811	rainwater fed	8111	folic peat
				moor peat (raised	8112	fibric peat
				bog)	8113	terric peat
			812	groundwater fed		
				bog peat		
	820	slime and ooze	821	gyttja, sapropel		
		deposits				
	830	Carbonaceous	831	lignite (brown		
		rocks		coal)		
		(caustobiolite)	832	hard coal		
			833	anthracite		
900 Anthropogenic deposits	910	redeposited	911	sand and gravel		
		natural materials		fill		
			912	loamy fill		
	920	dump deposits	921	rubble / rubbish		
			922	industrial ashes		
				and slag		
			923	industrial sludge		
			924	industrial waste		
	930	organic materials				

Appendix 2

The styles shown below demonstrate those used in the UKSO map portal for each of the main attributes.

GEN_GRAIN	RED	GREEN	BLUE	HEX	LOOKS LIKE
RUDACEOUS	205	245	122	CDF57A	
ARENACEOUS - RUDACEOUS	245	245	122	F5F57A	
ARENACEOUS	245	202	122	F5CA7A	
ARGILLIC - ARENACEOUS	245	162	122	F5A27A	
ARGILLIC	205	102	102	CD6666	
ARGILLACEOUS	205	102	102	CD6666	
COARSE	233	255	190	E9FFBE	
MEDIUM	255	235	175	FFEBAF	
FINE	255	190	190	FFBEBE	
MIXED (ARENACEOUS – RUDACEOUS)	245	245	122	F5F57A	
MIXED (ARGILLIC – RUDACEOUS)	215	194	158	D7C29E	
MIXED (ARGILLIC – ARENACEOUS)	245	162	122	F5A27A	
PEAT	170	102	205	AA66CD	
NA	190	232	255	BEE8FF	

SOIL GROUP	LEGEND TEXT	R	G	B	HEX	LOOKS LIKE
LIGHT	LIGHTEST SOILS	255	255	190	FFFFBE	
LIGHT(SILTY)	LIGHTEST SOILS	255	255	190	FFFFBE	
LIGHT(SANDY)	LIGHTEST SOILS	255	255	190	FFFFBE	
LIGHT(SANDY) TO MEDIUM(SANDY)	LIGHTEST SOILS	255	255	190	FFFFBE	
MEDIUM AND/TO LIGHT	MEDIUM AND/TO LIGHT	255	235	190	FFEBBE	
MEDIUM TO LIGHT (SILTY)	MEDIUM AND/TO LIGHT	255	34	0	FF2200	
LIGHT TO MEDIUM	MEDIUM AND/TO LIGHT	255	34	0	FF2200	
MEDIUM TO LIGHT	MEDIUM AND/TO LIGHT	255	34	0	FF2200	
LIGHT(SILTY) TO MEDIUM(SILTY)	MEDIUM AND/TO LIGHT	255	34	0	FF2200	
LIGHT(SILTY) TO MEDIUM(SILTY) TO HEAVY	MEDIUM AND/TO LIGHT	255	34	0	FF2200	
MEDIUM	MEDIUM	215	194	158	D7C29E	
MEDIUM(SILTY)	MEDIUM	215	194	158	D7C29E	
MEDIUM(SILTY) TO LIGHT(SILTY)	MEDIUM	215	194	158	D7C29E	
LIGHT AND MEDIUM	MEDIUM	215	194	158	D7C29E	
MEDIUM(SILTY) TO LIGHT(SILTY) TO HEAVY	MEDIUM AND/TO HEAVY	215	176	158	D7B09E	
MEDIUM TO LIGHT(SILTY) TO HEAVY	MEDIUM AND/TO HEAVY	215	176	158	D7B09E	
MEDIUM TO HEAVY	MEDIUM AND/TO HEAVY	215	176	158	D7B09E	
MEDIUM(SILTY) TO HEAVY	HEAVIEST SOILS	215	158	158	D79E9E	
HEAVY TO MEDIUM	HEAVIEST SOILS	215	158	158	D79E9E	
HEAVY TO MEDIUM TO LIGHT(SILTY)	HEAVIEST SOILS	215	158	158	D79E9E	
HEAVY TO MEDIUM(SANDY) TO LIGHT(SANDY)	HEAVIEST SOILS	215	158	158	D79E9E	
HEAVY AND MEDIUM	HEAVIEST SOILS	215	158	158	D79E9E	
HEAVY	HEAVIEST SOILS	215	158	158	D79E9E	
HEAVY AND MEDIUM TO LIGHT(SILTY	HEAVIEST SOILS	215	158	158	D79E9E	
ALL	MIXED or ORGANIC	204	204	204	CCCCCC	
NA (typically water)	na	190	232	255	BEE8FF	

SOIL DEPTH	RED	GREEN	BLUE	HEX	LOOKS LIKE
NA	255	255	255	E81515	
SHALLOW	255	255	190	FFFFFF	
INTERMEDIATE-SHALLOW	245	245	122	FFFFBE	
INTERMEDIATE	199	215	158	F5F57A	
DEEP-INTERMEDIATE	180	215	158	C7D79E	
DEEP	137	205	102	B4D79E	

CaCO3_RANK	RED	GREEN	BLUE	HEX	LOOKS LIKE
High	115	178	255	73B2FF	
Variable(high)	115	223	255	73DFFF	
Mod	163	255	115	A3FF73	
Variable	209	255	115	D1FF73	
Variable(low)	255	255	115	FFFF73	
Low	255	211	127	FFD37F	
None	225	225	225	E1E1E1	
Unknown	255	255	255	FFFFFF	
Not applicable	255	255	255	FFFFFF	

SOIL DEPTH	RED	GREEN	BLUE	HEX	LOOKS LIKE
CHALKY CLAY TO CHALKY LOAM	255	170	0	FFAA00	
CHALKY, SANDY LOAM	255	211	127	FFD37F	
CHALKY, SILTY LOAM	255	235	175	FFEBAF	
CLAY TO CHALKY CLAY	215	187	187	D79E9E	
CLAY TO CLAYEY LOAM	215	158	158	D79E9E	
CLAY TO LOAM	215	158	158	D79E9E	
CLAY TO SANDY LOAM	215	194	158	D7C29E	
CLAY TO SILT	205	164	103	CD8966	
CLAYEY LOAM	215	194	158	D7C29E	
CLAYEY LOAM TO SANDY LOAM	245	202	122	F5CA7A	
CLAYEY LOAM TO SILTY LOAM	215	176	158	D7B09E	
CLAYEY LOAM, LOCALLY CHALKY	215	194	158	D7C29E	
LOAM	205	205	102	CDCD66	
LOAM TO CLAYEY LOAM	215	176	158	D7B09E	
LOAM TO CLAYEY LOAM, LOCALLY CHALKY	215	176	187	D7B09E	
LOAM TO SANDY LOAM	245	245	122	F5F57A	
LOAM TO SILTY	180	215	158	B4D79E	
LOAM TO SILTY LOAM	180	215	158	B4D79E	
NA	255	255	255	FFFFFF	
PEAT	202	122	245	CA7AF5	
PEAT AND PEATY CLAY OR SILT	170	102	205	AA66CD	
PEAT AND PEATY SILT OR SAND	194	158	220	C29EDC	
PEATY CLAY	170	102	205	AA66CD	
PEATY CLAY OR SILT	170	102	205	AA66CD	
PEATY SILT	194	158	215	C29ED7	
SAND	255	255	115	FFFF73	
SAND TO LOAM	245	245	122	F5F57A	
SAND TO SANDY LOAM	255	255	117	FFFF75	
SAND TO SILT	233	255	190	E9FFBE	
SANDY LOAM	245	245	122	F5F57A	
SANDY LOAM TO CLAYEY LOAM	245	202	122	F5CA7A	
SANDY LOAM TO LOAM	245	245	122	F5F57A	
SANDY LOAM TO SAND	255	255	115	FFFF73	
SANDY LOAM TO SILTY LOAM	233	255	190	E9FFBE	
SILT TO SAND	158	215	194	9ED7C2	
SILT TO SILTY LOAM	180	215	158	B4D79E	
SILTY LOAM	185	215	158	B9D79E	
SILTY LOAM TO SANDY LOAM	165	245	122	A5F57A	
SILTY LOAM TO SILT	158	215	194	9ED7C2	
VARIED, LOCALLY PEATY	214	157	188	D69DBC	

WATER_ERZ	RED	GREEN	BLUE	HEX	LOOKS LIKE
NA	84	174	179	54AEB3	
Low	0	97	0	006100	
Low-moderate	122	171	0	7AAB00	
Moderate	255	255	0	FFFF00	
High	255	153	0	FF9900	
Very high	255	34	0	FF2200	

WIND_ERZ	RED	GREEN	BLUE	HEX	LOOKS LIKE
NA	151	219	242	97DBF2	
Soil is not prone to wind erosion	40	146	199	2892C7	
Soil may be prone to wind erosion	191	212	138	BFD48A	
Soil is prone to wind erosion	252	179	68	FCB344	
Soil is very prone to wind erosion	232	21	21	E81515	

SOIL_WASH	RED	GREEN	BLUE	HEX	LOOKS LIKE
NA	84	174	179	54AEB3	
Low	122	171	0	7AAB00	
Moderate	255	255	0	FFFF00	
High	255	34	0	FF2200	

ESB_DESC	R	G	B	Hex	LOOKS LIKE
CLASTIC ROCKS	203	127	127	CB7F7F	
CLASTIC ROCKS WITH CHEMICALLY PRECIPITATED ROCKS	203	127	127	CB7F7F	
CLASTIC ROCKS WITH LIMESTONE	203	127	127	CB7F7F	
CLASTIC ROCKS WITH DOLOMITE	203	127	127	CB7F7F	
CLASTIC ROCKS WITH PLUTONIC BASIC ROCKS	203	127	127	CB7F7F	
CLASTIC ROCKS WITH TUFFS	203	127	127	CB7F7F	
CLASTIC ROCKS WITH METAMORPHIC ROCKS	203	127	127	CB7F7F	
CLASTIC ROCKS WITH CALCEREOUS METAMORPHIC ROCKS	203	127	127	CB7F7F	
CLASTIC ROCKS WITH CALCSILICATE ROCKS	203	127	127	CB7F7F	
PSEPHITE OR RUDITE	178	178	152	B2B298	
BRECCIA	127	76	76	7F4C4C	
CONGLOMERATE	127	76	76	7F4C4C	
CONGLOMERATE AND SANDSTONE	127	76	76	7F4C4C	
BRECCIA AND SANDSTONE	127	76	76	7F4C4C	
PSAMMITE OR ARENITE	203	236	236	CBECEC	
PSAMMITE AND CALCSILICATE ROCKS	203	236	236	CBECEC	
CLAYEY SANDSTONE	178	152	0	B29800	
QUARTZITIIC SANDSTONE/ORTHOQUARTZITE	203	127	0	CB7F00	
CALCAREOUS SANDSTONE	203	203	0	CBCB00	
SANDSTONE	218	218	0	DADA00	
SANDSTONE AND CONGLOMERATE	218	218	0	DADA00	
SANDSTONE AND BRECCIA	218	218	0	DADA00	
SANDSTONE AND FERRUGINOUS SANDSTONE	218	218	0	DADA00	
SANDSTONE AND MUDSTONE	218	218	0	DADA00	
SANDSTONE AND MUDSTONE	218	218	0	DADA00	
SANDSTONE AND GYPSUM	218	218	0	DADA00	
ARKOSE	218	127	76	DA7F4C	
GREYWACKE	218	127	76	DA7F4C	
PELITE, ARGILLITE OR LUTITE (MUDROCKS)	254	178	127	FEB27F	
MUDSTONE AND CONGLOMERATE	254	178	127	FEB27F	
MUDSTONE AND BRECCIA	254	178	127	FEB27F	
MUDSTONE AND DOLOMITE	254	178	127	FEB27F	
MUDSTONE AND METAMORPHIC ROCKS	254	178	127	FEB27F	
MUDSTONE AND REGIONAL METAMORPHIC ROCKS ULTRABASIC	254	178	127	FEB27F	
MUDSTONE AND REGIONAL METAMORPHIC ROCKS CALCAREOUS	254	178	127	FEB27F	

MUDSTONE AND CONTACT METAMORPHIC ROCKS	254	178	127	FEB27F
MUDSTONE AND CALCSILICATE ROCKS	254	178	127	FEB27F
CLAYSTONE/MUDSTONE	218	152	127	DA987F
MUDSTONE AND SANDSTONE	218	152	127	DA987F
MUDSTONE AND DOLOMITE	218	152	127	DA987F
MUDSTONE AND TUFF	218	152	127	DA987F
SILTSTONE	178	127	127	B27F7F
SILTSTONE AND LIMESTONE	178	127	127	B27F7F
SILTSTONE AND GYPSUM	178	127	127	B27F7F
SILTSTONE AND HALITE	178	127	127	B27F7F
SILTSTONE AND CHERT	178	127	127	B27F7F
SILTSTONE AND BASALT	178	127	127	B27F7F
SILTSTONE AND TUFF	178	127	127	B27F7F
FACIES BOUND ROCK	254	152	76	FE984C
FLYSCH	178	76	76	B24C4C
MOLASSE	203	178	76	CBB24C
SEDIMENTARY ROCKS (CHEMICAL OR BIOGENIC ORIGIN)	254	236	0	FEEC00
CALCAROUS ROCKS AND CLASTIC ROCKS	254	236	0	FEEC00
CALCAREOUS ROCKS AND SANDSTONE	254	236	0	FEEC00
CALCAREOUS ROCKS AND MUDSTONE	254	236	0	FEEC00
CALCAREOUS ROCKS AND METAMORPHIC ROCKS	254	236	0	FEEC00
CALCAREOUS ROCKS	254	236	0	FEEC00
DETRITAL LIMESTONE	236	178	76	ECB24C
MARLY LIMESTONE	236	203	76	ECCB4C
CHALKY LIMESTONE	254	178	76	FEB24C
SOFT LIMESTONE	254	218	76	FEDA4C
HARD LIMESTONE	254	236	76	FEEC4C
LIMESTONE	254	254	76	FEFE4C
LIMESTONE AND CLASTIC ROCKS	254	254	76	FEFE4C
LIMESTONE AND CONGLOMERATE	254	254	76	FEFE4C
LIMESTONE AND DOLOMITE	254	254	76	FEFE4C
DOLOSTONE	254	254	203	FEFECB
DOLOMITE AND PSAMMITE	254	254	203	FEFECB
DOLOMITE AND SANDSTONE	254	254	203	FEFECB
DOLOMITE AND MUDSTONE	254	254	203	FEFECB
DOLOMITE AND CALCAREOUS ROCKS	254	254	203	FEFECB
DOLOMITE AND LIMESTONE	254	254	203	FEFECB
MARL	254	236	178	FEECB2
GYPSIFEROUS MARL	254	236	203	FEECCB
CHALK	254	254	152	FEFE98
GYPSUM	254	236	203	FEECCB
ANHYDRITE	254	236	203	FEECCB
HALITE	254	236	203	FEECCB
CHERT	254	236	203	FEECCB
ACID TO INTERMEDIATE ROCKS	236	76	152	EC4C98
ACID AND ULTRABASIC PLUTONIC ROCKS	236	76	152	EC4C98
ACID PLUTONIC ROCKS AND TUFF	236	76	152	EC4C98
GRANITE	254	152	178	FE98B2
GRANITE AND GABBRO	254	152	178	FE98B2
GRANODIORITE	254	152	178	FE98B2
GRANODIORITE AND DIORITE	254	152	178	FE98B2
GRANODIORITE AND ANDESITE	254	152	178	FE98B2
DIORITE	254	127	178	FE7FB2
DIORITE AND GRANITE	254	127	178	FE7FB2
DIORITE AND GRANODIORITE	254	127	178	FE7FB2
DIORITE AND SYENITE	254	127	178	FE7FB2
DIORITE AND GABBRO	254	127	178	FE7FB2
DIORITE AND ANDESITE	254	127	178	FE7FB2
DIORITE AND BASIC VOLCANIC ROCKS	254	127	178	FE7FB2
SYENITE	254	127	178	FE7FB2
BASIC PLUTONIC ROCKS	254	0	178	FE00B2
BASIC AND ULTRABASIC PLUTONIC ROCKS	254	0	178	FE00B2
GABBRO	218	0	178	DA00B2
GABBRO AND SANDSTONE	218	0	178	DA00B2
GABBRO AND ULTRABASIC PLUTONIC ROCKS	218	0	178	DA00B2
GABBRO AND BASIC VOLCANIC ROCKS	218	0	178	DA00B2

GABBRO AND BASALT	218	0	178	DA00B2	
ULTRABASIC PLUTONIC ROCKS	254	0	178	FE00B2	
PERIDOTITE	254	0	178	FE00B2	
ACID TO INTERMEDIATE VOLCANIC ROCKS	152	0	203	9800CB	
RHYOLITE	178	76	254	B24CFE	
DACITE	178	76	254	B24CFE	
DACITE AND TUFF	178	76	254	B24CFE	
ANDESITE	203	76	254	CB4CFE	
ANDESITE AND BASALT	203	76	254	CB4CFE	
TRACHYTE	203	76	254	CB4CFE	
BASIC TO ULTRABASIC VOLCANIC ROCKS	218	76	254	DA4CFE	
BASIC TO ULTRABASIC VOLCANIC ROCKS AND CLASTIC ROCKS	218	76	254	DA4CFE	
BASALT	236	76	254	EC4CFE	
BASALT AND SANDSTONE	236	76	254	EC4CFE	
BASALT AND GABBRO	236	76	254	EC4CFE	
BASALT AND ANDESITE	236	76	254	EC4CFE	
BASALT AND TUFF	236	76	254	EC4CFE	
PEGMATITE	236	76	254	EC4CFE	
LAMPROPHYRE	236	76	254	EC4CFE	
PYROCLASTIC ROCKS	254	127	254	FE7FFE	
PYROCLASTIC ROCKS AND SANDSTONE	254	127	254	FE7FFE	
TUFF	254	152	254	FE98FE	
TUFF AND LIMESTONE	254	152	254	FE98FE	
TUFF AND BASALT	254	152	254	FE98FE	
VOLCANIC BRECCIA	254	152	254	FE98FE	
VOLCANIC ASH	254	152	254	FE98FE	
METAMORPHIC ROCKS	254	127	218	FE7FDA	
METAMORPHIC ROCKS AND CALCAREOUS METAMORPHIC ROCKS	254	127	218	FE7FDA	
WEAKLY METAMORPHIC	254	127	218	FE7FDA	
WEAKLY METAMORPHIC ROCKS AND SANDSTONE	254	127	218	FE7FDA	
(META-)SHALE/ARGILITE	254	127	218	FE7FDA	
ARGILLITE-SLATE	254	203	218	FECBDA	
SLATE AND LIMESTONE	254	203	218	FECBDA	
ACID REGIONAL METAMORPHIC ROCKS	254	152	203	FE98CB	
QUARTZITE	254	152	203	FE98CB	
QUARTZITE AND CLASTIC ROCKS	254	152	203	FE98CB	
QUARTZITE AND CONGLOMERATE	254	152	203	FE98CB	
QUARTZITE AND PSAMMITE	254	152	203	FE98CB	
QUARTZITE AND MUDSTONE	254	152	203	FE98CB	
MICA SCHIST	254	178	203	FEB2CB	
SCHIST AND PSAMMITE	254	178	203	FEB2CB	
SCHIST AND GRANITE	254	178	203	FEB2CB	
GNEISS	218	178	203	DAB2CB	
BASIC REGIONAL METAMORPHIC ROCKS	218	178	203	DAB2CB	
GREENSCHIST	218	127	203	DA7FCB	
AMPHIBOLITE	218	127	203	DA7FCB	
SERPENTINITE	218	76	178	DA4CB2	
SERPENTINITE AND GABBRO	218	76	178	DA4CB2	
CALCAREOUS REGIONAL METAMORPHIC ROCKS	218	0	218	DA00DA	
CALCAREOUS METAMORPHIC ROCKS AND CLASTIC ROCKS	218	0	218	DA00DA	
CALCAREOUS METAMORPHIC ROCKS AND MUDSTONES	218	0	218	DA00DA	
CALCAREOUS METAMORPHIC ROCKS AND CALCSILICATES	218	0	218	DA00DA	
CONTACT METAMORPHIC ROCKS	218	0	218	DA00DA	
CONTACT METAMORPHIC ROCKS AND QUARTZITE	218	0	218	DA00DA	
HORNFELS	218	0	218	DA00DA	
CALCSILICATE	218	0	218	DA00DA	
CALCSILCATES AND PSAMMITE	218	0	218	DA00DA	
CALCSILICATES AND MUDSTONES	218	0	218	DA00DA	
CALCSILICATES AND TUFF	218	0	218	DA00DA	
CALCSILICATES AND CALCAREOUS METAMORPHC ROCKS	218	0	218	DA00DA	
TECTOGENETIC METAMORPHISM ROCKS OR CATACLASMIC METAMORPHISM	178	76	218	B24CDA	
TECTONIC BRECCIA	178	76	218	B24CDA	
MYLONITE	178	76	218	B24CDA	

UNCONSOLIDATED FLUVIAL DEPOSITS	203	254	0	CBFE00
UNCONSOLIDATED FLUVIAL AND GLACIGENIC DEPOSITS	203	254	0	CBFE00
MARINE AND ESTUARINE SANDS	236	254	178	ECFEB2
MARINE AND ESTUARINE SANDS AND SILTS	236	254	178	ECFEB2
PREQUATERNARY MARINE/ESTUARINE SAND	236	254	178	ECFEB2
PREQUATERNARY MARINE/ESTUARINE SAND AND SILT	236	254	178	ECFEB2
QUATERNARY MARINE/ESTUARINE SAND	0	254	254	00FEFE
QUATERNARY MARINE/ESTUARINE SAND AND SILT	0	254	254	00FEFE
MARINE AND ESTUARINE CLAYS AND SILTS	218	254	152	DAFE98
TERTIARY CLAY	254	178	127	FEB27F
PREQUATERNARY MARINE/ESTUARINE CLAY/SILT	254	203	152	FECB98
PREQUATERNARY MARINE/ESTUARINE SAND AND SILT	254	203	152	FECB98
QUATERNARY MARINE/ESTUARINE CLAY/SILT	254	178	76	FEB24C
QUATERNARY MARINE/ESTUARINE SAND AND SILT	254	178	76	FEB24C
FLUVIAL SANDS AND GRAVELS	218	254	203	DAFECB
FLUVIAL CLAYS, SILTS SANDS AND GRAVEL	203	254	76	CBFE4C
RIVER TERRACE SAND/GRAVEL	203	254	203	CBFECB
RIVER TERRACE SAND/GRAVEL	203	254	203	CBFECB
RIVER TERRACE SAND/GRAVEL	203	254	203	CBFECB
FLOODPLAIN SAND/GRAVEL	203	254	203	CBFECB
FLOODPLAIN CLAY, SAND/GRAVEL	203	254	76	CBFE4C
FLUVIAL CLAYS AND SILTS	203	254	76	CBFE4C
FLUVIAL CLAYS, SILTS SANDS AND GRAVEL	203	254	76	CBFE4C
RIVER CLAY AND SILT	152	254	0	98FE00
RIVERINE CLAY AND FLUVIAL SANDS AND GRAVEL	152	254	0	98FE00
RIVERINE CLAY AND FLOODPLAIN SANDS AND GRAVEL	152	254	0	98FE00
TERRACE CLAY AND LOAMY LOESS	152	254	0	98FE00
RIVER LOAM	178	254	76	B2FE4C
OVERBANK DEPOSITS	203	254	127	CBFE7F
LAKE DEPOSITS	203	254	178	CBFEB2
LAKE SAND	203	254	178	CBFEB2
LACUSTRINE SAND AND SILT	203	254	178	CBFEB2
LAKE SILT	203	254	178	CBFEB2
RESIDUAL AND REDEPOSITED LOAMS FROM SILICATE ROCKS	203	236	236	CBECEC
RESIDUAL LOAM	218	152	127	DA987F
STONY LOAM	218	178	127	DAB27F
CLAYEY LOAM	218	203	127	DACB7F
RESIDUAL AND REDEPOSITED CLAYS FROM CALCAREOUS ROCKS	254	236	0	FEEC00
CALCAREOUS CLAY	218	203	0	DACB00
FERRUGINOUS RESIDUAL CLAY	236	203	0	ECCB00
RESIDUAL CLAY	254	203	0	FECB00
RESIDUAL CLAY	254	203	76	FECB4C
RESIDUAL CLAY AND LOAMY LOESS	254	203	76	FECB4C
STONY CLAY	254	152	0	FE9800
SLOPE DEPOSITS	254	218	203	FEDACB
COLLUVIUM	254	218	178	FEDAB2
TALUS	254	218	203	FEDACB
UNCONSOLIDATED GLACIAL DEPOSITS	152	203	254	98CBFE
MORAINIC DEPOSITS	127	254	254	7FFEFE
MORANIC AND GLACIOFLUVIAL DEPOSITS	127	254	254	7FFEFE
GLACIAL TILL	203	254	254	CBFEFE
GLACIOFLUVIAL DEPOSITS	178	254	152	B2FE98
GLACIOFLUVIAL AND GLACIOLACUSTRINE DEPOSITS	178	254	152	B2FE98
OUTWASH SAND	203	254	218	CBFEDA
OUTWASH SAND AND OUTWASH GRAVEL	203	254	218	CBFEDA
GLACIOLACUSTRINE	203	254	178	CBFEB2
EOLIAN DEPOSITS	218	203	152	DACB98
LOESS	236	203	76	ECCB4C
LOAM LOESS	236	178	127	ECB27F
LOAMY AND SANDY LOESS	236	178	127	ECB27F
SAND LOESS	218	127	127	DA7F7F
EOLIAN SAND	218	254	236	DAFEEC
DUNE SAND	76	254	236	4CFEEC
COVER SAND	254	254	236	FEFEEC

ORGANIC MATERIALS	254	254	254	FEFEFE	
PEAT	137	137	137	898989	
PEAT AND GLACIOLACUSTRINE DEPOSITS	137	137	137	898989	
SLIME AND OOZE	155	155	155	9B9B9B	
COAL	0	0	0	000000	
FERRUGINOUS SANDSTONE	203	178	0	CBB200	
HOLOCENE SILT	254	178	76	FEB24C	
TERRACE CLAY	152	254	0	98FE00	
CLAY WITH FLINTS	254	203	76	FECB4C	
NA	0	0	0	000000	