



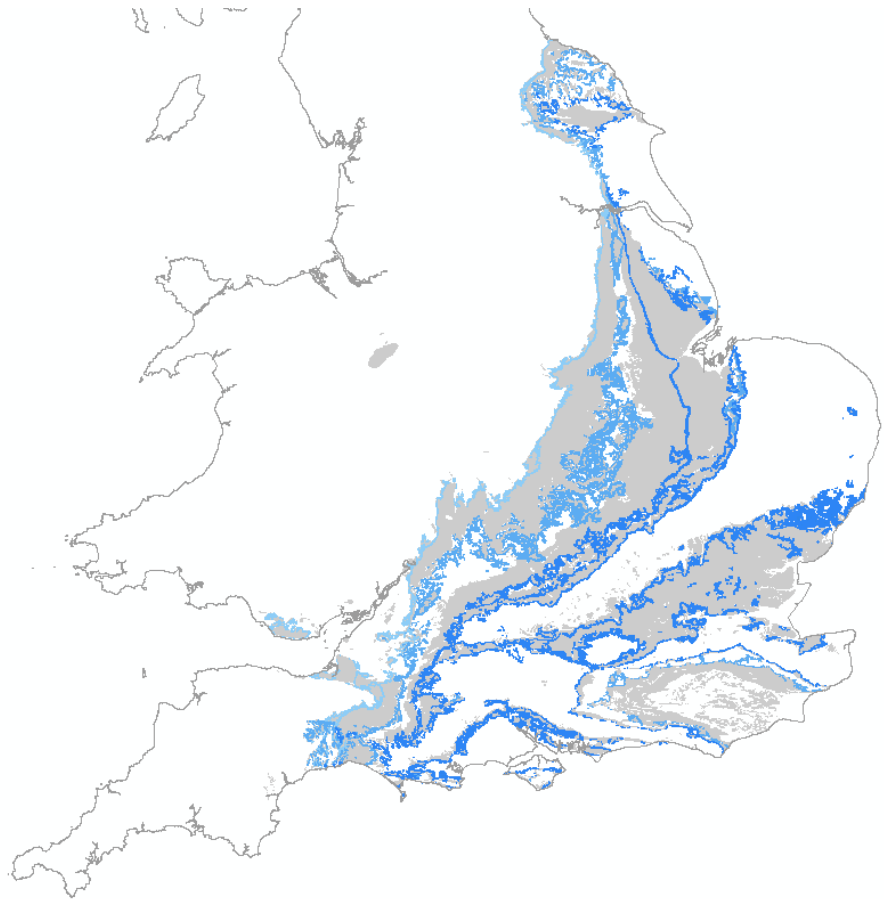
**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

User Guide for the Shrink-Swell Subsurface (GeoSure Extra) dataset

GeoAnalytics & Modelling Programme

Open Report OR/16/041



BRITISH GEOLOGICAL SURVEY

GEOANALYTICS & MODELLING PROGRAMME

OPEN REPORT OR/16/041

User Guide for the Shrink-Swell Subsurface (GeoSure Extra) dataset

The National Grid and other Ordnance Survey data are used with the permission of the Controller of Her Majesty's Stationery Office.
Licence No: 100017897/ 2018.

L Jones, D Diaz Doce, R Terrington

Keywords

Report; Geohazard, GeoSure, Shrink, Swell.

Contributor/editor

K A Lee

National Grid Reference

SW corner 0,0
Centre point 350000,550000
NE corner 700000,1300000

Map

Sheet 0, 1:50 000 scale, GeoSure

Bibliographical reference

L JONES, D DIAZ DOCE, R TERRINGTON 2016. User Guide for the Shrink-Swell Subsurface (GeoSure Extra) dataset. *British Geological Survey Open Report*, OR/16/041. 13 pp.

Copyright in materials derived from the British Geological Survey's work is owned by the Natural Environment Research Council (NERC) and/or the authority that commissioned the work. You may not copy or adapt this publication without first obtaining permission. Contact the BGS Intellectual Property Rights Section, British Geological Survey, Keyworth, e-mail ipr@bgs.ac.uk. You may quote extracts of a reasonable length without prior permission, provided a full acknowledgement is given of the source of the extract.

Maps and diagrams in this book use topography based on Ordnance Survey mapping.

BRITISH GEOLOGICAL SURVEY

The full range of our publications is available from BGS shops at Nottingham, Edinburgh, London and Cardiff (Welsh publications only) see contact details below or shop online at www.geologyshop.com

The London Information Office also maintains a reference collection of BGS publications, including maps, for consultation.

We publish an annual catalogue of our maps and other publications; this catalogue is available online or from any of the BGS shops.

The British Geological Survey carries out the geological survey of Great Britain and Northern Ireland (the latter as an agency service for the government of Northern Ireland), and of the surrounding continental shelf, as well as basic research projects. It also undertakes programmes of technical aid in geology in developing countries.

The British Geological Survey is a component body of the Natural Environment Research Council.

BGS Central Enquiries Desk

Tel 0115 936 3143 Fax 0115 936 3276
email enquiries@bgs.ac.uk

Environmental Science Centre, Keyworth, Nottingham NG12 5GG

Tel 0115 936 3241 Fax 0115 936 3488
email sales@bgs.ac.uk

The Lyell Centre, Research Avenue South, Edinburgh EH14 4AP

Tel 0131 667 1000 Fax 0131 668 2683
email scotsales@bgs.ac.uk

Natural History Museum, Cromwell Road, London SW7 5BD

Tel 020 7589 4090 Fax 020 7584 8270
Tel 020 7942 5344/45 email bgs london@bgs.ac.uk

Columbus House, Greenmeadow Springs, Tongwynlais, Cardiff CF15 7NE

Tel 029 2052 1962 Fax 029 2052 1963

Maclean Building, Crowmarsh Gifford, Wallingford OX10 8BB

Tel 01491 838800 Fax 01491 692345

Geological Survey of Northern Ireland, Department of Enterprise, Trade & Investment, Dundonald House, Upper Newtownards Road, Ballymiscaw, Belfast, BT4 3SB

Tel 028 9038 8462 Fax 028 9038 8461

www.bgs.ac.uk/gsni/

Parent Body

Natural Environment Research Council, Polaris House, North Star Avenue, Swindon SN2 1EU

Tel 01793 411500 Fax 01793 411501
www.nerc.ac.uk

Website www.bgs.ac.uk

Shop online at www.geologyshop.com

Contents

Contents	i
Summary	2
Acknowledgements	2
1 Introduction	3
2 About the Shrink–Swell Sub-crop Dataset	3
2.1 Background.....	3
2.2 Who might require this data?.....	4
2.3 What the dataset shows?.....	4
3 Technical Information	5
3.1 Definitions	5
3.2 Scale.....	5
3.3 Field descriptions.....	5
3.4 Creation of the dataset	6
3.5 Coverage	7
3.6 Data format	8
3.7 Limitations.....	8
4 Licencing Information	9
4.1 Contact information	10

Summary

This report describes the national scale Shrink–Swell sub-crop (GeoSure Extra) dataset. The methods used to create the dataset have been critically assessed and its fitness for purpose determined by specialists in BGS.

This document outlines the background to why the dataset was created, its potential uses and gives a brief description of the layer. Technical information regarding the GIS and how the data was created is described and advice is provided on using the dataset.

Acknowledgements

A number of individuals in the GeoAnalytics & Modelling and Engineering Geology Programmes have contributed to the project. This assistance has been received at all stages of the study. In addition to the collection and processing of data, many individuals have freely given their advice, and provided the local knowledge. Key staff have helped to review draft chapters of this report.

1 Introduction

Founded in 1835, the British Geological Survey (BGS) is the world's oldest national geological survey and the United Kingdom's premier centre for earth science information and expertise. The BGS provides expert services and impartial advice in all areas of geoscience. Our client base is drawn from the public and private sectors both in the UK and internationally.

Our innovative digital data products aim to help describe the ground surface and what's beneath across the whole of Great Britain. These digital products are based on the outputs of the BGS survey and research programmes and our substantial national data holdings. This data coupled with our in-house geoscientific knowledge are combined to provide products relevant to a wide range of users in central and local government, insurance and housing industry, engineering and environmental business, and the British public.

The GeoSure dataset comprises six different Geographical Information System (GIS) layers, with each layer representing a different natural ground stability hazard that occurs in Great Britain. The GeoSure datasets are polygon (area) layers, which are described using a straightforward A to E potential hazard classification.

This document provides information for users on an additional dataset for the assessment of the Shrink–Swell properties of the sub-crop of the 8 main clay formations in Great Britain.

Further information on all the digital data provided by the BGS can be found on our website at <http://www.bgs.ac.uk/data/home.html?src=topNav> or by contacting:

Central Enquiries
British Geological Survey
Environmental Science Centre
Keyworth
Nottingham
NG12 5GG
Direct tel. +44(0)115 936 3143
Fax. +44(0)115 9363150
email enquiries@bgs.ac.uk

2 About the Shrink–Swell Sub-crop Dataset

2.1 BACKGROUND

Public understanding of the effect of ground conditions on the safety of their property and the implication for the value of their property is growing. Local councils are under increasing pressure from central government to provide environmental information. Information about geological hazards is needed, in particular, the identification of areas with a potential for ground movement.

In response to this, The British Geological Survey initiated a development programme to produce datasets that identified and assessed potential geohazards threatening the

human environment in Great Britain. Along with the GeoSure ground stability datasets, the programme also generated:

- Superficial Deposit Thickness Models
- Scans of onshore borehole logs for Great Britain
- Scans of geology and historic topography maps
- Ground permeability data
- Susceptibility to groundwater flooding data
- Geological indicators of past flooding data
- Radon potential
- Soil Parent Material Model
- Non-coal mining hazards data

2.2 WHO MIGHT REQUIRE THIS DATA?

Natural ground stability hazards may lead to financial loss for anyone involved in the ownership or management of property, including developers, householders or local government. These costs could include increased insurance premiums, depressed house prices and, in some cases, engineering works to stabilise land or property.

These hazards may also impact on anyone involved in the construction of large structures (deep foundations), infrastructure networks (road or rail) or utility companies. The 3D properties of these materials can be used to identify potential problems at surface, in the shallow sub-surface or deeper underground (e.g. tunnels).

Armed with knowledge about potential hazards, preventative steps can be put in place to alleviate the impact of the hazard to people and property. The cost of such prevention may be very low, and is often many times lower than the repair bill following ground movement.

The identification of ground instability and other geological hazards can assist regional planners; rapidly identifying areas with potential problems and aid local government offices in making development plans by helping to define land suited to different uses. Other users of these data may include developers, construction companies, consulting engineers, builders, homeowners, solicitors, loss adjusters, the insurance industry, architects and surveyors.

2.3 WHAT THE DATASET SHOWS?

This addition to the GeoSure Shrink-Swell data consists of a single data layer in Geographical Information System (GIS) format that identifies areas of potential shrink-swell hazard at sub-crop level (up to 10 metres depth) in Great Britain. It is essentially a national hazard susceptibility map. This data has been produced by geologists, geotechnical specialists and information developers at the British Geological Survey and is presented as a GIS data layer. The dataset provides an indication of the presence of shrink-swell prone clays beneath other deposits (superficial or bedrock), up to a depth of c. 10 metres.

Swelling clays can change volume due to variation in moisture, this can cause ground movement, particularly in the upper two metres of the ground (or deeper if excavated and exposed) that may affect many foundations. Ground moisture variations may be related to a number of factors, including weather variations, vegetation effects (particularly growth or removal of trees) and the activities of people. Such changes can affect building foundations, pipes or services. During deeper excavation and construction works (i.e. basement excavations, tunnels or utility corridors), these volume changes might also affect clay shrink-swell prone lithologies.

3 Technical Information

3.1 DEFINITIONS

Hazard: A potentially damaging event or phenomenon.

Risk: The impact of the hazard on people, property or capital.

For example, a shrinkable clay could be perceived as a hazard, but the likelihood of it causing structural damage would be the risk.

A high hazard does not necessarily translate to a high risk. For example, if a particular location has a relatively high ground stability hazard, but the properties that are built there have taken this into account, and are designed to withstand the hazard, they will not have a comparable level of risk. This is because the likelihood of the hazard causing any loss has been reduced due to the design of the property.

GeoSure does not identify the cost of a hazard being realised, and therefore does not consider risk. GeoSure only examines the conditions that leave an area exposed to a hazard.

3.2 SCALE

The Shrink-Swell Subsurface for the GeoSure Extra dataset is produced for use at 1:625,000 scale providing a generic indication of the shrink-swell susceptibility at depths to 10 metres, as a planning tool prior to detailed site investigation.

3.3 FIELD DESCRIPTIONS

Table 1 – Attribute Table Field Descriptions

Field Name	Field Description
CLASS	Classification of hazard on a scale of B – D Class ‘-’ is already covered by the GeoSure Shrink-swell surface dataset which should be referred to
DEPTH	Depth of the Subsurface layer (5-10m)
LEGEND	Description of the hazard

VERSION	Dataset name and version number
---------	---------------------------------

Table 2 – GeoSure Legends

CLASS	SHRINK–SWELL
A*	Ground conditions predominantly non-plastic
B	Ground conditions predominantly low plasticity
C	Ground conditions predominantly medium plasticity
D	Ground conditions predominantly high plasticity
E*	Ground conditions predominantly very-high plasticity

*only classes B – D are currently present within the subsurface clay formations within this dataset. The full range of A- E equates to the GeoSure shrink swell layer that includes all geological deposits at surface.

3.4 CREATION OF THE DATASET

The part of the solid formation that is visible at surface (or under superficial deposits) is known as the Outcrop. The part of the formation that is underneath another solid formation (therefore hidden from the surface) is known as the Subsurface. This has been used to generate the Shrink–Swell Subsurface methodology.

3.5 BGS SUPPORTING DATASETS

The datasets used to create and validate the Shrink–Swell GeoSure Extra layer are:

- GeoSure Shrink-Swell V7
- DiGMap 625k
- UK 3D v2015 (GB 3D) dataset - 625k scale
- Superficial Deposits Thickness Model (ASTM) version 5.
- BGS National Geotechnical Information Database

3.6 METHODOLOGY

To produce the Shrink–Swell Subsurface for GeoSure natural ground stability data layer an assessment of hazard is made by:

- Identifying the factors that are involved in creating the hazard
- Assessing which are thought to be present at each location
- Assessing how significant they are thought to be at each location

The factors are then combined to estimate the level of hazard. The level of potential hazard does not mean that a damaging event is going to happen but is an indication of how many causative factors may be present and how severe they are thought to be.

Thus the hazard assessment method can be used to indicate how vulnerable areas are to experiencing hazard events and of how frequently these hazard events might be expected to occur.

Scattered data points derived from 3D cross section geological interpretations were extracted from the 625k scale UK 3D v2015 (GB 3D) dataset. The points were coincidental with the following lithostratigraphic units:

- Gault Formation and Upper Greensand Formation (GUGS)
- Kellaways Formation and Oxford Clay (KLOX)
- Lias Group (LI)
- Lambeth Group (LMBE)
- Mercia Mudstone Group (MMG)
- Thames Group (THAM)
- Wealdon Group (W)
- West Walton Formation, Ampthill Clay Formation and Kimmeridge Clay Formation (WWAK)

The cross section data points were then imported into GOCAD where individual clay unit surfaces were created by interpolation modelling; these were then imported into ArcGIS.

The hazard GIS layer is rated on an A – E classification (representing increasing hazard).

3.7 COVERAGE

3D information was created by modelling geologists at 1:625K scale using borehole analysis to create fence diagrams at regular intervals across the UK resulting in the UK National Geological Model (UK 3D v2015 (GB 3D)). From this 3D model, the top surfaces of the following lithostratigraphic units were extracted:

- Gault Formation and Upper Greensand Formation (GUGS)
- Kellaways Formation and Oxford Clay (KLOX)
- Lias Group (LI)
- Lambeth Group (LMBE)
- Mercia Mudstone Group (MMG)
- Thames Group (THAM)
- Wealden Group (W)
- West Walton Formation, Ampthill Clay Formation and Kimmeridge Clay Formation (WWAK)

The extent of these eight data layers is shown in Figure 1.

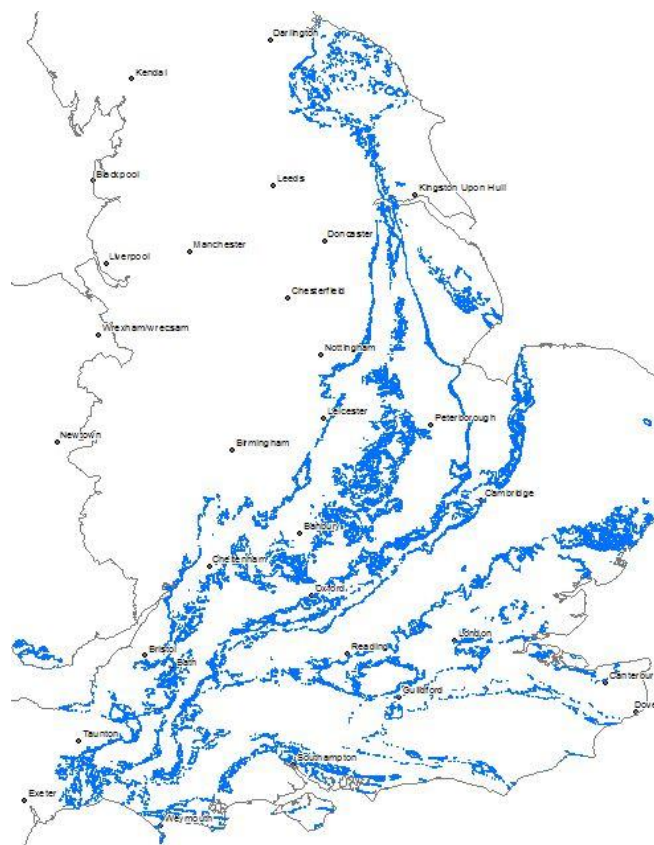


Figure 1 – Coverage of the Shrink–Swell Sub-crop dataset

N.B. Some formations may extend outside the area of Figure 1, but only in small patches.

3.8 DATA FORMAT

The dataset has been created as vector polygons and are available in a range of GIS formats, including ArcGIS (.shp), ArcInfo Coverages and MapInfo (.tab). More specialised formats may be available but may incur additional processing costs.

3.9 LIMITATIONS

- GeoSure Shrink-Swell Extra has been developed at 1:625 000 scale and is intended for use as a desk study screening tool prior to detailed site investigations.
- GeoSure Extra is concerned with potential ground stability related to NATURAL geological conditions only. It does NOT cover any man-made hazards, such as contaminated land or mining.
- GeoSure Extra is based on, and limited to, an interpretation of the records in the possession of The British Geological Survey at the time the data set was created.
- An indication of natural ground instability does not necessarily mean that a location will be affected by ground movement or subsidence.

- Site specific assessments should be carried out by suitably qualified and experienced professionals and using appropriate methods. The information provided in these data are designed for DESK STUDY phases.

4 Licencing Information

The British Geological Survey does not sell its digital mapping data to external parties. Instead, BGS grants external parties a licence to use this data, subject to certain standard terms and conditions. In general, a licence fee will be payable based on the type of data, the number of users, and the duration (years) of a licence.

All recipients of a licence (potential licensees) are required to return a signed digital data licence document before authorisation for release of BGS digital data is given.

In general terms, a BGS digital data licensee **will** be permitted to:

- make internal use of the dataset(s)
- allow a specified number of internal users to access/use the data (the number of users will be agreed with the licensee and specified in the licence document) for the purposes of their day-to-day internal activities
- reproduce extracts from the data up to A3 for use in external analogue (paper/hard copy) or non-queryable electronic (e.g. secured .pdf) format: to meet a public task duty; fulfil a statutory requirement; and/or as part of academic or other non-commercial research

But **will not** be permitted to:

- provide a bureau service for others or incorporate the data in the generation of products or services for commercial purposes
- sell, assign, sublicense, rent, lend or otherwise transfer (any part of) the dataset(s) or the licence
- place (any part of) the dataset(s) on the Internet

The BGS is committed to ensuring that all the digital data it holds which is released to external parties under licence has been through a robust internal approval process, to ensure that geoscientific standards and corporate quality assurance standards are maintained. This approval process is intended to ensure that all data released: (i) is quality assured; (ii) meets agreed BGS data management standards; (iii) is not in breach of any 3rd party intellectual property rights, or other contractual issues (such as confidentiality issues), that would mean that release of the data is not appropriate.

When the BGS digital datasets are revised any upgrades will be automatically supplied to the licensee, at no additional cost. Geological map datasets are revised on a periodic rather than on an annual basis, licensees will therefore not automatically receive a new dataset each year unless changes have been made to the data.

These are general comments for guidance only. A licensee of BGS's digital data is provided with full details of the basis on which individual BGS datasets licensed to them are supplied.

If you have any doubts about whether your proposed use of the BGS data will be covered by a BGS digital licence, the BGS Intellectual Property Rights (IPR) section will be happy to discuss this with you and can be contacted through the following email address: iprdigital@bgs.ac.uk BGS IPR will usually be able to provide reassurance that the licence will cover individual user requirements and/or to include additional 'special conditions' in the licence documentation, addressing specific requirements within BGS's permitted usage.

4.1 CONTACT INFORMATION

For all data and licensing enquiries please contact:

Central Enquiries
British Geological Survey
Environmental Science Centre
Keyworth
Nottingham
NG12 5GG
Direct tel: +44(0)115 936 3143
Fax: +44(0)115 9363150
Email: enquiries@bgs.ac.uk