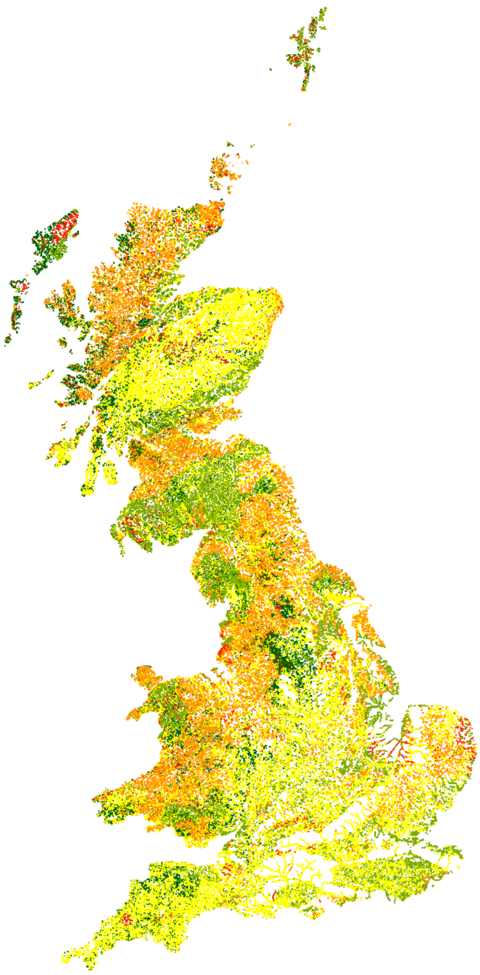
User Guide for the GeoScour GB V1 dataset

GeoAnalytics & Modelling Programme

Open Report OR/19/042



BRITISH GEOLOGICAL SURVEY

GEOANALYTICS & MODELLING PROGRAMME

OPEN REPORT OR/19/042

User Guide for the GeoScour GB V1 dataset

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BRITISH GEOLOGICAL SURVEY

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Summary

This report describes the BGS GeoScour data product. The methods used to create the component datasets have been critically assessed and its fitness for purpose determined by specialists in BGS.

GeoScour looks specifically and only at the geological factors that influence scour and does not consider any hydraulic or hydrodynamic factors.

This document outlines the background to why the dataset was created, its potential uses and gives a brief description of the data layers. 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.

Of the many individuals who have contributed to the project, we would particularly like to thank the following: Katie Whitbread, Jonathan Lee, Oliver Wakefield, Romaine Graham, Richard Haslam, Rhian Kendall, Russell Lawley, Kathrine Linley and Antonio Ferreira.

1 Introduction to BGS data products

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

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 GeoScour dataset comprises 3 different Tiers of geospatial data (containing eleven different data layers), with each Tier representing a different scale of assessment from a high-level catchment, sub-catchment data, to detailed river reach data. The datasets are polygon (area) layers and river lines, which are described using straight forward classifications and enabling a scour susceptibility assessment.

This data product and accompanying document provides information for users on the ***natural*** characteristics and properties of catchment and riverine environments for the assessment of river scour in Great Britain. GeoScour looks specifically at the geological factors that influence scour and does not consider any hydraulic or hydrodynamic factors. Tier 1 and 2 are designed as an overview for river management and Tier 3 riverine data is designed to provide input data into detailed hydraulic modelling algorithms.

Further information on all the digital data provided by the BGS can be found on our website at Data Products or by contacting

BGS Data Services
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Keyworth, Nottingham. NG12 5GG
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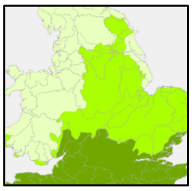
2 About the GeoScour Dataset

2.1 GEOLOGY: A KEY COMPONENT OF RIVER SCOUR ASSESSMENT

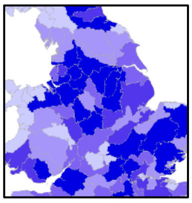
Geology varies considerably across Great Britain and has significant influence on the form and evolution of our river catchments. Catchments are continually changing and evolving over time, sometimes very slowly with limited visible change, others with sudden or rapid changes reflecting very dynamic events such as floods and landslides. Landscape morphology/topography and river processes are intrinsically linked to geology because the geology regulates the susceptibility of the channel bed and banks to erosion, plus how much stream power is used by the river to scour rather than transport material. Where hard rock catchments exist, valleys tend to be steep and narrow as the power of water flow gradually erodes and scours downwards. By comparison, in catchments where low durability rocks and sediments occur, rivers tend to develop wider valleys with broad flood plains. Scouring is likely to be ongoing during normal flow but highly-variable (both temporally and spatially) during transient flow conditions. The parameters assessed in this data product reflect this variation in the geology across the country and allow a more informed analysis of the geological potential for scour to occur.

2.2 TIER CONTENT AND USE

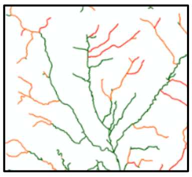
The GeoScour Data Product is designed to be used by multiple stakeholders with differing needs and therefore, can be interrogated at a number of levels.



Tier 1 data provides a summary overview of the catchment characteristics, typical response type, and evolution. It can be used as a high-level overview for incorporation into catchment management plans, national reviews and catchment comparisons.



Tier 2 data are available as smaller catchment areas and are focussed on providing data for more detailed catchment management, natural flood management and other related uses. It analyses geological properties such as flood accommodation space, catchment run-off potential, and geomorphology types, as well as additional summary statistics of key environmental parameters such as protected sites and urban coverage.



Tier 3 data provide detailed riverine information that is designed to be incorporated into more complex river scour models. It provides the baseline geological context for river scour development and identifies important factors that should be considered in any scour model. Factors such as material mineralogy, strength and density are key properties that can influence a river's ability to scour. In addition, an assessment of river fall, sinuosity and flood accommodation space is also provided. This data is of use to those assessing the propensity for river scour for any given reach of a river across Great Britain and can be used as an input into hydraulic/hydrodynamic models.

2.3 LICENSED & OPEN DATA PACKAGES

The GeoScour data product is provided as two options, either Open data (under an Open Government Licence) or more detailed licenced Premium version. The data content of each package is as follows:

GeoScour OPEN datasets

Tier 1 – Catchment level: consists of one dataset which identifies and describes the relative catchment-scale characteristics in terms of landscape evolution, sediment availability and typical response in flood conditions:

- Catchment_stability (1:625 000 scale)

Tier 2 – Sub-catchment level: consists of a suite of 5 sub-catchment datasets (1:250 000 scale) including:

- Catchment_Designated_Sites
- Catchment_Flood_Accommodation
- Catchment_Geological_Runoff_Potential
- Catchment_Morphology
- Catchment_Urban_Coverage

Tier 3 open consists of one layer at riverine level (1:50 000 scale):

- River_Geological_Properties

GeoScour PREMIUM datasets

The Premium licenced dataset contains all the datasets in the Open data plus additional detailed datasets at the Tier 3 riverine level.

Tier 3 consists of 5 layers at riverine level (1:50 000 scale):

- River_Geological_Properties
- River Geological Susceptibility layers:
    - River_**Average**_Geological_Susceptibility
    - River **Best**_Geological_Susceptibility
    - River_**Worst**_Geological_Susceptibility
- River_Morphology

Three of these layers (River Geological Susceptibility) have been provided as best-case, worst-case and average parameters to convey the variation and heterogeneous behaviour of geological deposits and to allow the user to consider both end members for scour potential according to their needs.

The River Geological Susceptibility data layers (River Average/Best/Worst Geological susceptibility) data layers identify the primary geological properties influencing scour potential including material density, strength (in line with technical engineering terminology BS5930:2015), and mineralogy.

The River Morphology data layer contains information on the key morphological characteristics of the catchment at the riverine level. These include the flood accommodation space available per river reach, the vertical fall of the river per reach and also the sinuosity factor.

2.4 SCALE & FORMAT

The GeoScour dataset is a three-tiered suite of datasets providing a range of catchment and riverine statistics and attributes. The recommended resolutions for use are:

- Tier 1 is produced for use at 1:625 000 scale
- Tier 2 is produced for use at 1:250 000 scale
- Tier 3 is produced for use at 1:50 000 scale

These data will allow an indication of the scour susceptibility according to the geological propensity. They can be used for input into hydrological modelling algorithms (Tier 3 data) or as a planning tool prior to detailed site investigation.

All datasets within the GeoScour data product are provided with a full coverage of Great Britain.

The dataset has been created as vector polygons and lines and are available in ArcGIS (.shp) format. Other formats such as MapInfo (.tab) may be available on request.

Multipart polygons have been used in Tier 1 (359 multipart features) and Tier 2 (1532 multipart features) which involves a geographic dispersion of the features. Considering the nature of the information given in GeoScour, these multipart features were necessary to provide information for the whole catchments, especially in coastal areas where catchments are divided by river estuaries.

We also recognise **overlaps** between England and Scotland catchments in Tier 1 (24 overlaps) and Tier 2 (28 overlaps). These overlaps have been kept as they reflect the difference between the source datasets provided by the Environment Agency and the Scottish Environment Protection Agency. We recommend that the catchment names are viewed to determine the geographic extent appropriate for user needs.

2.5 BACKGROUND

Following severe storms and flooding over successive winters, the BGS recognised river scouring as an important threat to in-river structures such as bridges. We also identified a gap in current scour modelling, with the geological deposit material having little influence or consideration in current modelling algorithms. This dataset aims to address those gaps. Vulnerability of river banks to erosion is poorly understood, even though consequences can mean sudden and catastrophic failure. Dwindling resources, particularly public sector, are a major barrier to tackling this growing problem. This data product provides an improved toolkit to more easily assess and raise the profile of scour risk, now and in the future, to help infrastructure providers and funders prioritise resources, identify remedial works to preclude costly and prevent disruptive failures. The GeoScour data product has broad applications through its adaptation to suit multiple types of asset likely to be affected by fluvial erosion. The underpinning information will also assist other environmental professionals seeking to identify the role of ‘change’ in the sedimentary environment, including remodelling of river channels and defences.

Timeliness: During winter 2015/16 Storm Desmond caused widespread damage to bridges across Cumbria (repair bill of c.£4M). The National Park suffered 257 damaged bridges, with consequent disruption lasting months. Similarly, a total of £3m was approved for remediation following Storm Frank damage across Scotland in 2016. Scour related damage and failure, results in costly repair, isolation of communities and impacts the infrastructure co-located on bridges. The bridge collapse at Tadcaster, Yorkshire (2015) provides a typical illustration of this with repair works costing £4.4m, and the community affected for 13 months, with costs of disruption estimated to be a further c. £5 million.

Understanding of the effect of geological conditions on the processes involved in river scour and erosion and the potential impacts is increasing. Recent increases in extreme events are mostly recognised by the flood impact where homes and assets are widely affected. However part of these flood events also involved the often overlooked scour of river banks. This affects riverine structures such as bridge piers, utility crossings, and also natural deposits. Where these natural deposits are prone to removal under extreme events, adjacent assets may then come under threat (e.g. Tadcaster Bridge, River Wharfe, Yorkshire, also Abergeldie Castle, River Dee, Scotland, and Cockermouth, Cumbria or more recently Grinton, North Yorkshire).

2.6 WHO MIGHT REQUIRE THIS DATA?

GeoScour provides a national-scale, geologically-influenced, scour susceptibility map for Great Britain by using a nested framework model (**Error! Reference source not found.**) to determine a 3-tiered data provision allowing increasing levels of understanding at different resolutions from catchment to local (channel/reach) scales. This is designed to feed into decision support tools and hydrological modelling. GeoScour will be useful for stakeholders, especially when used in conjunction with river velocity, dynamics, etc. to advise asset owners or managers (responsible for bridge infrastructure e.g. local authorities) on whether they need to undertake further work on the threat of scour. This will also be transferrable to owners/advisors of other infrastructure assets that are situated on or close to rivers. As well as bridges and the utilities that cross them, this includes infrastructure proximal to rivers such as road, rail, transmission towers and communications.

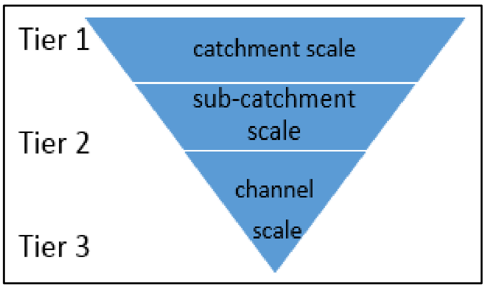


Figure 1: Tiered framework model

The GeoScour Data Product is a national to local scale scour assessment (based on the variable geological properties) at catchment and sub-catchment scale that will allow users to identify a) catchments with higher erosion activity due to landscape evolution and river sinuosity; b) identify sub-catchments that have a higher risk of scour due to the river morphology, underlying geological factors and catchment size (e.g. ability to shed or retain water); and c) identify specific sections of a given river to higher potential for scour (present day).

Change to current practice: Identifying geologically-influenced scour zones at sub-catchment resolution will allow users to make better-informed decisions for particular reaches of each river system. This will enable them to create or compile specific advice in terms of recommended investigations, monitoring, mitigation or resilience planning as well as identify gaps in knowledge where further investigation might be needed.

Benefits: the key benefits of GeoScour will be in minimising unnecessary mitigation work and provide 'hot spots' of potential risk areas, time saving associated with fewer manual site visits and risk reduction by mitigating asset defences etc. where needed. It can be used as part of a screening or planning tool, and the outputs of this work, when integrated within the river assessment workflows of our intended user base, will help prioritise remedial action, or help define structures at most risk, thereby reducing bridge damage/failure events and potentially saving the costs of rebuild (costs described above), diversion, and disruption (e.g. loss of tourism).

River scour 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.

3 Technical Information

3.1 TIER 1 CONTENT

Catchment Stability layer

The Tier 1 catchment stability data layer was developed as a high-level summary by identifying the glacial limits and quaternary history and attributing typical characteristic behaviours and management considerations using expert elicitation, quaternary domains data and glacial extents. The Quaternary history of a catchment has a large influence on its present day behaviours such as the availability of material/debris, the amount of erosion experienced, and the amount of ongoing natural landscape readjustment in response to isostatic and tectonic processes. Isostatic adjustment is the restoration to equilibrium of the earth's crust following a period of glaciation. Tectonic adjustment is the rebound in response to earth's tectonic events. These processes happen very slowly over millions of years but means that the landscape is in constant evolution.

Large coverage catchments were needed for this broad overview and therefore the Water Framework directive River Basin Districts Cycle 2 sourced from the Environment Agency (EA) (WFD River Basin Districts Cycle 2) were used to create the catchment polygons for England & Wales. The regions for Scotland were sourced from the Scottish Environment Protection Agency (© SEPA), and are based on the Local Plan Districts (see https://www.sepa.org.uk/media/219258/lpd-areas.pdf).

Tier 1 catchment stability is a summary overview of the evolution parameters affecting catchment response. It has been divided into three types as depicted below.

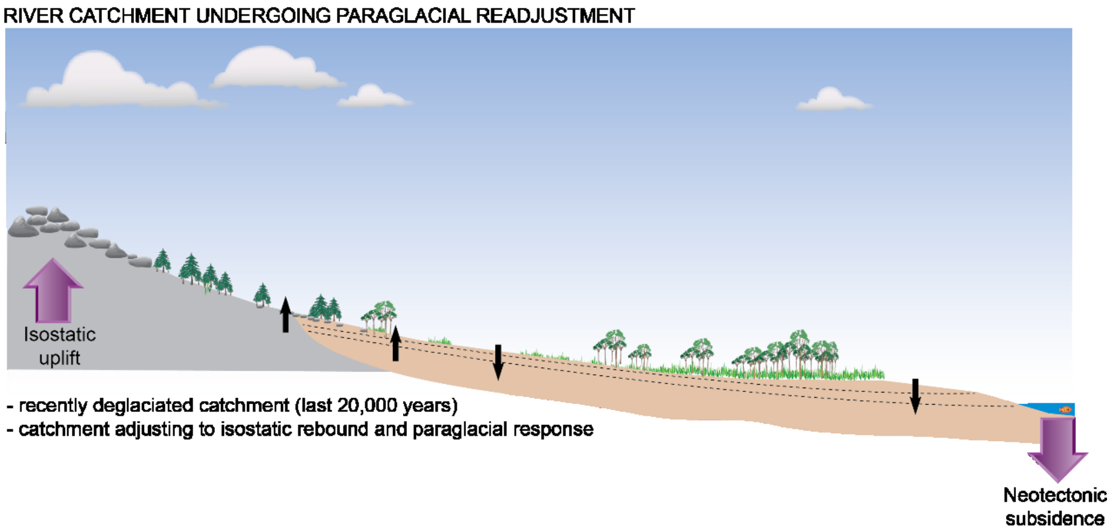


Figure 2: Unstable river catchments

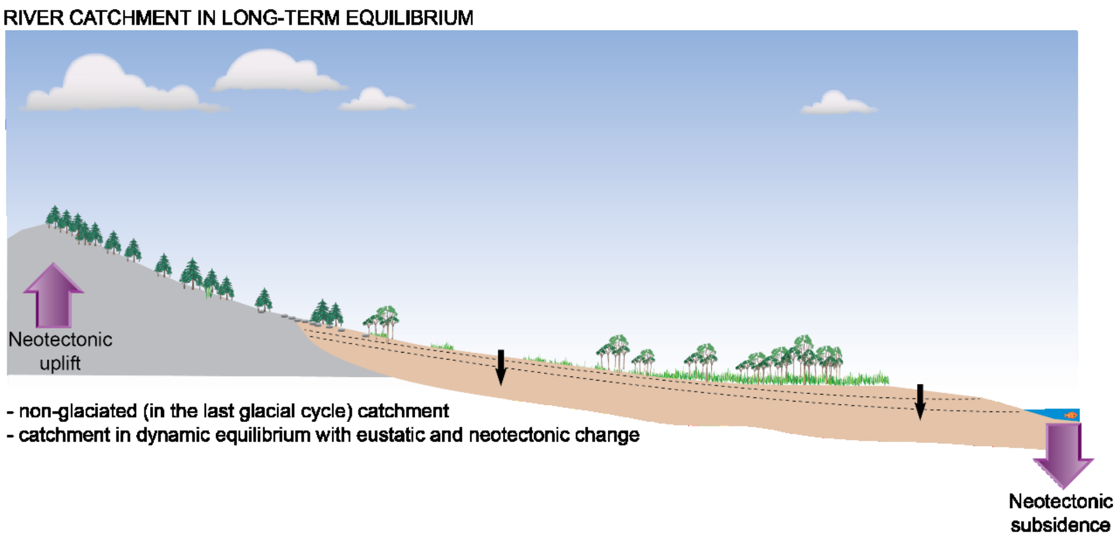


Figure 3: Meta-stable river catchments

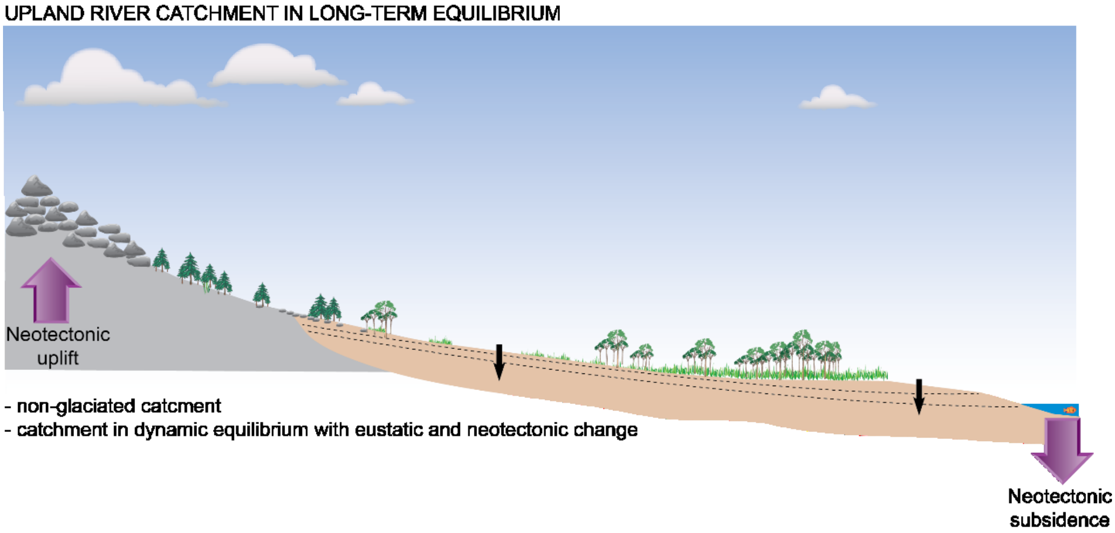


Figure 4: Stable river catchments

The Tier 1 catchment stability data contains the following fields:

Data source: BGS Quaternary glacial limits, SEPA Local Plan Districts.

Table 1: Tier 1 Catchment_Stability fields and descriptions

Field name	Field description
MNCAT_NAME	Catchment Name
TYPE	The name of the catchment type
DESC1	Description of the river system
DESC2	Description of previous glaciations
BEHAVIOUR1	Description of typical catchment behaviours
BEHAVIOUR2	Description of typical catchment behaviours
BEHAVIOUR3	Description of typical catchment behaviours
BEHAVIOUR4	Description of typical catchment behaviours
MANAGMNT1	Description of potential issues for management
MANAGMNT2	Description of potential issues for management
MANAGMNT3	Description of potential issues for management
MANAGMNT4	Description of potential issues for management
PRODUCT	Name of the data product
TIER	Tier number within the data product
DATASET	Name of the dataset layer

Note that not all fields are populated depending on the category and information available. Multiple fields for 'behaviour' and 'management' are provided due to the text limitation within each GIS field.

Individual descriptors within Tier 1 catchment stability layer

The 3 types of river catchment stability described within this data layer are described as follows:

Unstable River Catchments

Desc1	River systems that are still undergoing landscape adjustment following the last glaciation (i.e. the catchment was glaciated).
Behaviour1	A dynamic catchment with hillslopes and rivers still adjusting to non-glacial conditions
Behaviour2	Unpredictable river catchment response that is not in equilibrium with its host geology or relief
Behaviour3	Elevated sediment supply to rivers driven by hillslope instability and catchment fill
Behaviour4	Highly-variable changes in discharge and flow regime
Mangmnt1	Highly-unpredictable river catchment at all temporal and spatial scales
Mangmnt2	Elevated hillslope instabilities contributing higher and more variable levels of sediment to channels
Mangmnt3	High and complex patters of river scouring and floodplain aggradation
Mangmnt4	High-magnitude (e.g. storms) and transient (e.g. periods of prolonged rainfall) events, plus localised changes in catchment management (e.g. land-use, drainage, channel modification) are likely to have a high impact on channel processes

Semi-stable River Catchments

Desc1	River systems that were not glaciated during the last glaciation and are not undergoing a period of paraglacial adjustment
Desc2	Catchment has been glaciated previously during the Quaternary
Behaviour1	A river catchment that is generally in equilibrium with both external (e.g. climate and tectonics) and internal (e.g. geology, relief) drivers of landscape change
Behaviour2	Reduced hillslope instability and sediment delivery to river systems although moderate sediment availability (due to occurrence of Quaternary deposits e.g. glacial deposits, river terraces)
Mangmnt1	Fairly predictable catchment processes (scour and aggradation) under normal conditions
Mangmnt2	Unpredictable behaviour likely to be localised and due to either local catchment management practices (e.g. land-use, drainage, channel modification) or high-magnitude (e.g. storms) / transient (e.g. prolonged periods of rainfall) events

Meta-stable River Catchments

Desc1	River systems that were not glaciated during the last glaciation and are not undergoing a period of paraglacial adjustment
Desc2	Catchment has not been glaciated previously during the Quaternary
Behaviour1	A river catchment that is generally in equilibrium with both external (e.g. climate and tectonics) and internal (e.g. geology, relief) drivers of landscape change
Behaviour2	Limited sediment fill and availability; available materials largely restricted to pre-existing valley bottom sediments (terraces, alluvium, mass-movement deposits); available materials on slopes limited to soils and rock falls

Behaviour3	Much reduced hillslope instability and sediment delivery to river systems due to limited sediment availability (due to limited occurrence of Quaternary deposits e.g. glacial deposits, river terraces)
Managmnt1	Fairly predictable catchment processes (scour and aggradation) under normal conditions
Managmnt2	Reduced sediment budgets suggest rivers may be prone to more localised and widespread scouring especially in response to high-magnitude (e.g. storms), transient events (e.g. prolonged rainfall)
Managmnt3	Reduced sediment budgets suggest rivers may be prone to more localised and widespread scouring especially in response to changes in catchment management practices (e.g. land-use, drainage, channel modification)

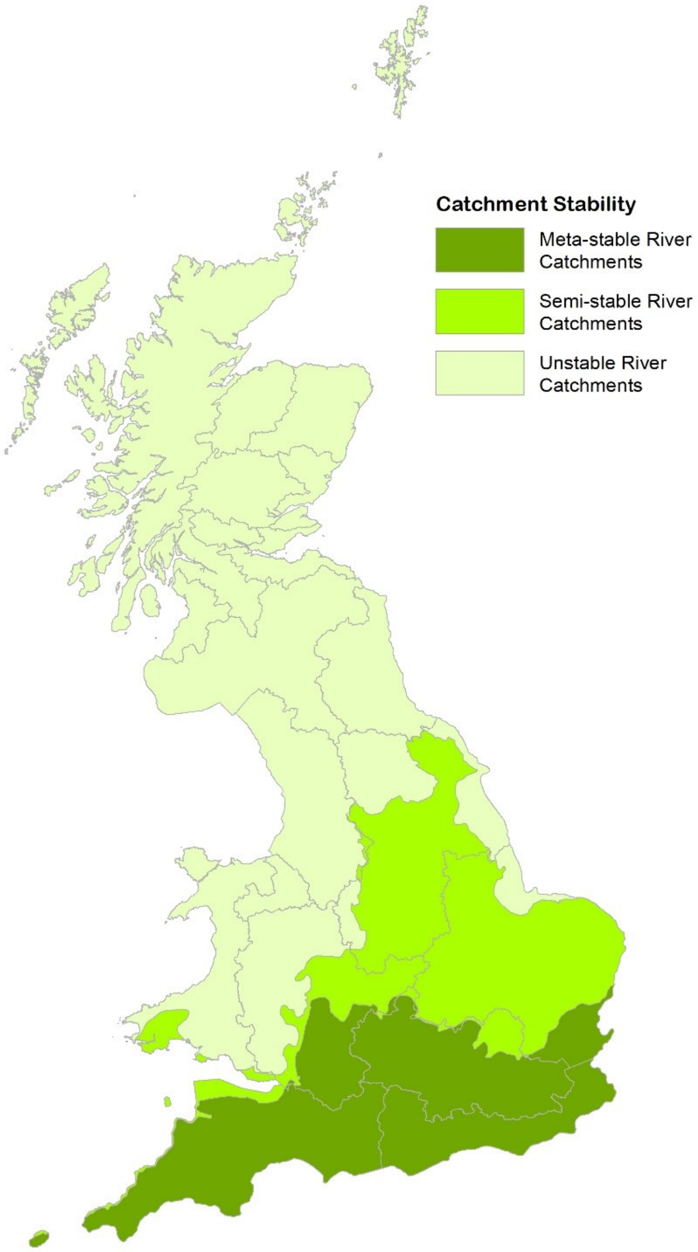


Figure 5: Catchment stability map

[*Local Plan Districts is sourced from SEPA: IHDTM Inflow grid derived catchment boundaries available free of charge under the terms of the current Open Government Licence (OGL) as per SEPA's licence with CEH (CEH 900). © SEPA. Some features of this information are based on digital spatial data licensed from the Centre for Ecology and Hydrology © NERC (CEH).*]

3.2 TIER 2 CONTENT

Tier 2 datasets provide a suite of information on different catchment parameters. They are calculated using the Water Framework Directive "WFD River Waterbody Catchments Cycle 2" for England and Wales; and Scotland Catchments from the Scottish Environment Protection Agency (SEPA). These were selected as they are widely available and widely used by practitioners and therefore the data should be easy to integrate alongside other datasets as necessary.

Tier 2 contains a suite of five dataset layers:

- Catchment_Designated_Sites
- Catchment_Flood_Accommodation
- Catchment_Geological_Runoff_Potential
- Catchment_Morphology
- Catchment_Urban_Coverage

3.2.1 Catchment Designated Sites

The inclusion of nationally important designated sites has been provided to allow a catchment assessment comparison and consideration (e.g. comparison with the urban area coverage or the flood accommodation space). This allows the user to assess the potential threats and competing factors present within and between catchments.

This data layer details the number, area coverage and percentage coverage of designated sites per catchment and includes the following fields:

Data source(s): Natural England Ramsar 2019, Natural England Ancient Woodland Inventory 2019, Natural England National Nature Reserves 2019, Natural England Special Areas of Conservation 2019, Natural England Special Protection Areas 2019, Natural England Sites of Special Scientific Interest 2019, SNH Ramsar 2005, SNH Ancient Woodland Inventory 2010, SNH National Nature Reserves 2018, SNH Special Areas of Conservation 2018, SNH Special Protection Areas 2019, SNH Sites of Special Scientific Interest 2019, NRW Ramsar 2018, NRW Ancient Woodland Inventory 2011, NRW National Nature Reserves 2018, NRW Special Areas of Conservation 2018, NRW Special Protection Areas 2018, NRW Sites of Special Scientific Interest 2019

Table 2: Tier 2 Catchment_Designated_Sites fields and descriptions

Name	Description
MNCAT_NAME	Management catchment name
NB_ALL	Total number of all designated sites per catchment
AREA_ALL	Coverage of all designated sites (m^2) per catchment
PERC_ALL	% coverage of all designated sites per catchment
NB_AWI	Number of Ancient Woodland Inventory sites per catchment
AREA_AWI	Coverage of Ancient Woodland Inventory sites (m^2) per catchment
PERC_AWI	% coverage of Ancient Woodland Inventory sites per catchment
NB_NNR	Number of National Nature Reserves per catchment
AREA_NNR	Coverage of National Nature Reserves (m^2) per catchment
PERC_NNR	% coverage of National Nature Reserves per catchment

NB_RAM	Number of Ramsar sites per catchment
AREA_RAM	Coverage of Ramsar sites (m^2) per catchment
PERC_RAM	% coverage of Ramsar sites per catchment
NB_SAC	Number of Special Areas of Conservation per catchment
AREA_SAC	Coverage of Special Areas of Conservation (m^2) per catchment
PERC_SAC	% coverage of Special Areas of Conservation per catchment
NB_SPA	Number of Special Protection Areas per catchment
AREA_SPA	Coverage of Special Protection Areas (m^2) per catchment
PERC_SPA	% coverage of Special Protection Areas per catchment
NB_SSSI	Number of SSSI sites per catchment
AREA_SSSI	Coverage of SSSI sites (m^2) per catchment
PERC_SSSI	% coverage of SSSI per catchment
PRODUCT	Name of the data product
TIER	Tier number within the data product
DATASET	Name of the dataset layer

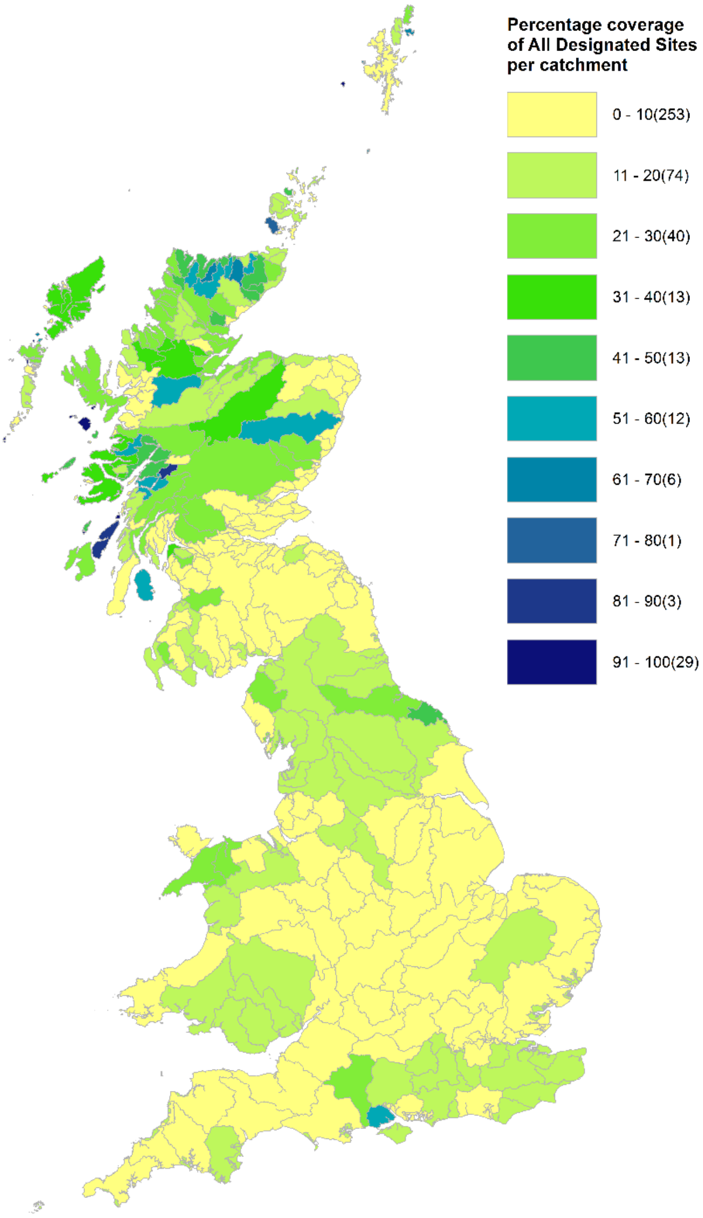


Figure 6: Coverage of all designated site per catchment map. Numbers in bracket indicate number of features

3.2.2 Catchment Flood Accommodation

The amount of accommodation space for flood waters is an important consideration for catchment management planning and assessing scour potential and it is directly linked to the underlying geology in terms of its strength properties and erosion history. Catchments that have large accommodation spaces tend to have wide shallow valleys with broad flood plains where water can temporarily escape to. These generally have a widespread flood impact but lower erosion impact (depending on the severity of the flood). However, catchments with smaller flood accommodation space tend to be of higher erosive power and potential for scour. The underlying rock types influence these to some degree e.g. strong resistant rocks develop downward scour over a longer period of time; weaker sediments and rocks create meandering environments and floodplains and lateral scour is more apparent.

The catchment flood accommodation space layer provides the potential total area of the catchment that is subject to flood given a 5m rise above existing river courses. The base elevation is taken from the NEXTMap® DTM where intersecting the OS Open Rivers data. A 5m height was taken as a nominal height for modelling and in-line with an assessment of river gauge levels (used for the Geological Indicators of Flooding dataset (BGS 2010). The data is simply a measure of increased water levels and does not take into account any simultaneous processes such as infiltration, permeability, flow rates, etc. The statistics are rounded up to the nearest metre for both the sum watercourse length within a catchment (LENGTH), and the sum coverage area within a catchment (AREA). Using BGS data derived from NEXTMap® DTM, a 5m flood zone was created to provide the necessary statistical output for flood zone coverage by catchment (FLOODZONE), and the percentage equivalent of flood coverage (AREA_PCT).

Data source: NextMap® DTM 5m 2004

Table 3: Tier 2 Catchment_Flood_Accommodation fields and descriptions

Field name	Field description
MNCAT_NAME	Management catchment name
AREA	Total Area (in m^2) of the catchment
FLOODZONE	Area (in m^2) of the flood accommodation space in the catchment
AREA_PCT	% coverage of flood accommodation space per catchment
LENGTH	Total length (in m) of rivers in the catchment
PRODUCT	Name of the data product
TIER	Tier number within the data product
DATASET	Name of the dataset layer

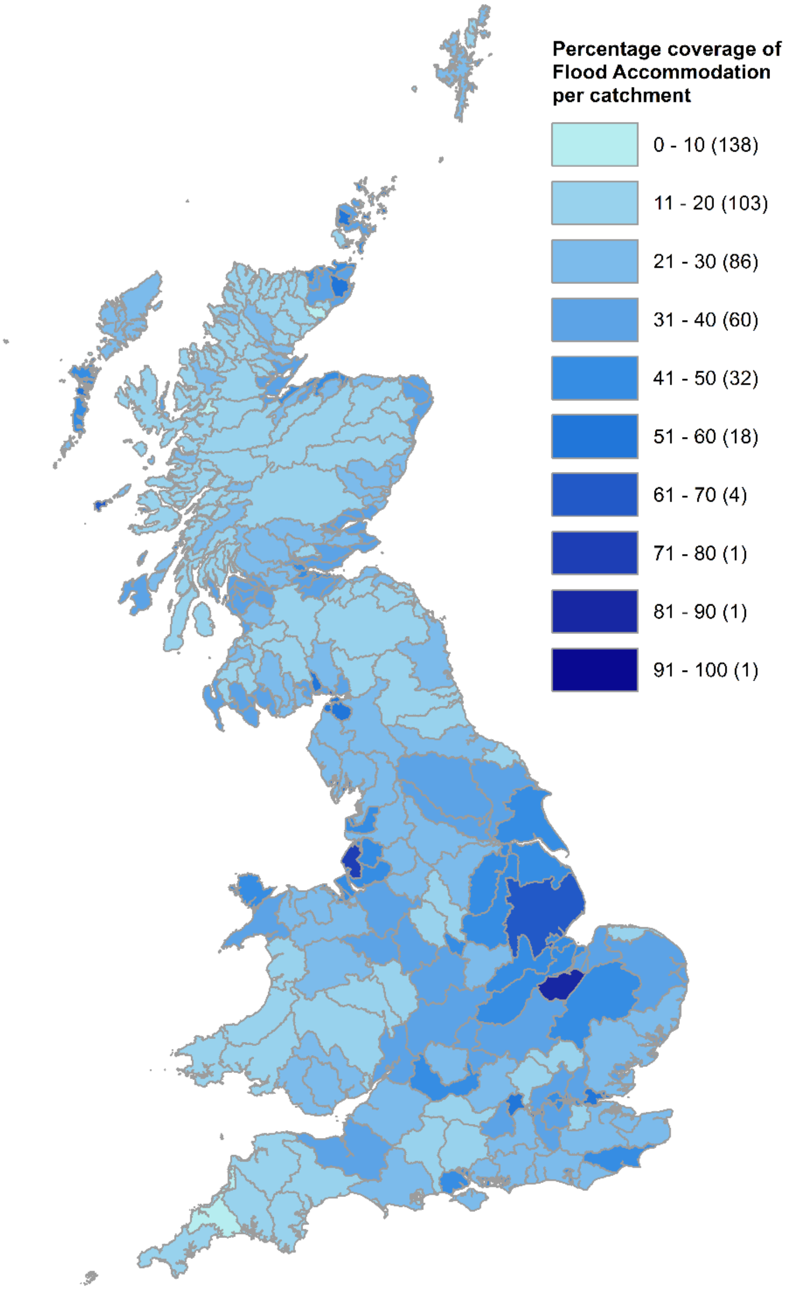


Figure 7: Flood Accommodation coverage per catchment map. Numbers in bracket indicate number of features

3.2.3 Catchment_Geological_Runoff_Potential

The geological run-off potential is an assessment of the underlying permeability of the catchment. The higher the coverage of impermeable deposits (e.g. clay-rich deposits, mudstones, etc.) the higher the potential for run-off and the increased threat of scour.

This data layer describes the run-off potential of the catchment, based on the geological properties and permeability of deposits. It does not take into account any other factors such as land cover or land use. The data layer provides the area coverage of each run-off potential class and identifies the dominant class and the worst-case for each catchment area. The data layer includes the following fields:

Data source: BGS Permeability v7

Table 4: Tier 2 Catchment_Geological_Runoff_Potential fields and descriptions

Name	Description
MNCAT_NAME	Management catchment name
PERC_LOW	Percentage coverage of catchment classed as low run-off potential
PERC_MOD	Percentage coverage of catchment classed as moderate run-off potential
PERC_HIGH	Percentage coverage of catchment classed as high run-off potential
DOM	Dominant run-off class
DOM_DESC	Description of the dominant class
WORST	Worst-case run-off class
WORST_DESC	Description of the worst-case
PRODUCT	Name of the data product
TIER	Tier number within the data product
DATASET	Name of the dataset layer

Potential run-off class descriptions

Name	Description
Low	Low overland flows, unless ground is excessively dry or saturated.
Moderate	Variable run-off potential due to the mixed nature of the deposits within the geological formation e.g. interbedded layers with differing properties.
High	Rapid overland flow into rivers.
No Data	No data available

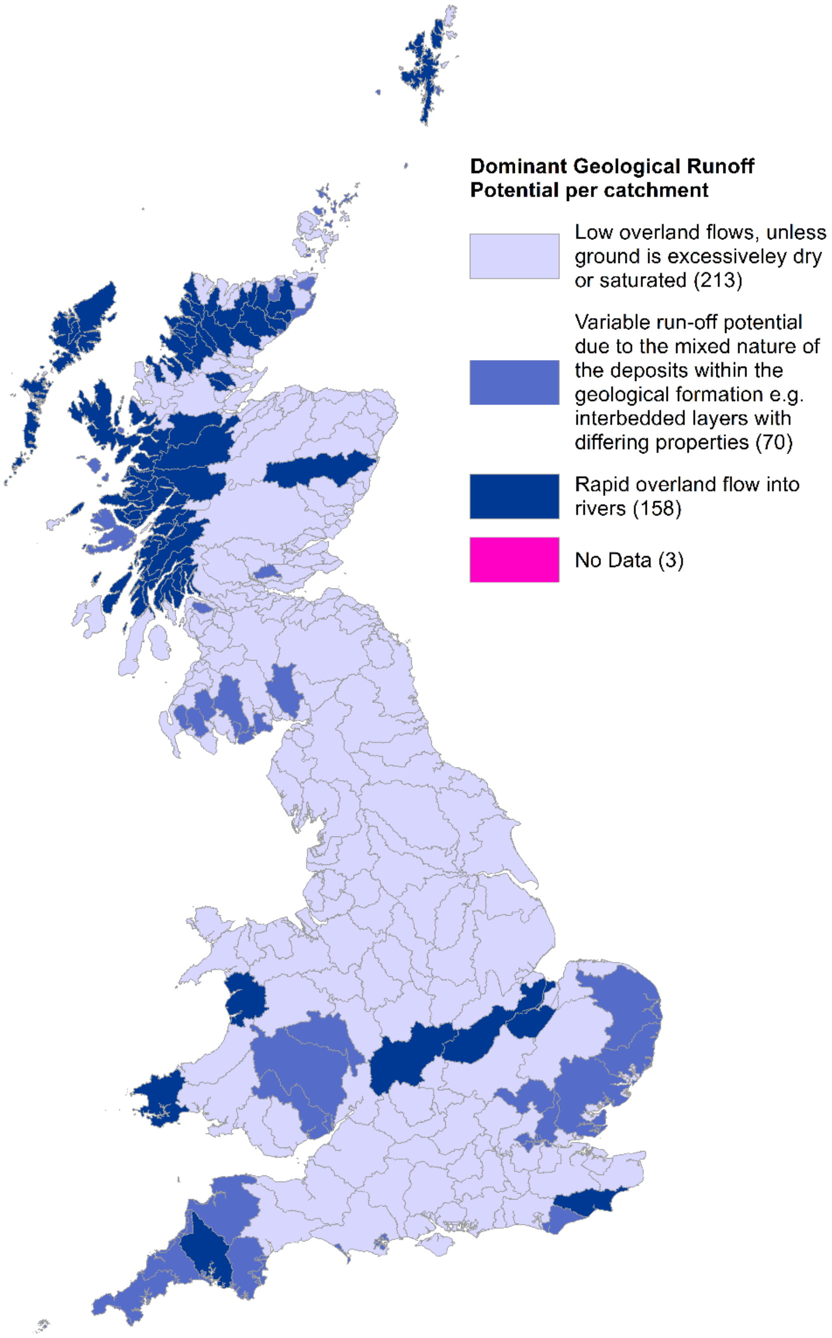


Figure 8: Dominant geological runoff per catchment map. Numbers in bracket indicate number of features

3.2.4 Catchment_Morphology

The morphology of a catchment is an important consideration in assessing river scour potential as its topography and sediment availability are intrinsically linked to the geological deposits and processes occurring both in the past and present. The morphology of a catchment provides an indication of the sediment likely to be available and therefore potentially inputting into the river processes, the types of deposits, (and thickness), likely to be present, and the amount of weathering likely to be taking place.

The catchment morphology layer was developed by analysing the dominant morphology type per catchment area and attributed into one of 4 categories: uplands, lowlands, hill & vale, or mountain.

This data layer describes the dominant catchment morphology type and contains the following fields:

Data source: BGS Quaternary domains (morphology descriptions).

Table 5: Tier 2 Catchment_Morphology fields and descriptions

Field name	Field description
MNCAT_NAME	Management catchment name
DOM_MORPH	The name of the catchment morphology type
DESCRIPTOR	Description of the catchment morphology type
PRODUCT	Name of the data product
TIER	Tier number within the data product
DATASET	Name of the dataset layer

The morphology types include the following 4 categories:

Morphology type	Description
Uplands	Mountainous terrain with active weathering, development of scree on some slopes, widespread erosion, minimal weathered bedrock.
Lowlands	Very low to gently undulating morphology. Major alluvial tracts. Floodplains with silt and clay commonly conceal water-saturated sand and gravel, river terraces mostly formed of sand and gravel. Can include lacustrine and peat deposits locally.
Hill and vale	Undulating morphology of hill and valley, local preservation of thick Quaternary deposits within valleys, weathered bedrock in upland areas. Valleys can be underlain by thick sequences of Quaternary deposits, dominated by fluvial sequences.
Mountain	Mountainous terrain or deeply dissected erosional plateaux with severe, yet geographically-restricted glacial erosion. Fresh Quaternary deposits mainly restricted to valleys. Local occurrence of weathered bedrock.

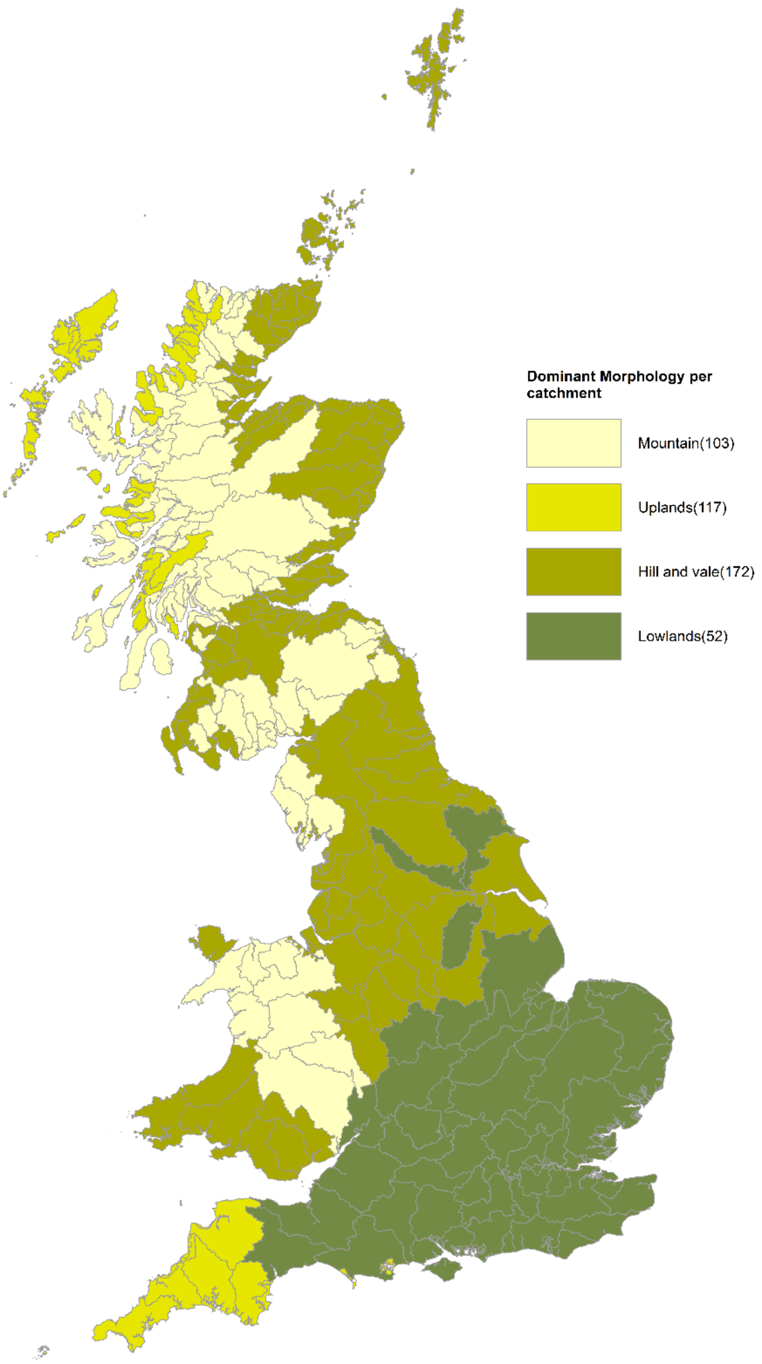


Figure 9: Dominant catchment morphology map. Numbers in bracket indicate number of features

3.2.5 Catchment Urban Coverage

The amount of urban coverage of a catchment is another attribute that could aid river catchment planning and assessments. Urban areas cause a 'surface sealing' effect, changing the drainage patterns substantially, often increasing run-off and therefore increasing the speed in which rainwater reaches the river network. Many urban areas have modified watercourses such as weirs, canalisation, flood defences and these should be considered as part of the catchment scour assessment. This data provides a catchment overview of the number and scale of urban areas. Large or very large conurbations will have potentially a much greater impact on the riverine environment as well as potential downstream consequences (e.g. higher erosion and scour creating greater impact on the rocks and sediments) that should be considered.

The catchment urban coverage layers have been provided as number, coverage and percentage of small and large urban areas. The OS Strategi Urban Region dataset was used and both the large and small urban areas have been extracted independently and exported to create two new layers.

This data layer describes the percentage urban coverage of each catchment and includes the following fields:

Data source: OS Strategi Urban Regions 2016

Table 6: Tier 2 Catchment_Urban_Coverage fields and descriptions

Name	Description
MNCAT_NAME	Management catchment name
NB_LARGE	Number of large urban areas within catchment
AREA_LARGE	Coverage (m^2) of large urban areas within catchment
PERC_LARGE	Percentage coverage of large urban areas
NB_SMALL	Number of small urban areas within catchment
AREA_SMALL	Coverage (m^2) of small urban areas within catchment
PERC_SMALL	Percentage coverage of small urban areas
PRODUCT	Name of the data product
TIER	Tier number within the data product
DATASET	Name of the dataset layer

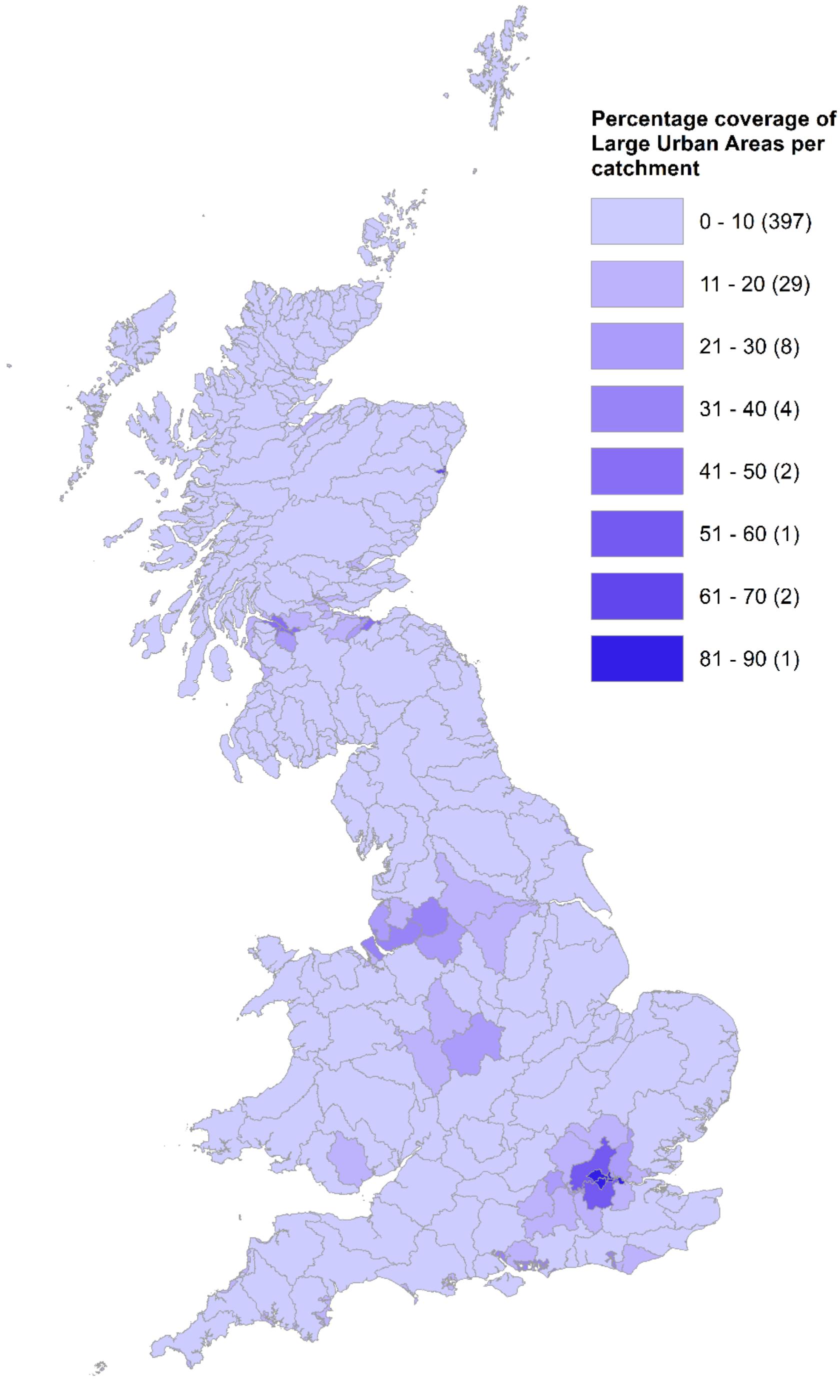


Figure 10: Percentage coverage of large urban areas per catchment map. Numbers in bracket indicate number of features

3.3 TIER 3 CONTENT

The Tier 3 dataset contains a suite of 5 layers. Three of these layers (river geological susceptibility) have been provided as best-case, worst-case and average parameters to convey the variation and heterogeneous behaviour of geological deposits and to allow the user to consider both end members for scour potential according to their needs.

GIS Note: The total number of features within the layers varies due to the methodologies used. The geological susceptibility layers have been assessed by intersecting the geology layers with the river network while the geological properties and morphology layers have been assessed by river reach (river segment contained between two river junctions).

3.3.1 River Geological Properties

This data layer provides the representation or coverage of four geological properties (bedrock, strength, density and mineralogy of materials) per river reach. It assesses the percentage length of each type of geological property (different densities, strengths, mineralogy) and the percentage length of bedrock for each individual river reach.

The material strength and density values are provided as standard geotechnical engineering values as described in BS5930 (BS5930:2015). The mineralogical component is derived from BGS databases and the BGS Parent Material Map.

Data source: BGS Civils Strength v6, BGS Parent Materials v6, BGS Geology 50k Surface V8.

Table 7: River_Geological_Properties fields and descriptions

Name	Description
	Bedrock coverage
BEDROCK	% length of reach classed as bedrock
	Material strength
FIRM	% length of reach classed firm
FIRMSTIFF	% length of reach classed from firm to stiff
SOFT	% length of reach classed soft or very soft
SOFTFIRM	% length of reach classed from soft to firm
STIFF	% length of reach classed stiff or very stiff
STIFFVWEAK	% length of reach classed from stiff to very weak
STIFFWEAK	% length of reach classed from stiff to weak
STRONG	% length of reach classed as very strong or extremely strong
VWEAK	% length of reach classed as very weak
VWEAKSTRON	% length of reach classed from very weak to strong
WEAKSTRONG	% length of reach classed from weak to strong
	Material density
DENSE	% length of reach classed dense or very dense
MDENSE	% length of reach classed as medium dense
LOOSE	% length of reach classed as loose
VARIABLE	% length of reach classed as variable
	Material mineralogy
BASIC	% length of reach classed as predominantly as basic igneous rocks
CARBONATES	% length of reach classed as predominantly carbonates

EVAPORITE	% length of reach classed as predominant sulphates and halides
INTERM	% length of reach classed as predominantly as intermediate igneous rocks
IRON_MIXED	% length of reach classed as predominantly iron or mixed lithology
ORGANIC	% length of reach classed as predominantly as organic material
SILICACLAY	% length of reach classed as predominantly silica and clay
NODATA	% length of reach where superficial deposits are not mapped
PRODUCT	Name of the data product
TIER	Tier number within the data product
DATASET	Name of the dataset layer

GIS Note

1. The percentage fields should not be all sum together but need to be looked at individually per category (e.g. sum percentages of material strength).
2. However, the NODATA field percentages can be summed with any of the other categories (bedrock coverage, material strength, material density and material mineralogy) for a given feature.

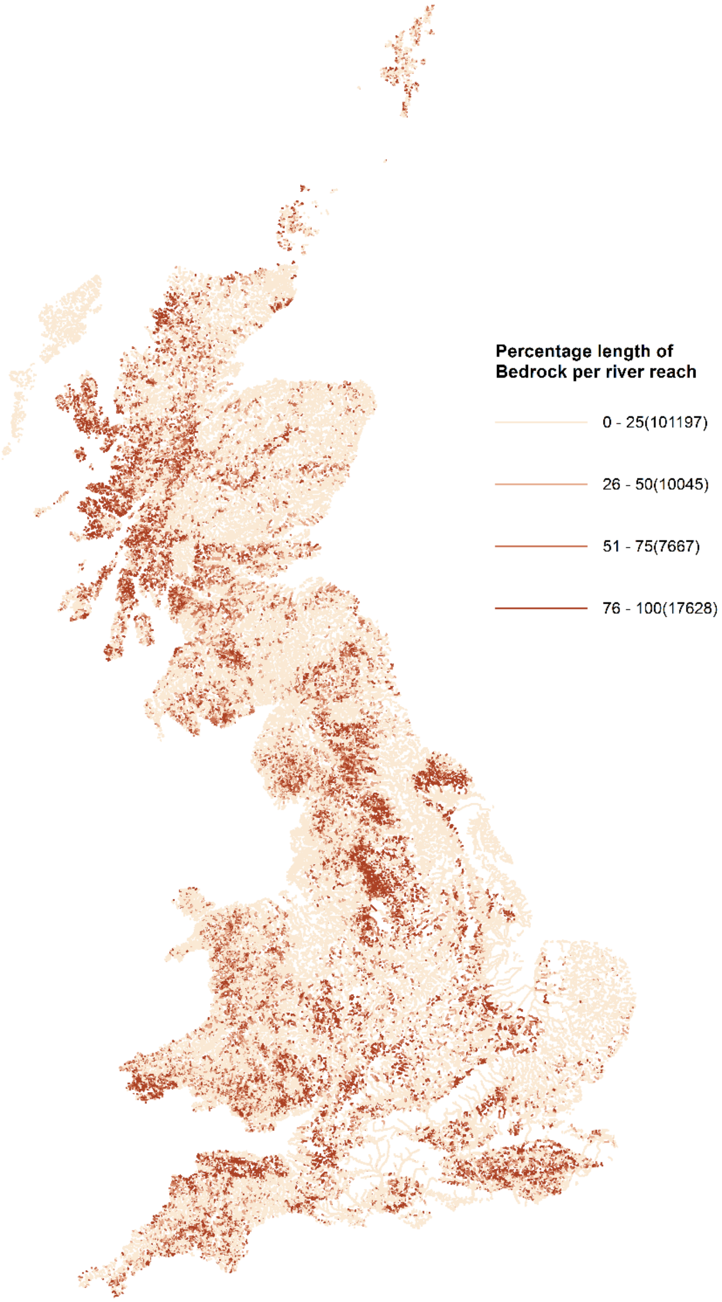


Figure 11: Geological properties per river reach map. Numbers in bracket indicate number of features

3.3.2 River Geological Susceptibility layers

The river geological susceptibility layers have been provided as average-case, best-case and worst-case parameters to convey the variation and heterogeneous behaviour of geological deposits and to allow the user to consider both end members for scour potential according to their needs. These data layers identify the primary geological properties influencing scour potential including material density, strength (in line with technical engineering terminology BS5930:2015), and mineralogy.

The strength and density engineering descriptions range from strong to loose materials (Figure 12) corresponding to a variation from well-consolidated to unconsolidated materials. A linear scale has accordingly been used to classify and score the density and strength values. The lowest value of 0.1 (avoiding the value 0 for next step of process) has been attributed to the strong and extremely strong materials. Materials classed as 'Strong' are well consolidated and have greater resistance to scouring. The highest value of 1 has been attributed to the 'very loose' and 'loose' materials. Those materials are completely unconsolidated and can be easily removed and displaced by water.

STRNGTH_TY Code	DESCRIPTION	SPT N-values	Uniaxial Compressive Strength (MPa)	
STRE	EXTREMELY STRONG		>250	0.1
STRV	VERY STRONG		100 - 250	
STR	STRONG		50 - 100	0.2
STR	MEDIUM STRONG		25 - 50	
WK	WEAK		5 - 25	
WKV	VERY WEAK		1 - 5	0.3
WKE	EXTREMELY WEAK		0.6 - 1	
HD	HARD			0.4
STIV	VERY STIFF			0.5
STI	STIFF			
FRM	FIRM			0.6
SFT	SOFT			0.7
SFTV	VERY SOFT			
DENV	VERY DENSE	>50		0.8
DEN	DENSE	30 to 50		
DENM	MEDIUM DENSE	10 to 30		0.9
LS	LOOSE	4 to 10		1.0
LSV	VERY LOOSE	<4		

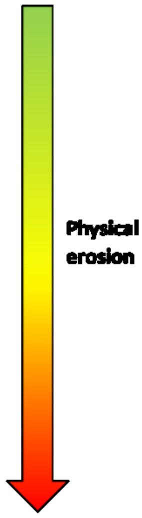


Figure 12: Definition of the Strength and Density scores (STG_SCR) for the average-case scenario river geological susceptibility

Similarly, the mineralogy types have been classified and scored using a linear scale from insoluble to soluble materials (Figure 13). The lowest value of 0.1 has been given to the silica and/or clay-rich materials (least potential to scour). Intermediate materials have been attributed a score of 0.2 and basic material of 0.3. Iron, ultrabasic and mixed materials have been attributed a middle score of 0.5, considering their potential unpredictable behaviour depending on the temperature or chemistry of the water or simply the dominant material in the case of a mixed rock type/formation. Any material containing carbonates (Mg carbonates or Ca carbonates regardless the amount and if dominant in the rock) have been attributed a score of 0.7 considering that however limited the portion of the material being carbonates, the rock could be easily weakened and then scoured due to the dissolution of the carbonates portion. Finally, organic and evaporate materials have been attributed a value of 0.8 and 1, respectively.

	D_MN_ CODE	DOM_MNRL class	DOMINANT MINERALOGY DEFINITION
	?	UNKNOWN	BULK MINERALOGY IS UNKNOWN
0.1	A	ACID	IGNEOUS ROCKS WITH HIGH SILICA (63%+)
0.3	B	BASIC	IGNEOUS ROCKS WITH LOW SILICA (45-52%)
0.1	C	CLAY	DOMINANT CLAY MINERALS (90%+)
0.7	D	MGCARBONATE	DOMINANT MgCaCO3 (with SOME CaCO3)
1.0	E	EVAPORITE	PREDOMINANTLY SULPHATES AND HALIDES
0.5	F	FERROAN SILICATE-FERROAN CARNONATE	DOMINANT Fe SiO2 OR Fe-Mg/CaCO3
0.7	G	CACARBONATE-MGCARBONATE	DOMINANT CaCO3 (60%+) SUBORDINATE MgCaCO3 (40%-)
0.7	H	MGCARBONATE-CACARBONATE	DOMINANT CaCO3 (60%+) SUBORDINATE MgCaCO3 (40%-)
0.2	I	INTERMEDIATE	IGNEOUS ROCKS WITH MOD SILICA (52-63%)
0.7	J	SILICA-CACARBONATE	DOMINANT SILICA (60%+) SUBORDINATE CaCO3 (40%-)
0.7	K	CACARBONATE-SILICA	DOMINANT SILICA (60%+) SUBORDINATE CaCO3 (40%-)
0.7	L	CACARBONATE	DOMINANT CaCO3 with SOME CaMgCO3
0.7	M	CLAY_CACARBONATE	DOMINANT CLAYS (60%+) SUBORDINATE CaCO3 (40%-)
0.7	N	CACARBONATE_CLAY	DOMINANT CaCO3 (60%+) SUBORDINATE CLAY (40%-)
0.8	O	ORGANIC	DOMINANT ORGANIC MATERIAL (90%+)
0.7	P	MGCARBONATE-SILICA-CLAY	DOMINANT MgCaCO3 (60%+) SUBORDINATE SILICA-CLAY (40%-)
0.1	Q	SILICA_CLAY	DOMINANT SILICA (60%+) SUBORDINATE CLAY (40%-)
0.1	R	CLAY_SILICA	DOMINANT CLAYS (60%+) SUBORDINATE SILICA (40%-)
0.1	S	SILICA	DOMINANT SILICA (90%+)
0.7	T	CACARBONATE_SILICA-CLAY	DOMINANT CaCO3 (60%+) SUBORDINATE SILICA-CLAY (40%-)
0.5	U	ULTRABASIC	IGNEOUS ROCKS WITH VERY LOW SILICA (45%-)
0.7	V	CLAY-SILICA-CACARBONATE	DOMINANT SILICA &CLAY (60%+) SUBORDINATE CaCO3 (40%-)
0.7	W	-SILICATE-MGCARBONATE	DOMINANT SILICA-CLAY (60%+) SUBORDINATE MgCaCO3 (40%-)
0.5	X	MIXED	BULK MINERALOGY IS VARIABLE DUE TO LITHOLOGY
	?	NA	NO APPLICABLE MINERALOGY

Figure 13: Definition of the Mineralogy scores (MNL_SCR)

Each river segment corresponds to a change in the underlying geology.

GIS Note: The layer fields containing the value -999 relate to No Data information due to the superficial deposits having not been mapped.

3.3.2.1 River Average Geological Susceptibility

The average-case uses both the density and strength information for given geological formations and uses the average score.

Data source: BGS Civils Strength v6, BGS Parent Materials v6

Table 8: Tier 3 River_Average_Geological_Susceptibility fields and descriptions

Name	Description
MINERALOGY	Average Geological description of material mineralogy
MNL_SCR	Average Mineralogy score per river segment
DENSITY	Average Engineering description of geological material density
STRENGTH	Average Engineering description of geological material strength
STG_SCR	Average Density/Strength score per river segment
AVERAG_SCR	Average geological susceptibility total score
SCR_DESC	Average geological susceptibility description

PRODUCT	Name of the data product
TIER	Tier number within the data product
DATASET	Name of the dataset layer

The average-case geological susceptibility data layer is using both the density and strength information for a given geological formation and uses the average score. (e.g. **STR_TY** = Strong = 0.2 and **DEN_TY** = Medium Dense = 0.9, overall score for strength will be 0.55).

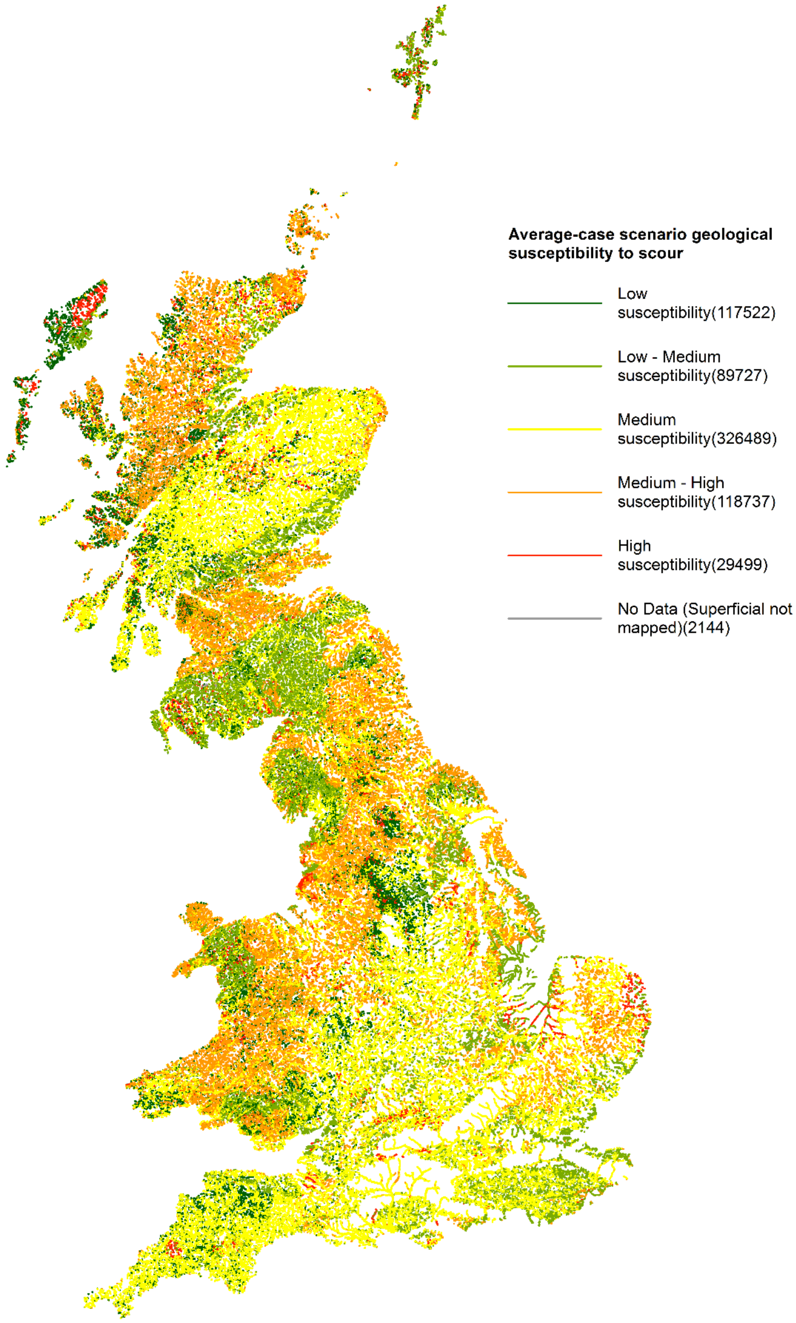


Figure 14: Average-case scenario geological susceptibility to scour map. Numbers in bracket indicate number of features

3.3.2.2 River Best Geological Susceptibility

The best-case only uses the strength values of the materials without integrating the density.

Data source: BGS Civils Strength v6, BGS Parent Materials v6.

Table 9: Tier 3 River_Best_Geological_Susceptibility fields and descriptions

Name	Description
MINERALOGY	Best Geological description of material mineralogy
MNL_SCR	Best Mineralogy score per river segment
STRENGTH	Best Engineering description of geological material strength
STG_SCR	Best Strength score per river segment
BEST_SCR	Best geological susceptibility total score
SCR_DESC	Best geological susceptibility description
PRODUCT	Name of the data product
TIER	Tier number within the data product
DATASET	Name of the dataset layer

The best-case geological susceptibility data layer is only looking at the strength values of the materials without looking at the density descriptions (**DEN_TY** field). However, some density values (Dense) are still provided in the **STG_TY** field (Figure 15). The same scores used in the previous average-case have been kept for the strength and for the Very Dense and Dense category, but all the remaining densities which are not used in the **STG_TY** field have been assigned the maximum value of 1.

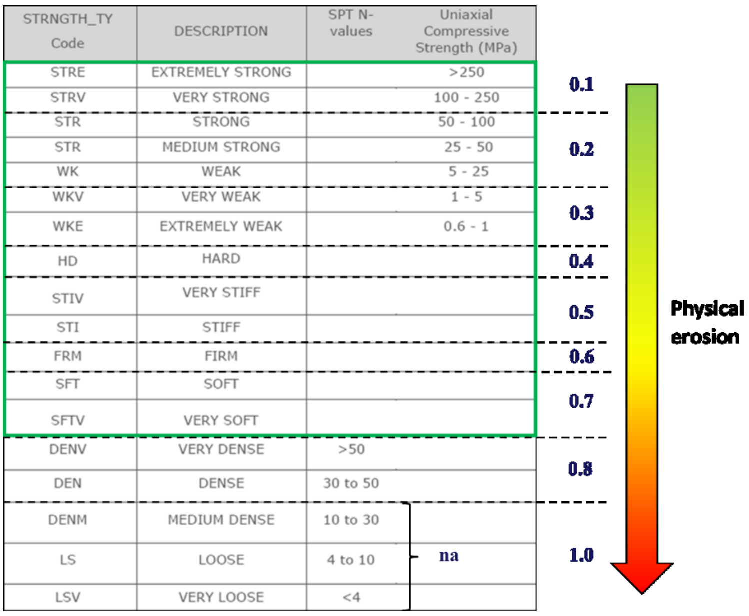


Figure 15: Definition of the Strength scores (STG_SCR) for the best-case scenario river geological susceptibility

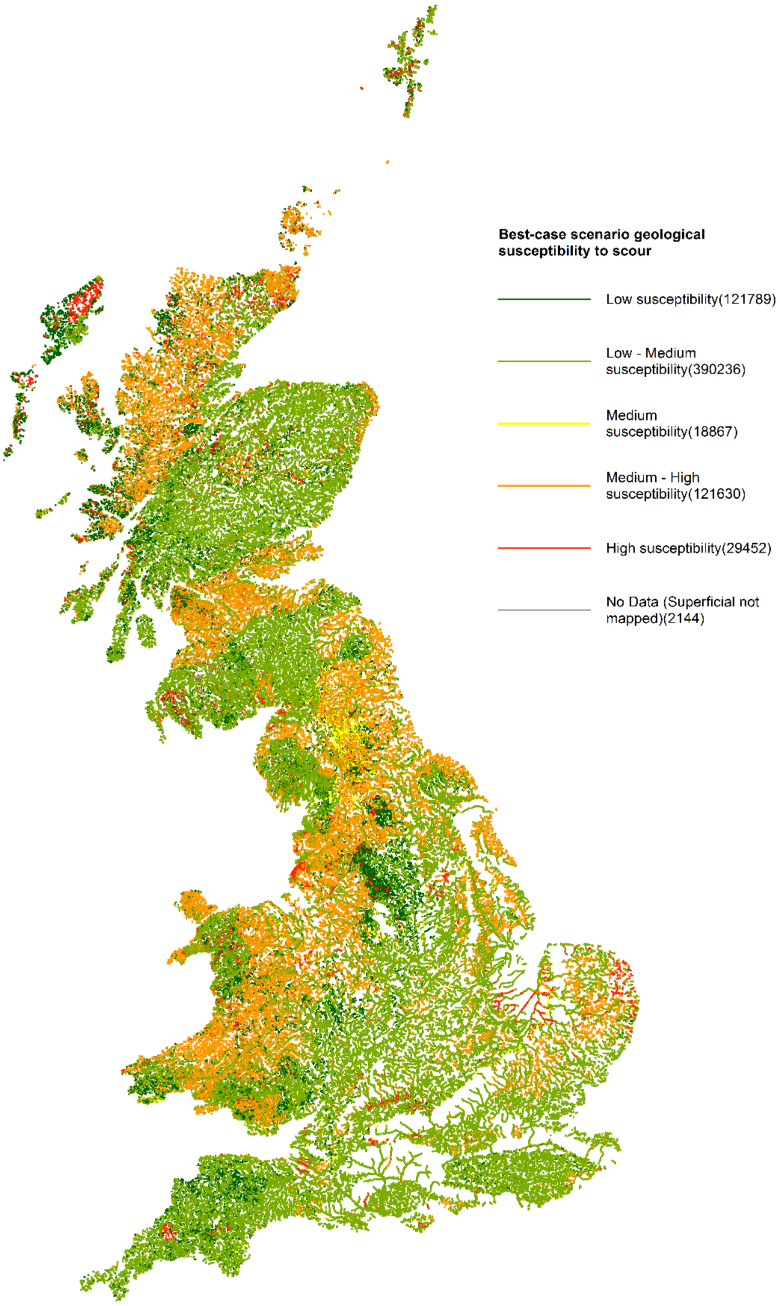


Figure 16: Best-case scenario geological susceptibility to scour map. Numbers in bracket indicate number of features

3.3.2.3 River Worst Geological Susceptibility

The worst-case uses the density values over the strength which means that when both density and strength are present for a given geological formation, only the density value is used.

Data source: BGS Civils Strength v6, BGS Parent Materials v6

Table 10: Tier 3 River_Worst_Geological_Susceptibility fields and descriptions

Name	Description
MINERALOGY	Worst Geological description of material mineralogy
MNL_SCR	Worst Mineralogy score per river segment
DENSITY	Worst Engineering description of geological material density
STRENGTH	Worst Engineering description of geological material strength
STG_SCR	Worst Density/Strength score per river segment
WORST_SCR	Worst geological susceptibility total score
SCR_DESC	Worst geological susceptibility score description
PRODUCT	Name of the data product
TIER	Tier number within the data product
DATASET	Name of the dataset layer

The worst-case geological susceptibility data layer is looking at the density values over the strength values which means when both density and strength are present for a given geological formation, the density value is used to determine the overall strength score (e.g. **STR_TY** = Strong = 0.2 and **DEN_TY** = Medium Dense = 0.9, overall score for strength will be 0.9).

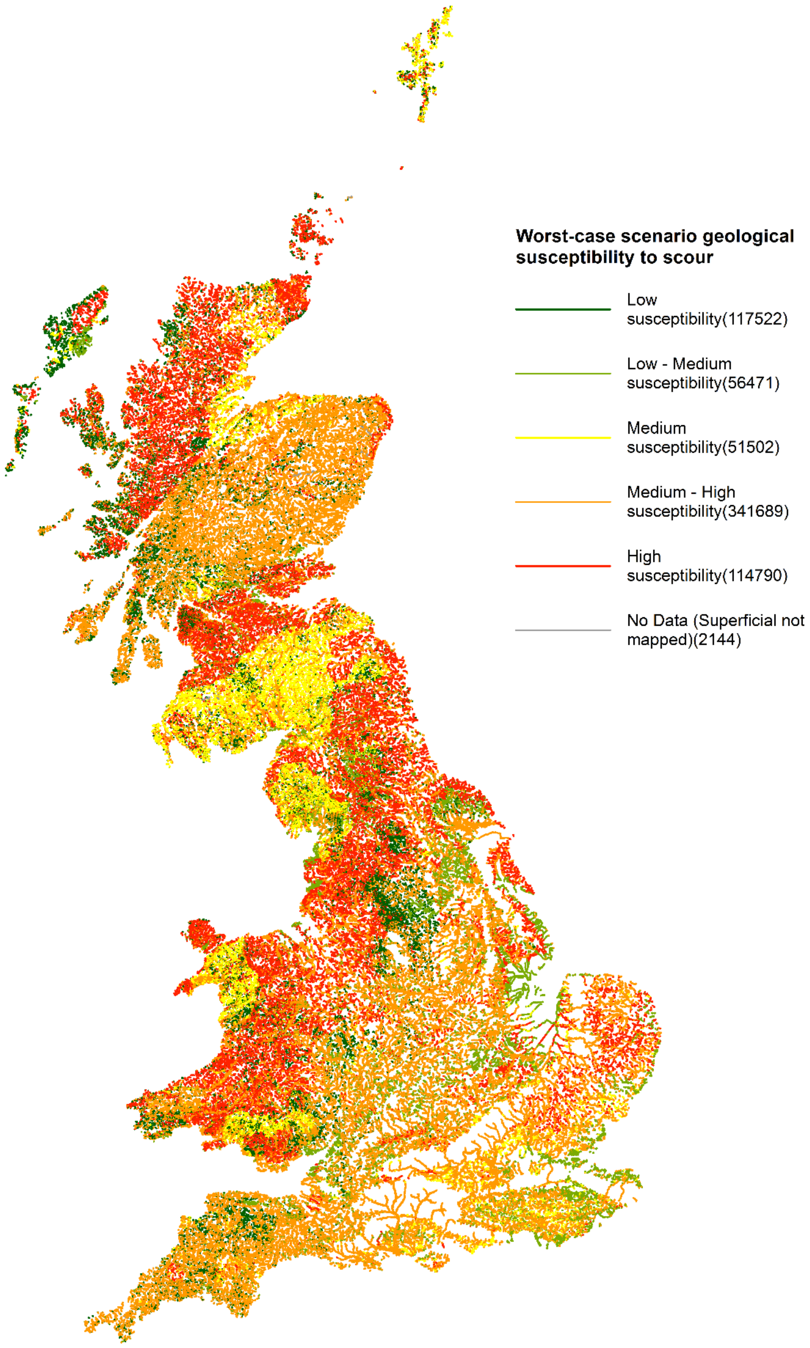


Figure 17: Worst-case scenario geological susceptibility to scour map. Numbers in bracket indicate number of features

3.3.3 River Morphology

The River Morphology data layer contains information on the key morphological characteristics of the catchment at the riverine level. These include the flood accommodation space available per river reach, the vertical fall of the river per reach and also the sinuosity factor. These factors can influence the location of, and intensity of scour processes and are strongly determined by the underlying geological deposits. This data does not include any artificial defences or modifications to the river, it is an assessment based purely on the geology and terrain morphology. This is useful to understand, especially in cases where artificial features might fail or be no longer maintained.

Data source: NEXTMap® DTM (5 and 10m)

Table 11: Tier 3 River_Morphology fields and descriptions

Field name	Field description
PERC_LOW	% length low flood accommodation space
PERC_MED	% length medium flood accommodation space
PERC_HIGH	% length high flood accommodation space
DOM	Dominant flood accommodation space class value
DOM_DESC	Dominant flood accommodation space class description
WORST	Worst-case flood accommodation space class value
WORST_DESC	Worst case flood accommodation flood class description
FALL	Numeric value of the river fall
SINUO	Numeric value of the sinuosity
SINUO_DESC	Sinuosity value description
PRODUCT	Name of the data product
TIER	Tier number within the data product
DATASET	Name of the dataset layer

3.3.3.1 River flood accommodation space

The accommodation space available for a river to flood is a key factor in determining scour potential. The wider and low-lying the valley, the more space there is for flood waters, allowing water flows to decreases and dissipate energy, which in turn, decreases the potential for scouring. The narrower and more constrained the river valley, the greater the likelihood for scour and vertical erosion reducing the level of the river bed. This data layer provides an initial assessment of this accommodation space by classifying the river valleys into three categories - low, medium and high.

Class	Description
Low accommodation space	Typically narrow and deep valley profiles, little accommodation space for flood waters, increased scour potential
Medium accommodation space	Typically limited floodplain capacity, valleys constrained
High accommodation space	Typically wide shallow valley profile, space for flood waters

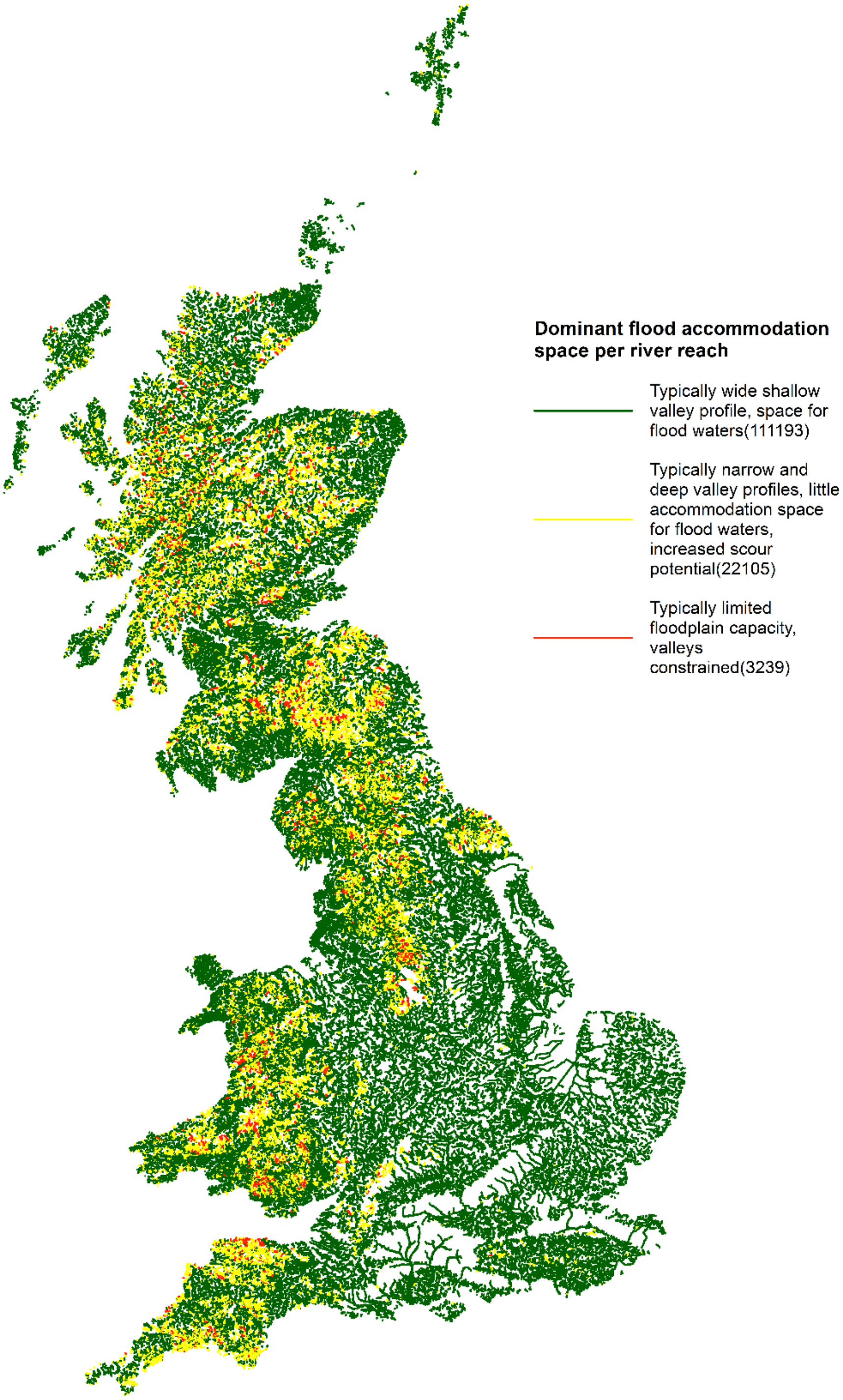


Figure 18: Flood accommodation space per river reach map. Numbers in bracket indicate number of features

3.3.3.2 River fall

The fall of the river is often coincidental with the underlying geology, (which can reflect changes in the geology) and influences the amount of stream power within specific sections of river reach. Generally, the steeper the fall, the more the potential for scour processes to occur.

The river fall is calculated as the difference in elevation of the start and end of the river reach divided by the distance between the start and end points.

3.3.3.3 SINUOSITY

Sinuosity is an important factor in evolving river morphology and again, can be influenced, to some degree, by the geological properties. The sinuosity component of the River Morphology dataset has used published literature to classify the data, for example, Hydraulic Design Manual, Notice: 2016-1.

Table 12: Threshold values for sinuosity

Class	Thresholds
Straight	1 =< sinuo =< 1.05
Sinuous	1.05 < sinuo =< 1.25
Meandering	1.25 < sinuo =< 2.0
Highly meandering	sinuo > 2.0

3.4 INPUT DATA

A range of different datasets were used to develop the various layers within the multi-tiered GeoScour dataset:

- BGS Quaternary Domains
- BGS Glaciation Limits
- BGS Permeability v7
- BGS Civils Strength v6
- BGS Parent Materials v6
- NEXTMap 5m 2004 (Intermap)
- NEXTMap 10m 2004 (Intermap)
- OS Strategi Urban Region 2016
- Ramsar England 2019 (Natural England)
- Ancient Woodland Inventory England 2019 (Natural England)
- National Nature Reserves England 2019 (Natural England)
- Special Areas of Conservation England 2019 (Natural England)
- Special Protection Areas England 2019 (Natural England)
- Sites of Special Scientific Interest England 2019 (Natural England)
- Ramsar Scotland 2005 (SNH)
- Ancient Woodland Inventory Scotland 2010 (SNH)
- National Nature Reserves Scotland 2018 (SNH)
- Special Areas of Conservation Scotland 2018 (SNH)
- Special Protection Areas Scotland 2019 (SNH)
- Sites of Special Scientific Interest Scotland 2019 (SNH)
- Ramsar Wales 2018 (NRW)
- Ancient Woodland Inventory Wales 2011 (NRW)
- National Nature Reserves Wales 2018 (NRW)
- Special Areas of Conservation Wales 2018 (NRW)
- Special Protection Areas Wales 2018 (NRW)

- Sites of Special Scientific Interest Wales 2019 (NRW)
- WFD River Waterbody Catchments Cycle 2 (EA)
- WFD River Basin Districts Cycle 2 (EA)
- WFD Management Catchments Cycle 2 England 2014 (EA)
- WFD Management Catchments Cycle 2 Wales 2015 (NRW)
- Main river and coastal catchments in Scotland 2018 (SEPA)[1]
- Local Plan Districts sourced from SEPA

The selection of these datasets was based on internal consultation with a range of BGS experts and were deemed the most useful for the development of the GeoScour dataset product at the time of creation.

The OS Open Rivers 2018 dataset has been used as a baseline to provide information at the Tier 3 level. Only the inland rivers have been taken into consideration. The rivers describe as lakes, tidal and canals have not been included.

3.5 LIMITATIONS

- BGS GeoScour has been developed as three tiers of information: Tier 1 at 1:625 000 scale; Tier 2 at 1:250 000 scale and Tier 3 at 1:50 000 scale. **It is intended for use as a desk study screening tool prior to detailed site investigations, input into catchment management planning or input into river scour models.** It should not be taken as a substitute for specialist interpretations, professional advice and/or detailed site investigations.
- BGS GeoScour datasets are concerned with the geological properties and propensity for scour processes related to **NATURAL geological conditions only. This version does NOT cover any man-made components, such as flood defences, weirs. It does not account for flow rates, sediment budget or other scour modelling parameters**.
- BGS GeoScour dataset 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 geological scour susceptibility does not necessarily mean that a location will be affected by scour or experience failure.
- 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 and input into scour models alongside other data (e.g. flow rates, sediment budgets, etc.).
- Whilst BGS has carried out all the necessary quality checks on the 11 layers within the GeoScour product it accepts no warranty as to quality of the third party products that have been used to create GeoScour.

[1] Hyperlink needs to be opened in Internet Explorer, does not work in Google Chrome

4 Licencing Information

4.1 BGS LICENCE TERMS

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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.

4.2 CONTACT INFORMATION

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5 Glossary

Terminology	Definition
Aggradation:	Deposition of sediment that results in an increase in land elevation within the river system. Aggradation occurs where the sediment supply is higher than the amount of material being transported.
Hazard:	A potentially damaging event or phenomenon.
Lacustrine:	Sediments deposited in low-energy lake environments.
Meta-stable:	River systems that were not glaciated during the last glaciation and are not undergoing a period of paraglacial adjustment.
Paraglacial adjustment:	Processes related to landscape response following previous glaciations. River systems that are still undergoing landscape adjustment following the last glaciation
Quaternary:	The current and most recent time period which includes the Pleistocene (2.588 million years ago to 11.7 thousand years ago) and the Holocene (11.7 thousand years ago to today).
Tectonics:	Tectonic adjustment is the rebound in response to earth's tectonic events such as plate collision (mountain building).
Risk:	The impact of the hazard on people, property or capital. e.g. a weak scour-prone deposit 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 scour potential, but the assets 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 asset. The GeoScour dataset does not identify the cost of a hazard being realised, and therefore does not consider risk. It only examines the conditions that leave an area exposed to the hazard.
River Scour:	The removal of sediment or engineered materials from the bed or banks of a watercourse, which can occur when the forces imposed by the flow on a sediment particle exceed the stabilizing forces (Kirby, *et al.* 2015, Highways Agency, 2006). In this dataset, the natural environment is considered only.

6 References

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