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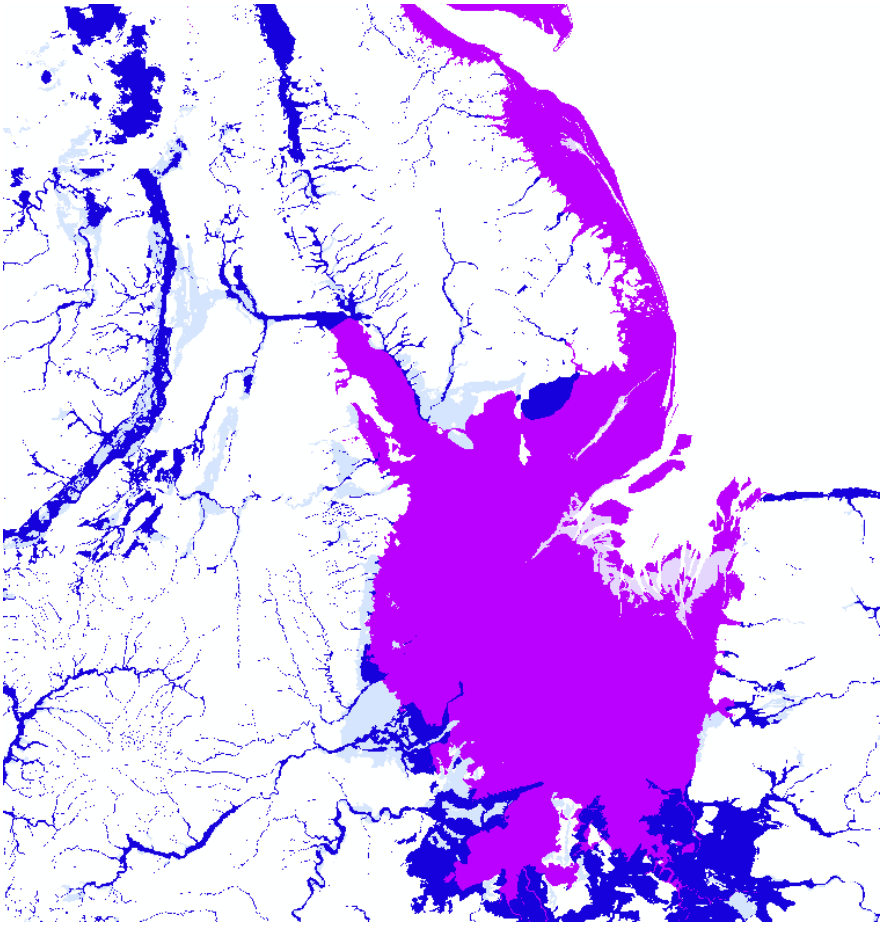
Geological Indicators of Flooding. User Guidance Notes

Information Products Programme
Open Report OR/10/12



BRITISH GEOLOGICAL SURVEY

INFORMATION PRODUCTS PROGRAMME

OPEN REPORT OR/10/12

Geological Indicators of Flooding: User Guidance Notes

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Part of the GIF dataset.

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BRITISH GEOLOGICAL SURVEY

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Contents

Summary

This report provides guidance notes for all users of the Geological Indicators of Flooding V5.2 dataset. It provides a description of the history, details of the data content and data format and notes on the recommended scale of use/search criteria.

1 The Geological Indicators of Flooding dataset

1.1 INTRODUCTION

The BGS Geological Indicators of Flooding (GIF) dataset is a digital map based on the BGS Digital Geological Map of Great Britain at the 1:50,000 scale (DiGMapGB-50, BGS, 2009). Current coverage includes England, Wales and Scotland. It characterises Superficial Deposits on DiGMapGB-50 in terms of their likely susceptibility to flooding, either from coastal inundation or fluvial (inland) water flow. These Superficial Deposits are considered 'recent' in geological terms, most having been formed within the last few tens of thousands of years. Typically they have been laid down by processes of erosion and deposition and they have produced subtle topographical features, resulting in low-lying landforms we call floodplains and coastal plains. The mapping of these landforms, in conjunction with characterisation of deposits that underlie them allows us to determine the extent of the coastal and inland flooding that created them. Observations made during recent major inland and coastal flooding events have demonstrated that the current floodplains and coastal plains continue to play a role in controlling where and how flooding occurs.

On this basis, the floodplains and coastal plains constituting areas at greatest risk from flooding can be both visualised and defined by superficial deposits as depicted on geological maps. These include deposits such as river alluvium and lacustrine (lake) alluvium, classified in the GIF as zone 1 deposits, as well as the younger river terraces or 'floodplain terrace' (raised level areas adjacent to or within floodplains, which represent the level of the floodplain prior to the most recent episode of floodplain formation). These latter are classified in the GIF as zone 2 deposits as they are perceived to be susceptible to flooding in more extreme events such as very heavy and prolonged periods of rainfall and/or extreme high tides, wind speeds and storm surges. They are the areas where secondary flooding may occur. Older and higher river terraces have been excluded as they tend to lie outside the geologically defined floodplain and relate to generations of floodplains extending back over hundreds of thousands of years in some cases. Areas at risk from coastal inundation are similarly characterised by a range of estuarine or marine deposits that include, for example, tidal flats and low-lying raised beaches. Reclaimed marine deposits have not been included as it is expected that these have adequate drainage designs and installations.

2 Rationale

The BGS Geological Indicators of Flooding (GIF) dataset is a digital map based on the BGS Digital Geological Map of Great Britain at the 1:50,000 scale (DiGMapGB-50, BGS, 2009). Current coverage includes England, Wales and Scotland. It characterises Superficial Deposits on DiGMapGB-50 in terms of their likely susceptibility to flooding, either from coastal inundation or fluvial (inland) water flow. These Superficial Deposits are considered 'recent' in geological terms, most having been formed within the last few tens of thousands of years. Typically they have been laid down by processes of erosion and deposition and they have produced subtle topographical features, resulting in low-lying landforms we call floodplains. The mapping of these landforms, in conjunction with characterisation of deposits that underlie them allows us to determine the extent of the coastal and inland flooding that created them.

Observations made during recent major inland and coastal flooding events (Oxfordshire and Hull were some of the regions badly affected in 2007 and Cumbria in 2009) have demonstrated that these previous floodplains continue to play a role in controlling where and how flooding occurs. In response to the flood events of summer 2007, the Pitt Review was commissioned. This review resulted in 92 recommendations being made by Sir Michael Pitt and publication of his full report, the 'Pitt Review' (see below).

2.1 LEGISLATION

In recent years, and particularly after the events of 2007, flooding hazard has been high profile both in the news and within governmental departments. This has resulted in new reviews, consultations, management plans, recommendations and government legislation. At the time of writing, much of this is ongoing and implementation is continuing. The Geological Indicators of Flooding dataset could provide additional valuable information for planners and other statutory bodies, and contribute towards mitigation strategies. A summary of the main legislative developments are outlined below;

2.1.1 The Pitt Review

An independent review of the 2007 flooding, commissioned by the government and led by Sir Michael Pitt, looked at its causes and subsequent management to see what lessons needed to be learned about how to manage and respond to this type of event in the future. Sir Michael's final report was published on 25 June 2008. The Pitt Review: Lessons learned from the 2007 floods

2.1.2 Summer 2007 Flooding and the Government Response

The Secretary of State published the Government's response to Sir Michael's Review of the 2007 Summer Floods on the 17 December 2008. It sets out a clear action plan to deliver against the challenging agenda identified by Sir Michael. The government response to the Pitt Review emphasizes the need for better knowledge of where flood risks are greatest to enable better planning. The BGS GIF dataset can assist in meeting this objective. Please see:

The Government's Response to Sir Michael's Review – progress report. June & Dec 2009
http://www.defra.gov.uk/environment/flooding/risk/floodreview2007.htm

Ministerial statement announcing review into floods 12 July 2007
http://archive.cabinetoffice.gov.uk/pittreview/thepittreview/statements/statement_announcement.html

Statement by Secretary of State 23 July 2007
http://archive.cabinetoffice.gov.uk/pittreview/thepittreview/statements/statement_oral_flood.html

Press releases
http://archive.cabinetoffice.gov.uk/pittreview/thepittreview/press_releases.html

The government promised to implement many of the recommendations made in Sir Michael Pitt's review. This includes giving local authorities a clear leadership role in local flood risk management, encompassing all sources of flooding.

2.1.3 The Floods and Water Bill: DEFRA

The Government are taking high profile action in the quest to mitigate climate change as Environment Secretary Hilary Benn announced a £15million increase in funding for local authorities to implement surface water management plans.

The plans for the Floods and Water Bill is set to take this further, with new responsibilities, tools and more importantly, funding to ensure that a changing water system can be effectively managed.

Floods and Water Bill: www.defra.gov.uk/environ/fcd/floodsandwaterbill.htm
The timeframe for the Floods and Water Bill is:-

- 14 May 2008 – Prime Minister announces proposed draft Floods and Water Bill in Legislative Green Paper

- Autumn 2008 – Work begins on planning the Draft Bill

- Spring 2009 – Government aim to produce Draft Floods and Water Bill for consultation. The consultation period ended 24 July 2009.

There is also a DEFRA Shore management Plan:
http://www.defra.gov.uk/environment/flooding/policy/guidance/smp.htm

2.2 THE ROLE OF THE ENVIRONMENT AGENCY

The Environment Agency has been given responsibility to be the point of contact for all flood related issues and is tasked with taking forward and implementing the recommendations in the Pitt Review. They now have a number of documents and guidance notes including the following:-

2.2.1 Catchment Flood Management Plans (CFMPs)

The Environment Agency, Defra and the Welsh Assembly have recently updated volume 1 of the draft guidance for CFMPs. This guidance sets out the scope of a CFMP and it has been revised to reflect the lessons learned to date from the pilot studies. It held a consultation process in 2004. Details can be found at http://www.environment-agency.gov.uk/research/library/consultations/54930.aspx and
http://www.environment-agency.gov.uk/static/documents/Research/cfmp_guideline_891473.pdf

2.2.2 Development and flood risk

Local Planning Authorities (LPAs) in England are now required to consult the Environment Agency (EA) on most development proposals at risk from flooding. Planning Policy Statement 25 (PPS25) 'Development and Flood Risk' and its associated Practice Guide set out Government policy and advice on the subject.
The PPS25 document and other information can be found at
http://www.environment-agency.gov.uk/research/planning/33698.aspx

The EA provide technical advice to LPAs and developers on how best to avoid, manage and reduce the adverse impacts of flooding. The aim is to encourage decision-makers to:

- carry out regional and strategic assessments of flood risk as part of sustainability appraisal
- include suitable flood risk objectives and indicators
- correctly apply the sequential test, steering new development to the lowest risk flood zone appropriate to the proposed use, and the exception test
- reduce flood risk through making space for water

- when climate change is expected to mean that some existing development may not be sustainable in the long-term, use regeneration to help relocate existing development to lower risk locations
- include policies that reflect PPS25's Key Planning Objectives.

The planning application may be rejected if:

- the proposed development is not consistent with Government Planning Policy
- lack of evidence that the sequential test and (where needed) the exception test have been applied correctly
- it is not supported by a flood risk assessment
- the flood risk assessment does not demonstrate that the development and its occupants/users will be safe for the lifetime of the development, does not increase flood risk elsewhere and does not seek to reduce risk overall

2.3 THE SCOTTISH PARLIAMENT

A 25-year plan for flood management measures should be drawn up, according to MSPs. Holyrood's Rural Affairs and Environment Committee has been conducting an inquiry into the issue. It also wants the Scottish Environment Protection Agency (SEPA) to have responsibility for flood-risk management. The Scottish Government is planning to introduce legislation on flood management later in the year. In February the committee held a session in Elgin, which has been badly hit by flooding in recent years. In evidence the Association of British Insurers called for a 25-year flood management strategy to plan an investment programme to mitigate flooding problems. (*BBC News 16 May 2008)*

3 What is the Geological Indicators of Flooding dataset?

3.1 TYPES OF FLOODING

The GIF dataset is designed to be relevant to most of the categories of flooding set out, for example, in the Government's Planning Policy Statement 25: *Development and Flood Risk* (PPS 25)**.** This recognises that flooding is a natural process and can happen at any time, with a wide variety of locations and geographical settings proving vulnerable.

- *Flooding from rivers* occurs when the amount of water in them exceeds the flow capacity of the river channel. Most rivers are surrounded by a floodplain, the natural function of which is to accommodate any excess water that spills over from the river. The geological deposits of the floodplains, as defined above, constitute large parts of the GIF; however, it is accepted that floodplains are commonly obstructed by barriers or development and the effects of such modifications cannot be taken into account in the GIF.
- *Flooding from land* happens when intense rainfall, often of short duration, either a) runs rapidly down slopes or b) is unable to soak into the ground or enter drainage systems before causing local flooding. The scenario envisaged by a) could occur in mountainous areas such as Wales and Scotland, however, scenario b) is the one most anticipated by the GIF dataset. It typically occurs in low-lying, poorly drained areas and the flood can be of long duration, a classic example

being the inundations of Hull, situated on a coastal plain, and subjected to severe floods in the summer of 2007.

- *Flooding from groundwater* cannot be anticipated by the GIF, except for the general case where groundwater flooding commonly accompanies surface flooding in permeable deposits that underlie floodplains and coastal plains. A separate dataset on groundwater flooding in areas of permeable bedrocks, such as the Chalk downlands, is available from BGS.
- *Flooding from reservoirs, canals* and other artificial sources cannot be anticipated by the GIF maps.
- *Flooding from the sea* typically results from a combination of high seasonal tides and weather patterns that generate storm surges. It results in the rapid inundation of low-lying areas, such as coastal plains and estuaries, the deposits of which form part of the GIF dataset.

3.2 FLOOD CATEGORIES IN THE GIF

In summary, GIF includes categorisation of deposits that may be susceptible to:-

Fluvial Zone 1 & Zone 2: Flooding from rivers where the capacity of the river channel is exceeded and water overflows. This is identified as "fluvial" in the GIF, and is subdivided into higher (zone 1) and lower (zone 2) susceptibility categories;

Coastal Zone 1 & Zone 2: Flooding from the sea as a result of high tides and storm surges is identified as "coastal" flooding in the GIF. This is similarly subdivided into higher (zone 1) and lower (zone 2) susceptibility categories.

Both classifications are also subject to an element of pluvial flooding from land as a result of and episode of heavy intense rainfall. We do not have a specific category to identify this type of event.

GIF does not currently identify the presence of permanent standing bodies of "water" such as lakes or canals.

3.3 WHO NEEDS GIF INFORMATION?

The Geological Indicators of Flooding dataset has been designed to meet the needs of a wide range of users wishing to assess flooding hazards across the UK. Its scale and coverage make it an ideal dataset for national, regional and local scales of assessment and so its user-base is envisaged to include:

- Non governmental organisations
- Local authorities
- Insurance companies
- Consultants
- Surveyors
- Planners (including development and incident)
- Environmental officers
- Developers
- Land owners
- Home owners

The BGS Geological Indicators of Flooding data should be regarded as complementary to, but not a replacement for, existing Environment Agency flood risk maps.

The Environment Agency flood web pages can be found at:

http://www.environment-agency.gov.uk/subjects/flood/

4 Using the Geological Indicators of Flooding dataset

4.1 FORMAT AND CONTENT

The dataset comprises a digital map showing areas prone to the two main types of flooding – fluvial (inland) and coastal/estuarine. The map is available in a range of popular vector formats; suitable for use within GIS systems such as ESRI's ArcGIS and MapInfo (other formats are available).

The data is supplied on CD and includes all the files necessary to open that data within the GIS system. Each dataset consists of a map 'layer' showing polygons of flooding potential, each polygon contain a number of attributes.

The content of the data includes the following:

- **Class**: this is the '*zone*' and '*mode*' combined giving 4 possible types of flooding-
  - coastal flood deposits
    - zone 1 – areas susceptible to the first influx of flood waters
    - zone 2 – areas that are susceptible in extreme flood events (e.g. storms surges and exceptionally high tides)
  - fluvial – inland fluvial flood deposits
    - zone 1 – areas susceptible to the first influx of flood waters
    - zone 2 – areas that are susceptible in extreme flood events
- **Zone**: this indicates the level of potential flooding, it is divided into 2 zones; *'Zone 1'* are areas with a high potential to flood; *'Zone 2'* are secondary flood areas that may be susceptible in extreme or prolonged events.
- **Mode**: this indicates the type of flood that an area might be susceptible to; either *'fluvial'* or *'coastal'* flooding.
- **Legend**: a brief explanation of the type of flooding potential
- **Version**: the version number of the dataset

4.2 DATA HISTORY

The GIF data is primarily derived from the 1:50 000 scale digital geological map of Great Britain, DiGMapGB-50. Where 1:50 000 data is not available, data of smaller scale has been used. BGS is continually surveying and resurveying areas of Britain, improving and updating the geological maps. These updates are made to DiGMapGB-50 annually. Therefore, each new release of GIF will be based upon the most recent version of DiGMapGB-50. Below is an outline of the data history of the GIF to date.

Version 1 (released 2007): Derived from DiGMapGB-50 version 3.14 (England & Wales)

Version 5.1 (released 2009): Derived from DiGMapGB-50 version 5.18 (England, Wales & Scotland)

Version 5.2 (released March 2010): Derived from DiGMapGB-50 version 5.18 (England, Wales & Scotland) using new methodologies.

Version 5.3 (released June 2010): Derived from DiGMapGB-50 version 5.18 (England, Wales & Scotland).

(In 2008 BGS introduced its new versioning system whereby the version number of the dataset relates to the version of DiGMapGB-50 base data, hence the reason for the jump between GIF version 1 to version 5).

4.3 POINTS TO CONSIDER WHEN USING THE DATASET

The dataset is based purely on observation of the types of geological deposit present and does not take into account any man-made influences such as flood protection schemes. Nor does the dataset take into account the possibility of flooding onto low-lying ground that is not occupied by the 'indicator' deposits described above and depicted on the GIS. It should also be noted that the dataset is based on geological maps compiled at different times, and at varying scales, and that while every effort is made to upgrade the geological coverage of Britain, there may at present be inconsistencies of interpretation and representation of these deposits from one area to another.

4.3.1 Using the GIF dataset

The dataset is derived from a digital map of 1:50,000 scale and should not be used at any scale greater than this. In practical terms, it is recommended that when carrying out a spatial search against the GIF data, the user should use a 50m buffer for their site/area of interest to allow for the spatial accuracy of the underlying DiGMapGB-50 data.

Users should also be aware that if the GIF indicates their site is underlain by deposits susceptible to flooding, that this **does not necessarily** mean that flooding will occur. The data behind the GIF are purely 'geological' and do not take into account any man-made factors such as flood protection schemes or landscape management. The data is simply indicating those geological deposits which have been associated with flooding in the recent geological past and which therefore may still be vulnerable to flooding.

In summary

- GIF has been developed at 1:50 000 scale and is not suitable to be used at larger scales (care must be taken when using the dataset at different scales due to the accuracy of the underlying geological maps from which the dataset was derived), and all spatial searches against the data should be done with a minimum 50 m buffer.
- Data coverage includes England, Wales and Scotland.
- GIF data are created as vector polygons and are available in a range of GIS formats, including ArcGIS (.shp), ArcInfo Coverages and MapInfo (.tab).
- GIF is concerned with geological deposits which may be vulnerable to flooding related to NATURAL geological conditions only. GIF does NOT cover any man-made factors.

- GIF 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 geological deposits which may be vulnerable to flooding does not necessarily mean that a location will be affected by flooding.

5 Further information and contacts

Further information on GIF and other digital data provided by the BGS can be found on our website at:-

http://www.bgs.ac.uk/science/landUseAndDevelopment/shallow_geohazards/floods_home.html

www.bgs.ac.uk or by contacting:

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Appendix 1: Mapping scales that the GIF data is based upon