



**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

Model metadata report for the Leeds-Aire Valley 3D Geological Model

Engineering Geology Programme

Open Report OR/14/044



BRITISH GEOLOGICAL SURVEY

ENGINEERING GEOLOGY PROGRAMME

OPEN REPORT OR/14/044

The National Grid and other
Ordnance Survey data © Crown
Copyright and database rights
2014. Ordnance Survey Licence
No. 100021290.

Model metadata report for the Leeds-Aire Valley 3D Geological Model

Keywords

Report; keywords 3D Model,
Leeds, Superficial Deposits.

National Grid Reference

SW corner 428000,427000
Centre point 432000,431000
NE corner 438000,434400

Map

Sheet 70, 1:10 000 scale, Leeds

Front cover

Leeds Superficial modelled
volumes with Ordnance Survey
Mini Scale Map (Contains
Ordnance Survey data © Crown
copyright and database right
2010)

Bibliographical reference

TERRINGTON, R., SHELLEY, C.,
RAMOS CABRERA, L.. 2013.
Model metadata report for the
Leeds Aire Valley 3D Geological
Model. *British Geological Survey
Open Report*, OR/14/044. 14pp.

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.

R L Terrington, C Shelley, L Ramos Cabrera

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.

British Geological Survey offices

BGS Central Enquiries Desk

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

Kingsley Dunham Centre, Keyworth, Nottingham NG12 5GG

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

Murchison House, West Mains Road, Edinburgh EH9 3LA

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, Colby House, Stranmillis Court, Belfast BT9 5BF

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

Foreword

This report is the published metadata details of a 3D modelling study by the British Geological Survey (BGS), and is based on the Leeds-Aire Valley superficial deposits model. The model was developed under the Urban Geoscience team, part of the Engineering Geology programme. The model was developed to provide a base layer for the Anthropogenic study in Leeds. The Anthropogenic research project particularly focussed on methods for enhancing the modelling of deposits such as Worked Ground (WGR), Worked and Made Ground (WMGR), Made Ground (MGR) and Landscaped Ground (LSGR).

Acknowledgements

A number of individuals have worked on the Anthropogenic study and have provided guidance and advice when constructing the Leeds-Aire Valley Model. We would particularly like to thank the following:

Simon Price

Steve Thorpe

Helen Burke

Helen Smith

Contents

Foreword	2
Acknowledgements	2
Contents	3
Summary	5
1 Modelled volume, purpose and scale	5
2 Modelled surfaces/volumes	6
3 Model datasets	6
3.1 DTM.....	7
3.2 Borehole data.....	7
3.3 Map data.....	8
4 Dataset integration	8
5 Model development log	8
6 Model workflow	9
7 Model assumptions, geological rules used etc	9
8 Model limitations	9
9 Model images	9
10 Model uncertainty	10
Glossary	10
References	11

FIGURES

Figure 1 Cross-section distribution of the GSI3D model constructed for the Leeds-Aire Valley region.....	5
Figure 2 Borehole considered (those on cross-section) in the construction of the Leeds Aire Valley Superficial Model.....	7
Figure 3 The whole model looking from the South East. Artificial deposits in grey, Alluvium in yellow, River terrace deposits in orange, Till in blue, Glacial Fluvial deposits in red and Glacial lacustrine deposits in purple. Includes outer extents of envelopes not constrained by cross-sections. Vertical exaggeration is x10.....	9

Figure 4 Leeds-Aire Valley Model cross-sections (coloured by Stratigraphy) and Boreholes
(coloured by Lithology)..... 10

TABLES

Table 1 List of geological units modelled in the Leeds Aire Valley 3D geological model..... 6

Summary

This report summarises the data and information used in the construction of the model of Leeds Aire Valley. The model was constructed using GSI3D v2012 and is of the artificial and superficial deposits only.

1 Modelled volume, purpose and scale

The Leeds Aire Valley 3D model is of the Artificial and Superficial deposits only. The model covers an area of approximately 40 km² ranges in thickness between 1 to 20 m and extends in elevation from 15 m to 75 m OD. The model cross-sections are aligned in a north west to south west and south west to north east direction along the River Aire valley, which extends across the south eastern part of the Leeds urban centre (Figure 1). The model was constructed to inform the Anthropogenic Processes Project about the types of superficial deposits in the Aire valley and their general thickness. Artificial ground has also been modelled as a base layer from which the Anthropogenic Processes Project would enhance this layer with further data and information from various detailed studies on the boreholes and historical landuse.

As the model extends across and along the River Aire Valley in an urban centre, much of the natural Holocene (e.g. Alluvium and River Terrace Deposits) and Devensian (e.g. glacial deposits such as Till, Glaciolacustrine and Glacial Fluvial deposits) are covered by artificial ground. Further details of these units can be found in section 2.

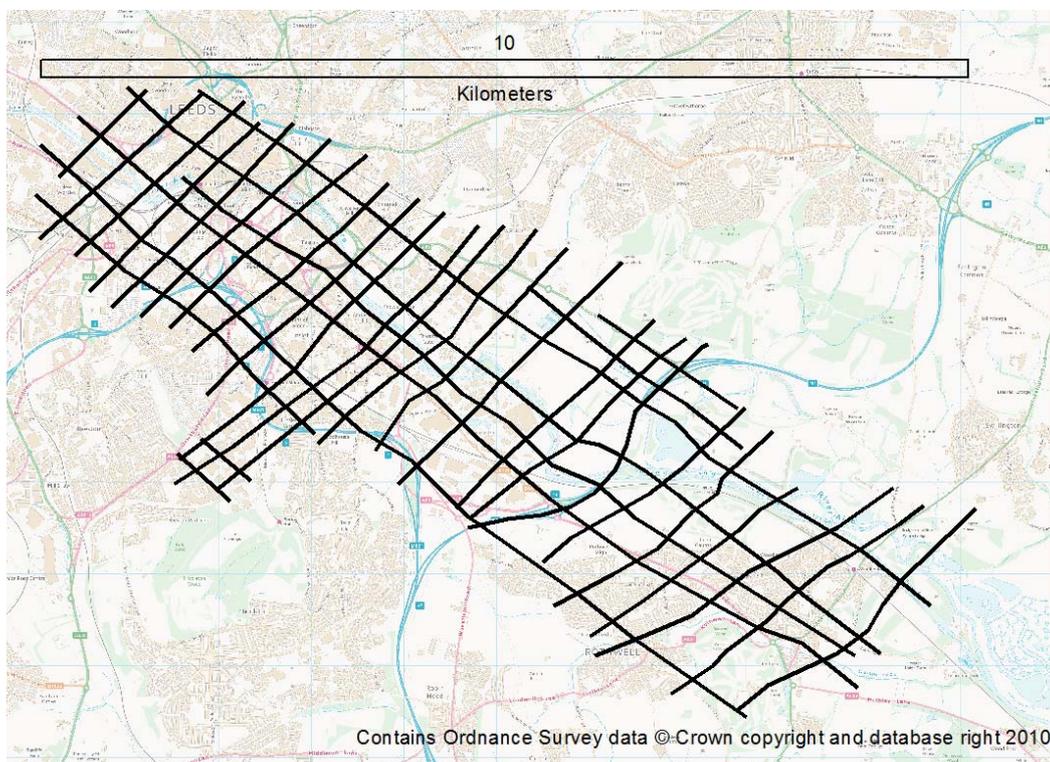


Figure 1 Cross-section distribution of the GSI3D model constructed for the Leeds-Aire Valley region

2 Modelled surfaces/volumes

Table 1 shows the list of units that have been modelled as surfaces/volumes in the Leeds Aire Valley model:

Model Unit Name	Lexicon Code	Rock Classification Scheme	Full Name	Age	Description, Lithology
soil	SOIL	SOIL	Soil	Holocene	Soil
mgr	MGR	ARTDP	Made Ground	Holocene	Made Ground (Undivided). Includes colliery spoil and industrial and commercial waste
lsgr	LSGR	ARTDP	Landscaped Ground	Holocene	Landscaped Ground (including sewage works, industrial trading estates)
wgr	WGR	VOID	Worked Ground	Holocene	Worked Ground (Undivided)
wmgr	WMGR	ARTDP	Worked and Made Ground	Holocene	Infilled Ground
alv_1	ALV	ZCS	Alluvium 1	Holocene	Silt, Clay and Sand
rtdu	RTD1	SV	River Terrace Deposits	Holocene	Sand and Gravel
till	TILL	CZSV	Main Till Sheet	Devensian	Diamicton
gld	GLLD	CZ	Glaciolacustrine Deposit	Devensian	Silt and Clay
gfdu	GFDU	SV	Glaciofluvial Deposit	Devensian	Sand and Gravel

Table 1 List of geological units modelled in the Leeds-Aire Valley 3D geological model

3 Model datasets

General caveats regarding BGS datasets and interpretations are:

- Geological observations and interpretations are made according to the prevailing understanding of the subject at the time. The quality of such observations and interpretations may be affected by the availability of new data, by subsequent advances in knowledge, improved methods of interpretation, improved databases and modelling software, and better access to sampling locations.
- Raw data may have been transcribed from analogue to digital format, or may have been acquired by means of automated measuring techniques. Although such processes are subjected to quality control to ensure reliability where possible, some raw data may have been processed without human intervention and may in consequence contain undetected errors.

3.1 DTM

NextMap (Intermap) and Bald Earth (Landform Panorama) digital terrain model sub-sampled to 25 m grid spacing.

3.2 BOREHOLE DATA

424 boreholes were coded by the authors using the Unlithified Deposits Coding scheme (Cooper et al., 2006)

The content code used in the BoreholeGeology database (BoGe) was 'LE'. The 'LE' content code was used to extract the BLG (the down hole geology file) and BID (the borehole index file) data from the BoGe database (Figure 2). The following fields were extracted:

- QS, Number, Bsuff (Concatenated to Borehole_ID in BLG file)
- Depth to base of Unit
- Stratigraphy
- Lithology
- Interpreter
- Content Code
- Base Bed Code
- Unit Description

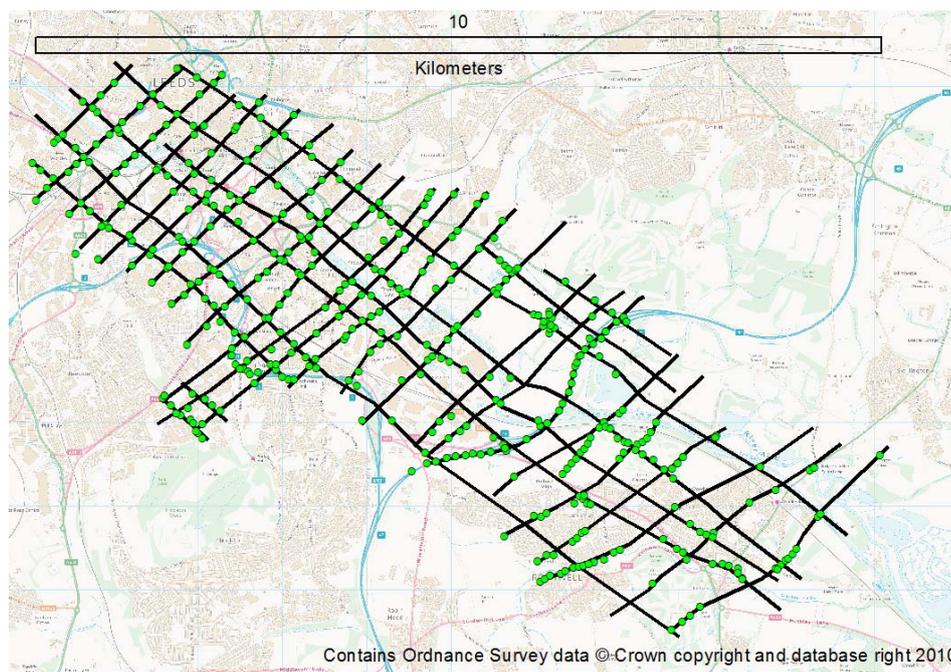


Figure 2 Borehole considered (those on cross-section) in the construction of the Leeds Aire Valley Superficial Model.

The BID file, which is the borehole index file, has no headers but contains the following columns in this order:

- Borehole_ID (Concatenation of QS, Number, Bsuff)
- Easting (In British National Grid)
- Northing (In British National Grid)

- Start Height
- Start Height Derivation (Either from the original log or automatically applied from the NextMap DTM value at the location)

Three BID files were produced in this study, a file showing all of the boreholes considered (LeedsAire_SOBI_All), those that were not used in the cross-sections (LeedsAire_SOBI_Not_Used) and those that were actually used to construct the cross-sections (LeedsAire_SOBI_Used).

3.3 MAP DATA

- OS1:50 000 map data was used as the base topographical map.
- BGS 1:10 000 DigMap GB artificial and superficial data was used for outcrop and geological unit formation (Version 2.18, released 15-01-2009)

4 Dataset integration

All data were brought together in the GSI3D modelling software where it can be viewed and interrogated in 2D and 3D.

5 Model development log

- All digital data were processed, prepared and imported into the GSI3D modelling software.
- A generalised geological sequence was devised to best fit the deposits seen and recorded in the data collection phase and based on the DigMap 1:10 000 scale data available which was recorded into the GVS file for the modelling.
- All borehole data were considered during interpretation.
- At the end of interpretation a checking phase based on interrogation of a fence diagram of all cross-sections was performed.
- Geological envelopes marking the extents of each geological unit were then created.
- Final model calculation was performed with several iterative phases to get the best model calculation possible.
- Model calculation is by triangulation of nodes from correlated geological units in cross-section lines, geological envelopes and DTM.

GSI3D models. Updates on:

GVS

LEEDS_V2_0.gvs

- Same content as LEEDS_V1_0 but soil has been re-positioned above the made ground.

LEEDS_V3_0.gvs

- Same content as LEEDS_V2_0 but till has been re-positioned above the glld.

6 Model workflow

The methodology for construction of models in GSI3D is described in great detail by (Kessler et al., 2008). It principally involves construction of cross-sections between the best quality data available followed by envelope construction around the limits of the geological units.

7 Model assumptions, geological rules used etc

- Soil has been modelled based on borehole data and topographical data as no soil was recorded on the DigMap 1:10 000 geological maps.
- All GLLD deposits are assumed to occur above Till in this model.

8 Model limitations

- No attempt has been made to subdivide the River Terrace Deposits into distinct levels.

9 Model images

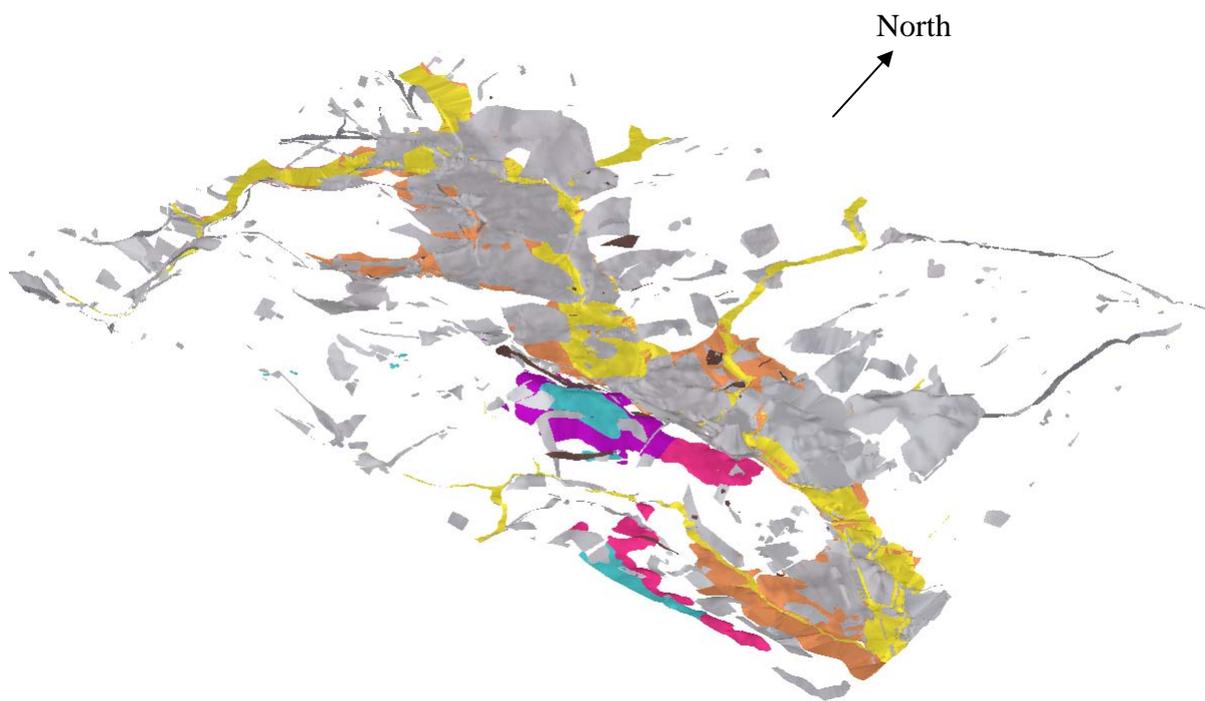


Figure 3 The whole model looking from the South East. Artificial deposits in grey, Alluvium in yellow, River terrace deposits in orange, Till in blue, Glacial Fluvial deposits in red and Glacial lacustrine deposits in purple. Includes outer extents of envelopes not constrained by cross-sections. Vertical exaggeration is x10.



Figure 4 Leeds-Aire Valley Model cross-sections (coloured by Stratigraphy) and Boreholes (coloured by Lithology)

10 Model uncertainty.

To-date no attempt has been made to quantify the uncertainty in this model

Glossary

<i>DTM</i>	Digital Terrain Model – Model of surface of the solid Earth (generally the boundary between geosphere and atmosphere or hydrosphere). This is traditionally derived from OS contours and spot heights and should therefore exclude all buildings, trees, hedges, crops, animals etc. Sometimes also referred to as ‘bald earth’ models
<i>Envelope</i>	Defined here as the extent of a geological deposit in plan view (2D): forming a distribution map of the particular unit, a presence – absence map.
<i>GSI3D</i>	Geological Surveying and Investigation in 3D geological modelling software

References

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

COOPER, A H, KESSLER, H, and FORD, J R. 2006. A revised scheme for coding unlithified deposits (also applicable to engineering soils). *British Geological Survey Internal Report*, IR/05/123.

KESSLER, H, MATHERS, S, SOBISCH, H-G, NEBER, A, ALDISS, D, BRIDGE, D, FORD, J, GARCIA-BAJO, M, HULLAND, V, NAPIER, B, PRICE, S J, ROYSE, K, RUTTER, H, and WILDMAN, G. 2008. GSI3D : the software and methodology to build systematic near-surface 3-D geological models. Version 2. (Nottingham, UK).