



**British  
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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

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# 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  
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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.

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

R L Terrington, C Shelley, L Ramos Cabrera

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## 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

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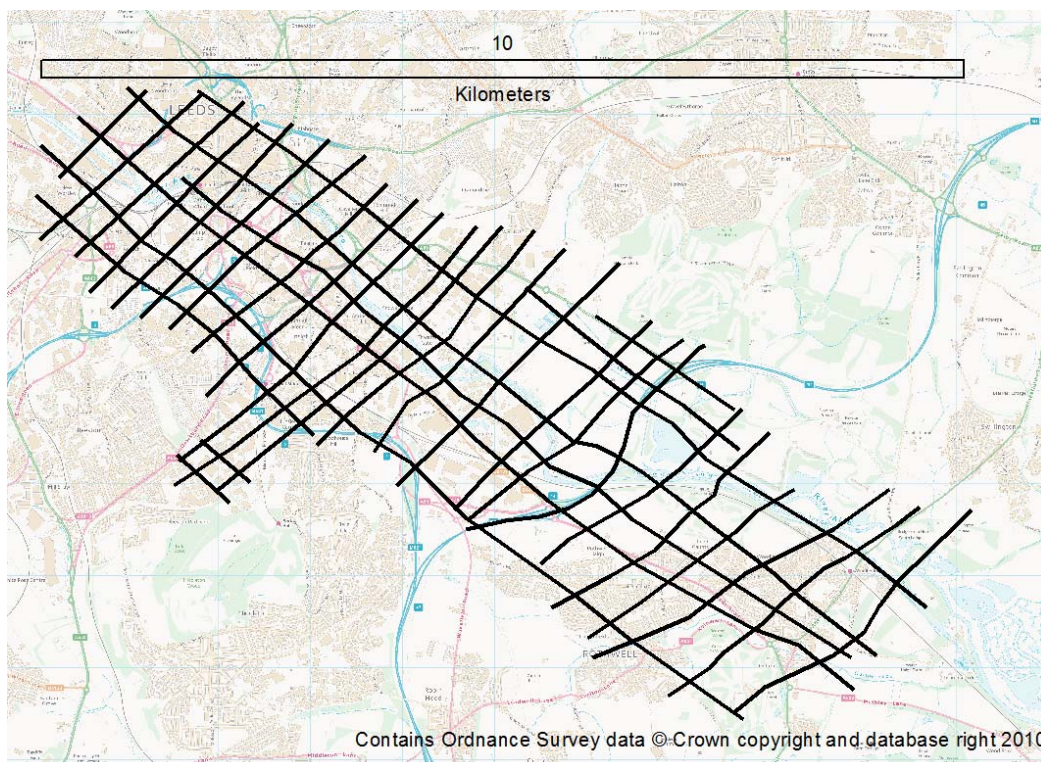
# Summary

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 km<sup>2</sup> 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

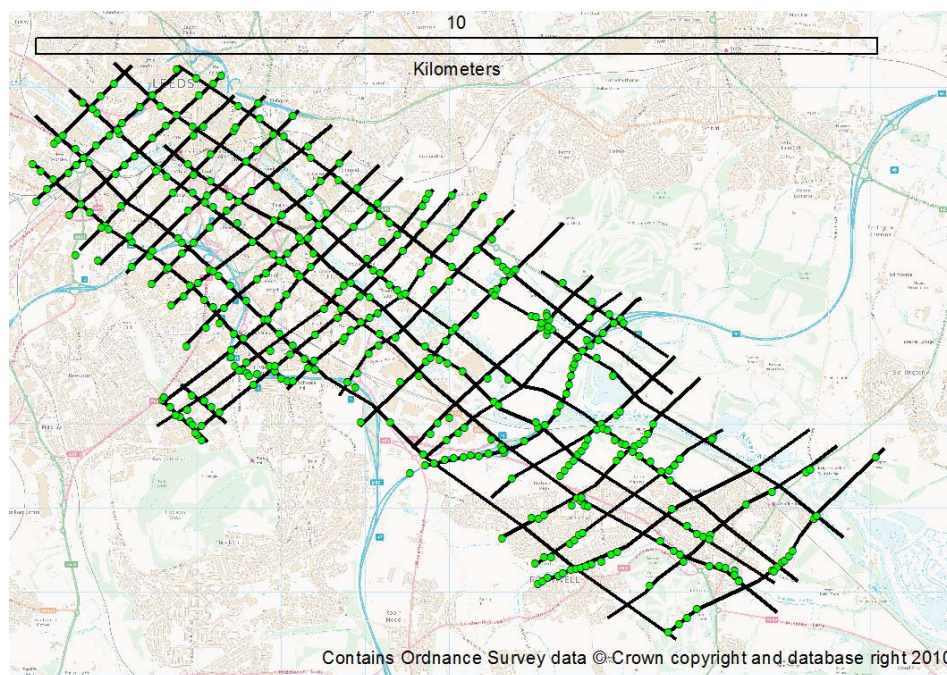
NextMap (Intermap) and Bald Earth (Landform Panorama) digital terrain model sub-sampled to 25 m grid spacing.

### 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.

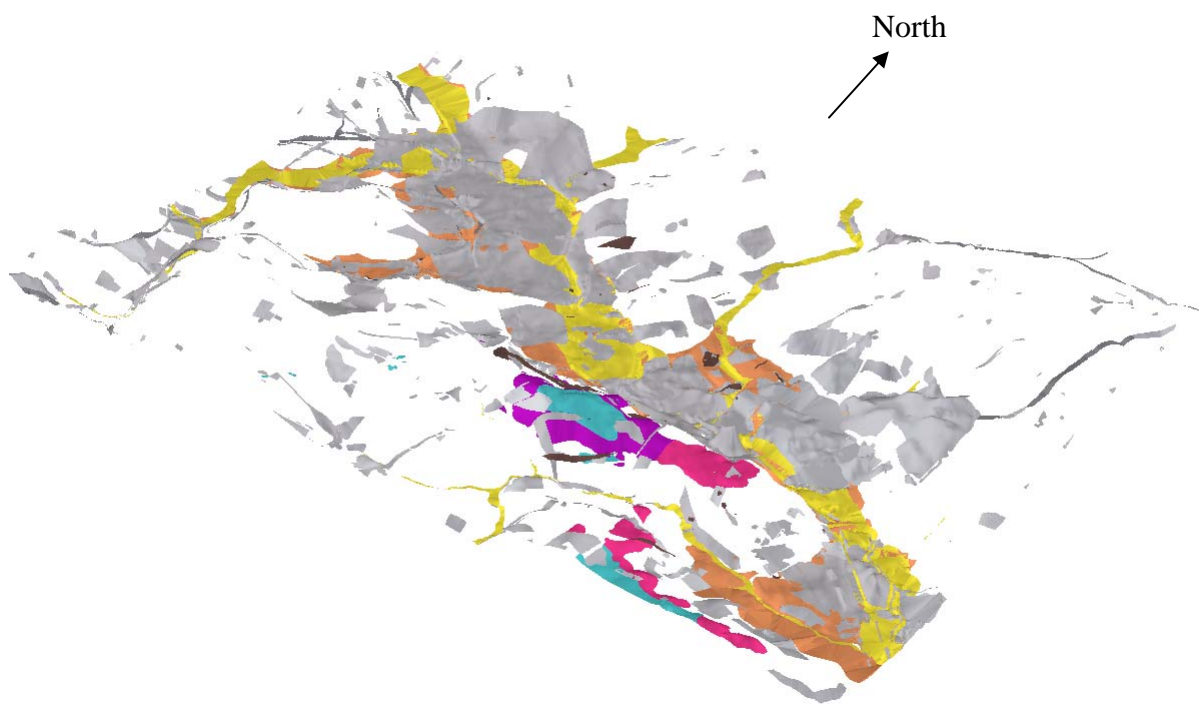
## 7 Model assumptions, geological rules used etc

- 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.

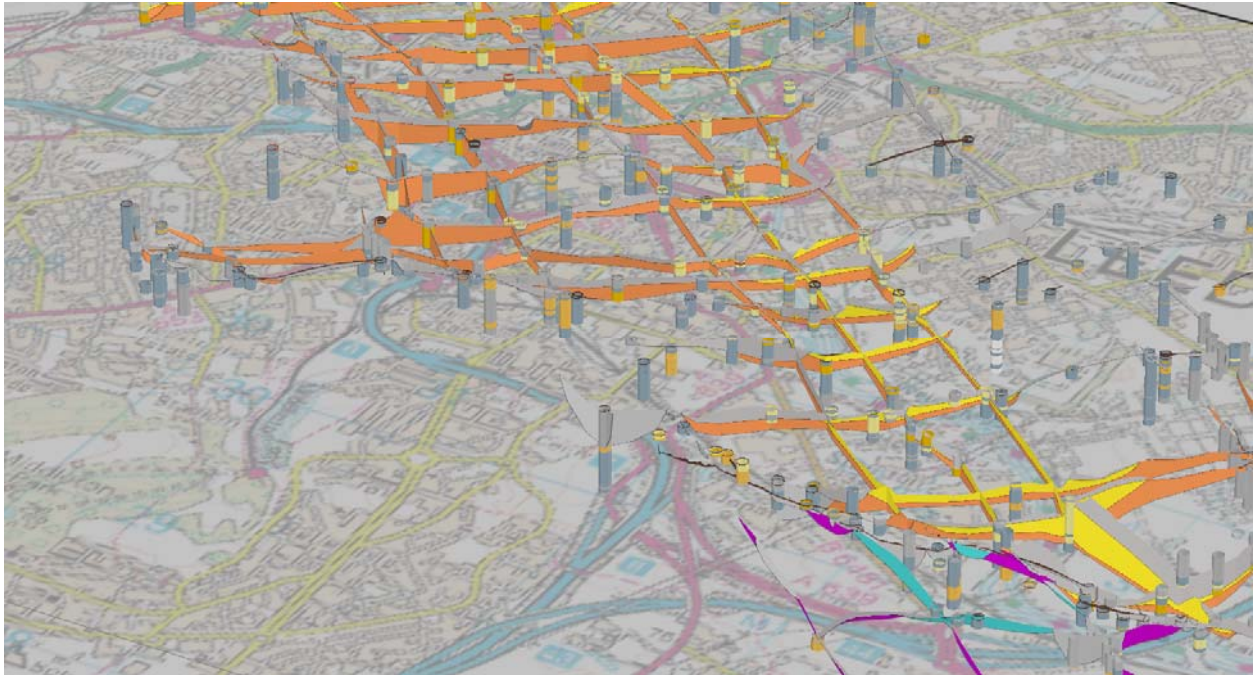
## 8 Model limitations

- 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](mailto:libuser@bgs.ac.uk) for details). The library catalogue is available at: <http://geolib.bgs.ac.uk>.

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