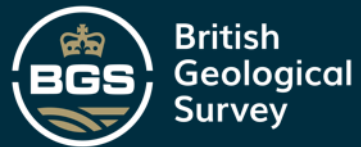




HANNAH CULLEN-GOW, DR VANESSA BANKS & GABRIELLA WILLIAMS

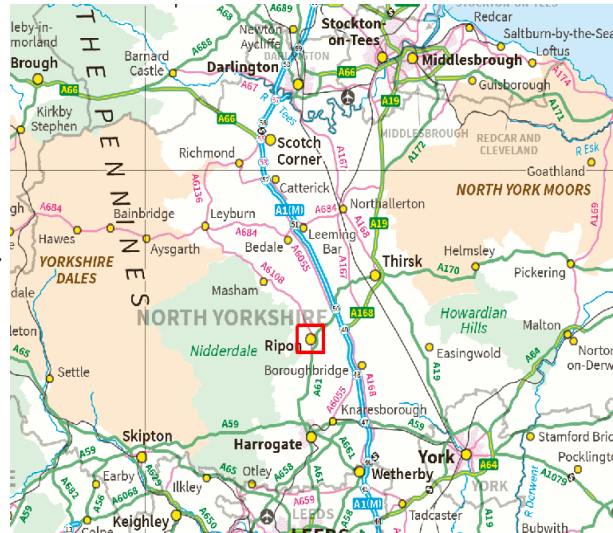
Who Gives a Sink? – 3D Geological Modelling and Geophysical Investigations of the Sinkhole Prone City of Ripon, UK



Where is Ripon?



North Yorkshire



Ripon

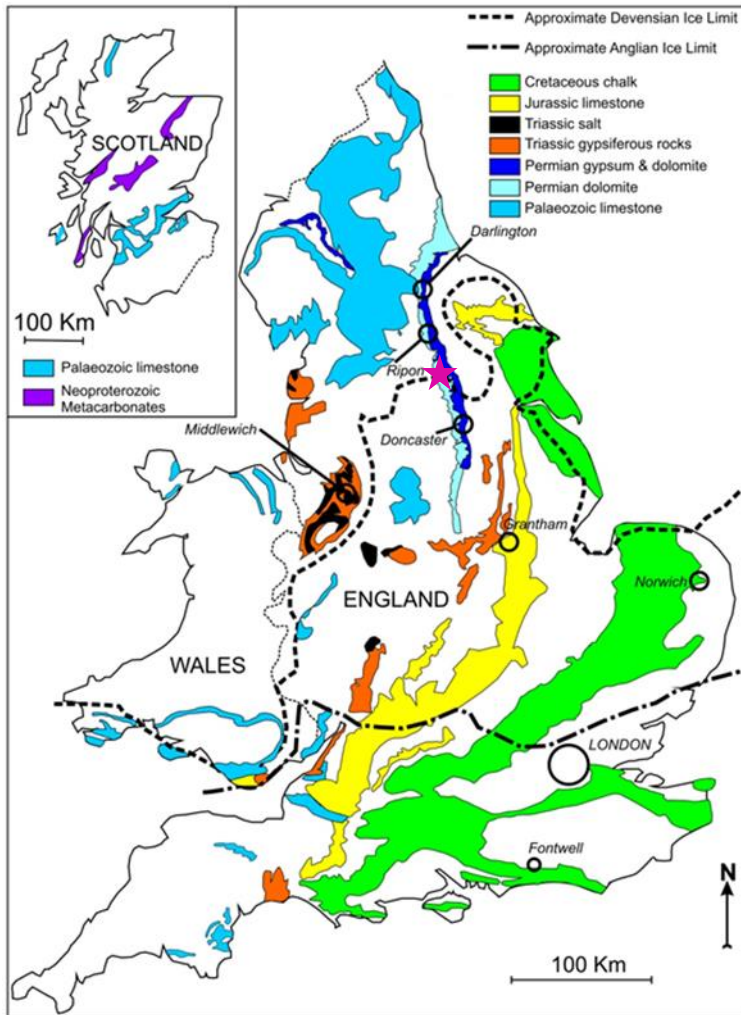




Crikey!

Ure Bank
Terrace –
April 1997

Photo and Human
scale curtesy of
Dr Tony Cooper



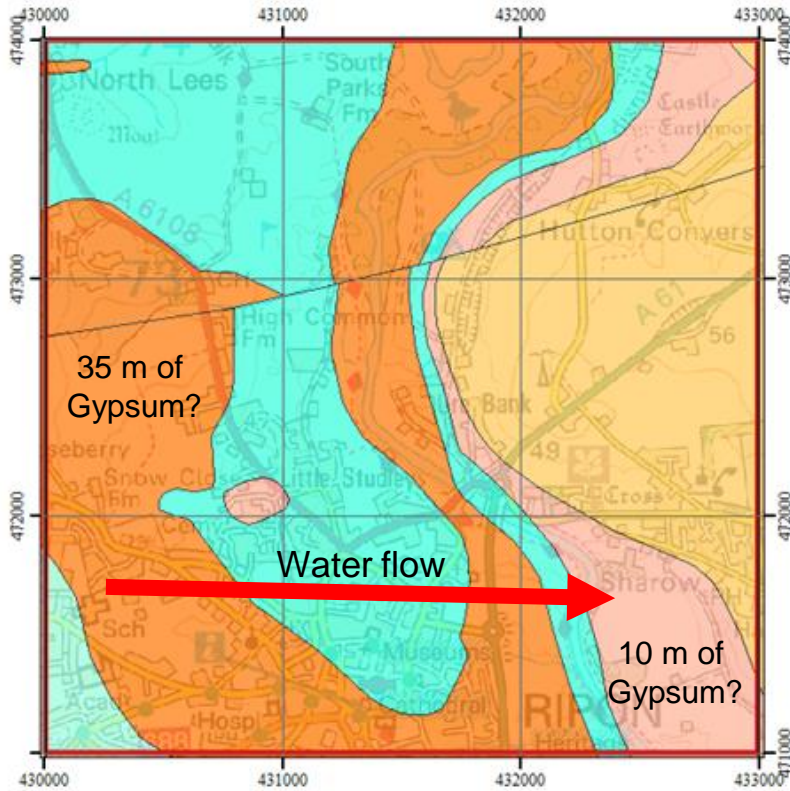
Karst

- Salt karst (Triassic)
- Gypsum karst (Permian & Triassic)
- Chalk karst – major aquifer (Cretaceous)
- Limestone karst (Carboniferous & Jurassic)

Increasing
solubility and
dissolution
rate

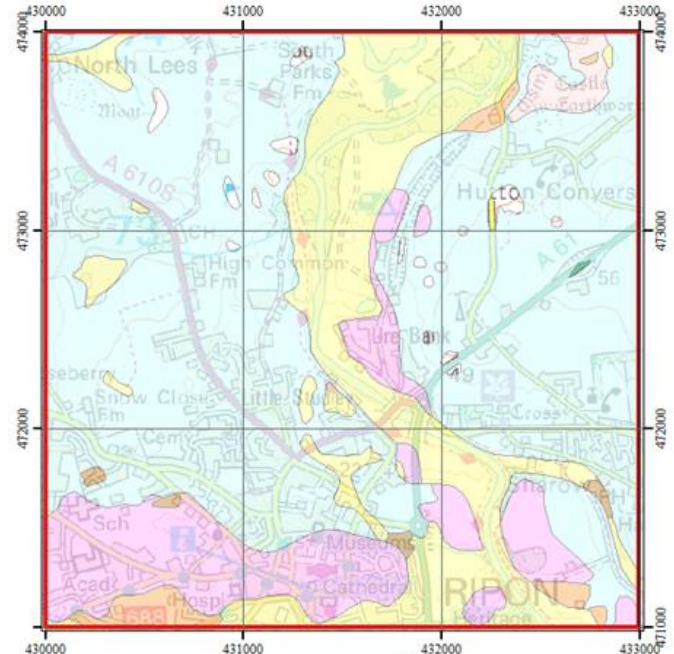
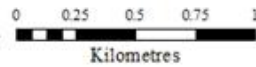
FARRANT, A.R. and COOPER, A.H. 2008. Karst geohazards in the UK: the use of digital data for hazard management. *Quarterly Journal of Engineering Geology and Hydrogeology* Vol. 41. 339-356

Geology in Ripon



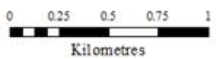
Bedrock Geology Legend

- Sherwood Sandstone Group - Sandstone
- Roxby Formation - Mudstone, calcareous
- Brotherton Formation - Limestone, Dolomitic
- Edlington Formation - Mudstone, calcareous
- Cadeby Formation - Dolostone



Superficial Geology Legend

- Peat
- Alluvium - Clay, silt, sand and gravel
- River Terrace Deposits - Sand and gravel
- Glaciofluvial Terrace Deposits - Sand and gravel
- Glaciolacustrine Deposits - Clay and silt
- Vale of York Formation - Sand and gravel
- Vale of York Formation - Clay, sandy gravelly



Magdalen's Road – November 2016

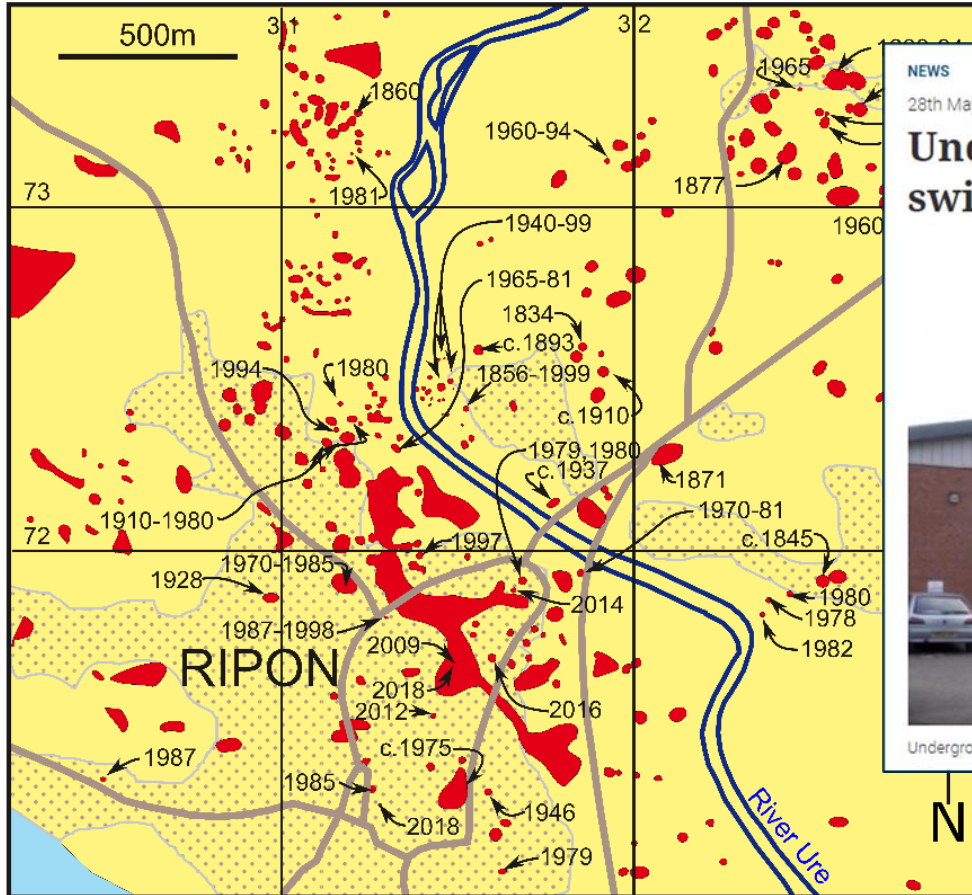
- On November 10th 2016 a sinkhole appears in a residential garden



- BGS response team visit on the 11th November and estimate the sinkhole to be 5 m deep

Subsidence Planning Areas

Ripon (UK)



NEWS

28th May 2021

Underground sinkhole discovered under Ripon swimming pool



BBC Yorkshire
@BBCLookNorth



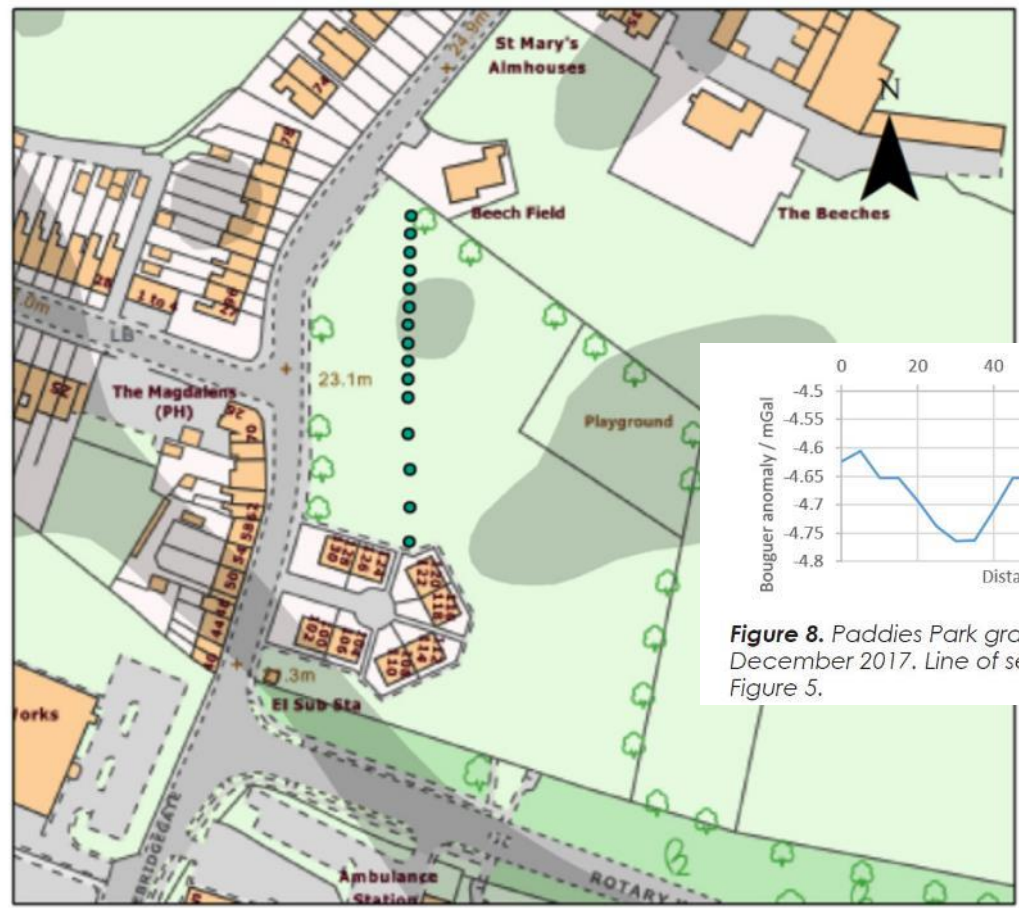
Underground sinkhole discovered under Ripon's new swimming pool

area with full
planning constraints



NERC Urgency Grant - 2016

Paddies Park, Magdalen's Road Microgravity geophysics investigation



● Survey points ■ Previously mapped dolines

0 50 Meters

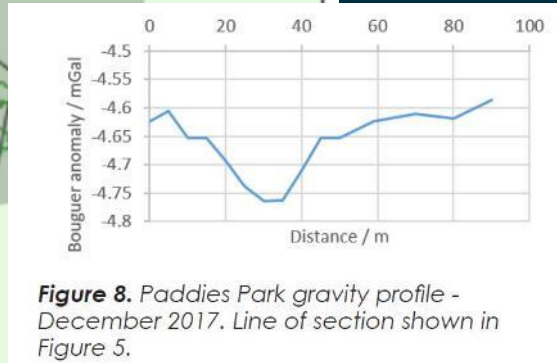


Figure 8. Paddies Park gravity profile - December 2017. Line of section shown in Figure 5.

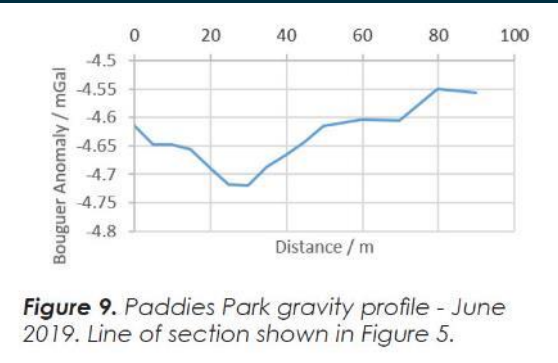
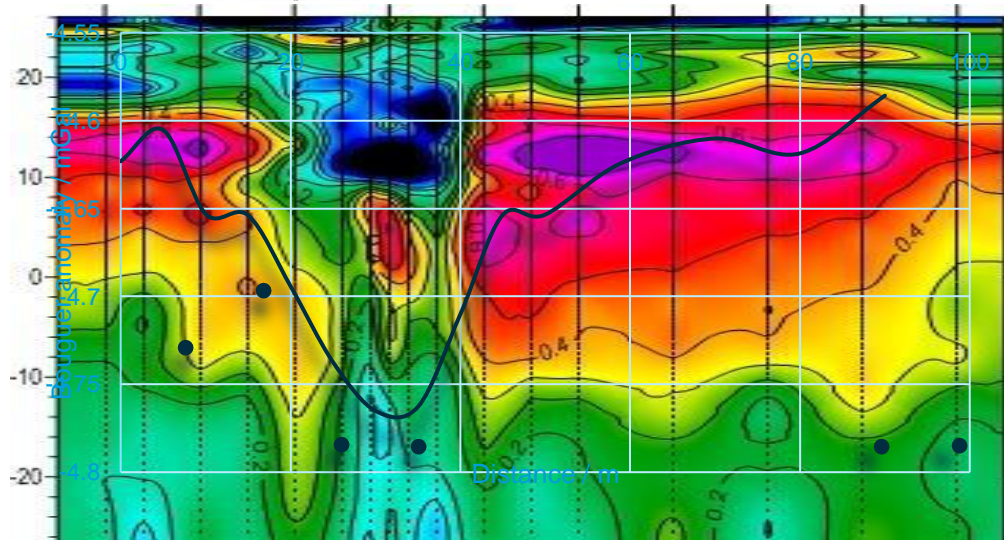
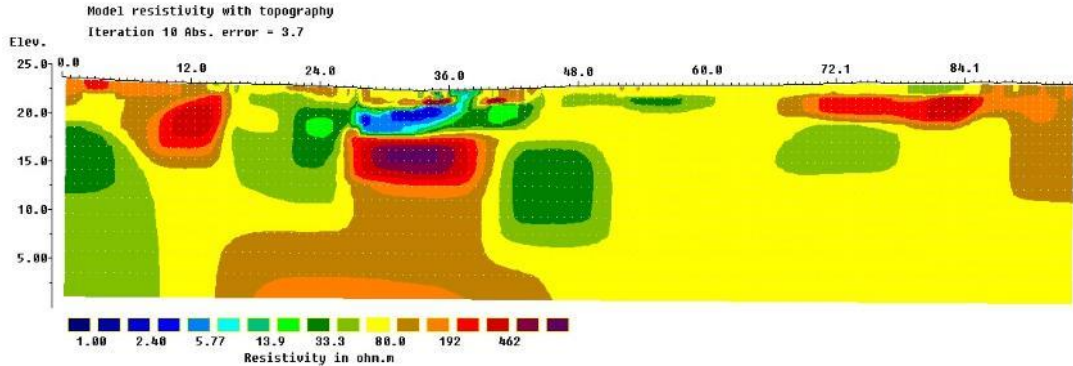


Figure 9. Paddies Park gravity profile - June 2019. Line of section shown in Figure 5.

Williams, G B; Banks, V J; Bowman, E T; Cooper, A H; Jones, L D; Kirkham, M P; Morgan, D J R; Shepley, P. 2020. Integrating monitoring techniques for a buried sinkhole in an urban environment. 110 -118 in Land, L., Kromhout, C. and Byle, M.J. Proceedings of the 16th Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst, NCKRI Symposium 8. <https://doi.org/10.5038/9781733375313.1020>



Geophysical investigation



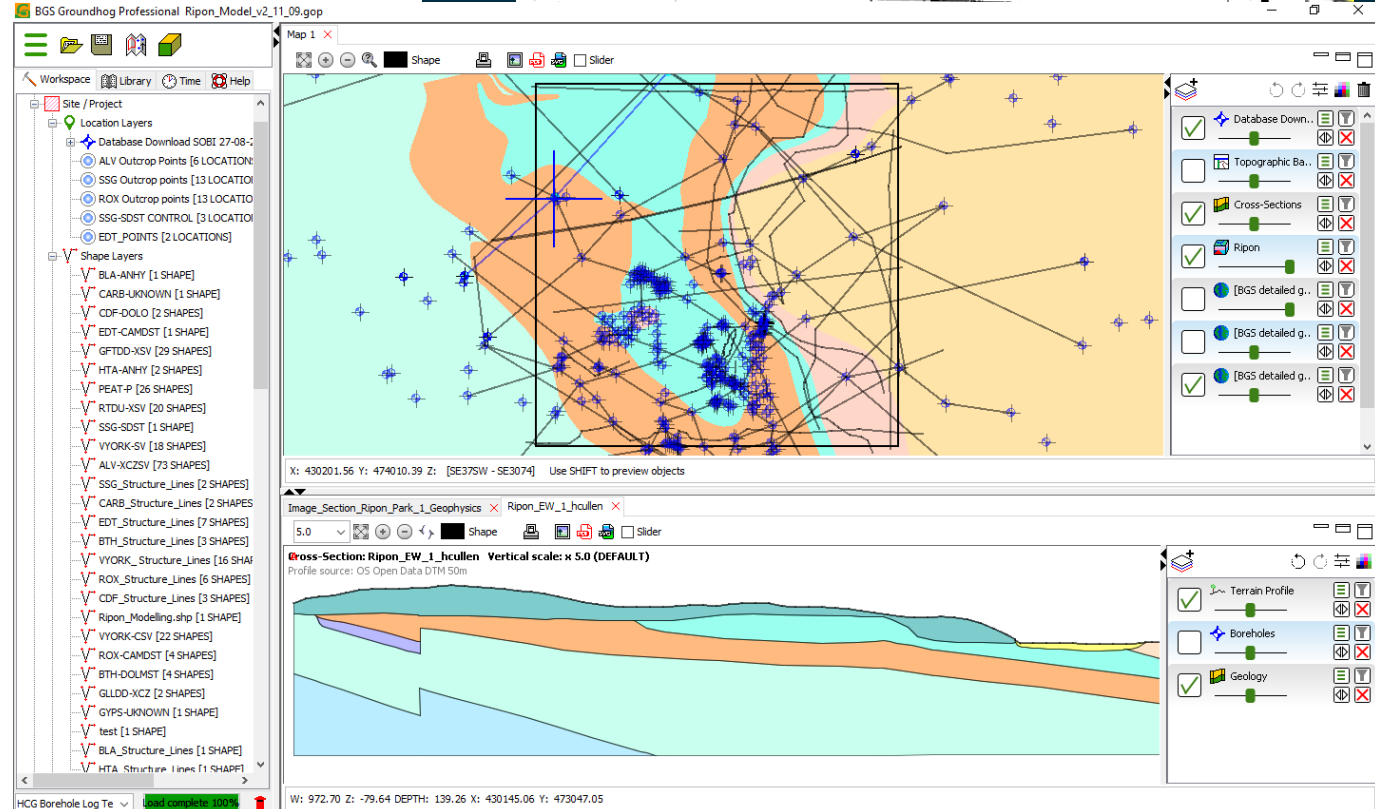
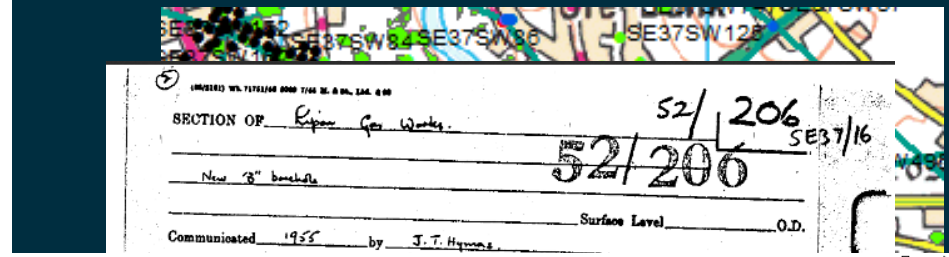
Resistivity Tomography (top)
Passive seismic (bottom)
Line shows microgravity (bottom)



Williams, G B; Banks, V J; Bowman, E T; Cooper, A H; Jones, L D; Kirkham, M P; Morgan, D J R; Shepley, P. 2020. Integrating monitoring techniques for a buried sinkhole in an urban environment. 110 -118 in Land, L., Kromhout, C. and Byle, M.J. Proceedings of the 16th Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst, NCKRI Symposium 8.
<https://doi.org/10.5038/9781733375313.1020>

3D Geological Modelling

- GIS compilation and data collation
- “Coding” boreholes - geological interpretation and assigning codes
- Modelling software - Groundhog Desktop to construct cross-sections and shapes
- Groundhog builds the model.....



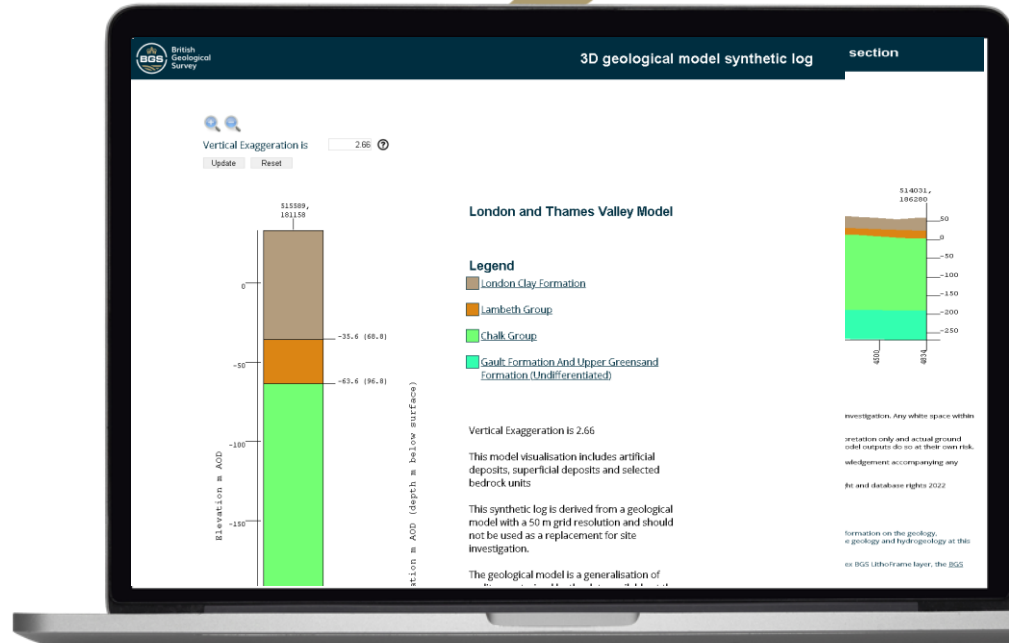
3D Geological Model of Ripon



SCAN ME

What's Next?

- Trialling 3D visualisation in alternative software engines
- Add model to BGS Onshore GeoIndex, create synthetic cross-sections, boreholes and horizontal slices
- Further monitoring work and value added data
- Continuing communication with our stakeholders and the public





Thank you for listening!

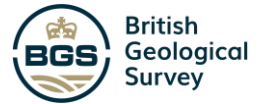
Big thanks to:

- Dr Vanessa Banks for her continued encouragement and support
- Dr Anthony Cooper for the use of his images and brilliant brain and Gabriella Williams for her PhD studies in Ripon
- The (now disbanded) Hog Team, especially Ben Wood, Jon Atherley-Mercantas, Steve Thorpe, Tanya Richmond and Tom Fletcher, for technical assistance and being my A Team!
- Harrogate Borough Council and the residents of Ripon
- Anyone else that has had to listen to me go on and on and on about 3D modelling in Ripon!

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Data Specialist



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Any Questions?

