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Geoscience Research
GSI
Suirbhéireacht Gheolaíochta Éireann
Geological Survey of Ireland

# Geological Survey of Ireland Research Programme
## - Short Call 2015, Final Report -



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|---|---|
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| Organisation name | British Geological Survey (Geological Survey Northern Ireland | | |
| Organisation type: | ☐HEI | ☒Public Sector (other) | ☐Private Sector |
| Department/section | Geological Survey of Northern Ireland – Environment and Hazards Team | | |



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|---|---|
| Project Title | All-Ireland Karst Landforms Dataset |
| Contract No. | 2015-sc-055 |

INFOMAR
Integrated Mapping for the Sustainable Development of Ireland's Marine Resource

Tellus
Understanding Underground

Marine Institute
Foras na Mara

**2. Project information**:

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|---|---|
| Title of project | All-Ireland Karst Landforms Dataset |
| Did you make any formal amendment to the project workplan / budget? | x yes no<br>If yes, please specify:<br>In the original proposal, the ground-truthing of karst landforms around Ballypatrick and Cuilcagh was included. In the rest of this report, the area around Ballypatrick is referred to more accurately as Carronmore and Knocklayd Hills.<br><br>Instead of doing a karst landforms mapping exercise on Cuilcagh Mountain, tracer tests were performed at Mullyard Sink in an effort to identify the source of the spring at Holywell Rising. During discussions with Richard Watson from MACGG, and Les Brown at a project review meeting in June, it was decided that a mapping exercise on Cuilcagh would not likely produce anything of value since most karst landforms in the Cuilcagh area are covered by thick vegetation to prevent animal grazing near to them. Instead of attempting this exercise in this area, consideration was given as to what research would be of value to do instead. From the karst landform and tracerline mapping exercise, it was discovered the area above Belcoo around Belmore Hill was deficient in any confirmed traced karst |

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| | connections. It was therefore decided that it would be worth undertaking tracer tests at Mullyard sink to identify if this was the source of Holywell Rising near Belcoo. |

Project Report (*max 1500 words, excluding figures and headings*):

(i) Objectives and scientific/engineering targets beyond the state of the art

The overall aim of this project was to make available, in an easily accessible and usable format, locations and descriptions of karst landforms for the whole of Ireland.

The objectives of this project were to:

- Capture and publish knowledge of karst systems and landforms
- Make karst landforms available through online portals and printable maps for scientific and engineering purposes
- Make known the presence of karst landforms so that they can be better protected
- Identify the drainage catchments of rivers fed by karstic springs and so increase the ability to carry out appropriate land management to protect and improve underlying karst aquifers and river water quality.
- Improve the coverage and accuracy of karst landform mapping using combinations of spatial datasets
- Raise the profile and interest in the hydrology of karst

(ii) Implementation (including reference to timelines, milestones, management)

The project was managed as part of the Environment and Hazards Team (E&H) programme of works. The E&H team leader reported progress monthly to the director of the GSNI in the form of a team leaders report and monthly team meeting.

Project resources were managed using the Natural Environment and Research Council (NERC) Resource Management System.

The key milestones were:

1. A literature and data source review of karst landform references and tracer test results for across Northern Ireland – Speleological journals, The Caves of Fermanagh and Cavan (Jones et al., 1997), PhD thesis and published journals were the main sources of data
2. Digitisation of karst landform data completed – Maps and tables from the above data sources were scanned and georeferenced. 23 karst domains were identified and sequentially, each was researched to digitise every reference to a karst landform found on the georeferenced maps and tables. Further verification of each landform was undertaken using aerial photography and topographic maps to improve the accuracy of the geospatial reference being given to each landform. 820 karst landforms were digitised.
3. Metadata of karst landforms – Supplementary information on each digitised karst landform was manually added to a database using the exact same architecture as the current GSI karst landform dataset. Information such as who surveyed it, the data source and the landform's name were added to the database.
4. Tracerlines – Using the references identified during the literature review, tracerlines were digitised between stream sinks and springs where positive links had been confirmed by tracer tests. Metadata was added to each tracerline with details such as the date of the test, weather conditions and the operator. 69 confirmed traces were digitised.
5. Karst Catchments – Once the karst landforms and tracerlines had been digitised, catchment boundaries were delineated in 9 karst domains where there was sufficient data to do so, to show the area which contributes water that subsequently emerges at the key springs and resurgences in each domain. Fig. 1 shows the catchment boundaries that were delineated on the flanks of Cuilcagh Mountain.

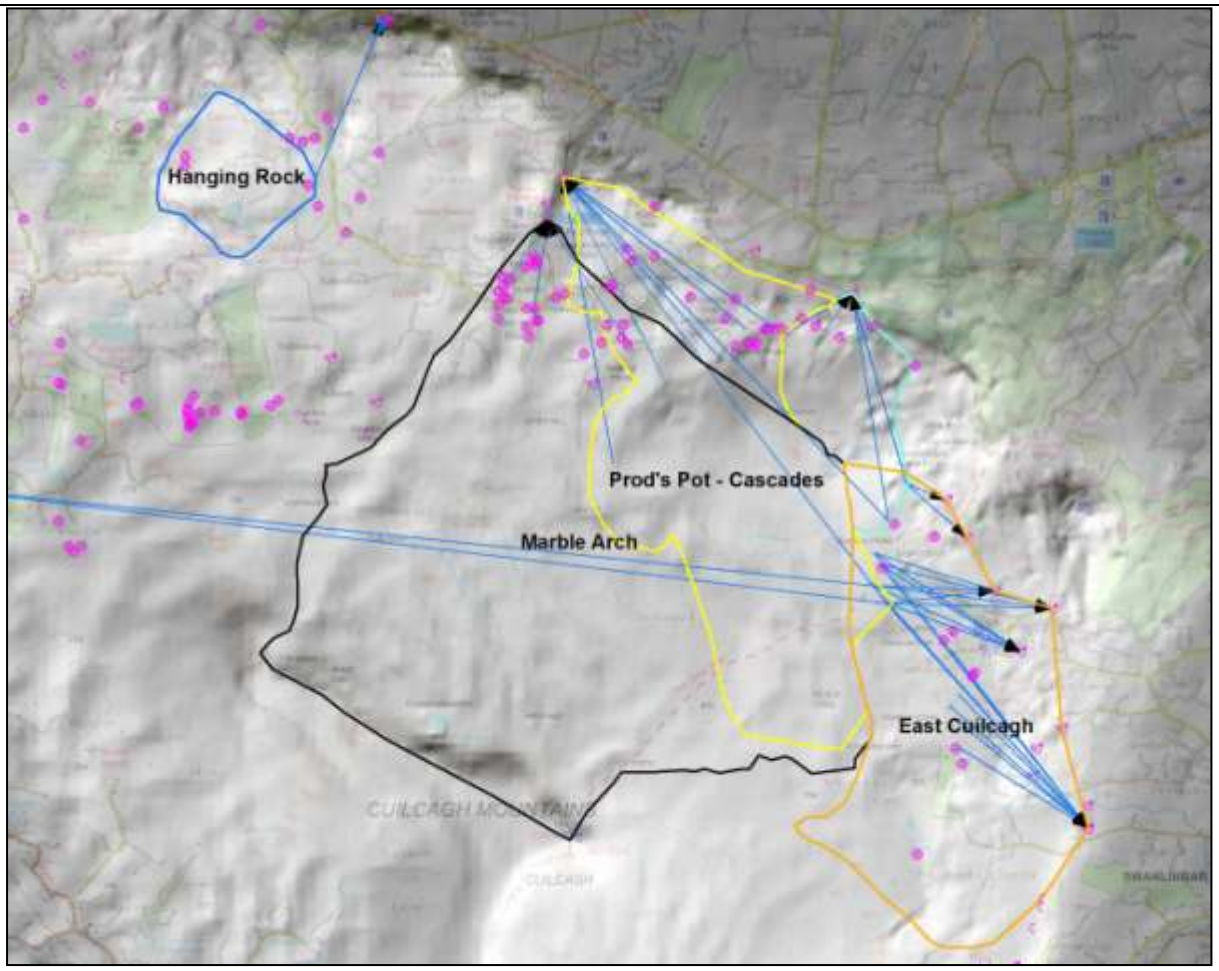

Fig. 1 – Karst Catchments around Cuilcagh Mountain

6. Completion of ground-truthing of karst landforms derived from spatial datasets – The area around Ballypatrick which took in Carronmore and Knocklayd in North East Antrim has not been mapped for karst landforms. An exercise was carried out to identify candidate landforms using spatial datasets. Over 2 days, these were ground-truthed to confirm they were karst landforms. 320 landforms were identified using spatial datasets. After ground truthing 382 landforms were identified and added to the karst landforms dataset.
7. Publication of an all-Ireland karst landforms dataset – The Northern Ireland data was sent to Caoimhe Hickey and Shane Carey in GSI. A day was then spent in Dublin reviewing the data prior to the new data being added to the existing dataset. Some minor alterations were made. Both the final karst landforms and tracerlines datasets and mapfiles have been sent to Shane at GSI to be stitched to the existing dataset.
8. Karst Landforms Map – A printable map was produced and presented at the Geoscience 2016 conference on the 2nd November 2016. This shows the location of all karst landforms with an inset showing the detail of the mapping in the cross border area of Counties Fermanagh and Cavan. This map is available as a printable pdf and could be made available online.
9. Project completion report
10. Conference paper completion – A paper was written detailing the use of spatial datasets in identifying karst landforms around the Ballypatrick Forest.

The project timeline ended up as follows:

| | Month | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Task** | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Literature and data source review | ■ | | | | | | | | |
| Delineation of karst drainage catchments | | ■ | | | | | | | |
| Digitisation of karst landforms | | ■ | ■ | | | | | | |
| Digitisation of tracerlines | | | ■ | | | | | | |
| Karst landform metadata in to the database | | | | ■ | ■ | | | | |
| Tracerline metadata | | | | | | | ■ | | |
| Identification of karst features using spatial datasets Carronmore and Knocklayd | | | ■ | | | | | | |
| Ground-truthing of Carronmore and Knocklayd karst landforms | | | ■ | | | | | | |
| Tracer Experiements Holywell, Belcoo | | | | | | ■ | ■ | | |
| Publication of an all-Ireland karst features dataset | | | | | | | ■ | | ■ |
| Cartography | | | | | | | ■ | | |
| Project completion report | | | | | | | | ■ | |
| Conference paper | | | | | | | ■ | ■ | |

(iii) Outputs (please use bullet points)

- Digital datasets – All-Ireland karst landforms and tracerlines. Combined with existing GSI datasets to produce All-Ireland datasets. A further 820 karst landforms and 69 tracerlines
- All-Ireland Karst landforms map – Formatted map in pdf format available online to download and print. Presented at Geoscience 2016
- 9 new karst catchments taking in parts of Counties Fermanagh and Cavan
- Project completion report
- Conference paper – Technical discussion paper suitable for the Irish Association of Hydrogeologists (IAH) annual conference. (Title: Identifying Karst Landforms in the Cretaceous Ulster White Limestone Using Spatial Datasets, Co. Antrim, Northern Ireland)
- Two new tracerlines from Mullyard Sink and a new appraisal of the hydrology of the Lurgan River, Belcoo.

Impact/value of the project (M*ax 500 words*):

- Development of new methodology/toolkits –

    - All-Ireland karst landforms dataset. Available for use in engineering projects, particularly as a screening tool as well as education and public engagement.
    - Identification and verification of karst landforms using a toolkit of spatial datasets. This enables more rapid identification of a higher resolution of karst landforms, particularly collapse structures; this enables the ongoing refinement of an Irish karst dataset.
- Positive Societal Impact – The bringing together of knowledge of karst landforms across Ireland, particularly the wonders that are karst drainage systems, has the potential to enhance public awareness and interest in karst landforms and landscapes.
- Policy and governance – Surface karst landforms act as preferential pathways for the migration of contaminants in to karst aquifers. The karst landforms dataset enables hydrogeological risk assessments produced for the purposes of development permissions and environmental regulatory licenses to consider the proximity of developments to karst landforms and therefore how the development will likely impact on them. The Northern Ireland Environment Agency has already expressed interest in using the extended dataset for the licensing of discharges in proximity to karst features.
- Cultural heritage and geotourism – The karst landforms dataset will be available for use by the Marble Arch Caves UNESCO Global Geopark and other heritage and tourism bodies to showcase the drainage systems that are intrinsic to the geopark and to visually demonstrate to visitors the extent of karst landforms across the whole of Ireland. More could be done and once the datasets are publically available as a data download, such bodies will be free to use them to enhance the profile of karst.
- Education – Limestone studies are an integral part of education at all levels in Irish society so the karst landforms dataset will be an important tool for schools, universities, students and public facilities such as the Marble Arch Caves UNESCO Global Geopark that have an educational remit.
- Exploration and recreation – Cavers and speleologists have expressed great interest in using an expanded karst landforms dataset to increase their knowledge and understanding of Ireland's caves and associated karst landforms, as well as helping plan exploration efforts and be of use to cave rescue.
- Environmental awareness and conservation – inclusion of Northern Ireland karst landforms in the dataset will assist the planning and operations of land managers such as the Forest Service NI, the Northern Ireland Environment Agency and local government authorities.

No active outreach or promotion of the datasets or the work was included as an output of this project and has therefore not yet been carried out to target the bodies detailed above and to raise awareness of the extended datasets. However, once the datasets have been made publically available we would welcome the opportunity to work with GSI on optimising the high impact potential, should this be a possibility.

Wilson, P.R. (2016) *Identifying Karst Landforms in the Cretaceous Ulster White Limestone Using Spatial Datasets, Co. Antrim, Northern Ireland.* Prepared Conference Paper

Wilson, P.R., Brown, L. 2017. Tracer Experiments, *Holywell Spring, Belcoo, Co. Fermanagh*. British Geological Survey Report. (In preparation)

Presentation – Geoscience 2016 Conference, Dublin Castle, Dublin, 02/11/16. Karst Landforms and Hydrology Mapping Ireland. Wilson, P.R.

**Appendix 2 – Any additional information not included above:**