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Murroe Sand and Gravel Aquifer Summary of Initial Characterisation



GW3D Project Report TR2023/58
July 2023

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This sand and gravel report forms part of a series representing the output of a body of work undertaken to re-evaluate previously mapped sand and gravel aquifers and to identify new sand and gravel aquifers. This study resulted in the refinement of existing sand and gravel aquifer mapped extents, the modification of some sand and gravel aquifer categories, and the removal of some previously mapped sand and gravel aquifers, as well as identification of new aquifers. In addition to mapping the extent and depths of the sand and gravel aquifers, the investigations consider the hydraulic properties.

The study, undertaken as part of the GW3D project (2015-2019), comprised three parts:

1) Desk study and fieldwork preparation

Sand and gravel bodies above a minimum size criterion were extracted from the GSI Quaternary Sediments 1:50,000 map. Where it was known that the surface expression of the sands and gravels was only a small portion of the subsurface body, such areas were retained. This process left several hundred sand and gravel bodies remaining as a starting point for field work.

2) Fieldwork including mapping and data collection

Field work included a visit to each of the areas which had the potential to be (at least) a Locally Important Sand and Gravel Aquifer owing to its area. In such areas, gravel pits and sand pits were visited and depth and type of sediment recorded, other exposures into the subsurface were visited and logged, wells (whether Public Supply, Group Scheme or private farm or domestic) were dipped and any information on depths recorded, and data was collected where geological and hydrogeological data existed for the area.

3) Data collation, analysis and reporting.

All field data, and information from earlier reports and studies, were compiled and analysed. Where a sand and gravel body had qualifying aquifer properties (either 10 m depth sand and gravel, or 5 m depth saturated sediments), these areas were digitised in a GIS. The aquifer area was then ascertained and drawn up. Such areas formed the basic building blocks for the sand and gravel aquifer map, which included details on the aquifer name, area, aquifer resource value (Rg or Lg), confidence level, county, and any important aspects to note for each body.

The updated mapped sand and gravel aquifers are found on the Geological Survey Ireland site <https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx#Aquifers>

The GW3D Mapping Team involved in the current revision of delineated sand and gravel aquifers were:

Geological Survey Ireland staff:

- Dr. Sophie O'Connor, Groundwater Programme / Land Mapping Unit
- Dr. Sarah Blake, Groundwater Programme

Consultant support:

- Dr. Robbie Meehan, Talamh Ireland
- Coran Kelly, Tobin Consulting Engineers
- Damien Doherty, independent Consultant Geologist/ Tobin Consulting Engineers
- Natalie Duncan, independent Consultant Geologist
- Sara Raymond, independent Consultant Geologist
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Hydrometric Area Local Authority		Associated surface water features	Associated terrestrial ecosystems	Area (km ²)
25 - Lower Shannon Limerick County Council		Rivers: Farnanefranklin River, Cullenagh River, Dooglasha River, Portnard River, Ballyvorheen River, Knockanerry River, Mongfune River, Gortavacoosh River, Moroe River, Knockanbaun River, Liscreeagh Stream, Glashanacloonaraveela River Streams: Several unnamed streams Lakes: Several unnamed lakes and ponds	Lower River Shannon SAC Ballyvorheen Bog pNHA	8.16 km ²
Topography	The Murroe sand and gravel body comprises hummocky sands and gravels which onlap onto the southwestern foothills of the Slieve Felim Mountains, as a wide, lowlying terrace resting above expansive peat and alluvial flats to their southwest. The deposit occurs at elevations between 70 m and 110 m AOD. The sand and gravel is bounded by till deposits and bedrock at or close to surface, at higher elevations, further up the mountain slopes.			
Geology and Aquifers	Aquifer categories	The area of the body and saturated thickness satisfies the criteria of a Locally Important Sand and Gravel Aquifer (Lg) (DELG/EPA/GSI, 1999; GSI, 2017).		
	Main aquifer lithologies	Glaciofluvial sands and gravels derived chiefly from Devonian sandstones (GDSs).		
	Key structures	In general, exposure is poor within this sand and gravel body, and no extensive exposures showing sand and gravel structures were noted during fieldwork. Data were available from 11 borehole records, and two of these records have descriptions of the composition of the subsoil materials. Subsoils described as SAND occur near Portnard Bridge, and fine SAND is recorded in a borehole at Farnanefranklin.		
	Key properties	There are six water level data points from within dug wells and boreholes recorded in this aquifer area, that have allowed for inferences to be made on water levels throughout the area of the entire body. There are two boreholes associated with Cappamore Public Water Supply at Murroe, of 16 m and 17 m depth respectively, with water levels at 9 m and 11 m BGL respectively (OCM, 2010). This confirms 5 m depth of saturated sands and gravels in this locality. Using these data with wider desk study data, it has been inferred that approx. 29% of the aquifer area has a depth of saturated sands and gravels greater than 5 m. Data from a borehole at Cullenagh, near Glasha Bridge along the eastern end of the body, records a shallow depth of at dry sands and gravels; thus this locality has not been included within the area of the sand and gravel aquifer. Additionally, the peat areas to the south of the aquifer do not shown evidence of sand and gravel beneath, and excepting a small sliver at the edge of the sand and gravels no peat has been included in the aquifer body. In general, sand and gravel aquifers consist of unconsolidated coarse-grained material, usually containing less than 8% fines (Ó'Súilleabháin, 2000).		
	Thickness	From the desk study of borehole data, the sands and gravels have depths varying from 3 m to 25 m, with the deepest depth in Moroewood Townland (GSI, 2023b). Given the topography and elevation of the body, in general across the area the materials are expected to be greater than 10 m deep.		
Overlying Strata	Lithologies	Approximately 3% of the area of the aquifer is overlain by peat and/or alluvium, with sands and gravels assumed beneath.		
	Thickness	Where present, the peat and/or alluvium is inferred to be less than 3 m deep.		
	% area aquifer near surface	Approximately 97% of the sand and gravel aquifer is at the surface, with the remainder beneath the peat and/or alluvial deposits.		



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	Vulnerability	The groundwater vulnerability of the sand and gravel is 'Extreme' where the water table is inferred to be < 3 m from the surface, this accounts for 36% of the area of the aquifer. In all other areas where the water table is at a depth > 3 m, the vulnerability is classed as 'High' (64% of the aquifer, Figure 3). There are quite extensive areas of 'Extreme' vulnerability within the area of the aquifer, all in lowlying areas, and mostly focused in linear belts adjacent to watercourses.
Recharge	Main recharge mechanisms	Diffuse recharge occurs by the infiltration of rainfall through the unsaturated sands and gravels. Due to the high permeability of sand and gravel, a high proportion of the available recharge will percolate down to the water table. Where peat overlies the sands and gravels, the proportion of rainfall that recharges the water table will be significantly less. It is assumed that there is a significant volume of rejected recharge from the high sandstone ridge to the northeast of the aquifer contributing to the groundwater resource in the sands and gravels at Murroe.
	Est. recharge rates	The annual average rainfall for the aquifer is 1,070 mm (Walsh, 2012), thus providing an estimated diffuse groundwater recharge of 595 mm/year. The minimum direct groundwater throughput in the aquifer is consequently estimated to be 3,819 m ³ /d, which rises to a minimum potential just over 6,531 m ³ /d when rejected recharge is from the bounding ridges to the northeast is included.
Discharge	Large springs and large known abstractions (m³/d)	There are six springs with a supplementary borehole that provides Murroe Public Water Supply (Deakin, 1995). The average discharge of the combined Murroe sources was estimated by the Local Authority to be in the order of 560m ³ /d (Deakin, 1995). Five of the largest springs are used during winter months but, during drier weather, the yield reduces and the sixth spring and borehole are used to supplement the resource. There are two boreholes associated with Cappamore Public Water Supply at Farnanefranklin, which combined abstract 90 m ³ /d (OCM, 2010).
	Main discharge mechanisms	Groundwater in the area will generally flow perpendicular to the topographic contours, in a southwesterly direction, sometimes altered slightly by the presence of streams.
	Hydrochemical Signature	At the Murroe Public Water Supply, conductivities are in the range 520–730 µS/cm, averaging approximately 560 µS/cm (Deakin, 1995). The water quality at the source is variable. At Murroe also, nitrate levels varied from 5.8–28.3 mg/l (Deakin, 1995). Chloride reached 39 mg/l and 40.5 mg/l in two of the analyses from Murroe (Deakin, 1995), and this may also be suggestive of contamination. It should be noted that a County Council borehole drilled at Glenstal Lodge in the 1990s was abandoned due to the presence of <i>E. coli.</i> , and high iron and silt (Deakin, 1995). The Groundwater Source Protection Zones report from Cappamore (OCM, 2010) shows the following results for hydrochemistry and water quality; the average conductivity is 547 µS/cm, ranging from 496 µS/cm to 848 µS/cm. The average pH is 7.2, while the range is 6.3 - 8.0. Faecal Coliforms were only detected on one occasion, in 2008. Ammonium is generally very low, with a mean well below the Threshold Value (0.175 mg/l). The nitrate concentration ranges from 3 to 16.3 mg/l, with a mean of 6.8 mg/l (as NO ₃). There are no exceedances above the EU MAC, or the Threshold Value of 37.5 mg/l (OCM, 2010).
Groundwater Flow Paths		Water enters the aquifer as diffuse recharge from rainfall, and discharges along ditches and to streams. The principal groundwater flow direction is thought to be southwestwards, although there will be localised deviations to this where streams dissect the body. On the Ordnance Survey 6 inch map, there are a number of wells marked, including Cotters Well and a holy well at Mongfunne Townland. There are also numerous "Rises" recorded between the area from Portnard House to Glasha Bridge on the Ordnance Survey 6 inch sheets of the eighteenth century; one which has been observed to be still in use during fieldwork, providing drinking water for two houses.



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Groundwater & Surface water interactions	Groundwater is believed to discharge into the streams and with the dense network of springs that flow from the aquifer, connectivity between the groundwater and surface water is expected to be high.	
Conceptual model	- The aquifer consists of an elevated, plateau-like, hummocky sand and gravel deposit, which occurs as a lowlying terrace at the southwestern footslopes of the Slieve Felim Mountains. - The sand and gravel deposits stand above the surrounding landscape, at elevations between 70 m and 110 m AOD. The highest elevations, around 110m AOD, are in the northeast, with the land sloping down towards the southwest in general. - Approximately 29% of the aquifer is inferred to have greater than 5 m depth of saturated sands and gravels, with the remainder inferred to have a saturated thickness less than this. - Depth to bedrock varies throughout the area of the aquifer body; depths seem to be in the order of >10 m over most of the area of the body, with the maximum depth to bedrock value of 25 m recorded in Moroewood Townland. - Diffuse recharge occurs <i>via</i> rainfall percolating through the unsaturated sands and gravels, with reduced recharge in the areas that are covered with peat and alluvium. - The water table within gravel aquifers is usually relatively flat and therefore the depth to water will depend on the exact topography of the locality concerned; the gradient in this body at Murroe is expected to be steeper than in general though, owing to the setting at the footslope of the Slieve Felim Mountains. - Groundwater is expected to discharge to the lowlying, flat peatlands at the southwest. Groundwater discharge will also occur <i>via</i> springs and seeps along the lowest boundaries of the body, and also along stream courses. There may also be discharge to rivers as baseflow where the water table lies above the river stage. - The minimum direct groundwater throughput in the aquifer is consequently estimated to be 3,819 m³/d, which rises to a minimum potential just over 6,531 m³/d when rejected recharge is included.	
Attachments	Figure 1: Location and extent Figure 2: Cross sections Figure 3: Groundwater vulnerability	
Instrumentation	Hydrometric gauges: National Water Monitoring Stations: River: Groundwater:	None present RS25D140300 (Dooglasla (Slieve Felim) - Br SW Ballyvorheen (K18)) GWIE_SH_G_21336000019 (Murroe) GWIE_SH_21336000005 - (Cappamore BH)
Information Sources	- DELG/EPA/GSI (1999). Groundwater Protection Schemes. Department of the Environment and Local Government, Environmental Protection Agency and Geological Survey Ireland. - Deakin, J. (1995). Murroe Public Supply, Groundwater Source Protection Zones. Report for Limerick County Council. Geological Survey Ireland. - EPA map viewer. https://gis.epa.ie/EPAMaps/ - GSI Mapviewer: https://www.gsi.ie/en-ie/data-and-maps - GSI (2017). A description of Irish aquifer categories. 3 pp. Available from: https://www.gsi.ie/documents/GSI%20Aquifer%20Category%20Descriptions.pdf - GSI (2023a). Geological Survey Ireland Map Viewer, Geomorphology Map. - GSI (2023b). Geological Survey Ireland Map Viewer, Quaternary Sediments Map. - GSI (2023c). Geological Survey Ireland, Internal groundwater databases. - Hunter-Williams, N.H., Misstear, B.D.R., Daly, D. and Lee, M. (2011). Development of a national groundwater recharge map for the Republic of Ireland. Quarterly Journal of Engineering Geology and Hydrogeology, 46(4):493-506. - NPWS Mapviewer: http://webgis.npws.ie/npwsviewer	



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Information Sources (contd.)	• OCM (2010). Establishment of Groundwater Protection Zones for Cappamore Group Water Supply Scheme. Report for EPA, with assistance from Robert Meehan and Jenny Deakin. • Ó'Súilleabháin, C. (2000). Assessing the boundary between high and moderately permeable subsoils. Unpublished MSc., University of Dublin. Department of Civil, Structural and Environmental Engineering, Trinity College Dublin. • Walsh S. (2012). A Summary of Climate Averages 1981-2010 for Ireland, Climatological Note No.14, Met Éireann, Dublin.
Disclaimer	Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae. Figures 1, 2 and 3 are used for illustrative purposes only.



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Murroe Sand and Gravel Aquifer

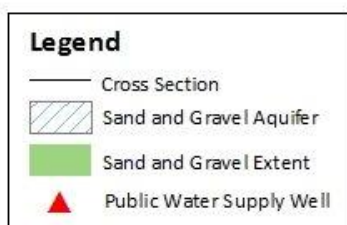
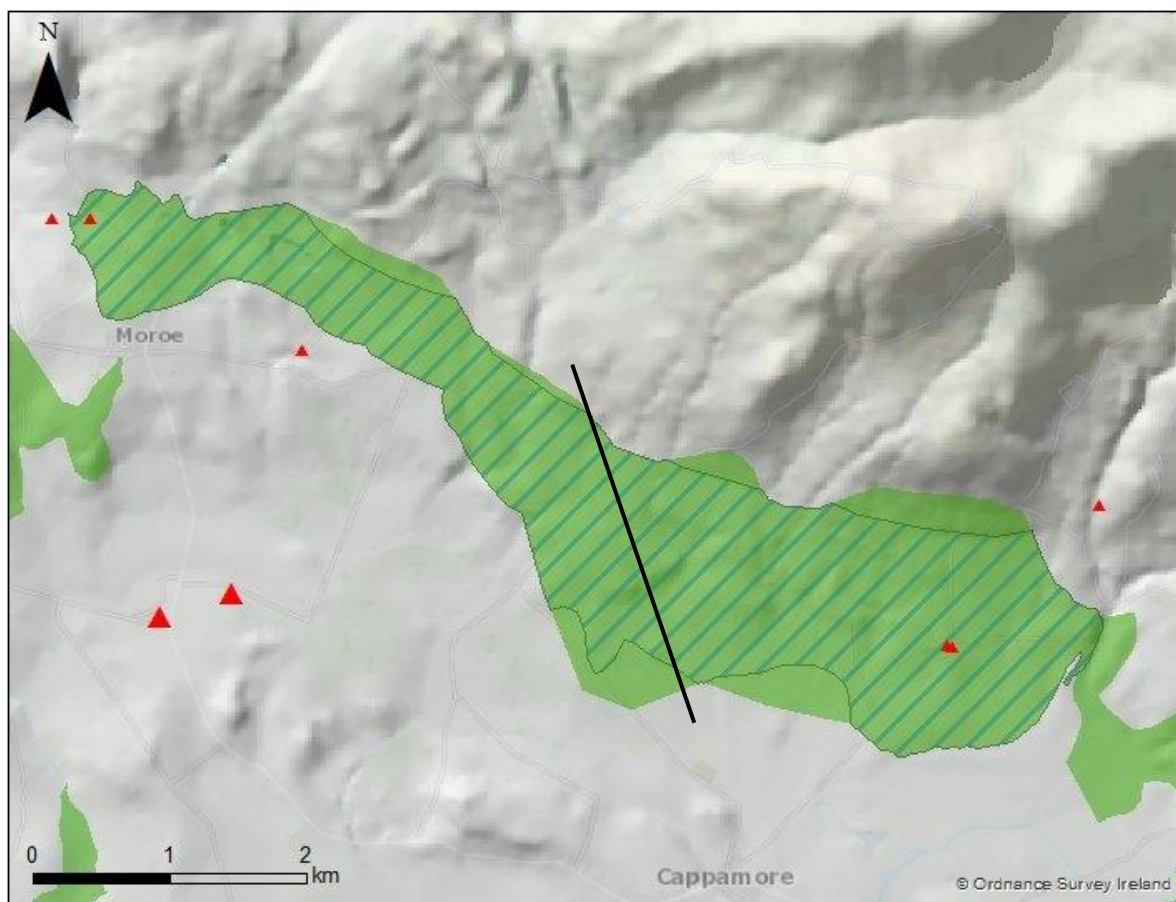


Figure 1: Murroe Sand and Gravel Aquifer extent with cross section location.



Cross Section



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Murroe Sand and Gravel Aquifer Vulnerability

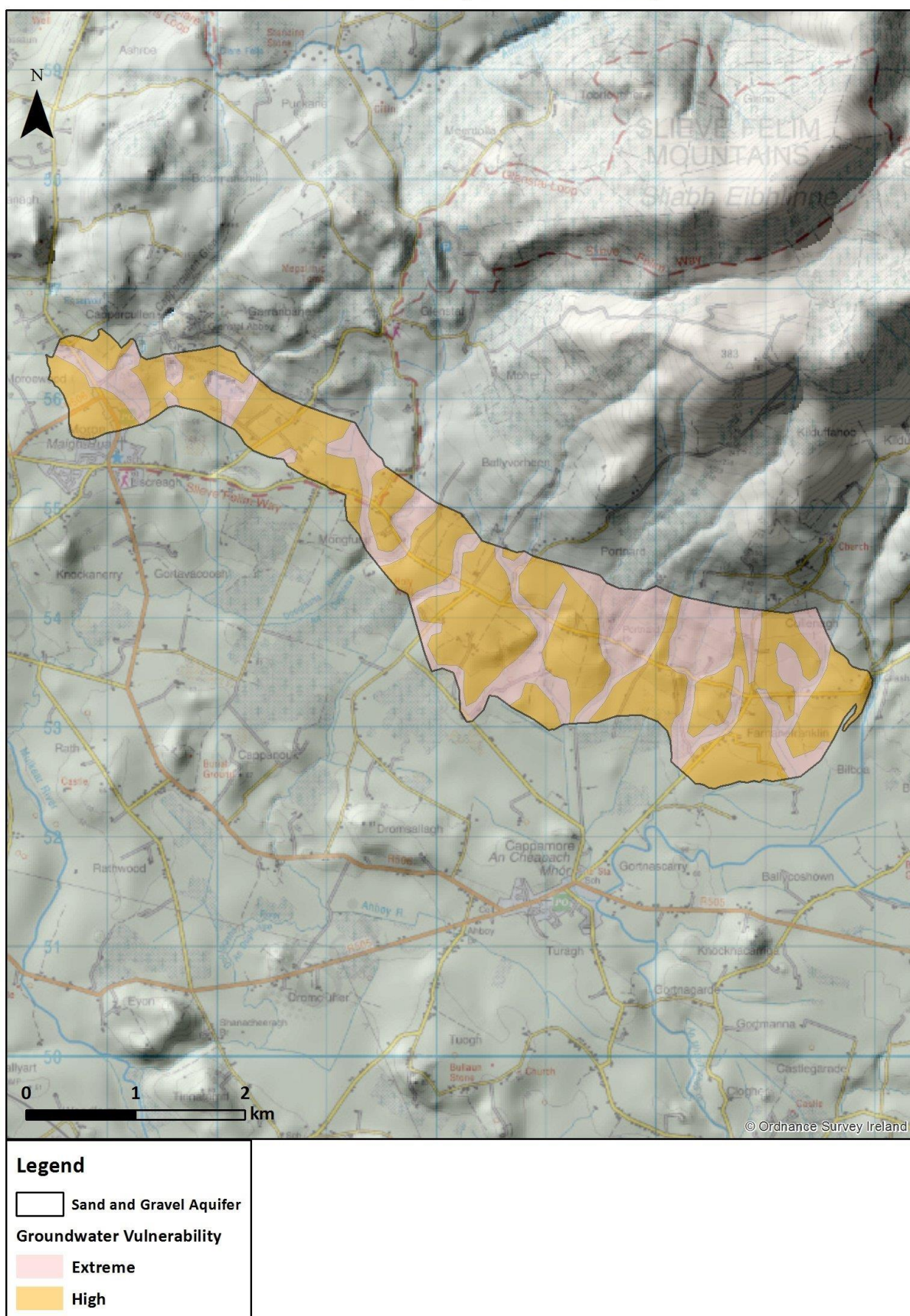


Figure 3: Groundwater vulnerability across the Murroe Sand and Gravel Aquifer.

