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Kilsaran Sand and Gravel Aquifer Summary of Initial Characterisation



GW3D Project Report TR2023/46
March 2023

Kilsaran Sand and Gravel Aquifer Description March 2023

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 ecosystem(s)	Area (km ²)
06 – Newry, Fane, Glyde and Dee Louth County Council		Rivers: River Dee, River Glyde Streams: Several unnamed streams Lakes: Several unnamed ponds	Stabannan - Braganstown pNHA	5.4
Topography	The Kilsaran sand and gravel body is located in central Louth, just south of the village of Castlebellingham (Figure1). The Rivers Glyde and Dee are situated northeast and southeast of the aquifer body respectively. The sand and gravel body is positioned between moraine ridges to the north and south. The deposit, being formed from glaciofluvial sands and gravels and alluvium, has a hummocky topography, which flattens out towards the west. The elevations across the aquifer area range between 10 m AOD and 40 m AOD. The area is bounded by till and peat deposits. At lower elevations, particularly at the west of the body, the sands and gravels are partly overlain by peat.			
Geology and Aquifers	Aquifer categories	The Kilsaran sand and gravel deposit is confirmed to be greater than 10 m in thickness and has a saturated thickness greater than 5 m. The thickness, saturated thickness and areal extent satisfy the criteria of a Locally Important Sand and Gravel Aquifer (Lg) (DELG/EPA/GSI, 1999; GSI, 2017).		
	Main aquifer lithologies	The main components of the aquifer are glaciofluvial sands and gravels derived chiefly from Lower Palaeozoic sandstones and shales (GLPSSs), and alluvium (A) (GSI, 2023a).		
	Key structures	Borehole logs (GSI, 2023b) show that the aquifer material consists largely of bedded sands and gravels, with occasional interbedded low permeability horizons. The underlying bedrock is of Silurian Metasediments and Volcanics which is classified as a ‘Poor’ Aquifer (GSI, 2023a). The sand and gravel deposit is intermittently in direct contact with bedrock, as the till deposits which are present beneath the sand and gravels are proven to be discontinuous (GSI, 2023b). The underlying till deposits are more prevalent towards the northeast, while in the southwest of the body the sands and gravels are more often in direct contact with the bedrock.		
	Key properties	Louth County Council Public Water Supply borehole logs (GSI, 2023b) show the variability of aquifer material. Borehole records indicate alternating layers of sandy GRAVEL, gravelly SAND, SAND, and clayey GRAVEL. Clay layers are deposited intermittently both over the gravel just below ground surface, and also as interbedded horizons. The groundwater is considered to be generally unconfined; however, where clay layers are present within and above the sand and gravel deposit, the aquifer may be locally confined. Well yields and borehole logging indicates that coarse material predominates, and that the permeability and storativity of the aquifer are high. The bedrock aquifer has a high degree of rejected recharge associated with it, as the underlying ‘Poor’ bedrock aquifer cannot accept all of the available recharge. There are four estimates of the potential yield of the sand and gravel aquifer ranging from ‘Poor’ to ‘Excellent’; 34 m ³ /day and 25.9 m ³ /day (both An Forás Forbartha and GSI, 1982), 545 m ³ /day (GSI, 2023b) and 120 m ³ /day (a combination of bedrock and sand and gravel aquifer, GSI, 2023b).		
	Thickness	The largest recorded thickness of the sands and gravels is 52 m, of which 35 m is saturated (GSI, 2023b). The sands and gravels are not deep and continuous throughout the aquifer extent however; towards the eastern and western boundaries of the body, the sands and gravels reduce to 2 m in thickness, and in low-lying areas in the south there are four borehole records with logs which record mainly unsorted ‘diamiction’ throughout the subsurface sequence. However, as sand and gravel layers are present here as well-defined layers, this locality is included within area of the delineated aquifer body.		
Overlying Strata	Lithologies	Mapped areas of peat and lake sediments have been recognised above the sands and gravels (GSI, 2023a), and these sediments overlie approximately 12% of the aquifer extent.		
	Thickness	Mapped peat, which overlies the sands and gravels on the western boundary of the delineated aquifer extent, is 0.3 m to 0.5 m in thickness (GSI, 2023b).		



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	% area aquifer near surface	Almost the entirety of the area of the delineated aquifer has sands and gravels just below the ground surface (88%)
	Vulnerability	Most of the aquifer is at the surface and therefore vulnerable; consequently pollutants can easily infiltrate the aquifer. Sand and gravel aquifers are categorised as having either 'High' or 'Extreme' groundwater vulnerability (DELG/EPA/GSI, 1999), with the vulnerability classification determined by the depth to the water table from ground level. Measured water levels range from 3.1 m to 15 m below ground level at Kilsaran. In areas where the water table is less than 3 m below ground level the aquifer vulnerability is mapped as 'Extreme', and where it is greater than 3 m below ground level the aquifer vulnerability is mapped as 'High'.
Recharge	Main recharge mechanisms	Diffuse recharge occurs <i>via</i> infiltration of rainfall through the unsaturated sands and gravels. The proportion of the effective rainfall that recharges the aquifer is largely determined by the thickness and permeability of the soil and subsoil, and by the slope (DELG/EPA/GSI, 1999). The peat and lake sediments which overly the sands and gravels act as a barrier and may reduce the amount of recharge reaching the aquifer. Typically, the proportion of recharge that infiltrates to ground water in sand and gravel is around 85% (Hunter Williams <i>et al.</i> , 2011)
	Est. recharge rates	The rainfall in the area of the Kilsaran sand and gravels is 790 mm (Walsh, 2012), and the estimated recharge rate to the aquifer from direct recharge is 265 mm/yr. The minimum direct groundwater throughput in the aquifer at Kilsaran is consequently estimated to be 1,223 m ³ /d.
Discharge	Large springs and large known abstractions (m³/d)	There are three wells in the townland of Bolies, and estimated yields from these wells range from 25.9 to 543 m ³ /d (GSI, 2023b).
	Main discharge mechanisms	Groundwater discharges to the River Dee to the southeast and to the River Glyde to the northeast of the aquifer body, as well as <i>via</i> streams. There are also a number of springs at the northwestern, western and southern extremities of the aquifer body.
	Hydrochemical Signature	There is no set of complete hydrochemical analyses readily available for this aquifer, but the groundwater is likely to have a calcium bicarbonate signature. According to Atkins (2002) groundwater pollution is an issue at the boreholes in Bolies. This is thought to be due to the proximity to a former landfill, and potentially the presence of dysfunctional septic tanks.
Groundwater Flow Paths		Flow paths are short due to the restricted lateral extent of the aquifer. There are not enough hydrogeological data to calculate precise groundwater gradients, but low gradients are expected, which are typical of sand and gravel deposits, due to the high permeability associated with these sediments.
Groundwater & Surface water interactions		Hydraulic connection between the groundwater and surface water is expected to be high.
Conceptual model	- The Kilsaran aquifer is located south of Castlebellingham between the River Glyde to the northeast, and River Dee to the southeast. - The boundaries of the aquifer are delimited for the most part by the extent of the mapped sand and gravel deposit (GSI 2023a). - Small areas of peat and lake sediments, which are proven to be underlain by sands and gravels, are included in the delineated aquifer body. - The aquifer is, in part, underlain by till. The thickness of the till between the sands and gravels and the bedrock decreases towards the west, and the sand and gravel is recorded to be in direct contact with the bedrock in the southwestern area of the body. - The depth to bedrock generally increases from north to south within the aquifer body. - Recharge to the aquifer occurs diffusely through the unsaturated zone, and though the aquifer is generally unconfined, it may be confined locally in places, by clay layers. - The permeability of the deposit is expected vary considerably throughout the area of the aquifer. It is	



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	thought the variability in the recorded yields is a reflection in the variability in composition of the deposit. - Groundwater is thought to flow towards the north and the south, towards the Rivers Glyde and Dee respectively, from a catchment divide within the central portion of the body. - The minimum direct groundwater throughput in the aquifer at Kilsaran is estimated to be 1,223 m³/d.	
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 None present None present
Information Sources	- Atkins (2002). Mid-Louth Regional Water Supply Strategy. Report to Louth County Council. - An Forás Forbatha and Geological Survey Office (1982). Groundwater Resources in the N.E.(R.D.O). Region. March 1982. Volumes 1 to 3. - DELG/EPA/GSI (1999). Groundwater Protection Schemes. Department of the Environment and Local Government, Environmental Protection Agency and Geological Survey of Ireland. - EPA map viewer. https://gis.epa.ie/EPAMaps/ - Groundwater 3D Project fieldwork, 2016. - 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 Spatial Resources Viewer. https://www.gsi.ie/en-ie/data-and-maps/Pages - GSI (2023b). Geological Survey Ireland. Internal Groundwater Database - GSI (2023c). Geological Survey Ireland. Internal Geotechnical Database - Hunter Williams, N., Misstear, B., Daly, G., Johnston, P., Lee, M., Cooney, P. and Hickey, C. (2011). National Groundwater Recharge Map for Ireland. Geological Survey Ireland and Department of Civil, Structural and Environmental Engineering, Trinity College Dublin. - Murphy, O. (2012). County Louth Groundwater Protection Scheme. Report to Louth County Council. Geological Survey of Ireland. - NPWS viewer. http://webgis.npws.ie/npwsviewer/ - O'Suilleabháin, 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. - Wright, G.R., Aldwell, C.R., Daly, D. and Daly, E.P. (1982). Groundwater resources in the Republic of Ireland, vol 6. In: European community's atlas of groundwater resources, SDG, Hannover, Germany.	
Disclaimer	Note that all calculation and interpretations presented in this report represent estimations and assumptions based on the information sources described above and established hydrogeological formulae. Figures 1, 2 and 3 are used for illustrative purposes only.	



Kilsaran Sand and Gravel Aquifer

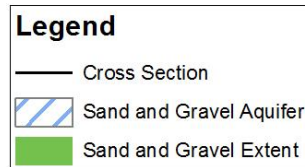
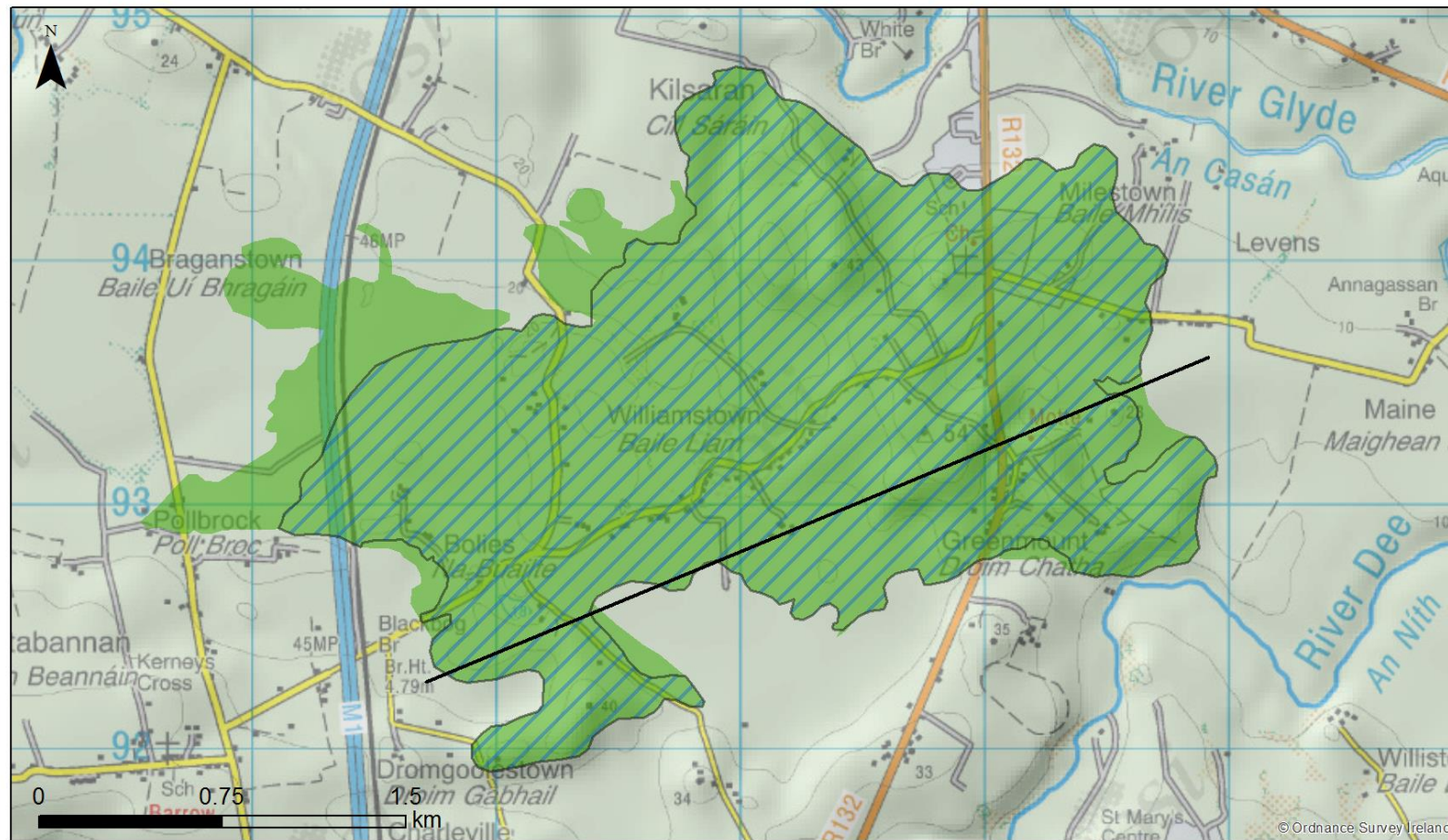
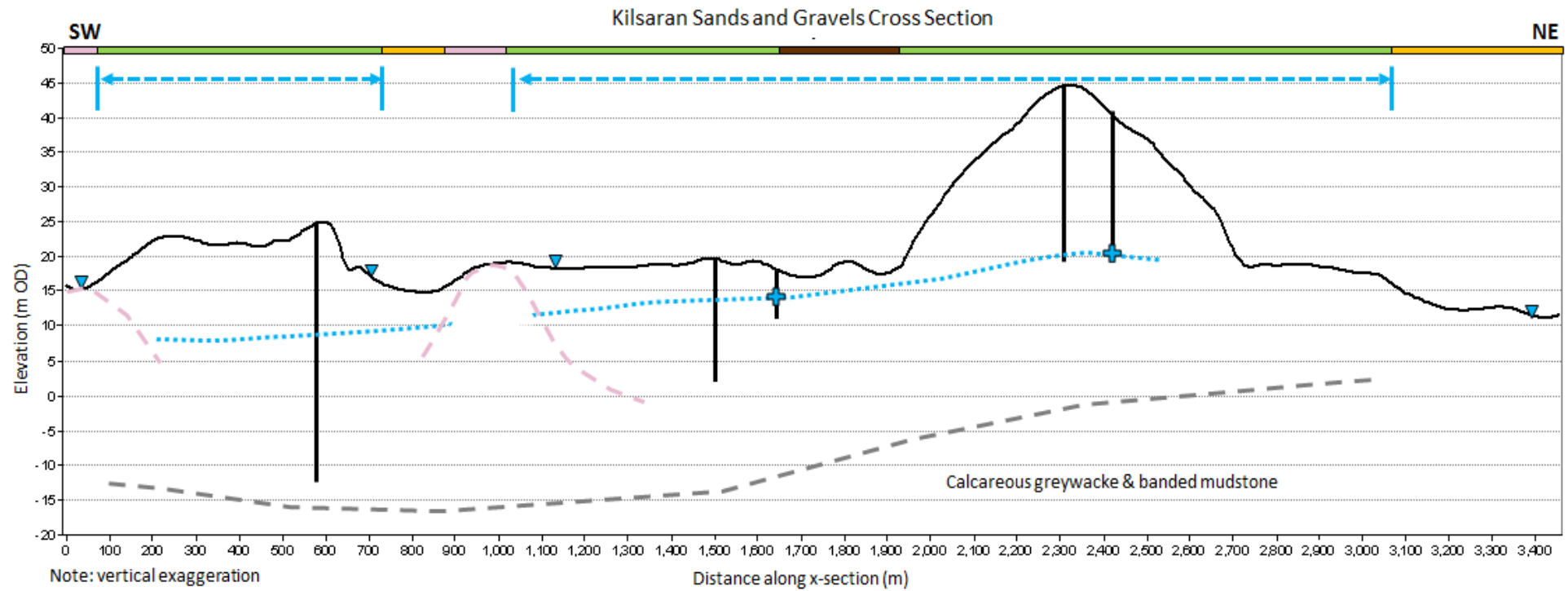


Figure 1. Kilsaran Sand and Gravel Aquifer extent with cross section location.



Elevation		Aquifer		Sand and gravel	
Groundwater level		Presumed Groundwater Level		Till	
Top of bedrock		Presumed Top of Bedrock		Alluvium	
River		Borehole/Trial Pit		Peat	

Figure 2. Cross section through the Kilsaran Sand and Gravel Aquifer body.

Kilsaran Sand and Gravel Aquifer Vulnerability

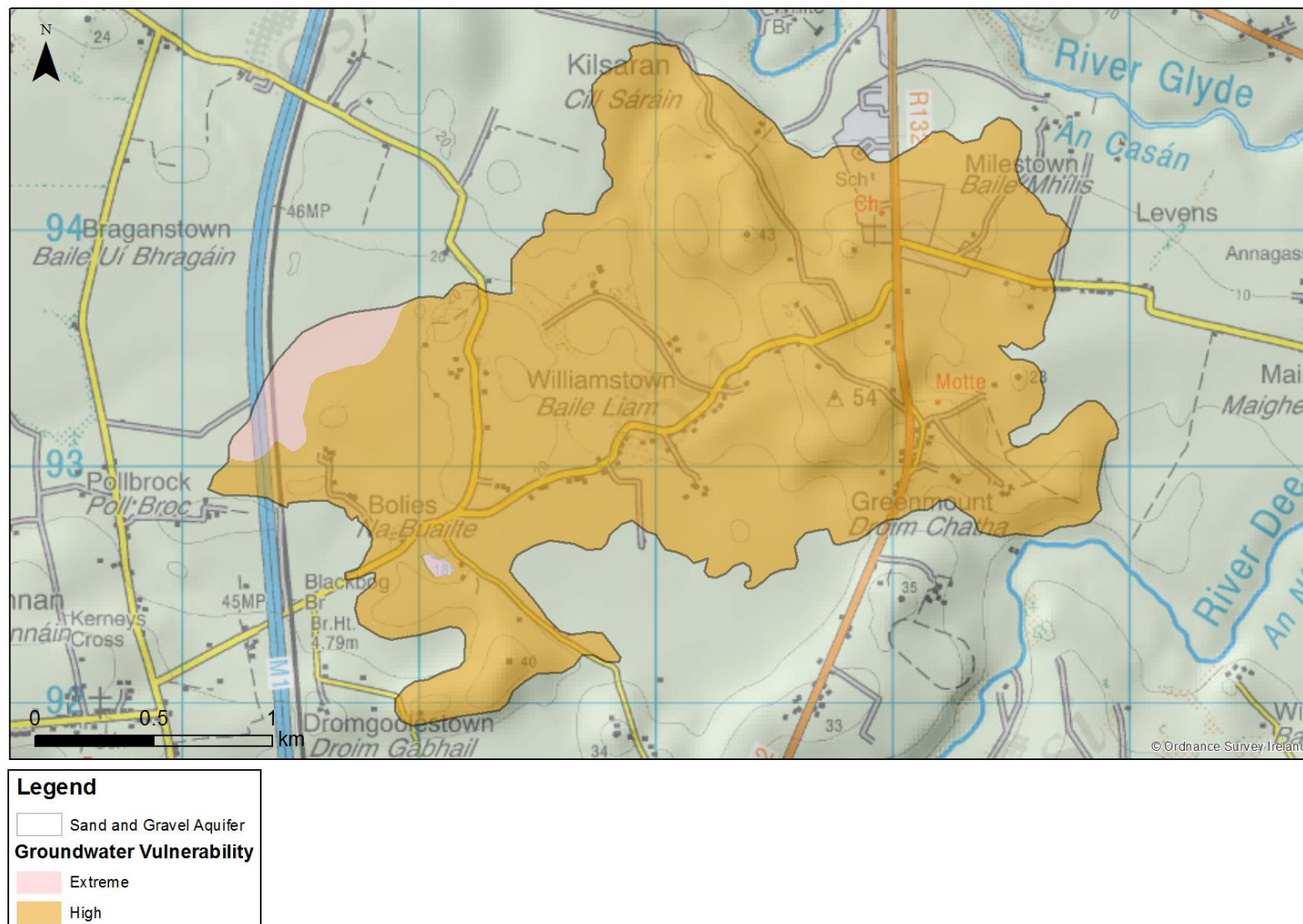


Figure 3. Groundwater vulnerability across the Kilsaran Sand and Gravel Aquifer.