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Summerhill Sand and Gravel Aquifer Summary of Initial Characterisation



GW3D Project Report TR2023/54
March 2023

Summerhill 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
- James McAteer, Gavin and Doherty Geosolutions



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Hydrometric Area Local Authority		Associated surface water features	Associated terrestrial ecosystem(s)	Area (km ²)
07 – Boyne 09 – Liffey and Dublin Bay Meath County Council		Rivers: Formal River, Rye Water River, Knightsbrook River, Dangan River, Laracor River Streams: Several unnamed streams Lakes: None	None	8.23
Topography	The Summerhill sand and gravel aquifer is a north-south oriented band of hummocky sands and gravels between Bray Hill and Agher in County Meath, with the villages of Summerhill and Rathmolyon to it's east and west respectively. The sand and gravel body rests at elevations between 70 m and 94 m AOD. The aquifer is long and relatively narrow, and generally flat to gently undulating, with a number of protruding ridges of higher elevation sands and gravels, and some eskers, present. The surrounding landscape is of bedrock cored ridges to the north, east and south, rising to between 110 m and 120 m AOD, and northeast-southwest trending ridges of glacial till at the west, with the sands and gravels draped along their flanks.			
Geology and Aquifers	Aquifer categories	There were data available from 35 boreholes and trial pits from within the aquifer body. One borehole in Ballinrig Townland recorded sands and gravels to a depth of 21.7 m, with a saturated thickness of 11 m present. Based on its areal extent, inferred thickness, saturated thickness, groundwater throughput and position in the landscape the deposit is classified as a Locally Important Sand and Gravel Aquifer (Lg) (DELG/EPA/GSI, 1999; GSI, 2017).		
	Main aquifer lithologies	Glaciofluvial sands and gravels derived chiefly from limestones (GLs) and esker derived from rocks of basic reaction (BasEsk).		
	Key structures	The exposures recorded during fieldwork showed high variability within the sediments, but in general interbedded sand and gravel sheets and thickly bedded fine sand deposits were the main structures seen. There is one isolated area of glacial till mapped within the aquifer body, which is assumed not to adversely affect transmissivity in the areas adjacent.		
	Key properties	There are 29 water level data points available from within the sand and gravel aquifer which have allowed for inferences to be made on water levels throughout the body. The eskers are considered to reach bedrock and act as conduits for groundwater flow. It is inferred that approx. 50% of the aquifer area has a depth of saturated sands and gravels greater than 5 m (Figure 2). Particle size analysis charts are available from sediment samples taken within the central portion of the aquifer, at Cloondoogan Townland, this sample contained approx. 5% fines (GSI, 2023a). Another sample further north, in Dangan Townland, contained 9% fines (GSI, 2023b). Sand and gravel aquifers generally consist of unconsolidated coarse grained material, usually containing less than 8% fines (Ó'Súilleabháin, 2000).		
	Thickness	The borehole in Ballinrig Townland recorded subsoil depths of 21.7 m, with a saturated thickness of 11 m present (GSI, 2023b). Only one of the 35 boreholes within the aquifer indicate depth to bedrock of less than 10 m. In general, thicknesses seem to be in the order of 15 m, with only a small isolated pocket less than 5 m in thickness (GSI, 2023b), in Clondoogan Townland.		
Overlying Strata	Lithologies	Approximately 14% of the aquifer is overlain with alluvial deposits, lake sediments and/or cutover raised peat, with sands and gravels assumed beneath		
	Thickness	Two trial pits excavated in the northern half of the aquifer have measured alluvial deposits at 0.2 m thick (GSI, 2023a). The remainder of the alluvial deposits, lake sediments and/or cutover raised peat are inferred to be less than 3 m thick.		
	% area aquifer near surface	Approximately 86% of the sand and gravel aquifer is at the surface, with the remainder beneath the alluvial deposits, lake sediments and/or cutover raised peat.		
	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 47% of the aquifer area. In all other areas where the water table is at a depth > 3 m, the vulnerability is classed as 'High' (53% of the aquifer, Figure 3).		



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Recharge	Main recharge mechanisms	Diffuse recharge occurs <i>via</i> rainfall percolating 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 cutover raised peat, lake sediments and/or alluvium overlie the sands and gravels, the proportion of rainfall that recharges the water table will be significantly less.
	Est. recharge rates	The annual average rainfall for the aquifer is 864 mm (Walsh, 2012), thus providing an estimated diffuse groundwater recharge of 307 mm/yr. The minimum direct groundwater throughput in the aquifer is consequently estimated to be of 3,497 m ³ /d.
Discharge	Large springs and large known abstractions (m ³ /d)	There are no known large springs or abstractions from this aquifer body.
	Main discharge mechanisms	Groundwater is expected to discharge <i>via</i> some small lowlying springs as seen on OSI 6 inch raster map (1830s – 1930s) at, for example, Rahinstown and Ballinrig Townlands. Groundwater is also assumed to discharge directly to the streams and rivers that flow through the aquifer.
	Hydrochemical Signature	The hydrochemistry of one of these low lying springs was measured during fieldwork; it had an Electrical Conductivity of 703 µS/cm (@20°C), and a pH of 7.8. Given the subsoil and bedrock types within the area of the aquifer body, the groundwater is expected to have a calcium bicarbonate (CaHCO ₃) signature.
Groundwater Flow Paths		The length of flow paths depend on the extent of the sand and gravel deposit. In general, locally important sand and gravel aquifers are expected to have relatively short flow paths <i>i.e.</i> up to several hundred metres. Given the geomorphology of the aquifer body at Summerhill, and the stream pattern, this is also expected to be the case here.
Groundwater & Surface water interactions		Groundwater has been seen to discharge <i>via</i> lowlying springs therefore; connectivity between groundwater and surface water is expected to be high.
Conceptual model	- The aquifer consists of flat to hummocky to gently undulating sands and gravels at elevations between 70 m and 94 m AOD. - Depth to bedrock varies throughout the aquifer; depths generally seem to be in the order of 15 m, with a maximum recorded depth to bedrock value of 21.7 m in Ballinrig Townland (GSI, 2023b). One small, restricted area has depth to bedrock of less than 5 m. - A particle size distribution analysis obtained from material sampled at Cloondoogan Townland contained approx. 5% fines. - Approximately 50% of the aquifer is inferred to have greater than 5 m depth of saturated sands and gravels, with the remainder of the aquifer inferred to have a saturated thickness less than this. - Diffuse groundwater recharge is estimated to be approx. 307 mm/yr. - The minimum direct groundwater throughput in the aquifer is consequently estimated to be of 3,497 m³/d.	
Attachments	Figure 1: Location and extent Figure 2: Cross section Figure 3: Groundwater vulnerability	
Instrumentation	Hydrometric gauges: National Water Monitoring Stations; River: Groundwater:	None present RS07K020300 (Dangan Bridge) RS07K020310 (Knightsbrook – Bridge d/s Dangan Br.) RS07K020320 (Knightsbrook – 2 nd Bridge d/s Dangan Br.) None present

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Information Sources	• DELG/EPA/GSI (1999). Groundwater Protection Schemes. Department of the Environment and Local Government, Environmental Protection Agency and Geological Survey Ireland. • EPA map viewer. https://gis.epa.ie/EPAMaps/ • 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, Internal geotechnical borehole databases. • GSI (2023b). Geological Survey Ireland, Internal groundwater databases. • Geotech Specialists Limited (2000). N4: Kinnegad-Enfield-Kilcock, Preliminary Site Investigation, Factual Report. Carried out for Westmeath County Council. • NPWS viewer. http://webgis.npws.ie/npwsviewer/ • O'Neill, S. (2003). Additional information for a planning application to develop a bottled water source at Agher Crossroads, Co. Meath. Report by O'Neill Groundwater Engineering. • 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 and assumptions based on the information sources described above and established hydrogeological formulae. Figures 1, 2, and 3 are used for illustrative purposes only.



Summerhill Sand and Gravel Aquifer

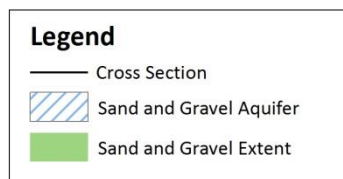
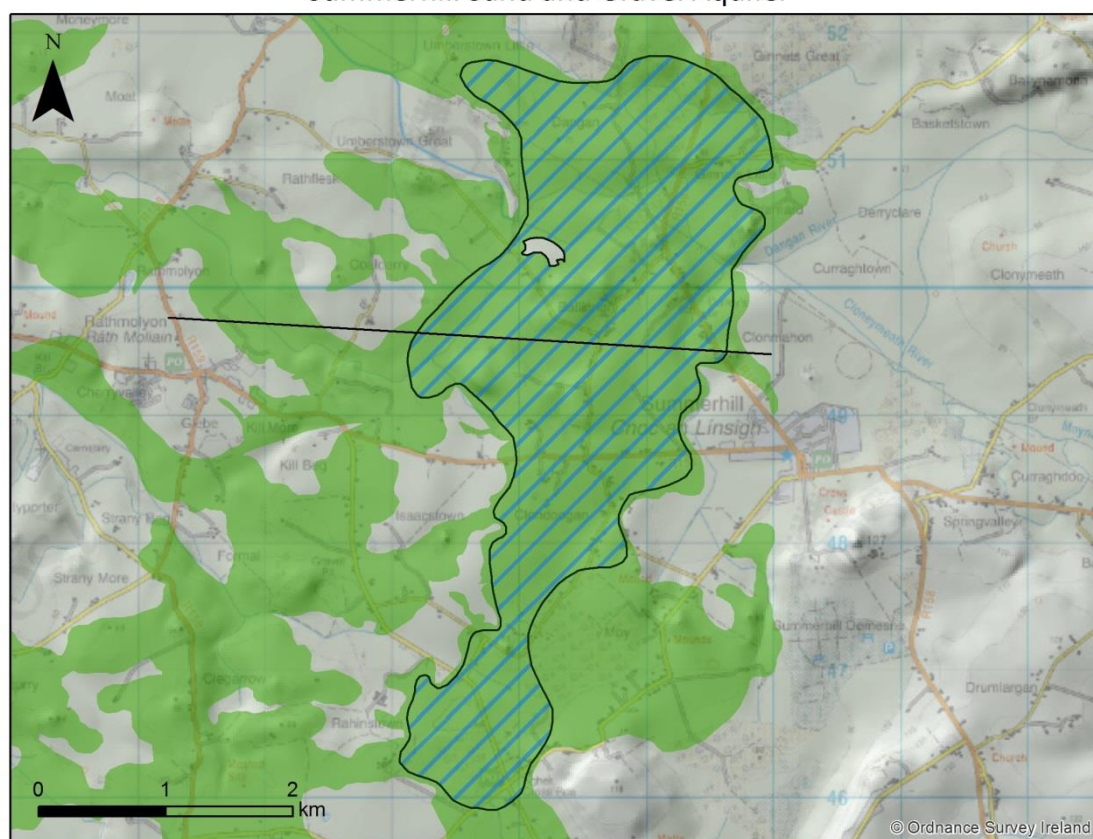


Figure 1: Summerhill Sand and Gravel Aquifer extent with cross section location.

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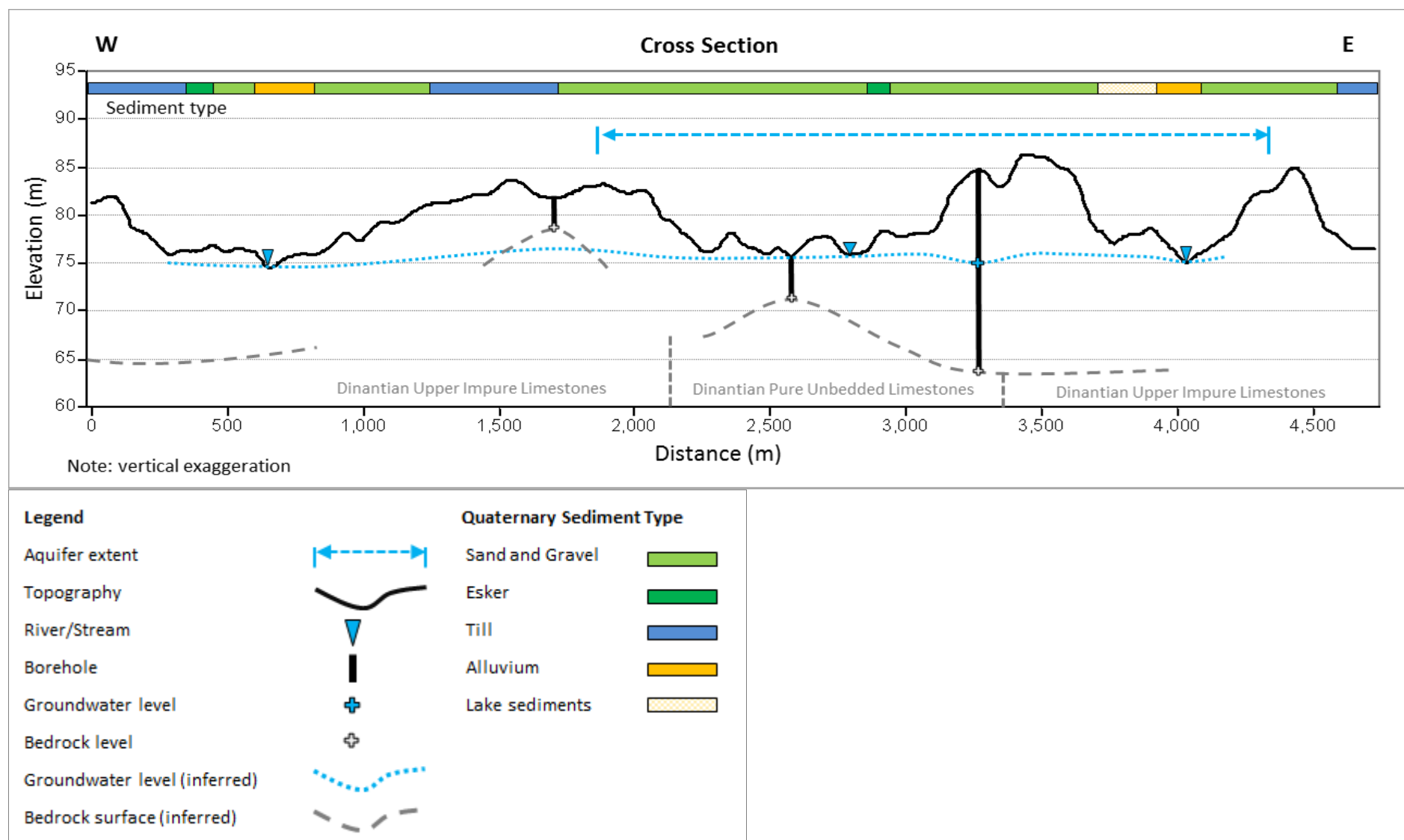


Figure 2: Cross section through the Summerhill Sand and Gravel Aquifer body.

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Summerhill Sand and Gravel Aquifer Vulnerability

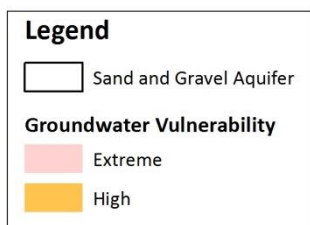
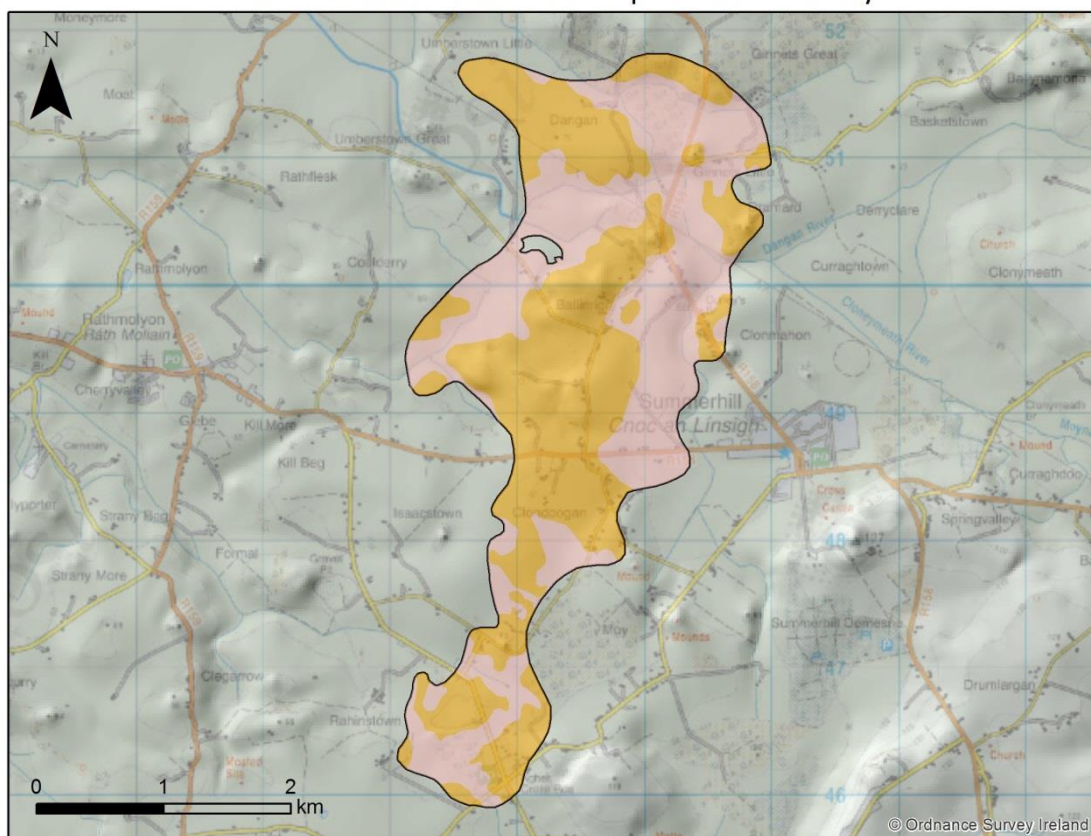


Figure 3: Groundwater vulnerability across the Summerhill Sand and Gravel Aquifer.