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Bridgetown Sand and Gravel Aquifer
Summary of Initial Characterisation

GW3D Project Report TR2023/01
January 2023

Geological Survey Ireland is a division of the Department of the Environment, Climate and Communications

Bridgetown Sand and Gravel Aquifer Description January 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 (km²)
25 – Lower Shannon Clare County Council	**Rivers:** River Shannon, Black River, Bridgetown River, Ardataggle River, Ardnacrusha Canal **Streams:** Several unnamed streams **Lakes:** McNamara's Lough	Lower River Shannon SAC	7.30

Topography	The Bridgetown sand and gravel aquifer set within a deep valley tributary of the Shannon around Bridgetown in southern County Clare (Figure 1). The southeastern edge of the aquifer is adjacent to the River Shannon itself, and the Ardnacrusha Canal passes through the southern end of the aquifer for a distance of 1.8 km. The majority of the aquifer topography is considered as a 'flat alluvial-glaciofluvial plain' (GSI, 2023a), though there are also marked zones of hummocky topography. The aquifer surface is found at elevations between 26 m and 94 m AOD, with the highest elevations at the northwestern end of the aquifer. The surrounding landscape to the west and north is much higher and classified as 'mountain to hill' topography (GSI, 2023a), with Lackareagh Mountain rising to 356 m AOD to the north of the aquifer. The body of the O'Briensbridge sand and gravel aquifer is present to the southeast of here, on the opposite side of the River Shannon.	
Geology and Aquifers	**Aquifer categories**	There are 32 desk study data points available within and adjacent to the sand and gravel aquifer. The aquifer body exceeds the groundwater throughput threshold of 1,000 m^3/d and is considered to be unconfined. Based on its areal extent, inferred thickness, inferred saturated thickness, groundwater throughput and position in the landscape, the deposit is classified as **Locally Important Sand and Gravel Aquifer (Lg)** (DELG/EPA/GSI, 1999; GSI, 2017).
	Main aquifer lithologies	Hummocky glaciofluvial sands and gravels derived chiefly from Lower Palaeozoic and Devonian sandstones and shales (GLPDSsS).
	Key structures	In general, exposure is good within the sand and gravel body, with two deep, extensive sand and gravel pits present at the northwestern end. The key depositional structures seen are unconsolidated, thickly bedded, sub-horizontal sheets of sands and gravels.
	Key properties	The groundwater levels are relatively well characterised within the area of the aquifer, with 12 groundwater level data points available, five of which were collected during fieldwork for this project. Analysis of groundwater levels would suggest that greater than 5 m depth of saturated sand and gravel is present in at least eight of the desk study boreholes, with 30 m depth of saturated sand and gravel inferred to be present in two of these, at Clonboy Townland (GSI, 2023c). Using these data, along with the streams and river level information, it has been inferred that approx. 59% of the aquifer area has greater than 5 m depth of saturated sand and gravel. In general, sand and gravel aquifers consist of unconsolidated coarse grained material, usually containing less than 8% fines (Ó'Súilleabháin, 2000).
	Thickness	The thickness of the deposits varies throughout the aquifer; the minimum depth recorded is 4.4 m at the eastern end of O'Briensbridge Townland (GSI, 2023c). Of the 32 desk study data points gathered in the area of the aquifer, 15 of these have subsoil thicknesses greater than 10 m, and seven of these are greater than 20 m in thickness (Figure 2). In general, the thicknesses are expected to be greater than 10 m throughout the area of the aquifer, excepting a small, localised area in the eastern end of O'Briensbridge Townland where shallow subsoils are proven to exist (GSI, 2023c).
Overlying	**Lithologies**	Approximately 41% of the aquifer area is overlain by cutover raised peat, fen peat, alluvium, estuarine silts and clays, or embankments, with sand and gravel inferred to be underneath all of these lithologies and structures.

	Thickness	The thickness of the estuarine silts and clays is measured at 5.4 m at one point locality in O'Briensbridge Townland (GSI, 2023c). The thickness of the cutover raised peat, fen peat, alluvium and the remainder of the estuarine silts and clays are inferred to be less than 3 m thick in general. The thicknesses of the embankments are unknown but examining their form and the surrounding topography, these are expected to be less than 10 m deep.
	% area aquifer near surface	Approximately 59% of the area of the sand and gravel aquifer is at the surface, with the remainder beneath the overlying strata.
	Vulnerability	The groundwater vulnerability of the sand and gravel is 'Extreme' where the water table is inferred to be < 3 m from the surface, and this accounts for 60% of the aquifer area. In all other areas where the water table is at depths > 3 m, the vulnerability is classed as 'High' (40%, Figure 3).
Recharge	**Main recharge mechanisms**	Diffuse recharge occurs *via* rainfall percolating through the unsaturated sand and gravel. Due to the high permeability of sand and gravel, a high proportion of the available recharge will percolate down to the water table. In the areas of the aquifer that is covered by overlying strata, a much lower proportion of the available recharge will percolate downwards, and there will be an element of lateral flow to streams and ditches. Rejected recharge has also been conceptualised as contributing to the aquifer throughput from the surrounding Locally Important **(Ll)** and Poor **(Pl)** Bedrock Aquifers, which are all at higher elevations**.**
	Est. recharge rates	The annual average rainfall for the aquifer is 1,204 mm (Walsh, 2012), thus providing an estimated diffuse groundwater recharge of 350 mm/yr. The minimum direct groundwater throughput in the aquifer body is estimated to be 3,397 m^3/d, which increases to a potential 6,821 m^3/d when rejected recharge is included.
Discharge	**Large springs and large known abstractions (m^3/d)**	There are no known large springs from within this aquifer area, though a number of small streams rise in the north central portion of the body in Clonboy, and in Fahy More and Fahy Beg townlands. Bridgetown Public Water Supply abstracts groundwater from a dug well, and the yield is reported to be approx. 40.9 m^3/d (GSI, 2023b).
	Main discharge mechanisms	Groundwater is expected to discharge into the River Shannon and the streams that flow through the aquifer, as well as at their headwater springs. Some small, lowlying springs are also seen on OSI 6 inch raster map (1830s -1930s) in O'Briensbridge Townland.
	Hydrochemical Signature	There are no data readily available to assess the hydrochemistry of this aquifer, but the groundwater is likely 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.e*. up to several hundred metres. The geomorphology of this sand and gravel aquifer and the pattern of streams within it would suggest groundwater flows paths are unlikely to exceed a few hundred metres.
Groundwater & Surface water interactions		Groundwater has been seen to discharge *via* lowlying springs therefore; connectivity between groundwater and surface water is high throughout the majority of the aquifer.
Conceptual model		• The topography over a considerable proportion of the aquifer area is classified as a 'flat alluvial-glaciofluvial plain' (GSI, 2023a), while much of the rest of the body has a marked hummocky topography. The land surface is at elevations between 26 m and 94 m AOD. • Shallow thicknesses of sand and gravel are found in a small isolated pocket in the eastern end of O'Briensbridge Townland, where the aquifer surrounds a pocket of outcropping bedrock. • Elsewhere in the aquifer area, sand and gravel thicknesses up to 30 m have been identified in two boreholes in the central portion of the aquifer body (GSI, 2023c), at Clonboy Townland (Figure 2). • Approximately 59% of the aquifer area is inferred to have a depth of saturated sand and gravel greater than 5 m. The remainder of the aquifer is inferred to have a saturated thickness less than this. • Approximately 41% of the aquifer area is overlain with cutover raised peat, fen peat, alluvium, estuarine silts and clays, or embankments, with sand and gravel assumed to be underneath each lithology and/or structure.

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	• An area of 3.82 km^2 of rejected recharge from the surrounding Locally Important **(LI)** and Poor **(Pl)** Bedrock Aquifers contributes significant groundwater recharge into the sand and gravel area. • The minimum direct groundwater throughput in the aquifer is estimated to be 3,390 m^3/d, and increases to a potential 6,814 m^3/d when rejected recharge is included.	
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 RS25B220200 (Black River Bridge) RS25B220100 (Aughayarha Bridge) RS25B230200 (Bridgetown Bridge) RS25B230100 (Fahy Bridge) None present
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, Spatial Resources Viewer: Quaternary Geomorphology Map. https://www.gsi.ie/en-ie/data-and-maps/Pages • GSI (2023b). Geological Survey Ireland, Internal groundwater databases. • GSI (2023c). Geological Survey Ireland, Internal bedrock borehole databases. • NPWS viewer. http://webgis.npws.ie/npwsviewer • 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.	

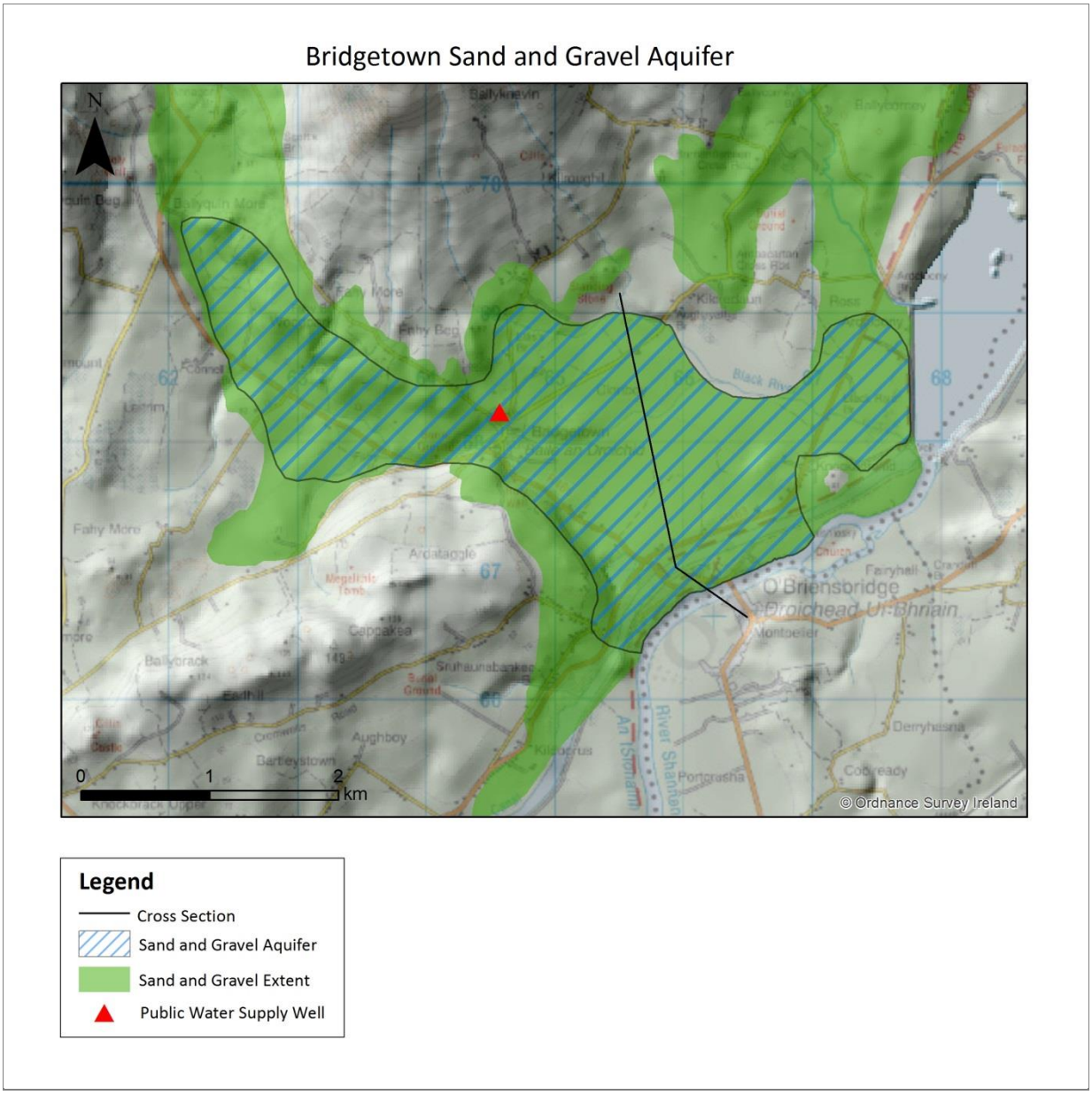

Figure 1: Bridgetown Sand and Gravel Aquifer extent with cross section location.

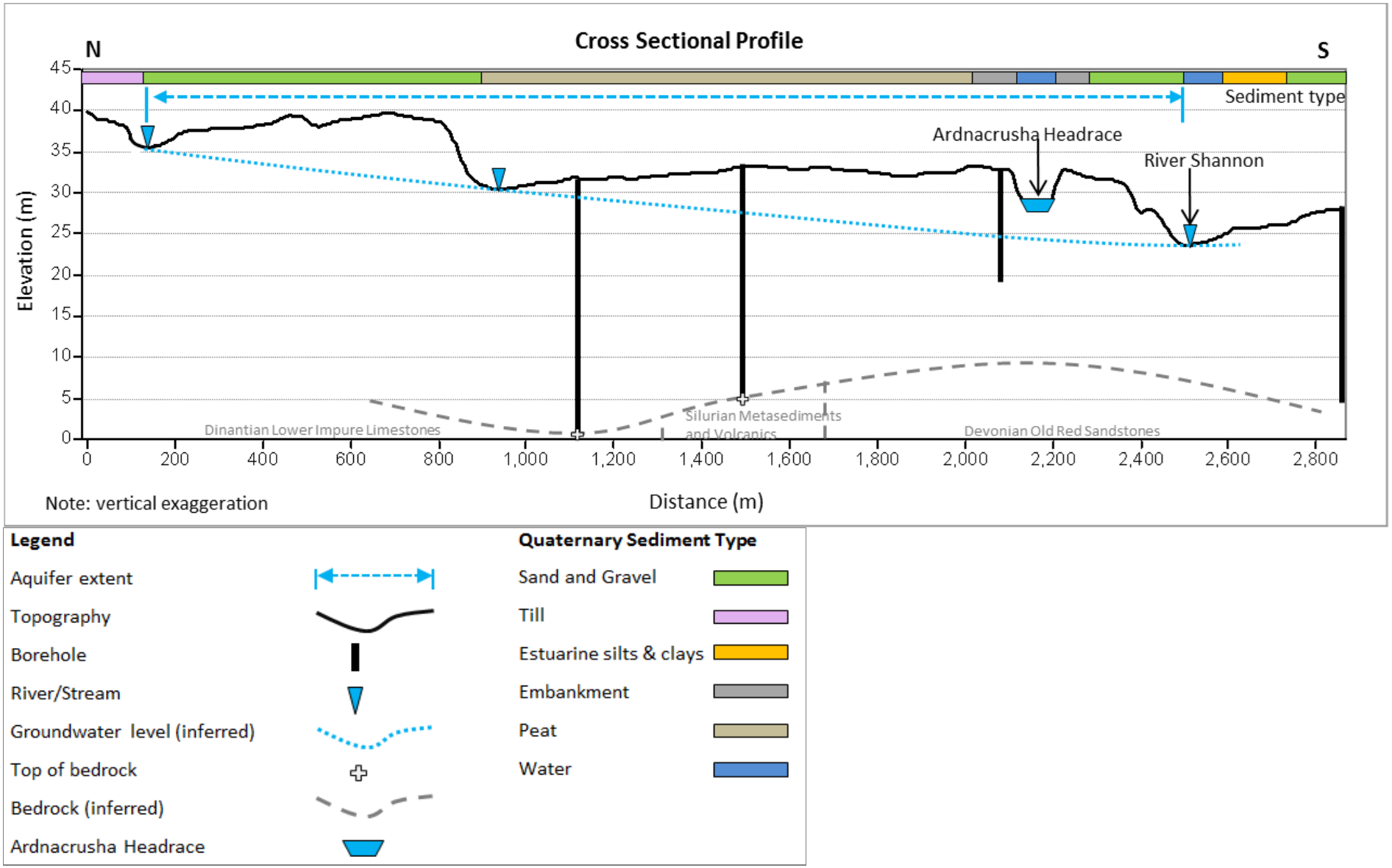

Figure 2: Cross section through the Bridgetown Sand and Gravel Aquifer body.

Bridgetown Sand and Gravel Aquifer Vulnerability

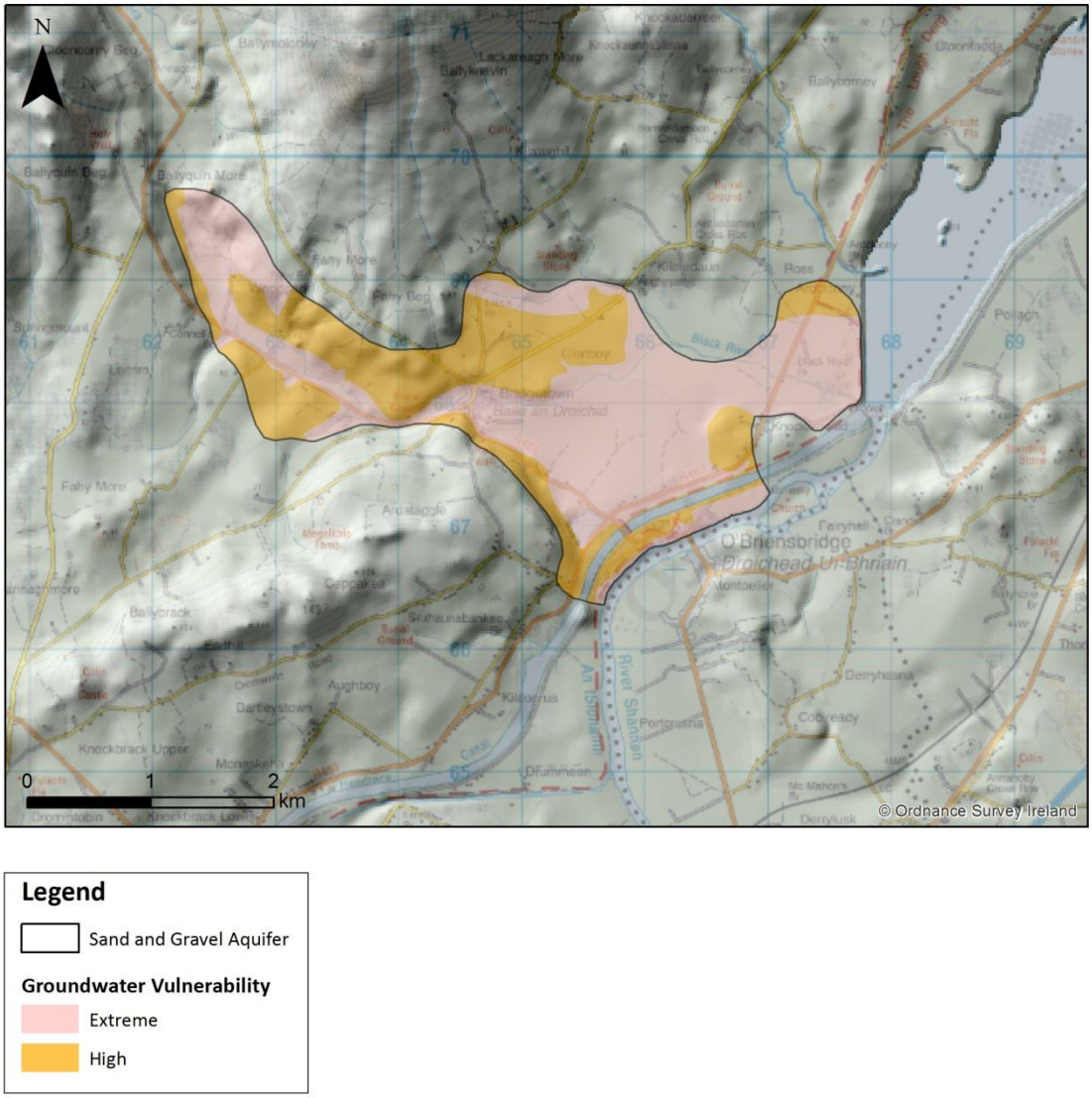

Figure 3: Groundwater vulnerability across the Bridgetown Sand and Gravel Aquifer.