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Laytown-Gormanston Sand and Gravel Aquifer Summary of Initial Characterisation

GW3D Project Report TR2023/55
March 2023

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

Laytown-Gormanston 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

Laytown-Gormanston Sand and Gravel Aquifer Description March 2023

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Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
08 – Nanny-Delvin Meath County Council Fingal County Council	**Rivers:** River Nanny, Mosney River, Delvin River, Gormanston River **Streams:** Several unnamed streams **Lakes:** None	River Nanny Estuary and Shore SPA Laytown Dunes/Nanny Estuary pNHA	11.1

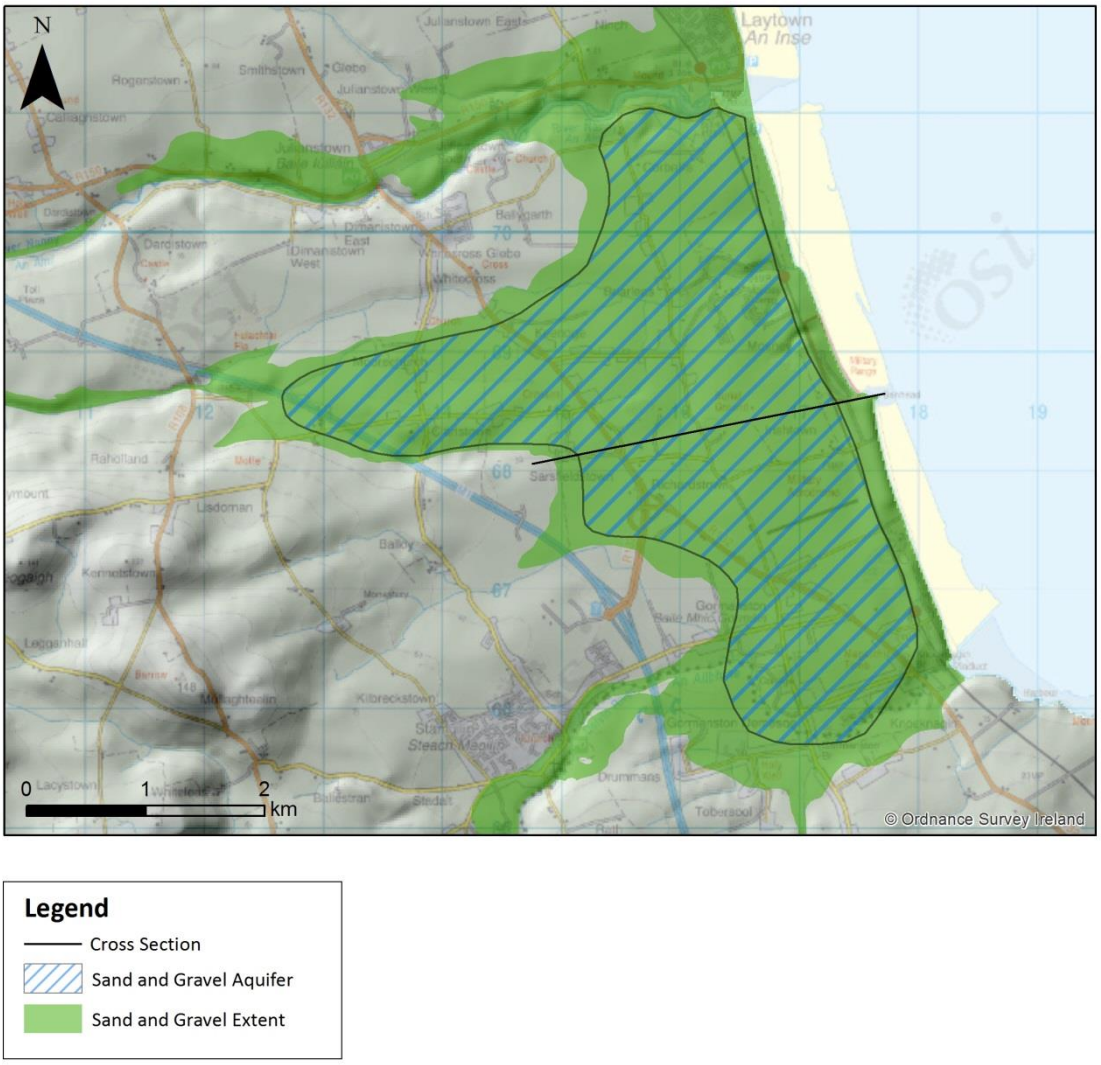
Topography	The Laytown-Gormanston sand and gravel aquifer is situated between the villages of Laytown and Gormanstown, in a wide, lowlying plain along the eastern coastline of County Meath. The aquifer is set at elevations between 5 m and 40 m AOD, between the deep-set channels of the Nanny and Delvin Rivers. The aquifer topography is flat to gently undulating, with a number of marked ridges within. The majority of the aquifer comprises an outwash plain, deposited by rivers in front of the retreating ice sheet (McCabe, 1972). To the west of the aquifer body the topography rises where the sand and gravel on laps on to bedrock cored ridges near Bellewstown, which rise to 120 m AOD.	
Geology and Aquifers	**Aquifer categories**	There are data from 29 boreholes and 13 groundwater wells within the sand and gravel body, which were used to determine the depth of sand and gravel, and the water table elevation. Based on its areal extent, inferred thickness, 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	Glaciofluvial sand and gravel deposits derived chiefly from limestones (GLs) which are basic in chemical reaction. A small portion at the southern end of the aquifer has gravel clasts and sand derived chiefly from Lower Palaeozoic sandstones and shales (GLPSsS).
	Key structures	The key structures in the body vary from sheets of sand and gravel deposits at Murphy's Pit in Sarsfieldstown Townland, to poorly sorted sand and gravel which have been shunted by the Ice, visible at Ben Head (McCabe, 1972). The depth of clean beds of sand and gravel is expected to vary over the area of the aquifer due to this shunting and the presence of occasional units of Irish Sea Till interbedded among the sands and gravels. The Irish Sea Till also underlies the sands and gravels continually in exposures at the coast, and is expected to extend at least 2 kilometres inland also (McCabe, 1972; Meehan, 1998). Groundwater was observed discharging from these cliffs where sand and gravel overlies till along the coast, directly into the sea (see also Figure 2).
	Key properties	The groundwater level data points available in the sand and gravel aquifer have allowed for inferences to be made on water table depth, and depths range from 0 m to 11.7 m below ground level. Groundwater was observed discharging along the cliff at the coast, at levels between 2 m and 5 m above beach level (R. Meehan, *personal communication*, 2019). It is inferred that approx. 55% of the aquifer area has a depth of saturated sand and gravel greater than 5 m (Figure 2). Two particle size analysis charts are available, from sediment samples taken within the body, one each in Moorechurch and Gormanston Townlands. Both samples contained less than 7% fines (GSI, 2023). Sand and gravel aquifers generally consist of unconsolidated coarse grained material, usually containing less than 8% fines (Ó'Súilleabháin, 2000).
	Thickness	Subsoil thicknesses are greater than 10 m over almost all of the body; one borehole in Briarleas Townland, to the west of Mosney Camp, shows greater than 45 m depth of sands and gravels (GSI, 2023). This means that the bedrock is well below sea level here and there are likely to be groundwater discharges at depth beneath the sea also. The majority of the aquifer is inferred to have greater than 10 m depth of sands and gravels, with some portions containing interbedded lenses of till. None of the desk study data points suggest that the subsoils are less than 10 m thick anywhere within the delineated body.
Overlying Strata	**Lithologies**	Approximately 5% of the aquifer is overlain with cutover raised peat, lake sediments and/or alluvial deposits, with sand and gravel assumed beneath.
	Thickness	The cutover raised peat, lake sediments and/or alluvial deposits are inferred to be less than 3 m thick.

	% area aquifer near surface	Approximately 95% of the sand and gravel aquifer is at the surface, with the remainder beneath the cutover raised peat, lake sediments and/or alluvial deposits.
	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 aquifer area. In all other areas where the water table is at a depth > 3 m, the vulnerability is classed as 'High' (64% of the area, Figure 3).
Recharge	**Main recharge mechanisms**	Diffuse recharge occurs *via* 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. Rejected recharge from the surrounding Poor Bedrock Aquifer **(Pl)**, which is at higher elevations at the southwest and south of the body, has also been included in throughput calculations.
	Est. recharge rates	The annual average rainfall for the aquifer is 750 mm (Walsh, 2012), thus providing an estimated diffuse groundwater recharge rate of 227 mm/yr. The minimum direct groundwater throughput in the aquifer is estimated to be 3,830 m^3/d, which increases to a potential 4,084 m^3/d when rejected recharge is included.
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 considered to discharge to the various streams and rivers that flow through the aquifer, in some places *via* discrete springs *e.g.* at Beechville and Gormanston Townlands. Along the coastline groundwater was observed discharging from the cliffs where sand and gravel overlies till, directly into the sea.
	Hydrochemical Signature	Hydrochemistry data of the sand and gravel aquifer is available for samples taken on a yearly basis through the EPA Waste Licence W0151-01. Groundwater samples taken in March 2018 from one borehole into the subsoils show a total hardness value of 72 mg/l (equivalent $CaCO_3$), and electrical conductivity (EC) value of 182 µS/cm suggesting that the groundwater has a calcium bicarbonate ($CaHCO_3$) hydrochemical signature. Alkalinity was measured at 118 mg/l $CaCO_3$ (Patel Tonta Environmental Solutions, 2018).
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. This is also expected to be the case at Laytown-Gormanston, given the geomorphology of the locality, and the stream pattern.
Groundwater & Surface water interactions		Groundwater is considered to discharge to the various rivers and streams that flow through the aquifer, therefore connectivity between the groundwater and surface water is expected to be relatively high. Along the coastline groundwater was observed discharging from the cliffs, directly into the sea.
Conceptual model		• The Laytown-Gormanston aquifer rests at elevations between 5 m and 40 m AOD, in a wide coastal plain between the deep-set river channels of the Nanny and Delvin Rivers. • The majority of the aquifer comprises a flat to gently undulating outwash plain, deposited by rivers in front of the retreating ice sheet (McCabe, 1972). • Irish Sea Till is present in beds and lenses within, and as a blanket substrate beneath, the sand and gravel deposit. • Subsoil thicknesses are likely to be at their greatest towards the eastern half of the aquifer, and one borehole, in Briarleas Townland recorded 45 m depth of sand and gravel (GSI, 2023). • Two particle size analysis charts are available, from samples taken from sediment within the aquifer body, one each in Moorechurch and Gormanston Townlands. Both contained less than 7% fines (GSI, 2023).

Laytown-Gormanston Sand and Gravel Aquifer Description March 2023

	• Approximately 55% 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. • An area of 0.53 km^2 of rejected recharge from the surrounding Poor Bedrock Aquifer **(Pl)** has been included in throughput calculations for the aquifer. • The minimum direct groundwater throughput in the aquifer is estimated to be 3,830 m^3/d, which increases to a minimum 4,084 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 RS08M020200 (Mosney – Railway Br. E Mosney Ho.) RS08M020100 (Bridge South of Mosney House) RS08D010400 (Bridge nr Bridgefoot House) 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 (2023). Geological Survey Ireland, Internal groundwater databases. • McCabe, A.M. (1972). The Glacial Stratigraphy of Eastern Counties Meath and Louth. Proceedings of the Royal Irish Academy. Section B: Biological, Geological, and Chemical Science. vol. 73 (1973), pp. 355-382. • Meehan, R. T. (1998). The Quaternary Geology and last glaciation and deglaciation of northwest Meath and adjacent parts of Westmeath and Cavan. Unpublished PhD Thesis, National University of Ireland, Dublin, 504pp. • 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. • Patel Tonta Environmental Solutions (2018). Murphy Environmental, Groundwater Monitoring Report for Gormanston Inert Waste facility, (EPA Licence W0151-01), Quarter 1, April 2018. • 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.	

Laytown-Gormanston Sand and Gravel Aquifer



Legend

- Cross Section
- Sand and Gravel Aquifer
- Sand and Gravel Extent

Figure 1: Laytown-Gormanston Sand and Gravel Aquifer extent with cross section location.

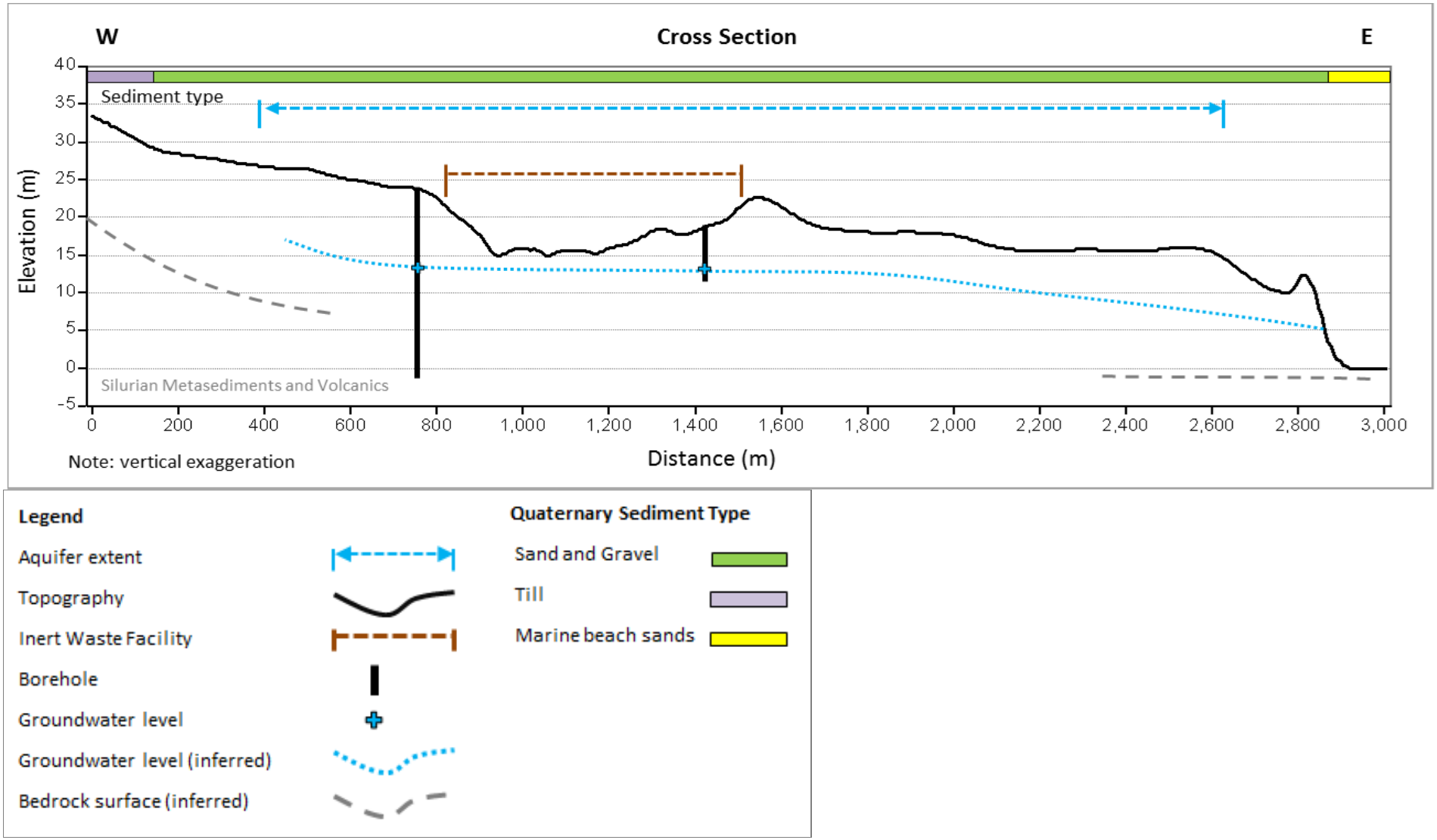


Figure 2: Cross section through the Laytown-Gormanston Sand and Gravel Aquifer body.

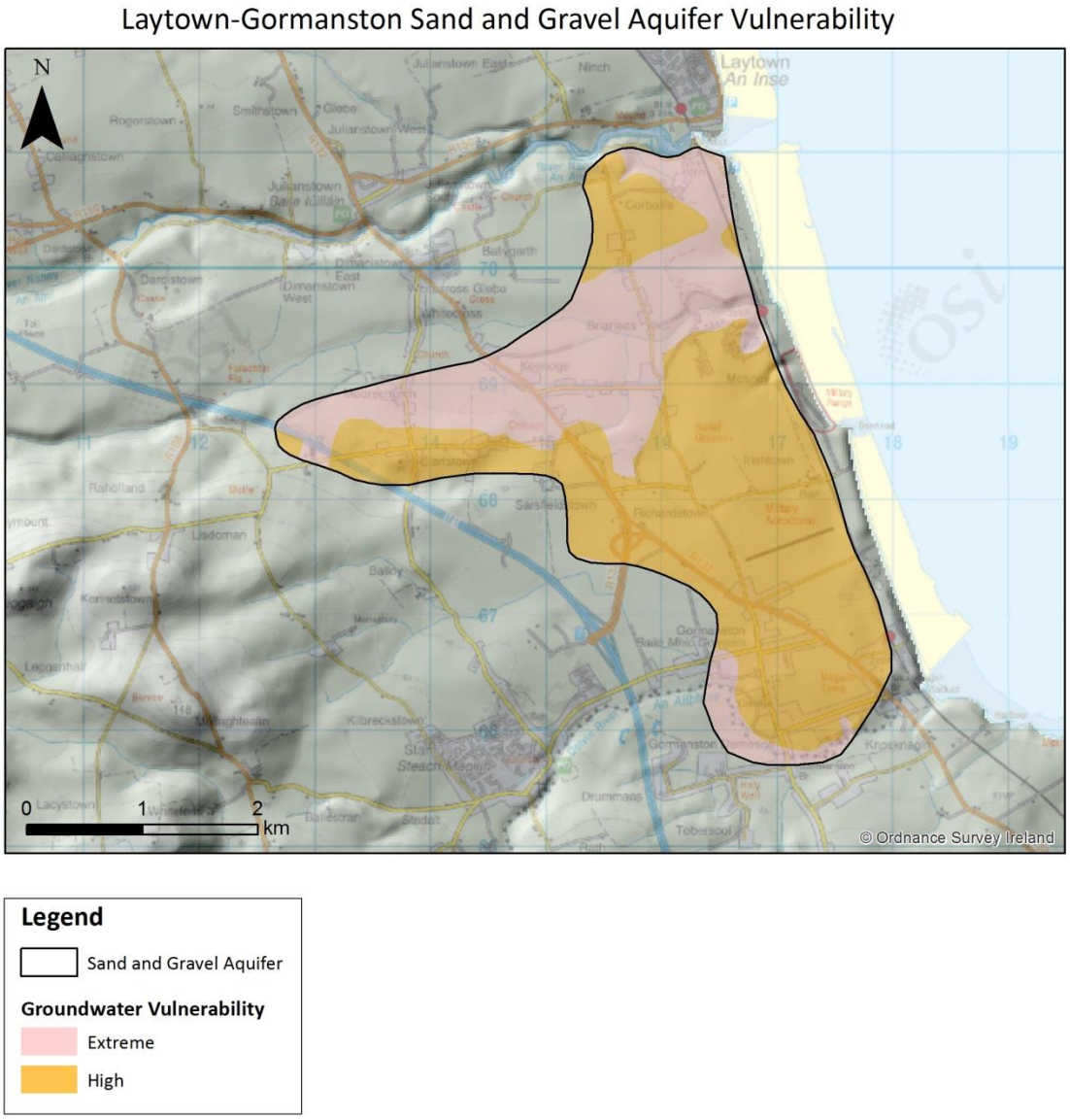


Figure 3: Groundwater vulnerability across the Laytown-Gormanston Sand and Gravel Aquifer body.