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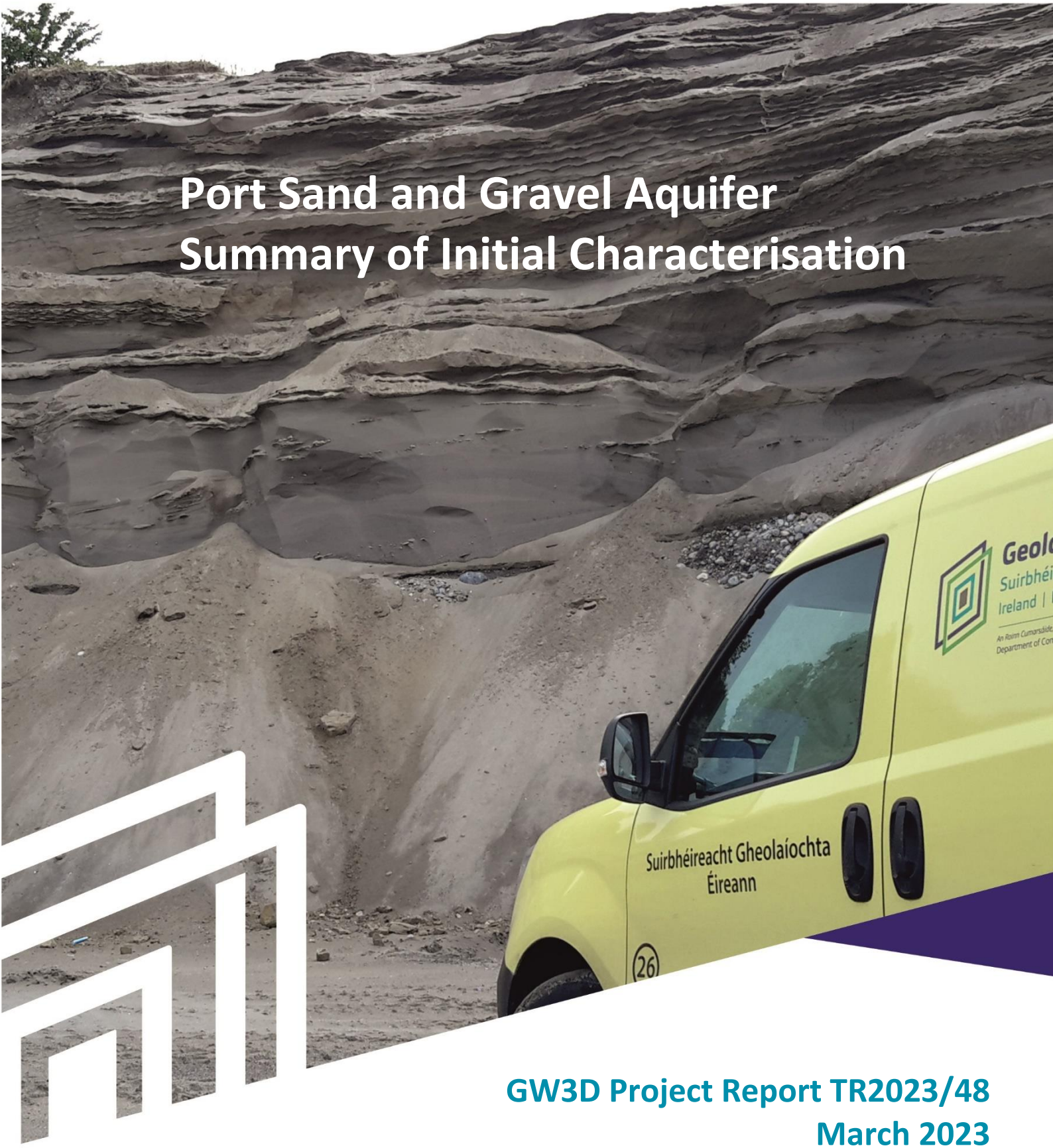

Port Sand and Gravel Aquifer
Summary of Initial Characterisation

GW3D Project Report TR2023/48
March 2023

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

Port 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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Port Sand and Gravel Aquifer: Summary of Initial Characterisation.

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:** Port River, Slieveboy River, Morganstown River, Glebe East River **Streams:** Several unnamed streams **Lakes:** None	None	4.1

Topography	The Port sand and gravel body runs along the crescentic coastal embayment between Clogher Head and Dunany Point in southeastern County Louth (Figure 1). The topography of the body is gently undulating and elevations vary from 20 m AOD at the west of the body to sea level at the east along the coastline. Rivers and streams flow through the body and drain from west to east into the Irish Sea. In the east, the sand and gravel extent is limited by the coastline and to the west it is bounded by Irish Sea Till which occurs at a higher elevation.	
Geology and Aquifers	**Aquifer categories**	The Port 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 aquifer is comprised of raised beach sands and gravels (MGs), as well as some glaciofluvial sands and gravels derived chiefly from Lower Palaeozoic sandstones and shales (GLPSsS) in Painestown at the west of the body (GSI, 2023a).
	Key structures	Borehole logs (GSI, 2023b) from within the area of the delineated aquifer body show the variability of the subsurface materials, which consist largely of sands and gravels, with occasional low permeability horizons. The sands and gravels themselves are also underlain by discontinuous tracts of till sediment, and bedrock. The bedrock is comprised of Silurian Metasediments and Volcanics, which is classified as a 'Poor' Aquifer (GSI, 2023a).
	Key properties	The groundwater in the Port sand and gravel aquifer 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. The variability in grain sizes will affect the permeability of the aquifer. Borehole logging data indicate that coarse material predominates and therefore permeability and storativity are expected to be high. In the absence of permeability test data, gravels with a fines content of less than approximately 8% are generally considered to have sufficient permeability for aquifer development (O'Suilleabhain, 2000). The bedrock aquifer beneath the sand and gravel has a high degree of rejected recharge associated with it. Given the depth of sands and gravels at Port, and the topography, the retention of recharge in the basal layers of the sands and gravels therefore causes the water table to be at a relatively shallow depth. Daly and O'Connell (2013), using Tellus Airborne Geophysical Survey AEM data, found no evidence of potential saltwater intrusion into this aquifer. They suggested that this may be due to the shallow nature of the bedrock along the coastline and/or the presence of the impermeable Irish Sea Till beneath the sand and gravel aquifer body near the coast.
	Thickness	The deposit is generally at its thickest in the west and north of the body. Areas of shallow bedrock occur in the central portion of the sands and gravels, where rockhead rises to 3.7 m bgl, as well as along the southwestern boundary, where rockhead is at 1.5 m bgl. Depth to bedrock is recorded as being greater than 10.5 m along the coast; however, the sands and gravels are present only to 7 m bgl here, and are underlain by till. The greatest thickness of sand recorded is 13 m, in the northern portion of the delineated aquifer body, near Port itself.
Overlying Strata	**Lithologies**	There are no sediments overlying any portion of the Port sand and gravel aquifer.
	Thickness	N/A
	% area aquifer near surface	100%

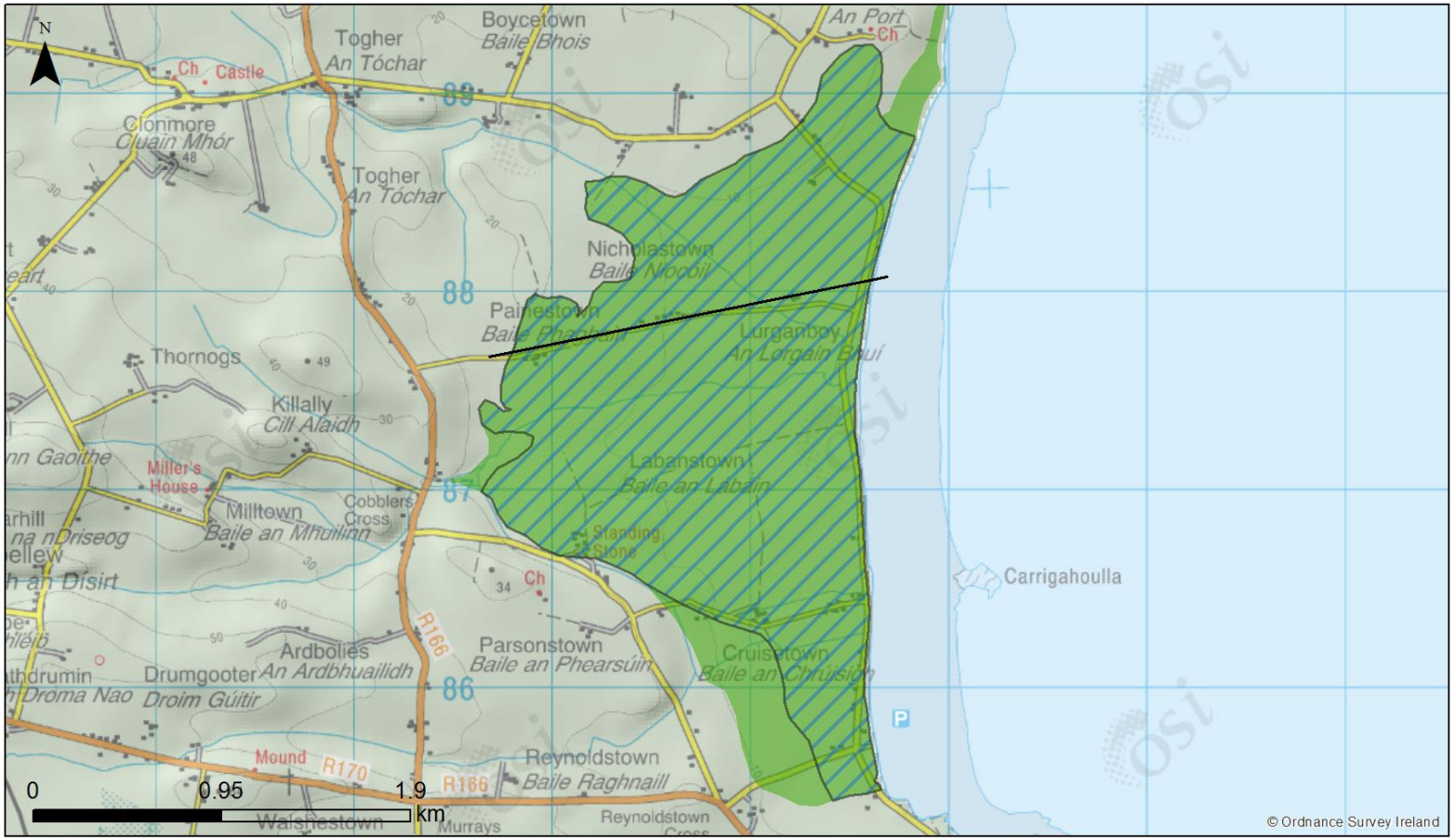
<table>
<tr><td></td><td>Vulnerability</td><td>The aquifer is at the surface and therefore vulnerable; consequently, pollutants can easily infiltrate the aquifer body. Sand and gravel aquifers are categorised as having either ‘High or ‘Extreme’ vulnerability (DELG/EPA/GSI, 1999), with the vulnerability classification determined by the depth to the water table from ground level. Measured water levels range from 1.4 m to 2.2 m below ground level at Port. 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’.</td></tr>
<tr><td rowspan="2">Recharge</td><td>Main recharge mechanisms</td><td>Diffuse recharge occurs via infiltration of rainfall through the unsaturated sands and gravels. The proportion of 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). Typically the proportion of recharge that infiltrates to ground water in sand and gravel is around 85% (Hunter Williams et al., 2011). Depending on the relationship between the water table and river stage, the rivers and streams may also recharge the aquifer.</td></tr>
<tr><td>Est. recharge rates</td><td>The rainfall in the area of the Port sand and gravels is 765 mm (Walsh, 2012), and the estimated recharge rate to the aquifer from direct recharge 245 mm/yr. The minimum direct groundwater throughput in the aquifer at Port is consequently estimated to be 1,027 m^3/d.</td></tr>
<tr><td rowspan="3">Discharge</td><td>Large springs and large known abstractions (m^3/d)</td><td>The NERDO report (An Forás Forbartha and GSI, 1982) includes estimates of the yields of five dug wells and springs within this sand and gravel aquifer body. These records indicate ‘Poor’ yields from the aquifer, typically 8.6 to 25.9 m^3/day (An Forás Forbartha and GSI, 1982).</td></tr>
<tr><td>Main discharge mechanisms</td><td>The main discharge mechanisms are baseflow discharge to rivers and streams, seepages at the coast and discharge via springs. A limited amount of groundwater from the aquifer will also recharge the underlying bedrock aquifer</td></tr>
<tr><td>Hydrochemical Signature</td><td>EPA Groundwater Monitoring Programme (1993) found the conductivity to be between 630-712 µS/cm at Port. The following data suggests that the groundwater in the Port sand and gravel aquifer body is of calcium bicarbonate type.
<table>
<tr><th>Ca mg/l</th><th>Mg mg/l</th><th>Na mg/l</th><th>K mg/l</th><th>Cl mg/l</th><th>CO_3 mg/l</th><th>HCO_3 mg/l</th><th>SO_4 mg/l</th><th>NO_3 mg/l</th></tr>
<tr><td>91.75</td><td>16.18</td><td>19.49</td><td>12.86</td><td>35.00</td><td>0.00</td><td>292.80</td><td>16.00</td><td>6.32</td></tr>
</table></td></tr>
<tr><td colspan="2">Groundwater Flow Paths</td><td>The principal groundwater flow direction is thought to be from west to east through the delineated aquifer body. Flow paths are short due to the restricted area of the aquifer and the presence of low permeability layers which dissect the sand and gravel deposits in places. Water enters the aquifer as diffuse recharge from rainfall, and discharges at ditches, to the streams and rivers, and along the coast.</td></tr>
<tr><td colspan="2">Groundwater & Surface water interactions</td><td>Hydraulic connection between the groundwater and surface water is expected to be high due to the shallow positioning of the water table and the high permeability of the sand and gravel aquifer.</td></tr>
<tr><td>Conceptual model</td><td colspan="2">

This aquifer is composed mainly of raised beach sands and gravels, with a small pocket of glaciofluvial sands and gravels at the western boundary, in Painestown.
The thickness of the sorted sand and gravel sediments ranges between 1.5 m to over 13 m.
The aquifer is in part underlain by till, and in places is in direct contact with the underlying bedrock.
The aquifer is recharged by infiltration of direct rainfall through the unsaturated zone.
The underlying bedrock is classified as a ‘Poor’ Bedrock Aquifer (GSI, 2023a) which can only accept a limited amount of recharge; this has the effect of retaining groundwater within the basal units of the sands and gravels.
Recorded well yields are low within this deposit.
Most of the recharge discharges at the coastline and to the streams and rivers that run through the aquifer area, with a minor component interpreted to discharge to the underlying ‘Poor’ bedrock aquifer.

</td></tr>
</table>

	• The minimum direct groundwater throughput in the sand and gravel aquifer at Port is estimated to be 1,027 m^3/d.	
Attachments	Figure 1: Location and extent Figure 2: Cross sections Figure 3: Groundwater vulnerability	
Instrumentation	**Hydrometric gauges:** **National Water Monitoring Stations;** **River:** **Groundwater:**	RS06S160790 SLIEVEBOY_06 - Interstitial, 2nd Br d/s from Rathdrumin R conf. None present None present
Information Sources	• An Forás Forbartha 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/ • 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 • 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 map viewer. http://webgis.npws.ie/npwsviewer/ • O'Connell, Y. and Daly, E. (2013). Groundwater and Land Resources in Tellus Border Coastal Zones: Final Report. Geological Survey of Northern Ireland and Geological Survey of Ireland Open Report. 65pp. • 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. • 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.	

Port Sand and Gravel Aquifer



Legend

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

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

Port Sand and Gravel Aquifer Description March 2023

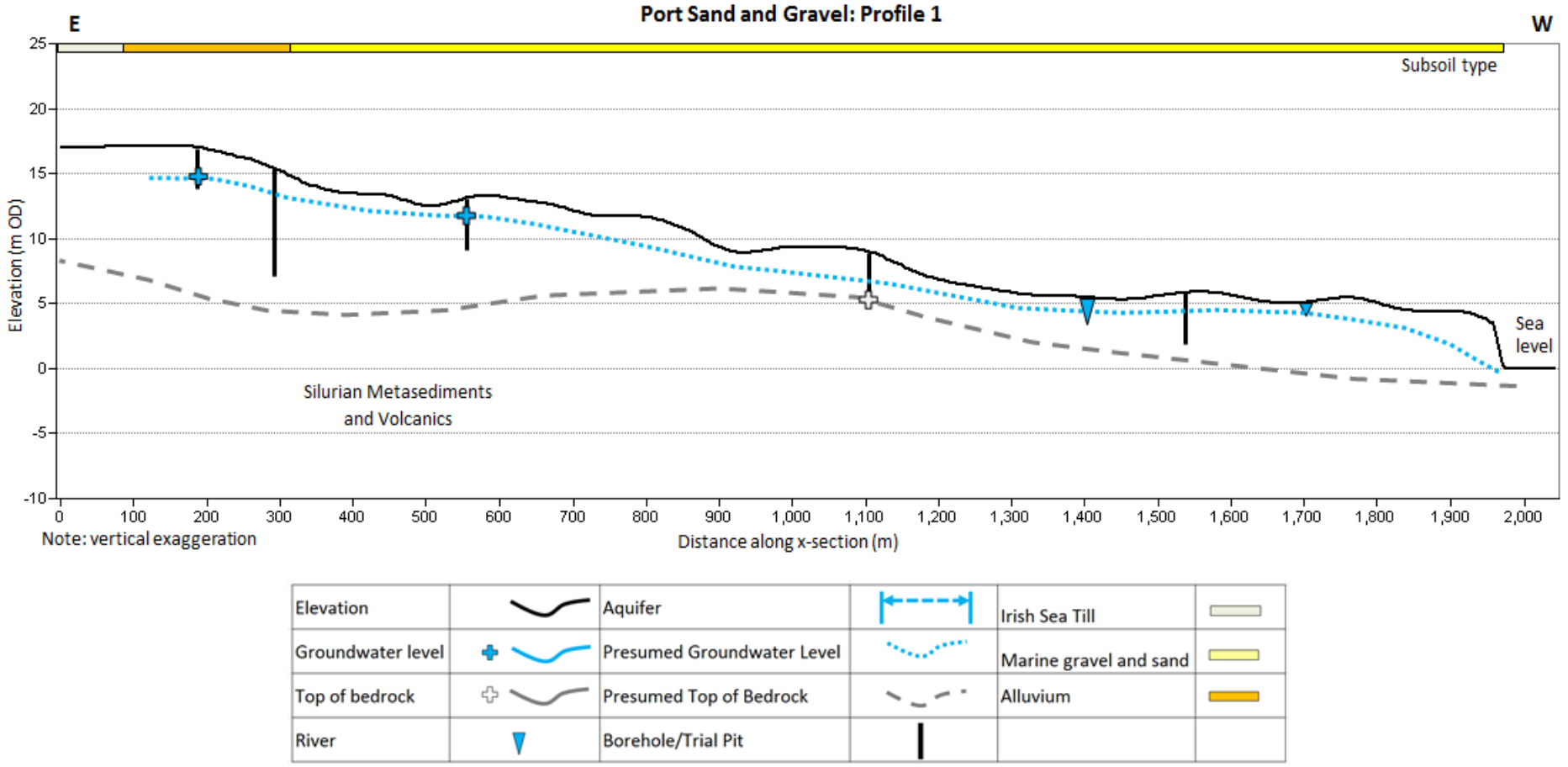
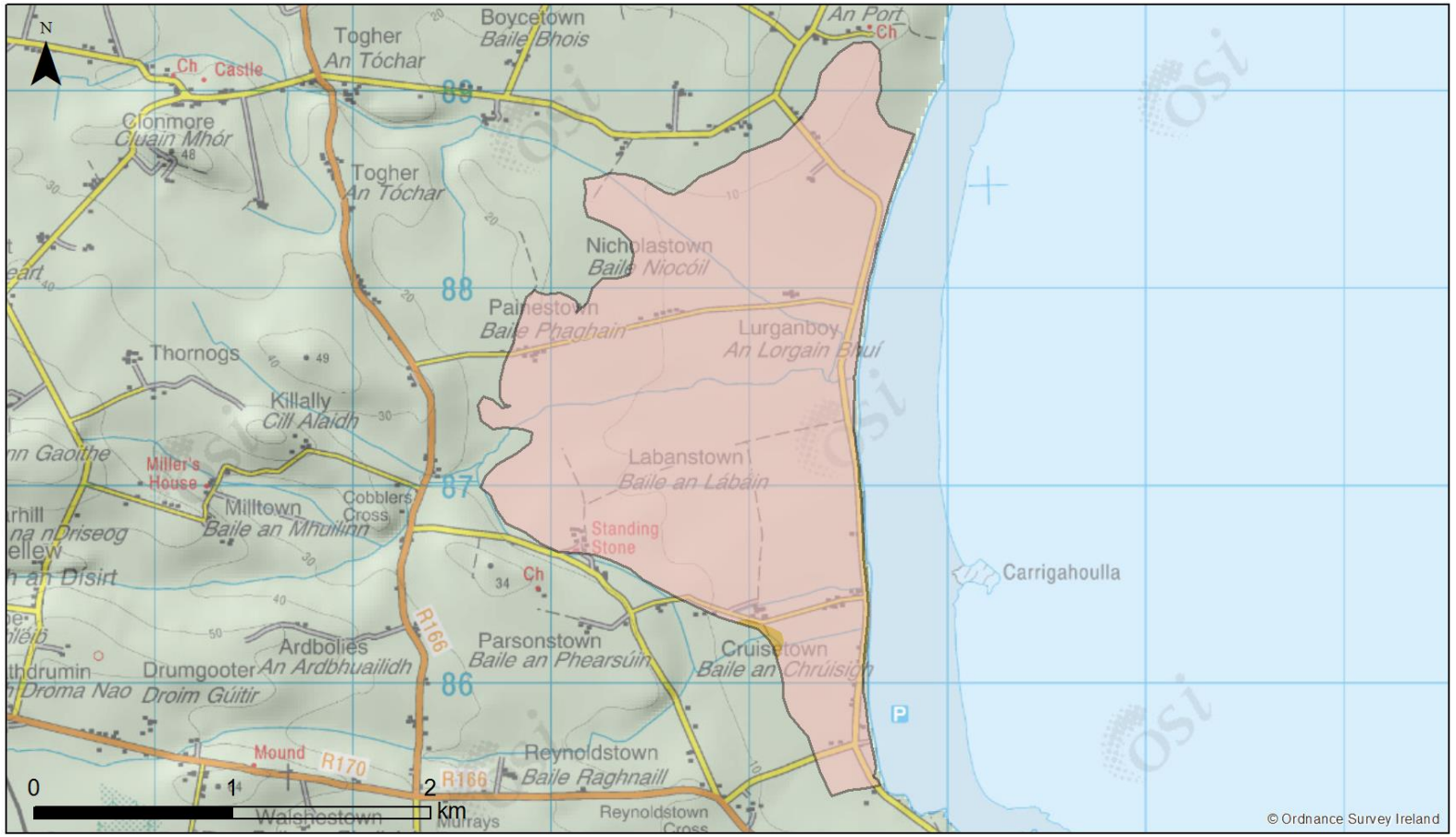


Figure 2. Cross section through the Port Sand and Gravel Aquifer body.

Port Sand and Gravel Aquifer Vulnerability



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Sand and Gravel Aquifer

Groundwater Vulnerability

Extreme

High

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