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Ballylemon Sand and Gravel Aquifer Summary of Initial Characterisation



GW3D Project Report TR2023/63
July 2023

Ballylemon 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 ecosystems	Area (km ²)
17 – Colligan – Mahon Waterford County Council		Rivers: Colligan River, River Douglas Streams: Several unnamed streams Lakes: None	None	2.6 km ²
Topography	The Ballylemon sand and gravel body includes an area of hummocky sands and gravels and associated river terraces situated northwest of Dungarvan Town, along and west of the Colligan River (Figure 1). The deposit forms a marked bench on land south of a high, bedrock-cored ridge, and rests at elevations between 10 m and 40 m AOD.			
Geology and Aquifers	Aquifer categories	Data were available from records of four boreholes drilled into the sand and gravel body. Thus, the Ballylemon sand and gravel is confirmed to be greater than 10 m in thickness and have a saturated thickness greater than 5 m. The saturated thickness satisfies the criteria of a Locally Important Sand and Gravel Aquifer (Lg) (DELG/EPA/GSI, 1999; GSI, 2017).		
	Main aquifer lithologies	Glaciofluvial sands and gravels derived chiefly from Devonian sandstones (GDSs), and alluvium (A).		
	Key structures	The Dungarvan Public Water supply has a zone of contribution report which includes borehole log details. The detailed log of the Dungarvan borehole at Ballymacmague South indicates that there is 6m depth till overlying 6m depth of saturated sands and gravels at that locality (Cronin <i>et al.</i> , 1998).		
	Key properties	Four water level data points were taken from boreholes during fieldwork in this aquifer body, which have allowed for inferences to be made on water levels throughout its extent. The water levels are all at a similar depth, at between 8 m and 15 m AOD. In the central area of the sand and gravel body, a borehole record shows 12 m depth to bedrock, with 5 m depth saturated sands and gravels here. Using these data, with other desk study data, it has been inferred that approx. 20% of the aquifer area has a depth of saturated sand and gravel greater than 5 m. In general, sand and gravel aquifers consist of unconsolidated coarse grained material, usually containing less than 8% fines (Ó'Súilleabháin, 2000).		
	Thickness	From collation of desk study borehole data (GS1, 2023b), the sands and gravels have depths greater than 12 m in their central portion.		
Overlying Strata	Lithologies	Approximately 7% of the aquifer is overlain with alluvium, with sand and gravel assumed beneath.		
	Thickness	Where present, the alluvial deposits are inferred to be less than 3 m thick.		
	% area aquifer near surface	Approximately 93% of the sand and gravel aquifer is at the surface, with the remainder beneath the alluvial deposits.		
	Vulnerability	The groundwater vulnerability of the sand and gravel is 'Extreme' where the water table is inferred to be less than 3 m from the surface, and this accounts for 6% of the area of the aquifer body. In all other areas where the water table is at depths greater than 3 m, the vulnerability is classed as 'High' (94%, see Figure 3). There are areas of extreme vulnerability within the aquifer, all in lowlying areas throughout this body. The extremely vulnerable areas are therefore mostly focused adjacent to watercourses, including the streams.		



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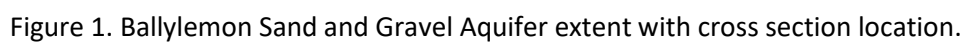
Recharge	Main recharge mechanisms	Diffuse recharge occurs by the infiltration of rainfall through the sands and gravels. Due to the high permeability of the sand and gravel materials, a high proportion of the available recharge will percolate down to the water table. Where alluvium overlies the sands and gravels, the proportion of rainfall that recharges the water table will be significantly less. The sand and gravel body is also assumed to receive a high proportion of rejected recharge from the ridge at Ballylemon Upper, to its north.
	Est. recharge rates	The annual average rainfall for the aquifer is 1,129 mm (Walsh, 2012), thus providing an estimated groundwater recharge of 608 mm/year. The minimum direct groundwater throughput in the aquifer is estimated to be 731 m ³ /day, but with rejected recharge from the hills at the north this rises to 2,097 m ³ /d.
Discharge	Large springs and large known abstractions (m ³ /d)	There are no known large springs or groundwater abstractions from this aquifer body.
	Main discharge mechanisms	Groundwater in the area will generally flow perpendicular to the topographic gradient, and is expected to discharge to the streams flowing through the body, as well as to the Colligan River at its' east.
	Hydrochemical Signature	There are no data which record the groundwater hydrochemical signature from this aquifer body, but given the bedrock and subsoils lithology this is expected to have a calcium bicarbonate (CaHCO ₃) to potassium bicarbonate (KHCO ₃) signature.
Groundwater Flow Paths		Water enters the aquifer as diffuse recharge from rainfall, and discharges along ditches, streams and rivers.
Groundwater & Surface water interactions		Groundwater is expected to discharge to the streams and rivers that flow through the aquifer, therefore connectivity between groundwater and surface water is expected to be high.
Conceptual model		- The aquifer consists of a series of hummocky sand and gravel deposits, in association with some dry, relatively flat-topped, glaciofluvial terraces. - The deposits stand proud above the surrounding landscape at elevations between 10 m and 40 m AOD. - The highest elevations, around 40 m AOD, are in the north, with the land sloping down from the edges of the bedrock-cored ridges there. - Depth to bedrock varies throughout the area of the aquifer. Depths seem generally to be greater than 10 m, with the maximum depth to bedrock value of just over 12 m. - Approximately 20% 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 recharge occurs <i>via</i> rainfall percolating through the unsaturated sands and gravels, with reduced recharge in the areas that are covered with alluvium. - The water table within sand and gravel aquifers is usually relatively flat, and therefore the depth to groundwater will depend on the exact topography at the locality concerned. - Groundwater flow directions are expected to be generally towards the south and east. - Groundwater discharge will occur <i>via</i> springs and seeps along the lowest boundaries of the aquifer body, and also along river courses. There may also be discharge to rivers as baseflow where the water table lies above the river stage. - The direct groundwater throughput in the aquifer is calculated as 731 m³/day, but with rejected recharge this rises to an estimated minimum of 2,097 m³/day.



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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 RS17CO10250 (Br near Kiladangan) None present
Information Sources	• Cronin, C., Daly, D. and Meehan, R. (1998). Dungarvan Public Supply, Groundwater Source Protection Zones. Geological Survey of Ireland. • DELG/EPA/GSI (1999). <i>Groundwater Protection Schemes</i>. 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 Map Viewer, Geomorphology Map. • GSI (2023b). Geological Survey Ireland Map Viewer, Quaternary Sediments Map. • GSI (2023c). Geological Survey Ireland, Internal groundwater databases. • 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. • NPWS Mapviewer: http://webgis.npws.ie/npwsviewer • Ó'Súilleabháin, C. (2000). <i>Assessing the boundary between high and moderately permeable subsoils</i>. 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 based on the information sources described above and established hydrogeological formulae. Figures 1, 2 and 3 are used for illustrative purposes only.	

Ballylemon Sand and Gravel Aquifer



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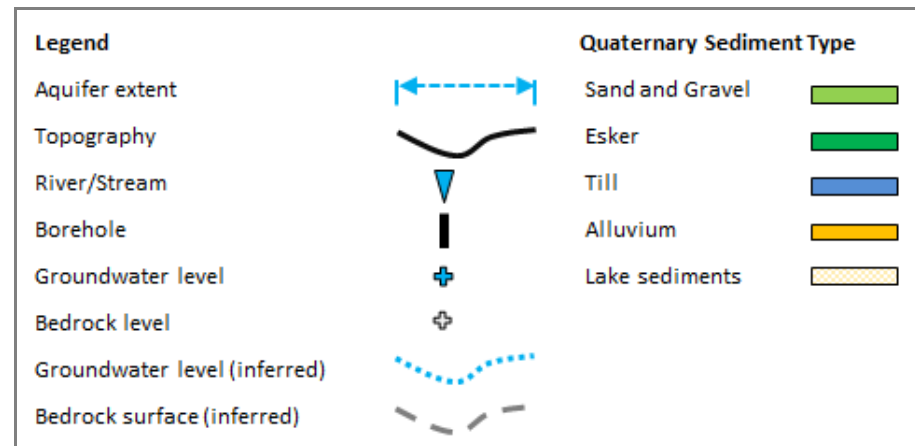
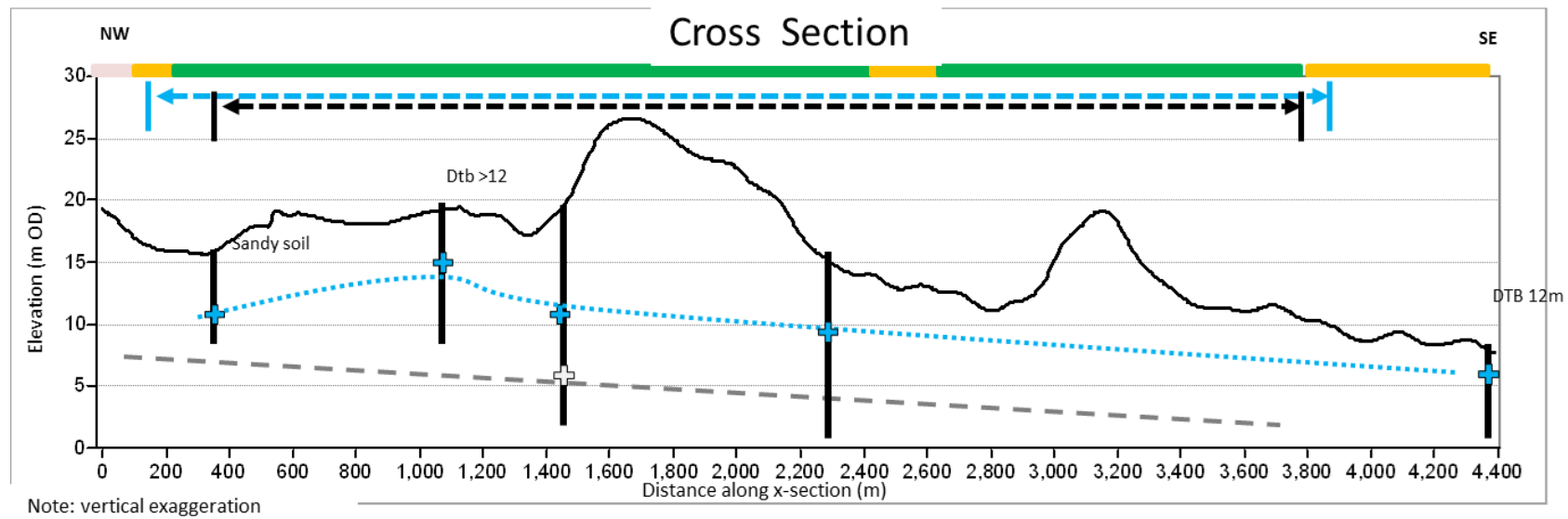


Figure 2: Cross section through the Ballylemon Sand and Gravel Aquifer.

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Ballylemon Sand and Gravel Aquifer Vulnerability

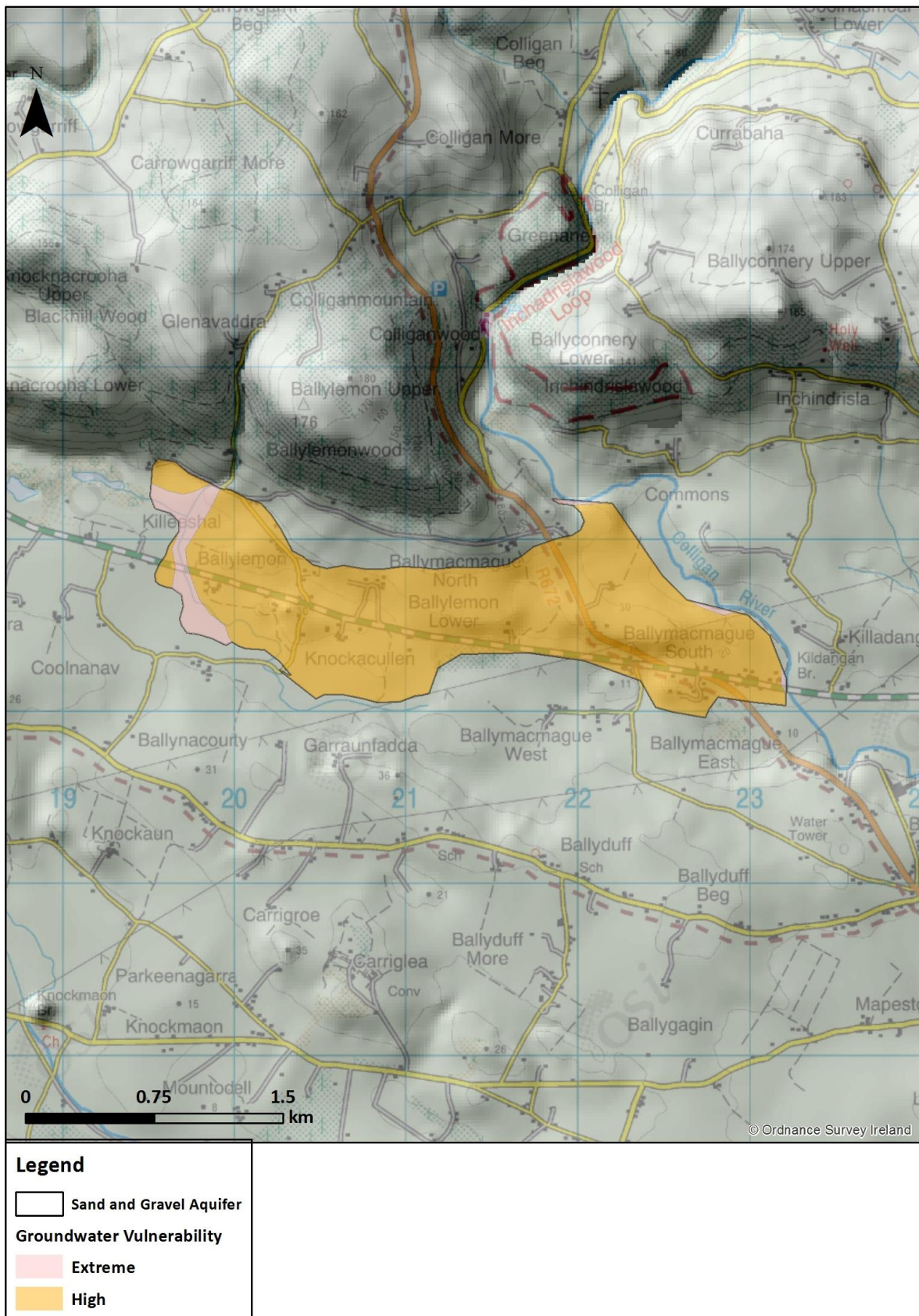


Figure 3: Groundwater vulnerability across the Ballylemon Sand and Gravel Aquifer.