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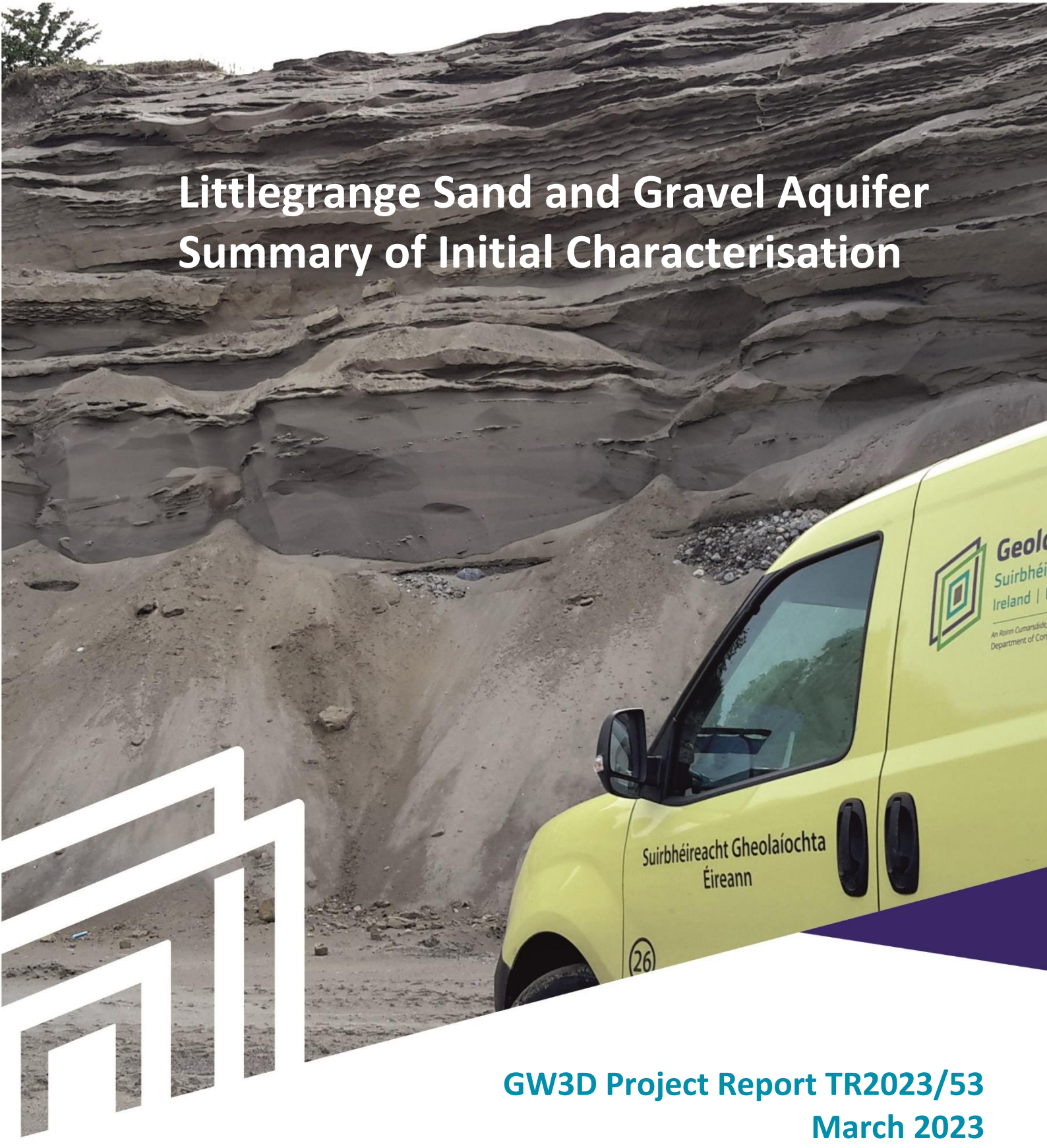

Littlegrange Sand and Gravel Aquifer
Summary of Initial Characterisation

GW3D Project Report TR2023/53
March 2023

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

Littlegrange 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 Meath County Council Louth County Council	**Rivers:** River Boyne, Mattock River, Balfeddock River **Streams:** Several unnamed streams **Lakes:** None	River Boyne and River Blackwater SAC, River Boyne and River Blackwater SPA, Dowth Wetland pNHA	1.71

Topography	The sand and gravel aquifer at Littlegrange is situated west of the Battle of the Boyne site, along the valley floor of the Mattock River, and west of the River Boyne. The aquifer topography comprises a flat to gently undulating glaciofluvial terrace, and is situated at elevations between 6 m and 32 m AOD, among higher, streamlined bedrock-cored ridges which occur south, west and north of it. The channel in which the aquifer rests is a subglacially-cut meltwater channel (McCabe, 1972) which has been choked with sand and gravel during deglaciation. The aquifer is considered separate to the similar sand and gravel body on the opposite side of the Boyne channel at Oldbridge, which does not constitute an aquifer owing to the presence of highly permeable karstified bedrock beneath it..	
Geology and Aquifers	**Aquifer categories**	The Mattock River has been taken as a groundwater level baseline, which complements the water levels recorded within the sand and gravel body during fieldwork. 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	Flat to gently undulating, glaciofluvial sands and gravels derived chiefly from Lower Palaeozoic sandstones and shales (GLPSsS).
	Key structures	Exposure is poor within this sand and gravel body, and no sand and gravel structures were noted during fieldwork for this project.
	Key properties	Two boreholes indicate 20 m depth of subsoils beneath the level of the River Boyne in the adjacent sand and gravel body in Oldbridge, and the depth to bedrock has been extrapolated west along the Mattock valley to Littlegrange using these data. A particle size analysis chart is available from a sediment sample taken at the western extent of the aquifer, in Monknewtown Townland, and it contained approx. only 9% fine sized particles. Sand and gravel aquifers generally consist of unconsolidated coarse grained material, usually containing less than 8% fines (Ó'Súilleabháin, 2000).
	Thickness	Subsoil thicknesses are expected to be greater than 10 m depth over the vast majority of the aquifer area, using borehole data and geomorphological analysis of the setting.
Overlying Strata	**Lithologies**	Approximately 38% of the aquifer is overlain with alluvial deposits, with sand and gravel assumed beneath.
	Thickness	The alluvial deposits are inferred to be less than 3 m thick.
	% area aquifer near surface	Approximately 62% of the sand and gravel aquifer is at the surface, with the remainder beneath the alluvial deposits along the Mattock River.
	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 43% of the aquifer. In all other areas where the water table is at a depth > 3 m, the vulnerability is classed as 'High' (57% of the aquifer, 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 alluvium overlies the sands and gravels, the proportion of rainfall that recharges the water table will be significantly less. Rejected recharge from the surrounding Poorly Productive Bedrock Aquifer **(Pl)** to the north and southwest have also been included in the groundwater throughput calculation.
	Est. recharge rates	The annual average rainfall for the aquifer is 800 mm (Walsh, 2012), thus providing an estimated groundwater recharge rate of 275 mm/yr, for the aquifer. The minimum direct groundwater throughput in the aquifer is estimated to be 736 m^3/d, which increases to a potential 1,230 m^3/d when rejected recharge in included.

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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 into the Mattock River directly, and *via* some small lowlying springs as seen on OSI 6 inch raster map (1830s – 1930s), at for example Littlegrange 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. Given the geomorphology of the sands and gravels at Littlegrange, and the stream pattern, this is also likely to be the case at Littlegrange.
Groundwater & Surface water interactions		Groundwater is expected to flow towards the Mattock River which flows through the centre of the aquifer, as well as towards the River Boyne which flows along the eastern boundary of the aquifer.
Conceptual model		• The aquifer consists of predominately terraced sand and gravel deposits nestled in the wide valley of the Mattock River. • A particle size distribution analysis obtained from a sediment sample taken at one point locality at the western end of the aquifer contained approx. 9% fines. • Diffuse recharge occurs *via* rainfall percolating through the unsaturated sand and gravel. • Rejected recharge is considered to occur from the Poorly Productive Bedrock Aquifers **(Pl)**, to the north and south of the aquifer. This has increased the groundwater throughput amount. • Approximately 56% of the aquifer is inferred to have greater than 5 m depth of saturated sands and gravels, with the remainder inferred to have a saturated thickness less than this. • Groundwater is expected to discharge into the River Mattock directly, and *via* some small lowlying springs. • The minimum direct groundwater throughput in the aquifer is estimated to be 736 m^3/d, which increases to a potential of 1,230 m^3/d when rejected recharge in included.
Attachments		Figure 1: Location and extent Figure 2: Cross section Figure 3: Groundwater vulnerability
Instrumentation	**Hydrometric gauges:** **National Water Monitoring Stations;** **Rivers:** **Groundwater:**	None present RS07M010300 (New Bridge- u/s Boyne R confluence) RS07M010270 (Mattock – Ford d/d Mattock Bridge) RS07M010250 (Mattock – Mattock 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 • 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 • 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.

Information Sources (contd.)	• 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.

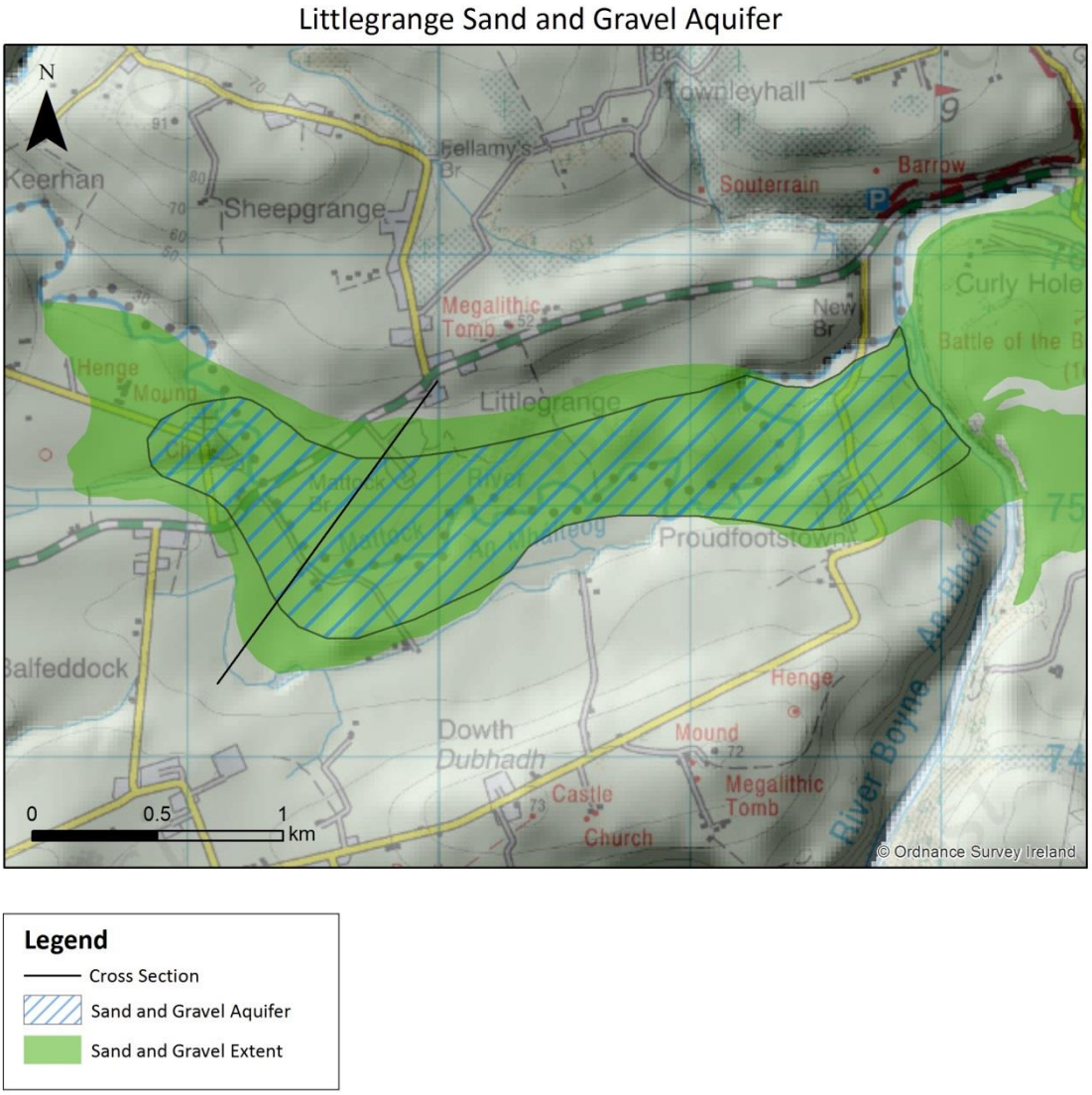

Figure 1: Littlegrange Sand and Gravel Aquifer extent with cross section location.

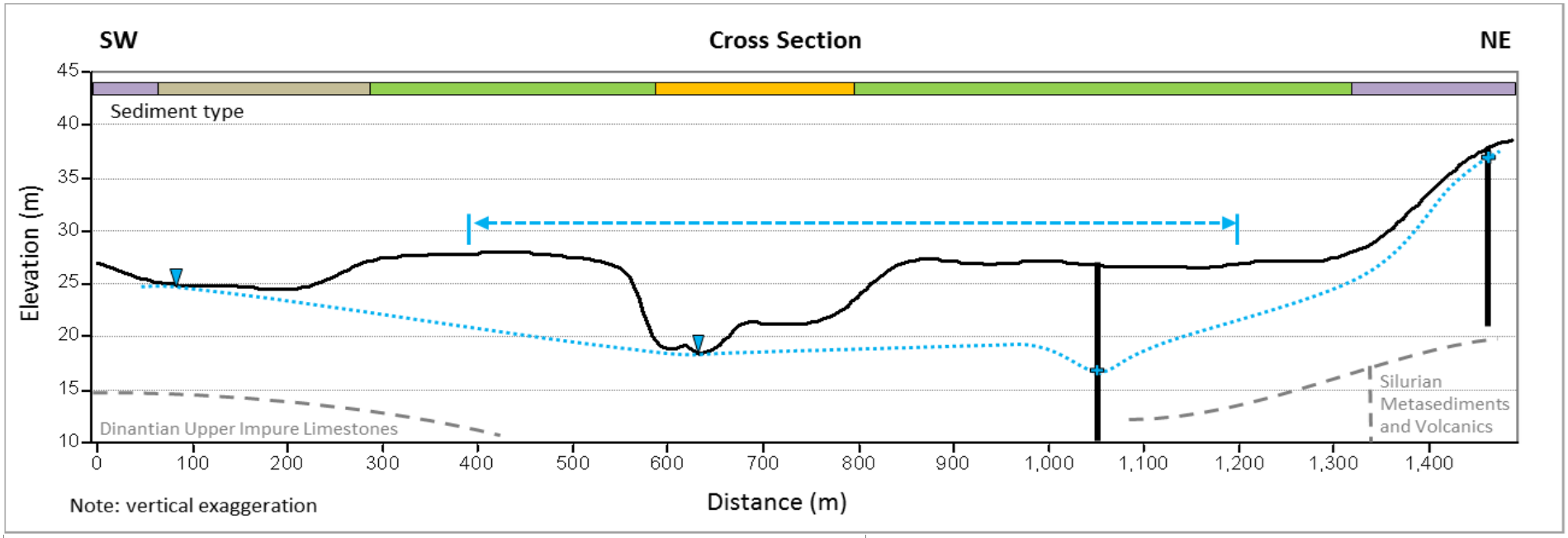

Figure 2: Cross section through the Littlegrange Sand and Gravel Aquifer body.

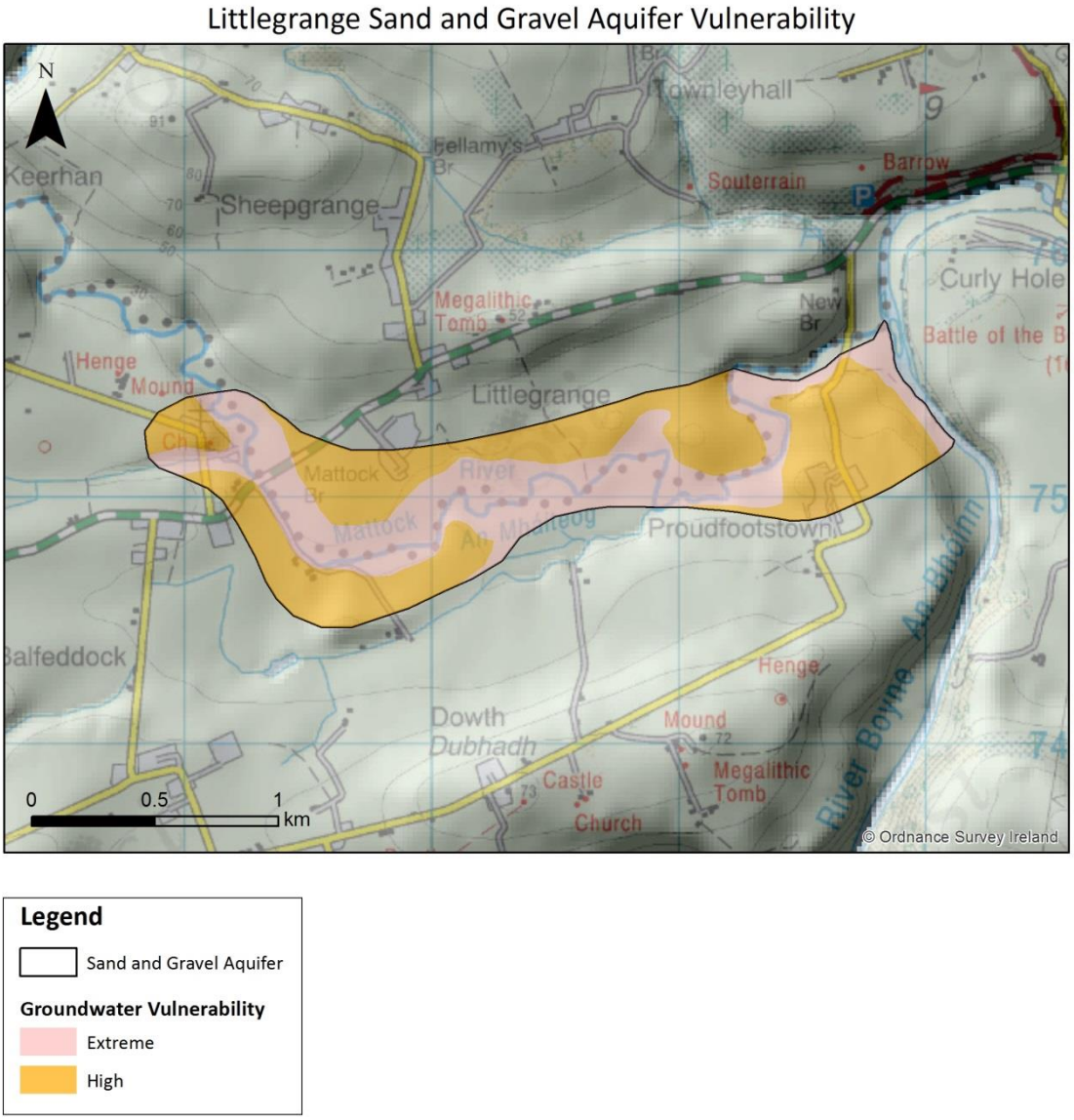

Figure 3: Groundwater vulnerability across the Littlegrange Sand and Gravel Aquifer.