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Tallaght Sand and Gravel Aquifer
Summary of Initial Characterisation

GW3D Project Report TR2023/14
February 2023

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

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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

Tallaght Sand and Gravel Aquifer February 2023

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Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
09 - Liffey and Dublin Bay South Dublin County Council	**Rivers:** River Dodder, Tymon River **Streams:** Jobstown Stream, Whitestown Stream and several unnamed streams **Lakes:** Ponds in Sean Walsh Memorial Park	Dodder Valley pNHA	1.3

Topography	The Tallaght sand and gravel deposit is situated along but slightly askance to the main channel of the River Dodder at Tallaght, and may form part of a deglacial tributary channel along the Tymon River course. The body is southeast of Tallaght town centre (Figure 1) and is overlain in the majority by 'Made' ground (GSI, 2020a). The Rivers Dodder and Tymon drain the area, and elevations across the aquifer area range from between 70 m AOD to 100 m AOD.	
Geology and Aquifers	**Aquifer categories**	The sand and gravel deposit is confirmed have pockets which reach over 10 m in thickness, and have 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 glaciofluvial sands and gravels derived chiefly from Lower Carboniferous limestones (GSI, 2023c).
	Key structures	Borehole logs (GSI, 2023c and Solmec Ireland Ltd., 1978) show the extent of variability within the Quaternary sediments of this area, which include deep deposits of till, interbedded with sand and gravel beds of varying thicknesses. The precise interconnectivity of the sand and gravel lenses is unknown. Where silt and clay layers occur, they can create perched water tables. The underlying bedrock is of 'Calp' limestones (GSI, 2023a) which is a Locally Important Aquifer (GSI, 2023a). The sand and gravel deposit is in direct contact with bedrock intermittently, as the till deposits beneath the gravel are proven to be discontinuous (GSI, 2023c). The depth to bedrock is greatest at the centre of the deposit area, which is thought to suggest the presence of a trough into which the sands and gravels have been deposited (Harkin, 1997).
	Key properties	Borehole logs (GSI, 2020c and Solmec Ireland Ltd., 1978) show the variability of the grain sizes of the aquifer material, which include sands and gravels interbedded with low permeability deposits of silt and clay. The aquifer is confined, as thick deposits of boulder clay are present within and above the sand and gravel materials. Variability in the aquifer material influences the hydrogeological behaviour of the body. Aquifer transmissivity estimates range between 22 m^2/day and 154 m^2/day (Solmec Ireland Ltd., 1978). Grain size data are available for samples taken, and the particle size distribution curves show percentages of fines in sands and gravels between 0% and 20%. 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). Permeability is estimated from the test pumping to be in the order of up to 40 m/day (Solmec Ireland Ltd., 1978).
	Thickness	The largest recorded thickness of the sands and gravels is 30 m, and the average saturated thickness is estimated to be approximately 8.5 m.
Overlying Strata	**Lithologies**	Till derived chiefly from Lower Carboniferous limestones overlies and buries all of the sand and gravel aquifer body.
	Thickness	The till deposits are between 3 m and 18 m thick, over the shallowest sand and gravel beds.
	% area aquifer near surface	None of the aquifer crops out at or just beneath the surface.

	Vulnerability	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. In general, 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'. Measured water levels at Tallaght represent the actual piezometric surface and it is on the basis of these that the vulnerability of the Tallaght sand and gravel aquifer is prescribed. Although the aquifer is somewhat protected at the surface by overlying deposits of till, this is not considered in the vulnerability classification. Measured water levels in the Tallaght sand and gravel body range from 1 m to 7 m below ground level, meaning that the majority of the area of the aquifer is mapped a being of 'High' vulnerability.
	Main recharge mechanisms	The aquifer receives both direct and indirect recharge. Diffuse recharge occurs by the infiltration of rainfall through the unsaturated sands and gravels. The aquifer is also expected to receive recharge from the underlying bedrock aquifer. The channel morphology of the bedrock surface would accommodate groundwater flowing from the low permeability bedrock into the 'trough' of high permeability sands and gravels.
	Est. recharge rates	The rainfall in the area of the Tallaght sands and gravels is 800 mm (Walsh, 2012). Wright (1978) calculated the recharge and potential throughput in "assuming the aquifer only extends for a few square kilometres, at 20% of annual rainfall recharge, would likely to be 2,700 m^3/day". However Wright (1978) expected "additional recharge can be from surrounding areas which drain into the trough, particularly from the mountain areas to the south which have a higher rainfall". Harkin (1997) estimated recharge to the aquifer as 5.9 x 10^6 m^3/year (16,153 m^3/d).
Discharge	**Large springs and large known abstractions (m^3/d)**	There two springs mapped in the area of the aquifer, but there are no yield data available for these. Pumping tests undertaken by Geoex Ltd. (1979) and Solmec Ireland Ltd. (1978) show that borehole yields are quite variable, ranging from between 30 m^3/day and 2,784 m^3/day. In 1978 there were two factories abstracting groundwater in the area (Harkin, 1997), but there are no more recent details on abstractions from the aquifer.
	Main discharge mechanisms	The main discharge mechanisms are baseflow discharge to rivers and streams, as well as discharge *via* springs.
	Hydrochemical Signature	Hydrochemical analyses from this aquifer show that the groundwater is moderately hard. Very high manganese and iron levels have been recorded (Harkin, 1997).
Groundwater Flow Paths		Groundwater flow path length depends on the extent of the sand and gravel deposit, and also upon the spacing of internal groundwater divides and the distance between streams. In general, locally important sand and gravel aquifers are expected to have relatively short flow paths, and this would seem to be the case at Tallaght given the extent and geometry of the deposit. The variability in the composition of this aquifer also disrupts flow, probably shortening groundwater flow paths even further. It is assumed that, generally, the surface water and groundwater flow directions coincide at Tallaght. The principal groundwater flow direction is therefore thought to be northeasterly (Harkin, 1997). Information on water levels elsewhere in the general area around Tallaght is limited however. There are not enough hydrogeological data to calculate precise groundwater gradients, but low gradients are typical of sands and gravels, and it is assumed to be less than the topographic gradient. For the purposes of calculations undertaken the gradient is assumed to be 0.08 (after Harkin 1997).
Groundwater & Surface water interactions		Hydraulic connection between groundwater and surface water is expected to be high.

Tallaght Sand and Gravel Aquifer February 2023

Conceptual model	• The sand and gravel aquifer at Tallaght is buried beneath thick deposits of till. • Wright (1978) suggested that the aquifer was composed of thick deposits of glaciofluvial outwash material deposited within a bedrock trough. • Using borehole records it was estimated that a quarter of the deposit was made up of high permeability sands and gravels, which would serve as a good aquifer. • This sequence has only been proven over a limited area, however, where boreholes have been drilled; the variability of the Quaternary sediments means that it is nearly impossible to extrapolate the boundaries of the sands and gravels from these data with any certainty. • The boundaries of the delineated aquifer thus represent the area where, based on available information, there are most likely deposits of saturated sands and gravels; however, the aquifer may be much larger, and a conservative approach has been taken. • According to Harkin (1997), the aquifer body may reach 12 km^2 in area. • The confidence in the location of the aquifer increases towards the centre of the delineated area. • Further drilling is needed to better define the aquifer boundaries. • Well yields vary considerably within sand and gravel layers in boreholes, and between individual boreholes; this is due to the variability in composition of the glaciofluvial materials (Wright, 1978). • The bedrock is classified as a Locally Important Bedrock Aquifer (GSI, 2023a) and there is assumed to be considerable interaction with the sand and gravel aquifer above it. • The groundwater gradient is generally shallow, sloping towards the northeast (Harkin, 1997). • Recharge to the aquifer occurs diffusely through the unsaturated zone. Water enters the aquifer as diffuse recharge from rainfall, and discharges at springs and rivers. • The minimum aquifer throughput has conservatively been estimated as 2,700 m^3/d (Wright, 1978), but may be as high as 16,153 m^3/d (after Harkin, 1997).
Attachments	Figure 1: Location and extent Figure 2: Cross sections Figure 3: Groundwater Vulnerability
Instrumentation	**Hydrometric gauges:** None present **National Water Monitoring Stations;** **River:** RS09J020100 (Jobstown Stream - Outfall to Dodder) RS09D010400 (Dodder - Footbridge Firhouse (Balroth Weir)) RS09D010420 (New Br., Firhouse) **Groundwater:** None present
Information Sources	• Creighton, J.R., Daly, D. and Reilly, T.A. (1979). The Geology and Hydrogeology of County Dublin with particular reference to the location of waste disposal sites. Geological Survey of Ireland. • Cullen, K.T. (1990). Groundwater Development prospects in the Great Dublin Region. Unpublished report for Dublin City and County Councils. • Geoex Ltd. (1979). Report on Wells Constructed for Dublin County Council by Ground Water Development Ltd. (2A & 3A). • 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 • GSI (2023c). Geological Survey Ireland. Internal Geotechnical Database • Harkin, B. (1997). Groundwater Development in South Dublin. Unpublished MSc. Thesis, Department of Civil, Structural and Environmental Engineering, Trinity College Dublin. • Ó'Súilleabháin, C. (2000). Assessing the boundary between high and moderately permeable subsoils. Unpublished MSc. Thesis, University of Dublin. Department of Civil, Structural and Environmental Engineering, Trinity College Dublin.

Tallaght Sand and Gravel Aquifer February 2023

Information Sources (contd.)	• Solmec Ireland Ltd. (1978). Trial Borings on the Tallaght Water supply for Dublin County Council. Unpublished report on Tests on Trial Borings for Dublin County Council.
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.

Tallaght Sand and Gravel Aquifer

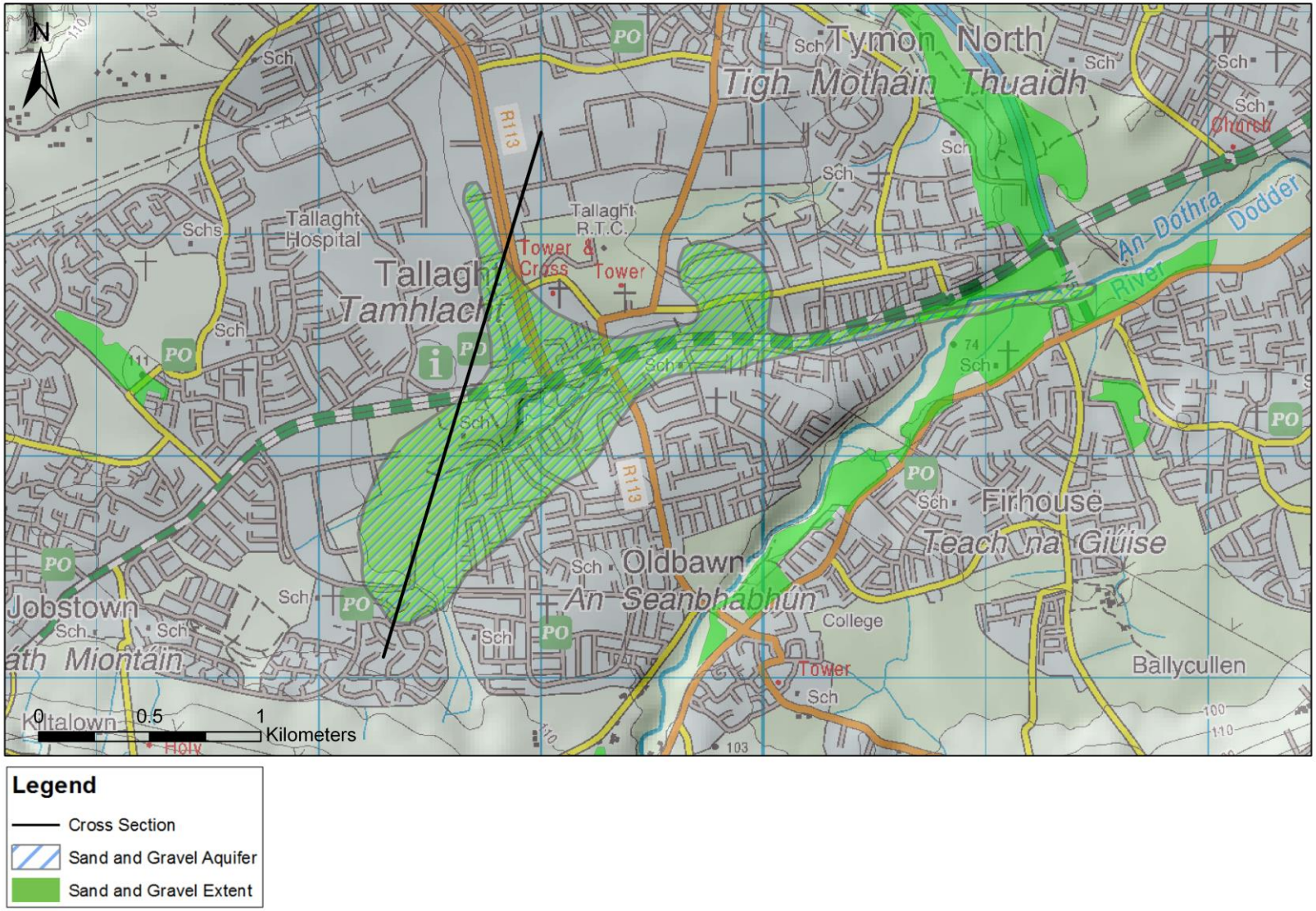

Figure 1. Tallaght Sand and Gravel Aquifer extent with cross section location.

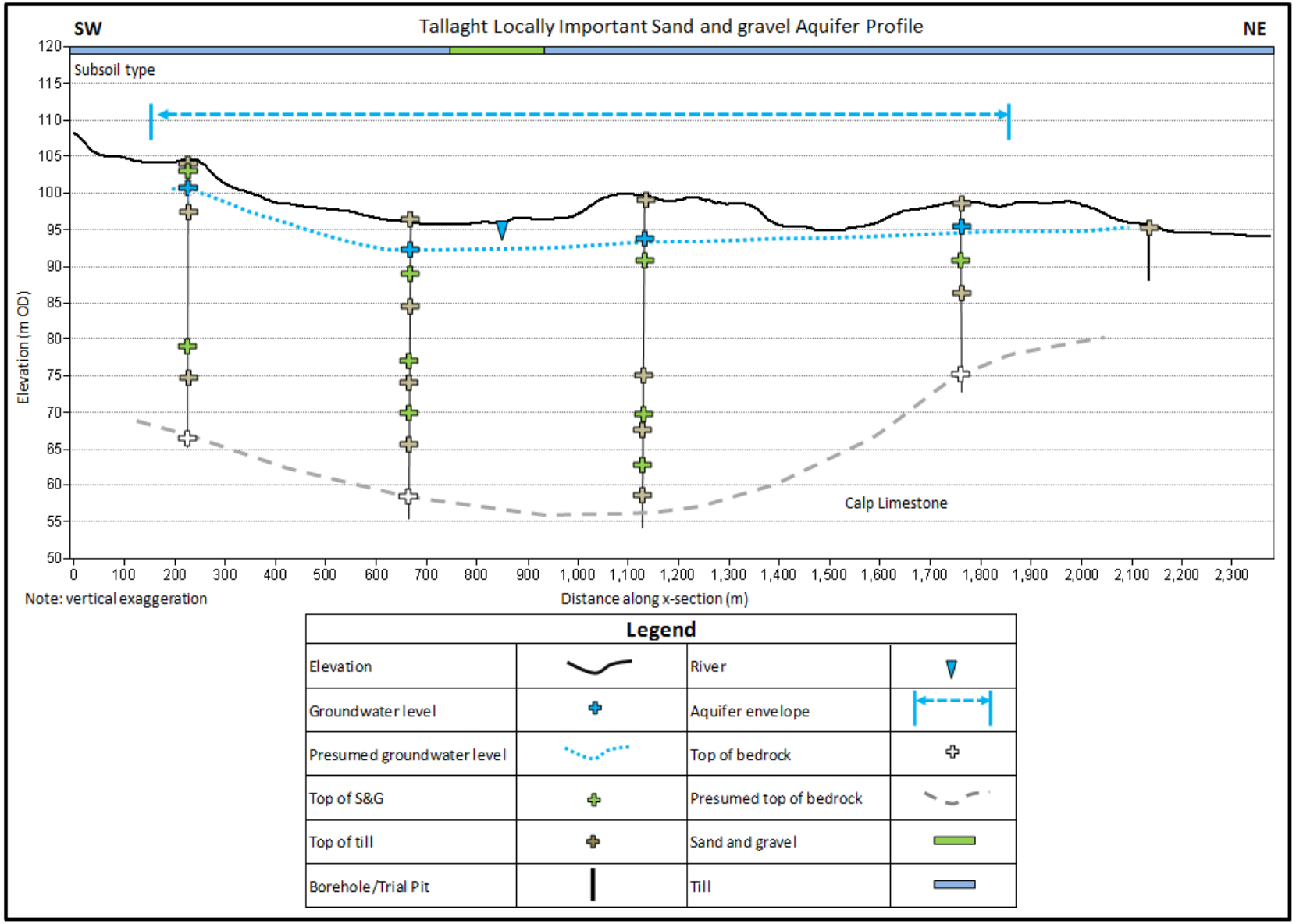

Figure 2. Cross section through the Tallaght Sand and Gravel Aquifer body.

Tallaght Sand and Gravel Aquifer Vulnerability

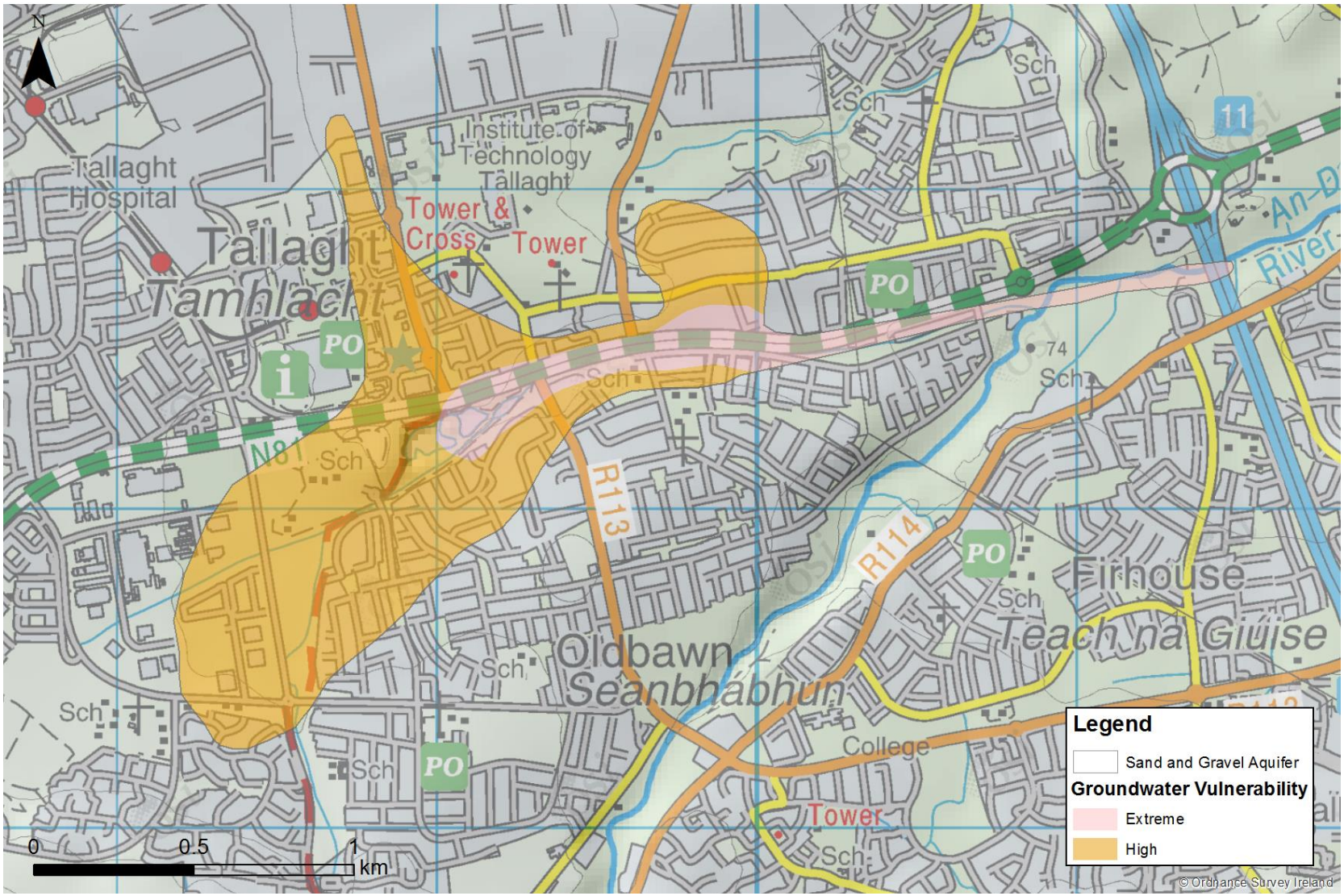

Figure 3. Groundwater vulnerability across the Tallaght Sand and Gravel Aquifer.