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O'Briensbridge Sand and Gravel Aquifer Summary of Initial Characterisation



GW3D Project Report TR2023/26
February 2023

O'Briensbridge Sand and Gravel Aquifer Description February 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)
25 - Lower Shannon Tipperary County Council Limerick County Council		Rivers: Annagh River, Newport River, River Shannon Streams: Several unnamed streams Lakes: None	Lower River Shannon SAC	21.1
Topography	The sands and gravels at O'Briensbridge extend southwards for several kilometres, east of Castleconnell and as far south as Lisnagry, along the southern side of the River Shannon in northwestern County Tipperary (Figure 1). The sand and gravel body is bounded at the north by the River Shannon and by the Annagh River in the south. The sands and gravels have a hummocky topography, which flattens at the centre due to overlying peat deposits. The elevation across the aquifer area varies from between 30 m AOD to 50 m AOD. It is bounded by estuarine silts and clays along the Shannon in the north, and till deposits at slightly higher elevations to the west, east and south.			
Geology and Aquifers	Aquifer categories	The sand and gravel deposit is confirmed to be greater than 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 glaciofluvial sands and gravels at O'Briensbridge are derived chiefly from Lower Palaeozoic and Devonian sandstones (GSI, 2023b).		
	Key structures	The sands and gravels include glaciofluvial terraces associated with the deglacial system of the River Shannon in the northwest, and hummocky sands and gravels, which may be subaerial fans, in the east and south. Borehole logs show that the aquifer material consists predominantly of sands and gravels, with occasional low permeability horizons (GSI, 2023a). The sand and gravel deposit is generally in direct contact with bedrock (GSI, 2023a). The bedrock underlying the sand and gravel body is highly variable in its' composition, but is dominated by locally important aquifers which have a high proportion of rejected recharge associated with them.		
	Key properties	Though permeability testing data are limited, productivity, borehole logging and quarry data indicate that coarse material predominates and that permeability and storativity are high (EPA, 2011). The groundwater is considered to be generally unconfined; however where low permeability layers are present within and above the sand and gravel deposit the aquifer may be locally confined.		
	Thickness	The sand and gravel deposit reaches up to 36 m in thickness, with the saturated thickness of the deposit reaching up to 28 m (GSI, 2023a).		
Overlying Strata	Lithologies	Peat, alluvium and estuarine silts and clays are mapped as overlying portions of the sand and gravel body (GSI, 2023a).		
	Thickness	The thickness of the peat, alluvial and lacustrine deposits is unknown, but where they occur all are expected to be no more than 3 m deep. The alluvium and estuarine silts and clays may be of significant depth moving northwestwards towards the River Shannon.		
	% area aquifer near surface	Approximately 60 % of the area of the sand and gravel body has sands and gravels just below the surface.		
	Vulnerability	Most of the aquifer is at the surface and therefore unprotected; consequently pollutants can easily infiltrate the aquifer. Sand and gravel aquifers are categorised as having either 'High' or 'Extreme' vulnerability (DELG/EPA/GSI, 1999). The vulnerability classification of a sand and gravel aquifer is determined by the depth to the water table from ground level. Measured water levels range from 0.5 m to 10 m below ground level. In areas where the water table is less than 3 m below ground level the aquifer vulnerability is classified as 'Extreme' and where it is greater than 3 m below ground level the aquifer vulnerability is classified as 'High'.		



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Recharge	Main recharge mechanisms	Diffuse recharge occurs by the infiltration of rainfall through the unsaturated sands and gravels. The proportion of the 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 groundwater in sands and gravels is around 85% (Hunter-Williams et al, 2011). Recharge to the aquifer occurs diffusely through the unsaturated zone and potentially through interaction with the rivers passing through the sand and gravel body, and the River Shannon to the north. According to the EPA (2011) “there is likely to be a hydraulic connection with the River Shannon”.								
	Est. recharge rates	The rainfall in the area of the O’Briensbridge sand and gravel deposit is 1,190 mm/yr (Walsh, 2012), and the estimated recharge rate to the aquifer from direct recharge is 273 mm/yr. The minimum direct groundwater throughput in the aquifer is consequently estimated to be 7,896 m³/d, but with rejected recharge the throughput increases to a minimum potential of 11,485 m³/d.								
Discharge	Large springs and large known abstractions (m³/d)	The O’Briensbridge - Montpelier Public Water Supply supplies 725 m³/day (EPA 2011). However smaller dug wells have much lower yields of 27.3 m³/day and 32.8 m³/day (GSI, 2023a).								
	Main discharge mechanisms	The main discharge mechanisms are baseflow discharge to rivers, seepages at the extremities of the body and discharge via springs. Groundwater discharges at ditches, springs and, depending on the river stage, also along the rivers.								
	Hydrochemical Signature	The groundwater has a calcium magnesium bicarbonate (C ₄ H ₆ CaMgO ₁₃) hydrochemical signature (EPA, 2003). Summary water quality analysis from three 2003 sampling rounds follow.								
		Cl mg/l	HCO ₃ mg/l	SO ₄ mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	NO ₃ mg/l	
		18.35	242	8.95	86.4	6.39	11.67	4.04	11.16	
		20.03	241	9.47	86.1	6.27	11.52	4.38	12.73	
			17.12	242	9.2	86.8	6.25	12.12	3.36	10.55
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. The variability in the composition of this aquifer disrupts flow, shortening groundwater flow paths. The groundwater gradient across the aquifer body is interpreted to be shallow.								
Groundwater & Surface water interactions		Hydraulic connection between the groundwater and surface water is expected to be high.								
Conceptual model	• The sand and gravel body at O’Briensbridge is classified as a Locally Important Sand and Gravel Aquifer. • The boundaries of the aquifer are delimited for the most part by the extent of the mapped sands and gravels, and by topographic analysis as well as the evidence from borehole logs (GSI, 2023b). • Areas of mapped peat and estuarine sediments under which sand and gravel is considered as present are included within the boundaries of the delineated aquifer body. • The bedrock underlying the sand and gravel body is highly variable in its’ composition, but is dominated by locally important aquifers which have a high proportion of rejected recharge associated with them. • Borehole logs indicate that the sand and gravel deposit ranges in thickness from 10 m to 36 m (GSI, 2023a). • The permeability of the deposit is expected vary considerably throughout the area of the aquifer body. • The Montpelier PWS abstracts groundwater from this aquifer and has a proven yield of 725 m³/day (EPA 2011). However smaller dug wells have much lower yields of 27.3 m³/day and 32.8 m³/day (GSI, 2023a). • The groundwater gradient across the aquifer body is interpreted to be shallow.									



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	- Recharge to the aquifer occurs diffusely through the unsaturated zone and potentially through interaction with the rivers passing through the sand and gravel body, and the River Shannon to the north. - Groundwater discharges at ditches, springs and, depending on the river stage, also along the rivers. - The minimum direct groundwater throughput in the aquifer is consequently estimated to be 7,896 m³/d, but with rejected recharge the throughput increases to a minimum potential of 11,485 m³/d.	
Attachments	Figure 1: Location and extent Figure 2: Cross section Figure 3: Groundwater vulnerability Figure 4: Piper diagram	
Instrumentation	Hydrometric gauges: National Water Monitoring Stations; River: Groundwater:	25308 WATERPARK BRIDGE RS25S012400 SHANNON (LOWER) - O'Briensbridge (LHS) RS25S012401 SHANNON (LOWER) - O'Briens Br (Mid) RS25S012402 SHANNON (LOWER) - O'Briens Br RHS RS25B770990 BALLYARD 25 - Interstitial, Bunkey Br. RS25N020400 NEWPORT (TIPPERARY) - Br nr Bunkey Br (K2) None present
Information Sources	- Daly, D., Keegan, M., Wright, G., Flynn E. (2001). County Tipperary (South Riding) Groundwater Protection Scheme Main Report. Geological Survey of Ireland and Tipperary (South Riding) County Council. - DELG/EPA/GSI (1999). Groundwater Protection Schemes. Department of the Environment and Local Government, Environmental Protection Agency and Geological Survey of Ireland. - EPA (2011). Water Framework Directive Groundwater Monitoring Programme: Site Information for Montpellier 2 Water Supply Borehole. - EPA (2023). Environmental Protection Agency 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 internal groundwater database. - GSI (2023b). Geological Survey Ireland Map Viewer. https://www.gsi.ie/en-ie/data-and-maps - Hunter Williams, N., Misstear, B., Daly, G., Johnston, P., Lee, M., Cooney, P., Hickey, C., (2011) National Groundwater Recharge Map for Ireland. Geological Survey Ireland and Department of Civil, Structural and Environmental Engineering, Trinity College Dublin. - NPWS (2018). National Parks and Wildlife Service Map Viewer. http://webgis.npws.ie/npwsviewer - Ó'Suilleabháin, 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. Figure 1 and Plate 1 are used for illustrative purposes only.	



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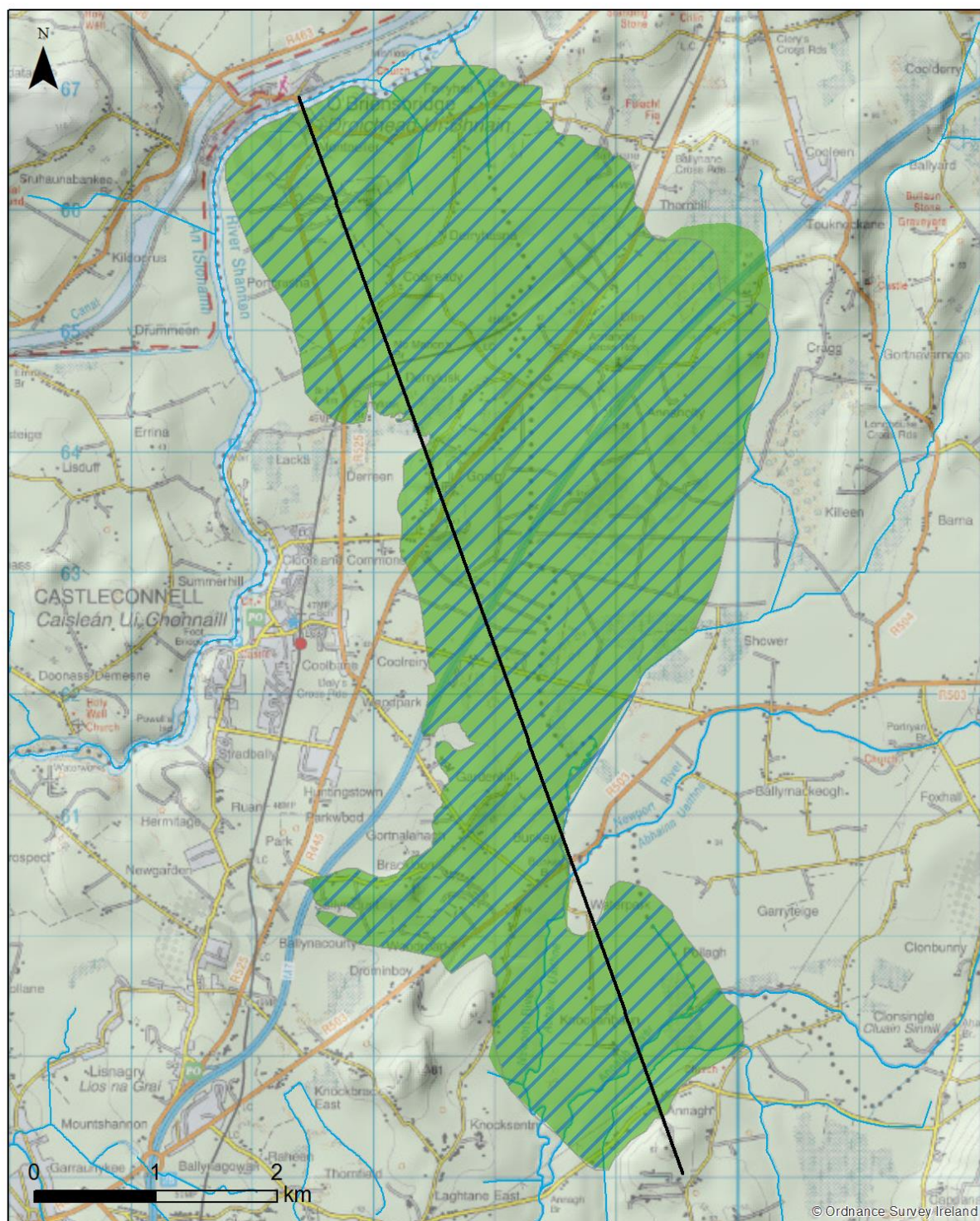


Figure 1. O'Briensbridge Sand and Gravel Aquifer extent with cross section location.

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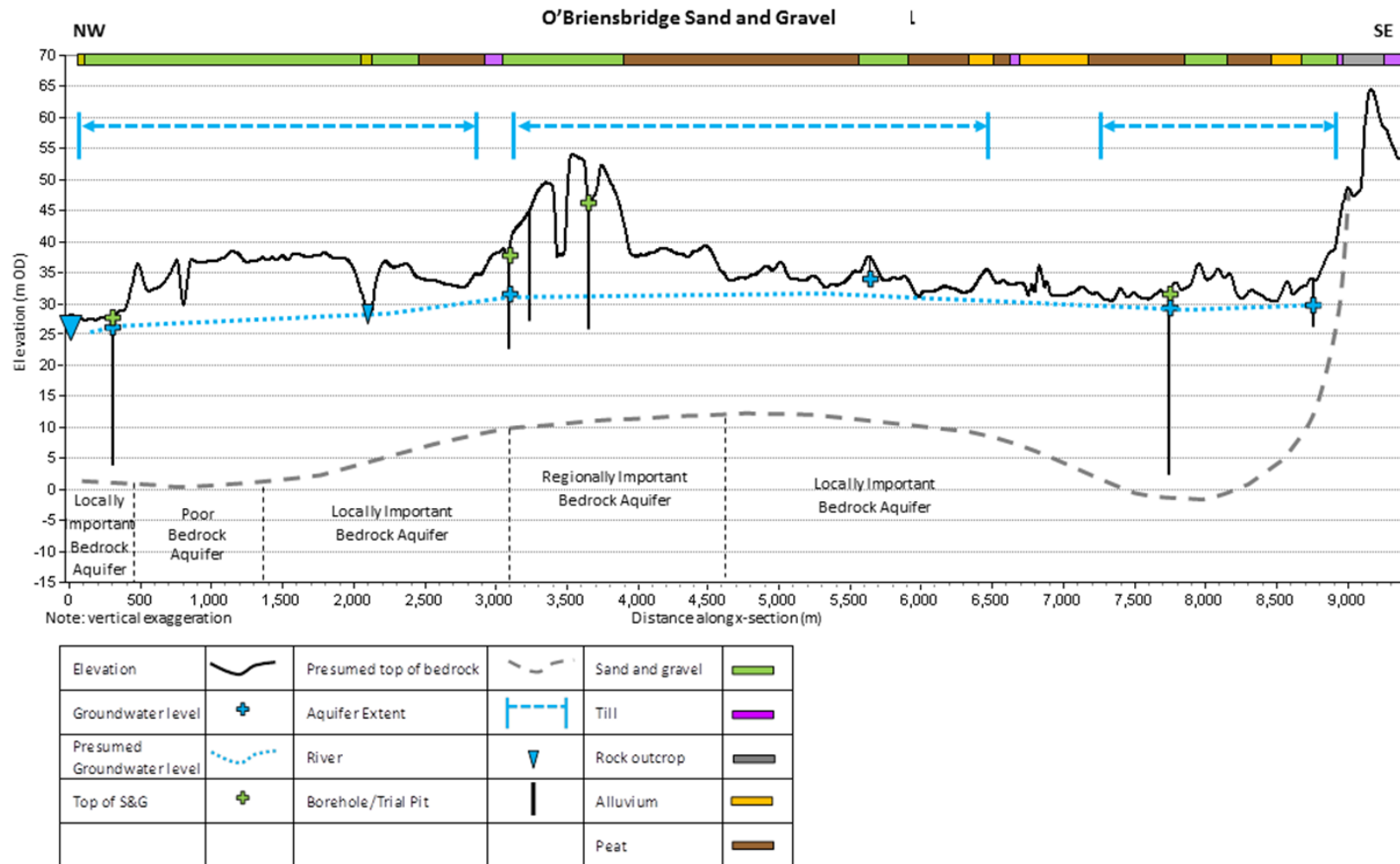


Figure 2: Cross section through the O'Briensbridge Sand and Gravel Aquifer body.

The map displays the River Shannon and its tributaries, including the River Binn. Key locations marked include O'Brien's Bridge, Derrynasna, Castleconnell, and various smaller villages like Derrinacorney and Derrinacorney. The map is overlaid with a grid of latitude and longitude lines. A scale bar at the bottom indicates distances up to 2 km. The map is titled 'Castleconnell' and 'Aisleán Uí Chóinnáil'.

Figure 3. Groundwater vulnerability across the O'Briensbridge Sand and Gravel Aquifer.

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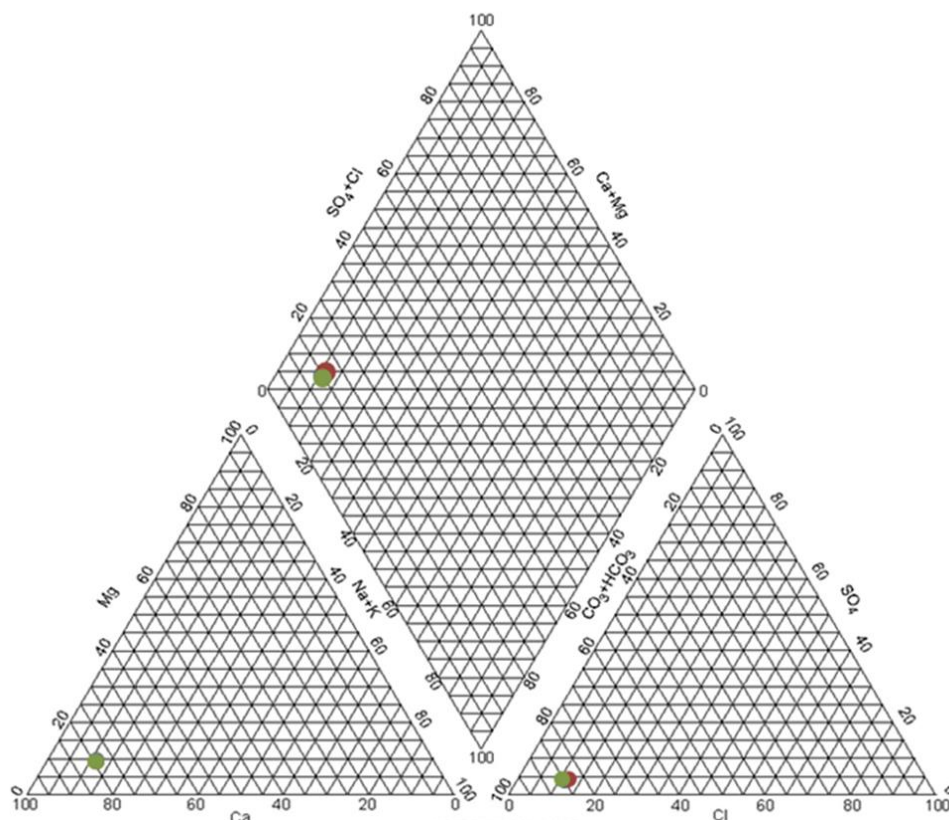


Figure 4. Piper Diagram of analysed groundwater from the O'Briensbridge Sand and Gravel Aquifer, suggesting a calcium bicarbonate signature (EPA, 2011).

