

Raphoe GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km ²)
Hydrometric Area 01 Donegal Co. Co.	Rivers: Foyle, Swilly Burn, Deelee, Cloghroe. Stream: Leslie Hill Stream – 196 unnamed streams. Lakes: 2 unnamed.	River Finn (O' Riain, 2004)	160
Topography	This is an irregularly shaped GWB (Figure 1) as it predominantly bounded by lower productivity aquifers in a highly faulted area. Only the northern (topographic divide – Hydrometric Area 39) and a small section of the eastern (River Foyle) boundaries are not formed by differing aquifer types. The topography comprises higher areas cut by E-W aligned river valleys. Elevations range from <10 mAOD along the banks of the Foyle to 230 mAOD along the northwest boundary. Surface water flow is eastwards, towards the R. Foyle.		
Geology and Aquifers	Aquifer categories	The vast majority (c85%) of the GWB is underlain by LI: Locally important aquifer which is moderately productive only in local zones. The remaining areas are PI: Poor aquifer which is generally unproductive except for local zones.	
	Main aquifer lithologies	The main lithology in this GWB is Precambrian Marbles (c.80%). The small remaining area is underlain by the Pecambrian Quartzites, Gneisses and Schists rock group. Refer to Table 1 for details.	
	Key structures	This part of Donegal has undergone significantly deformation, giving rise to the irregular shape of the GWB. A further result are the c.15 approximately SW-NE orientated faults, and adjacent SE-NW trending anticline and syncline features. Consequently, the rocks are dipping in various directions, by an assumed 20-30°, although the angle of dip is unknown.	
	Key properties	<p>Yields in this GWB range from 2-330 m³/d (6 wells), with 2 specific capacity values of 4 and 165 m³/d/m. The adjacent northern GWB comprises the same rocks (Manor Cunningham GWB) and therefore these data are also likely to be representative – yields ranging from 7-1090 m³/d, averaging 308 m³/d for 9 wells; transmissivity values of 11-12 m²/d calculated for the Magherabeg/Veagh WSS; specific capacity values for 5 wells (0.1, 0.4, 0.8, 31 and 82 m³/d/m). Interestingly, the highest 4 yields and 2 specific capacities in the Manor Cunningham GWB are recorded for the wells within the 'marble-rich' unit (DGmb). The same rocks are also found in Culdaff, which supply the Culdaff WSS: yield of 523 m³/d, transmissivity of c.110 m²/d, and specific capacity of 126 m³/d/m.</p> <p>Additionally it is noted that karstification may occur in these rocks e.g. Pollnapaste Cave at the mouth of the Gweebarra River, west Donegal (Parkes <i>et al</i>, 1999). A 'fractured cavity' recorded in the Culdaff WSS borehole log may also reflect some degree of solution. However, Faulkner (2000) does note that not all marble units appear to be susceptible to karstification.</p> <p>Overall, the Donegal data highlight that yields and transmissivities are variable and that there are productive zones in these rocks that may have been enhanced by karstification. However, transmissivity values are not generally expected to be high i.e. <20 m²/d, and storativity is also considered to be relatively low (<1%).</p> <p>All 16 groundwater levels are 0-8 m below ground level. The data are inadequate to calculate groundwater gradients however, these are expected to be greater than 0.01, given the relatively low permeability of the rock.</p> <p><i>(Precambrian Aquifer Chapter; Donegal GWPS; Magherabeg/Veagh Source Report; Culdaff Source Report)</i></p>	
	Thickness	Most groundwater flux is expected to be in the uppermost part of the aquifer comprising a broken and weathered zone typically less than 3 m thick, a zone of interconnected fissuring around 10-15 m thick, and a zone of isolated poorly connected fissuring typically less than 150 m. In this GWB, deeper water strike are recorded in 2 wells that are within 500 m of each other: 30, 45 and 48 m below rock head, which reflect the third component of the groundwater flux.	
Overlying Strata	Lithologies	The GWB is predominantly covered peat (77%), with a small proportion of alluvium (11%).	
	Thickness	From the Donegal GWPS, subsoil is absent or thin over the higher areas i.e. more in the west of the GWB and between valleys. Deposits become thicker (>3 m) to the east, with the deepest deposits limited to the centre of river valleys (5-10 m).	
	% area aquifer near surface	<i>[Information will be added at a later date]</i>	
Recharge	Vulnerability	The majority of this GWB is classified as Extremely vulnerability, due to the high percentage of thin subsoil and rock outcrops. Where subsoil is thicker, such as in the valleys, the vulnerability is mainly High, with occasional small areas of Moderate that are associated with areas of deeper deposits.	
	Main recharge mechanisms	Diffuse recharge occurs via rainfall percolating through the subsoil and rock outcrops. Due to the low permeability of some subsoil deposits and the aquifers, a high proportion of the effective rainfall will quickly discharge to the streams in the GWB. The reasonably high stream density is reflects the high proportion of surface runoff as opposed to recharge.	
	Est. recharge rates	<i>[Information will be added at a later date]</i>	

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Discharge	Large springs and high yielding wells (m³/d)	Sources: None identified. Excellent Wells: None identified. Good Wells: Boyagh – 110 m ³ /d, 110 m ³ /d. Springs: None identified.
	Main discharge mechanisms	The main groundwater discharges are to the rivers and streams crossing the GWB, reflecting short groundwater flow paths. Small springs and seeps are likely to issue at the stream heads and along their course.
	Hydrochemical Signature	Data are limited within this particular GWB. <i>National classification:</i> Precambrian Marbles Calcareous. Generally CaHCO ₃ signature. Alkalinity (mg/l as CaCO ₃): range of 112-428; mean of 274 (22 data points) Total Hardness (mg/l): range of 180-436; mean of 311 (22 data points) Conductivity (μS/cm): range of 414-814; mean of 667 (22 data points) <i>(Calcareous/Non calcareous classification of bedrock in the Republic of Ireland report)</i>
Groundwater Flow Paths	In the absence of inter-granular permeability, groundwater flow is expected to be concentrated in upper fractured and weathered zones and in the vicinity of fault zones, which may have some degree of karstification. Available groundwater levels are mainly 0-5 m below ground level. Unconfined flow paths are likely to be short (30-300 m), with groundwater discharging rapidly to nearby streams and small springs. Water strikes deeper than the estimated interconnected fissure zone suggest a component of deep groundwater flow, however shallow groundwater flow is dominant. Groundwater flow directions are expected to follow topography i.e. generally to the east to discharge into R. Foyle.	
Groundwater & Surface water interactions	Groundwater will discharge locally to streams and rivers crossing the aquifer and also to small springs and seeps. Owing to the poor productivity of the aquifers in this body it is unlikely that any major groundwater - surface water interactions occur. Baseflow to rivers and streams is relatively low.	

Conceptual model	<ul style="list-style-type: none"> The southwest and northeast GWB boundaries comprise less productive aquifers. The body is bounded to the north by a topographic divide (Hydrometric Area 39) and by the R. Foyle along a small section of the eastern boundary. Elevations range from <10 mAOD along the R. Foyle, to 230 mAOD along the northwest boundary. The GWB is composed primarily of low transmissivity rocks (c.<20 m²/d), although there are more productive zones. Most of the groundwater flux is likely to be in the uppermost part of the aquifer comprising: a broken and weathered zone typically less than 3 m thick; a zone of interconnected fissuring less than 10 m; and a zone of isolated fissuring typically less than 150 m. Recharge occurs diffusely through the subsoil and rock outcrops, although is limited by any thicker low permeability subsoil and bedrock. Therefore, most of the effective rainfall is not expected to recharge the aquifer. Flow paths are likely to be short (30-300 m) with groundwater discharging rapidly to the streams crossing the aquifer, and to small springs and seeps. Overall, the flow directions are expected to be to the southwest, as determined by the topography. 	
Attachments	Figure 1. Table 1.	
Instrumentation	Stream gauges: 01041, 01046, 01048, 01049, 01052. EPA Water Level Monitoring boreholes: None identified. EPA Representative Monitoring points: None identified.	
Information Sources	Faulkner, T. (2000) <i>Caves in Metamorphic Limestones of the Irish Dalradian Supergroup</i> . Limestone Research Group, Department of Geographical Sciences, University of Huddersfield, Queensgate, Huddersfield, HD1 3DH, UK. From Irish Speleology 17, 2000, pp43-49. Lee M. and Daly D. (2004). <i>Magherabeg/Veagh Public Water Supply Scheme, Source Protection Zones</i> . Geological Survey of Ireland Report. Lee M. and Daly D. (2004). <i>Culdaff Water Supply Scheme, Source Protection Zones</i> . Geological Survey of Ireland Report. Lee M. and Fitzsimons V. (2004). <i>County Donegal Groundwater Protection Scheme</i> . Main Report. Draft Report to Donegal County Council. Geological Survey of Ireland 58pp. Long, C.B. and McConnell (1999) <i>Geology of South Donegal: A geological description, to accompany bedrock geology 1:100,000 scale map, Sheet 3, South Donegal</i> . With contributions by G.I. Alsop, P. O'Connor, K. Carlingford and C. Cronin. Geological Survey of Ireland, 116pp. O' Riain, 2004. <i>Water Dependent Ecosystems and Subtypes (Draft)</i> . Compass Informatics in association with National Parks and Wildlife (DEHLG). WFD support projects. Parkes, M., Johnston, D., Simms, M.J. and John G. Kelly (1999). <i>Geological guidance of speleogenesis in marble of the Dalradian Supergroup, County Donegal, Ireland</i> . Cave and Karst Science Vol. 26. No3. December 1999. Transactions of the British Cave Research Association.	
Disclaimer	Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae.	

Figure 1. Location and Boundaries of GWB.

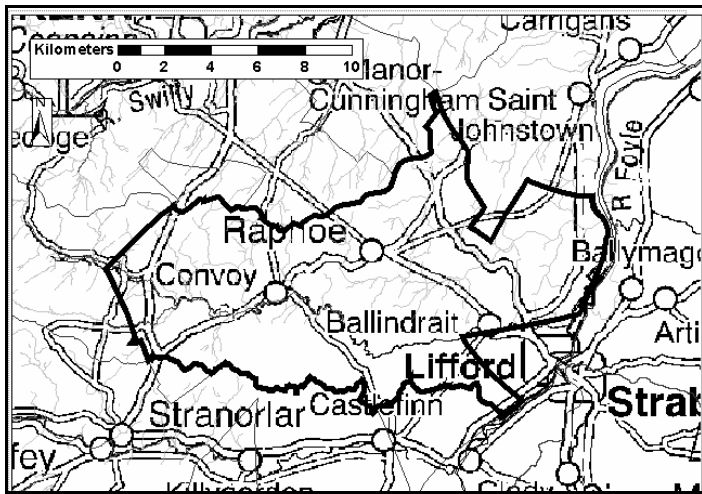


Table 1. List of Rock units in GWB

Rock Unit Name	Code	Description	Rock Unit Group	Aquifer Class.	% Area
Aghyaran & Killygordon Limestone Formations	DG	Marble, quartzite, psammite; graphitic	Precambrian Marbles	LI	73.52%
Mullyfa and Deelee Formations	MF	Psammite, pebble beds, marble, schist	Precambrian Quartzites, Gneisses & Schists	PI	13.26%
Marble unit	DGmb	Marble-rich unit	Precambrian Marbles	LI	5.50%
Killeter Quartzite Formation	KT	Slightly impure quartzite	Precambrian Quartzites, Gneisses & Schists	PI	4.45%
Termon Formation	TE	Banded semi-pelitic & psammitic schist	Precambrian Quartzites, Gneisses & Schists	PI	3.27%