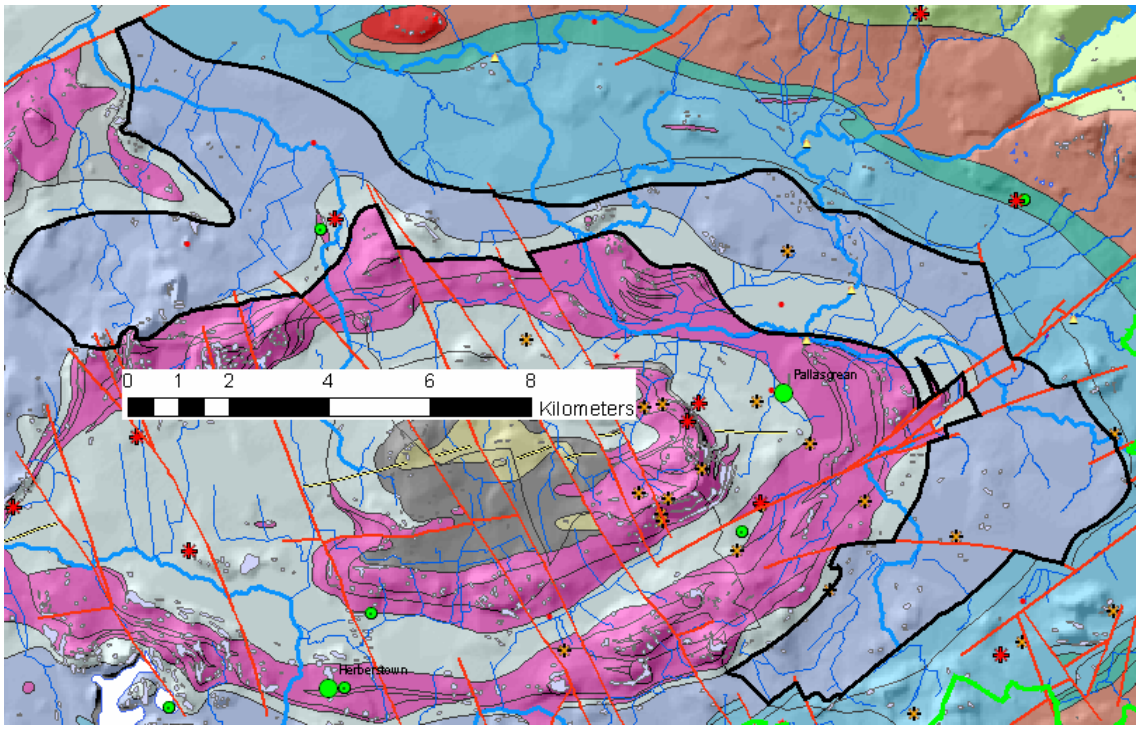
Ballyneety GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authorities		Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
25 - Mulkear Limerick Co. Co.		Rivers: Mulkear, Groody, Dooglasha, Dead, Reask, Bilboa, Cahernanalia.	None.	68
Topography	The GWB is curved like a backwards 'C' and to the west, it wraps around the Knockroe East. Narrow, it is around 1-2 km wide. Over most of the GWB ground elevation ranges between 50–80 mAOD. Lower ground occurs in the NW and NE of the GWB, where the major rivers cross the GWB and elevations are 30-50 mAOD. Higher ground is found in the very west, in the SW, and along parts of the 'inner' (western) margin of the GWB. Here, average elevations are 80-100 mAOD but can reach > 160 mAOD. High elevations are generally associated with the more resistant volcanic rocks or cherty bedded limestones. Surface water drainage is generally NW.			
Geology and Aquifers	Aquifer categories	The majority of the GWB is comprised of an **Rk^d:** Regionally important karstified aquifer dominated by diffuse flow. The Pure Bedded Limestones along most of the western margin of the GWB are classified as **Lm:** Locally important aquifers which are generally moderately productive. The small areas of volcanic rocks in the east of the GWB are currently classified as **Ll:** Locally important aquifers which are moderately productive only in local zones.		
	Main aquifer lithologies	Dinantian Pure Unbedded Limestones are predominant. Dinantian Pure Bedded Limestones occur in a narrow band along the western margin. There is < 1 km^2 of Basalts and other Volcanic rocks mapped at the surface.		
	Key structures	The rocks are part of a synclinal structure, and in this area form the limbs of the fold. The axis of the fold is orientated ENE-WSW. Dip angles are low, between 5^o and 20^o. Overall, will dip roughly at right angles to the edges of the GWB (i.e., to the south, west and east), but the shapes of the limestone mounds result in measured dips in all directions. NW-SE and ENE-WSW to E-W trending faults cross-cut the limbs of the fold.		
	Key properties	Transmissivities in diffusely karstified aquifers (the Dinantian Pure Unbedded Limestones) are in the range 20–2000 m^2/d. In this area of the country, the median value will probably be towards the lower-middle end of the range. At Croom and Fedamore WSs in the nearby Fedamore GWB, transmissivities are 120 m^2/d [estimate range 95–145 m^2/d] and 34 m^2/d [estimate range 23–41 m^2/d], respectively. Groundwater gradients within the karstic aquifer are low, ranging from approximately 0.005 to 0.01. Within- the Pure Bedded Limestones, transmissivities will tend to be lower, in the range 10-100 m^2/d. Transmissivities in the volcanic rocks are variable; in places, clays from weathering after their deposition have blocked the fissures; in others areas, these weathering products have been washed out of the fracture system. Transmissivities will be in the range 2–100 m^2/d. Groundwater gradients can be up to 0.05 in these rocks, since they tend to form higher ground with steep slopes. Specific yield in all aquifers will be low, on the order of a few percent or less. *(data sources: Rock Unit Group Aquifer Chapters, Limerick GWPS Report, Source Reports, see references)*		
	Thickness	The Dinantian Pure Unbedded Limestones attain maximum thicknesses of more than 1200 m. However, most groundwater flow is likely to take place in the top ~30 m, in the zone that comprises a weathered layer of a few metres and a connected fractured layer below this. Deeper groundwater flow occurs along fault zones and large fractures or in dolomitised zones. An epikarstic layer at least a couple of metres thick is likely to exist at the top of the bedrock, below which a network of fissures and small conduits will exist. Within the less transmissive rocks, groundwater will flow in a more shallow system of around ≤20 m that comprises a weathered zone of a few metres and a connected fractured zone below this, although more isolated water-bearing fractures or faults can be intercepted at greater depths.		
Overlying Strata	Lithologies	*[Information to be added at a later date]*		
	Thickness	Subsoil thickness data are clustered in the east of the GWB. Here, subsoil thickness varies significantly in a small area, ranging from 3 m to more than 30 m. The frequency distribution of thickness data is bimodal, with a large peak at 5-6 m and a smaller peak at 18-22 m. Some but not all of the thicker subsoils recorded are associated with mapped fault traces. Outcrops are small and sparsely scattered across the GWB. They are slightly more prevalent in the SE of the GWB than in the NW.		
	% area aquifer near surface	*[Information to be added at a later date]*		
	Vulnerability	Over most of the west of the GWB, vulnerability is High, with smaller areas of Extreme. In the east and SE of the GWB, however, vulnerability is predominantly Moderate, with areas of Low and small patches of Extreme vulnerability. In the SW groundwater vulnerability High and Extreme.		
Recharge	Main recharge mechanisms	Diffuse recharge will occur via rainfall percolating through the subsoil. 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. In areas where the water table is at or very close to the surface, potential recharge may be rejected.		
	Est. recharge rates	*[Information to be added at a later date]*		

Discharge	Springs and large known abstractions (m^3/d)	There are two Excellent (> 400 m^3/d) yielding boreholes known in this GWB: one at Caherconlish WS; abstraction is 470 m^3/d from this borehole (EPA database), and one at Ballyneety Golf Course, where the yield is 545 m^3/d (GSI database). There are two Good (100 m^3/d < yield < 400 m^3/d) yielding wells – at Inch Lawrence, and at Ballyneety. Both borehole yields are at the upper end of this range. There are no High (> 2,160 m^3/d) yielding springs known in this GWB, but at Caherconlish there is a spring with an Intermediate yield (>430 m^3/d > yield > 2,160 m^3/d).
	Main discharge mechanisms	Water level data indicate that there is a perched water table in the subsoils, and a deeper groundwater system in the bedrock aquifer. There are only three water level data for the bedrock aquifer – in boreholes ranging from 50-140 m deep that have Good (300-330 m^3/d) to Poor (27 m^3/d) yields, water levels are 18.3 mbgl, 41.75 mbgl and 76.2 mbgl. These boreholes, which occur in the very NW of the GWB, are separated by 2.5 km at the most, and indicate that there is either no continuous piezometric surface or that there are parts of the aquifer that are hydraulically isolated from the rest of the aquifer. Despite very deep groundwater levels, the rivers and streams are probably in hydraulic continuity with shallow groundwater where subsoils are not too thick or impermeable. Therefore, the main groundwater discharges are considered to be to the streams and rivers crossing the GWB, particularly the Rivers Mulkear, Groody and Dead, and to the springs within the GWB. Drainage density across this GWB is relatively high; this may be a function of subsoil properties rather than indicating low bedrock aquifer permeability.
	Hydrochemical Signature	Limited hydrochemical data are available for this GWB. The hydrochemical signature of groundwaters from Caherconlish WS is calcium-bicarbonate, as would be expected in this GWB. Data indicate typically Hard (220–355 mg/l as $CaCO_3$) groundwater, with high alkalinities (190–320 mg/l as $CaCO_3$) and electrical conductivities (680-710 μS/cm), and neutral pHs. Background chloride concentrations may be higher than in the central Midlands, due to closer proximity to the sea.
Groundwater Flow Paths		These rocks are devoid of intergranular permeability; groundwater flows through a diffuse network of solutionally-enlarged fissures and small conduits, and along faults. There is one cave known in the GWB, adjacent to the River Mulkear at Kiluragh. Groundwater levels measured in boreholes are surprisingly deep, ranging from 18.3-76 mbgl (3 measurements), indicating that there is a deep groundwater system, at least in the NW part of the GWB where these measurements were taken. It is possible that faulting has compartmentalised the aquifer. Water level measurements in dug wells are shallow (around 1-7 mbgl) and there are many streams and rivers crossing the mostly High vulnerability aquifers within this GWB. This indicates that there is a shallow groundwater system, with the water table lying within the subsoils, that is in hydraulic continuity with the surface water features. There are a few springs within the GWB, and, since the rivers and streams are in hydraulic continuity with the aquifer, they represent the local water table elevation. The shallow groundwater system is probably unconfined. Only in the southwest of the GWB are subsoils sufficiently thick to (partially) confine the aquifer. The degree of interconnectedness between the shallow and deep systems is not known. Groundwater flow paths in the deeper groundwater system may be long (> 1000 m). Within the shallow flow system, groundwater discharges locally to surface water features or springs. In discharge zones, flow paths will be short, around 100–300 m; in recharge zones, flow paths may be up to 1000 m. Local groundwater flow is from the higher ground between surface water bodies to the rivers and streams. Any regional flow will be generally northwards and eastwards, being driven by topography.
Groundwater & Surface water interactions		Groundwater discharges to the streams, rivers and springs within the GWB, certainly from the shallow system. The inferred deeper groundwater system may only discharge to the major rivers. Two specific dry weather flows of 2.22 and 0.9 l/s/km^2 on the Mulkear River indicate that the baseflow from the aquifer to the Mulkear is moderate to high. The higher figure relates to where the river is crossing the karstified Pure Unbedded Limestone aquifer, and the lower figure relates to where the river crosses the less karstic, cherty Pure Bedded Limestone aquifer.

Conceptual model	• The GWB is shaped like a backwards 'C'. It is bounded on its 'inner' (western) margin by the contact with the lower transmissivity volcanic aquifer of the Knockroe East GWB. The very western and SW margin of the GWB coincide with surface water catchment divides, which are inferred groundwater highs. Most of the 'outer' (SE, E and NE) margin of the GWB is formed by the contact with the low transmissivity aquifers of the Slieve Phelim GWB. The NW boundary is the contact between this GWB and the cherty Pure Bedded Limestones of the Limerick City East GWB. The terrain is generally gently hilly. Ground elevation decreases eastwards and northwards. • The GWB is composed primarily of highly transmissive diffusely karstified rocks. Lower transmissivity cherty limestone aquifers occur along part of the western edge of the GWB. All rocks within the GWB have low storativity. • Recharge occurs diffusely through the subsoils and at outcrop. Recharge may be rejected where the water table is high. There may be a small volume of cross-flow from the upstream aquifers within the Knockroe East GWB. • Groundwater flow in this aquifer will be concentrated in both a shallow zone at the top of the bedrock and in a deeper groundwater flow system. The shallow zone is likely to comprise an epikarstic layer of a few metres, below which is a network of diffuse solutionally-enlarged joints and small conduits, fractures and faults. A deeper groundwater flow, at least within the NW of the GWB, is evidenced by deep water levels (18-76 mbgl). This may be an extensive deep system in which groundwater flows within a deep karstic network that was formed in response to a lower base level, or may be a restricted deeper flow system that is compartmentalised by faulting, and in which flow occurs along permeable fault zones or deeper fractures. • It is considered that most of the GWB is unconfined, with the water table mainly residing within the subsoil. Near rivers and streams, the water table is close to the surface. Only in the SE of the GWB do the subsoils attain sufficient thicknesses to (partially) confine the aquifer. • In the shallow, unconfined system, flow paths will be short in discharge zones, around 100–300 m; in recharge zones, flow paths may be up to 1000 m. Groundwater flow paths in the deeper groundwater system may be longer (> 1000 m). • Groundwater discharges to the streams and rivers crossing the GWB, and to the springs within the GWB. • On a local scale, the topography and the surface drainage distribution determines groundwater flow directions. Regional groundwater flow is northwards and eastwards, driven by the general topographic slopes.
Attachments	None.
Instrumentation	Stream gauges: 25004*, 25159, 25211, 25317. *(Station marked with * has specific dry weather flows calculated.)* EPA Representative Monitoring boreholes: Caherconlish (LIM 25).
Information Sources	Deakin, J., Daly, D. and Coxon, C. (1998) *County Limerick Groundwater Protection Scheme*. Geological Survey of Ireland Report to Limerick Co. Co., 72 pp. Deakin, J. (1995) *Croom WS – Groundwater Source Protection Zones*. Geological Survey of Ireland Report to Limerick Co. Co., 6 pp. Deakin, J. (1995) *Fedamore WS – Groundwater Source Protection Zones*. Geological Survey of Ireland Report to Limerick Co. Co., 6 pp. Aquifer chapters: Dinantian Pure Unbedded Limestones; Dinantian Pure Bedded Limestones; Basalts and other Volcanic rocks.
Disclaimer	Note that all calculations and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae



Rock units in GWB

Rock unit name and code	Description	Rock unit group
Waulsortian Limestones (WA)	Massive unbedded lime-mudstone	Dinantian Pure Unbedded Limestones
Lough Gur Formation (LR)	Pale cherty crinoidal limestone	Dinantian Pure Bedded Limestones
Knockroe Vitric-Lithic Tuff Member (KRv)	Vitric-lithic tuff & agglomerate	Basalts & other Volcanic rocks
Trachyte (T)		Basalts & other Volcanic rocks
Trachyte Breccias (Tb)		Basalts & other Volcanic rocks