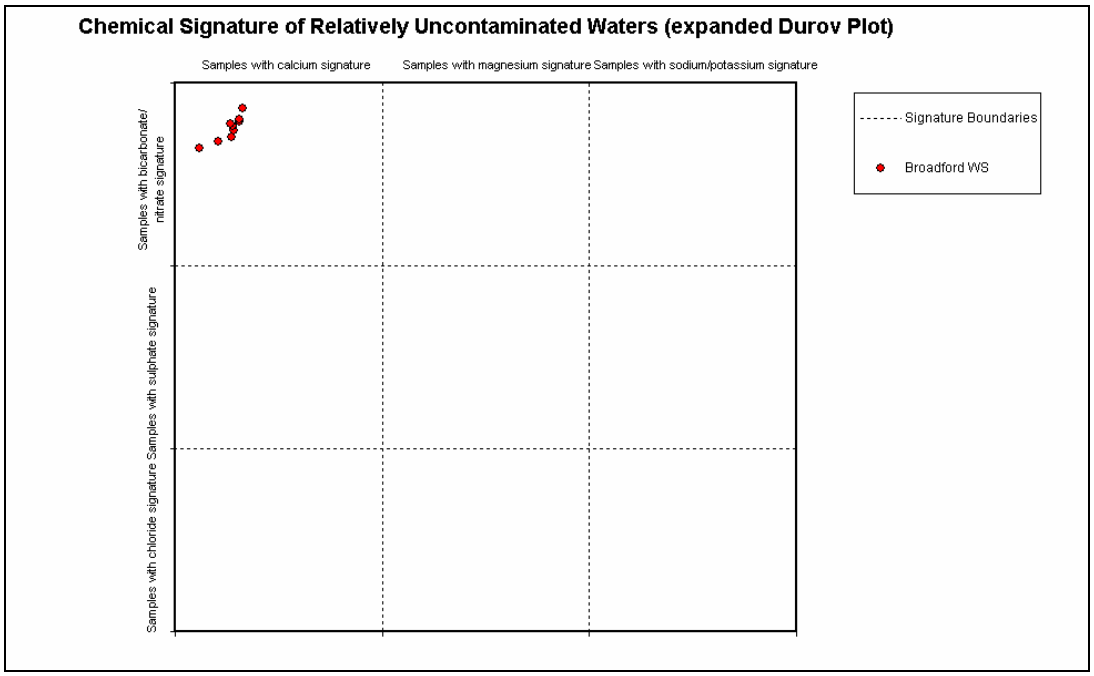
Shanagolden GWB: Summary of Initial Characterisation.

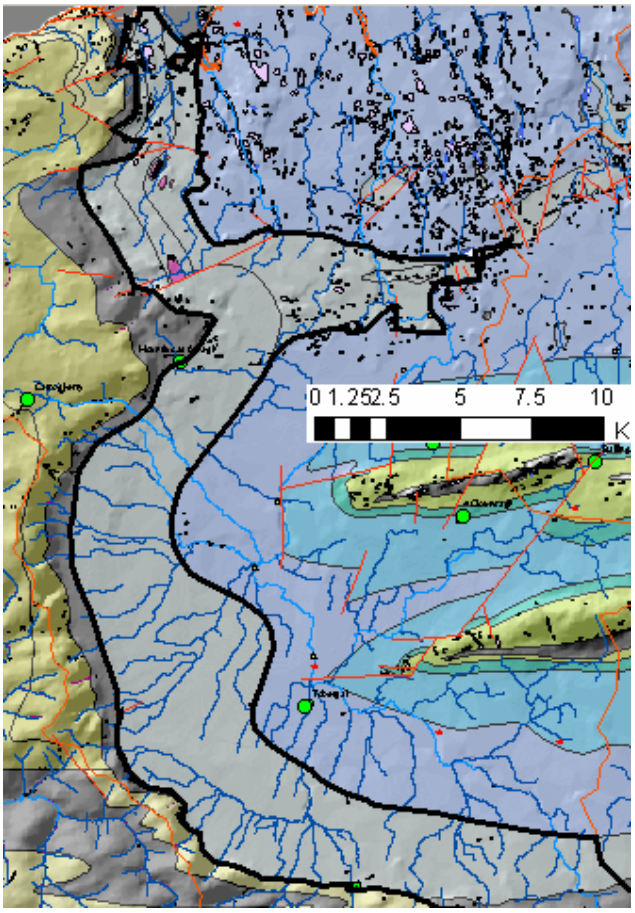
Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
24 - Deel/ Shannon Estuary South. Limerick, Cork Co. Co.'s	Rivers: Deel, Daar, Dooally, Arra, Bunoke. Streams: Shanagolden, Broadford, Ahavarraga, Slewnaun, Ballytraley, Ehernagh, Glashanakirka, Lisheenine. Loughs: Doohyle.	Inner Shannon Estuary (000435).	171

Topography	The GWB is roughly 'C'-shaped, with an additional small spur running northwards from the top of the 'C'. Most of the ground in this GWB is flat-lying, with elevations in the range 40-120 mAOD. The lowest elevations are in vicinity of the River Maigue and towards the coast. The foot of a double arc-shaped ridge forms the western boundary of the GWB. Elevations decrease eastwards away from the ridge, from a maximum of 180 mAOD. Drainage densities are high, particularly in the west and south of the GWB where streams drain the uplands of the Ballylongford GWB and flow across areas underlain by thick subsoils.	
Geology and Aquifers	Aquifer category(ies)	The GWB comprises a **Ll:** Locally important aquifer which is moderately productive only in local zones. Towards the north of the GWB, there are very small areas of Volcanic rock that are currently classed as **Lm:** Locally important aquifers which are generally moderately productive.
	Main aquifer lithologies	The dominant rock unit group is the Dinantian Upper Impure Limestones. There are very small areas of Basalts and other Volcanic Rocks in the northern part of the GWB.
	Key structures	The rocks within the GWB are folded into large, west-southwest plunging anticlines. Strata are tilted at about 20-45^{o}, with dip directions varying from SW to NW, depending on location. There are likely to be smaller, parasitic folds on the larger structures. Faults oriented ENE-WSW and WNW-ESE cross-cut the fold; because of the thickness of subsoil, not all structures are mapped. Fractures and joints may be more open on the fold axes.
	Key properties	Transmissivity in the Upper Impure Limestones will generally be in the range 5-20 m^2/d, although a pumping test at Broadford WS, in the south of this GWB, indicated a transmissivity of approximately 80 m^2/d. Large yields (>1000 m^3/d) are known, but it is unclear to what extent gravel lenses in the subsoil are contributing to yields. Water table gradients will be up to 0.02. Piezometric surface gradients in confined areas may be higher (e.g., west of Newcastle West). *(data sources: Rock Unit Group Aquifer Chapters, Source Reports, see references; estimation from maps)*
	Thickness	Flow in the aquifer is likely to be concentrated in a thin zone at the top of the rock. The weathered zone may be up to 3 m thick, with a zone of well-fractured bedrock below this extending 10-15 m, and a final zone of poorly fractured bedrock up to 60 m thick where significant inflows can only sometimes be encountered.
Overlying Strata	Lithologies	*[Information to be added at a later date]*
	Thickness	South of Ardagh, depth to bedrock is on the order of 5-10 m, reaching 15 m west of Newcastle West. Outcropping rock is restricted to the N-S area between Ardagh and Foynes, and to the W-E area between Ardagh and Rathkeale. In these areas, subsoils are generally 2-6 m thick, although greater thicknesses can be attained.
	% area aquifer near surface	*[Information to be added at a later date]*
	Vulnerability	*[Information to be added at a later date]*
Recharge	Main recharge mechanisms	Diffuse recharge will occur over the entire groundwater body via rainfall soaking through the subsoil. However, due to thick subsoils, a significant percentage of rainfall will not recharge the aquifer, but will runoff.
	Est. recharge rates	*[Information to be added at a later date]*
Discharge	Springs and large known abstractions (m^3/d)	Broadford WS (250 m^3/d), Killeedy GWS (#4) (unknown), Killeedy GWS (#5) (unknown). Creggan's Well spring (327 m^3/d) is artesian with gas bubbles. It emerges in Upper Impure Limestone strata, but the source of the groundwater is believed to be the underlying Waulsortian limestone. Ardagh WS (245 m^3/d) overlies this GWB, but abstracts water from 'till with gravels' that are not delineated as a gravel aquifer. *[More Information to be added at a later date]*
	Main discharge mechanisms	Groundwater will discharge to streams and rivers crossing the GWB, if the subsoil thickness and permeability permit it. Springs that are known to emerge from bedrock aquifers occur in the west of the GWB near where subsoil thicknesses are 15 m. This indicates that there are local zones of thin subsoil and/or that there are gravel lenses in the till cover that provide pathways to the surface for groundwater.
	Hydrochemical Signature	The upper impure limestone aquifers that form the bulk of the GWB have a calcium-bicarbonate signature, are hard (280-360 mg/l $CaCO_3$) and alkaline (240-290 mg/l $CaCO_3$), with high conductivities (630-660 µS/cm). Both iron and manganese can exceed allowable concentrations, with these components coming from the shales. The bedrock strata of these aquifers are **calcareous**. No data are available for the very small areas of volcanic rock. If there is limestone till covering these areas, groundwaters in these rocks will have a similar chemical composition to the surrounding impure limestones. Otherwise, the groundwaters will be softer and have less dissolved solids. The bedrock strata of this aquifer are **siliceous**. Background chloride concentrations may be higher than in the Midlands, due to proximity to the sea.

Groundwater Flow Paths	These rocks are devoid of intergranular permeability; groundwater flow occurs in faults, fractures and joints. Over most of the GWB, flows in the aquifer are likely to be concentrated in a thin zone at the top of the rock; the weathered zone may be up to 3 m thick, with a connected fractured zone a further 10-15 m, below which is a generally poorly fractured zone. Because of the generally thick subsoils, many wells in this GWB penetrate only into the top two metres or so of bedrock. Dug wells tap perched water tables within the subsoil. Water levels vary across the GWB. In the area north of Ardagh up to Foynes and also northeast of Ardagh, water levels vary between 0-15 mbgl, with a median of about 6 mbgl. Conditions are mainly unconfined. Where subsoil is thick (>10 m), groundwater is locally confined. A shallow well (11 m) at the coast experiences saline intrusion during summer high tides. East of Ardagh, water levels range between 4-10 mbgl with an average of 6 mbgl; they lie mainly in the subsoil. Springs are noted in the vicinity. In the western part of the GWB, from Ardagh to 6 km south of Newcastle West, the groundwater is significantly confined. Groundwaters are thought to partially derive from underlying Waulsortian rocks, and are sometimes pressurised with slightly elevated temperatures (approx 14.5^{o}C). Water levels range from 2-12 mbgl, with median values of 5-6 mbgl. In the southwest of the GWB, near the Bunoke River along to Drumcolliher, despite thick subsoils (3-41 m), groundwater levels are below the base of the subsoil, so an unsaturated zone exists. It is not clear whether the depressed groundwater levels are due to inhibited recharge, or to higher permeability in this area and the existence of a discharge zone (cross flow – outwards - to adjacent GWB??). Groundwater flow is influenced by topography and most flow is of a local nature. Unconfined groundwater flow paths are short (30-300 m), with groundwater discharging to the streams. Confined flow paths may be significantly longer. Overall, flow directions in the south and west of the GWB are towards the inner margins of the GWB (i.e., north and east). North of Ardagh, flows are northwards to the Shannon Estuary. East of Ardagh, groundwater flow will be to the larger rivers (e.g., Maigue, Deel).
Groundwater & Surface water interactions	Groundwater discharges to streams and springs where the subsoil is not too thick or impermeable. There is a cluster of springs west of Newcastle West. Streams beginning as seeps on the western slopes of the GWB may be fed mainly by perched groundwater within the subsoils. There is one river gauging station for which a useful specific dry weather flow can be computed; this value is low 0.28 l/s/km^2, indicating that the aquifer has low storage and cannot sustain significant contributions to summer surface water flows.
Conceptual model	• The groundwater body is 'C'-shaped, with a small northern spur to Foynes. It is bounded to the west and south by its contact with the Namurian rocks of the Ballylongford GWB. The eastern limits of the GWB coincide with the surface water catchment boundary. The rest of the inner (eastern) boundary is formed by the contact with the Pure Unbedded Limestones of the Askeaton and Newcastle West GWBs. The small northwards spur meets the Shannon estuary. The ground is flat-lying, with elevations generally decreasing eastwards. • The groundwater body is composed primarily of low transmissivity rocks, although localised zones of enhanced permeability do occur along faults. Groundwater flows along fractures, joints and major faults. • Recharge occurs diffusely through the subsoils and via outcrops. It occurs where the subsoil is thinner or where there are rock outcrops. In areas of thick, impermeable subsoils, rain will run-off to the nearest watercourse. • The aquifers within this GWB are both unconfined and confined. Most flow in this aquifer will occur near the surface; the effective thickness of this aquifer is likely to be about 10-15 m, comprising a weathered zone of a few metres and a connected fractured zone below this. The water table is from 0-15 m below ground level and follows topography in unconfined areas. Unconfined flow path lengths are relatively short, and in general are between 30 and 300 m. Confined flow path lengths may be significantly longer. Low DWFs indicate that aquifer storage is low. • Groundwater discharges to the streams crossing the aquifer where the subsoil is not too thick or impermeable, and to the springs and seeps. Groundwater-fed springs occur in areas of thick subsoil, suggesting that there are gravelly zones in the subsoil allowing the groundwater to reach the surface. These springs, west of Newcastle West, have slightly elevated temperatures (around 14.5^{o}C) and are thought to be fed by groundwater from the adjacent karstic aquifer (Newcastle West GWB). Local flow directions are controlled by local topography. Overall, flow directions in the south and west of the GWB are towards the inner margins of the GWB (i.e., north and east). North of Ardagh, flows are northwards to the Shannon Estuary. East of Ardagh, groundwater flow will be to the larger rivers (e.g., Maigue, Deel). The Strand Gravel GWB overlies this bedrock GWB in the west.
Attachments	Hydrochemical signature (Figure 1).
Instrumentation	Stream gauges: 24013*, 24014, 24015, 24017*, 24020, 24038, 24043. *(Stations marked with * have specific dry weather flow calculated.)* EPA Representative Monitoring boreholes: Broadford WS (LIM 19).
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. Hudson, M. (1995) Ardagh PS: Groundwater Source Protection Zones. Geological Survey of Ireland Report to Limerick Co. Co., 7 pp. Aquifer chapters: Dinantian Upper Impure 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

Figure 1: Hydrochemical signature





Rock units in GWB

Rock unit name and code	Description	Rock unit group
Parsonage and Corgrig Lodge Formations (PA)		Dinantian Upper Impure Limestone
Rathkeale Formation (RK)		Dinantian Upper Impure Limestone
Shanagolden Formation (SG)		Dinantian Upper Impure Limestone
Durnish Formation (DU)		Dinantian Upper Impure Limestone
Undifferentiated Visean Limestones (VIS)		Dinantian Upper Impure Limestone
Volcaniclastic rocks (V)		Basalts and other Volcanic Rocks