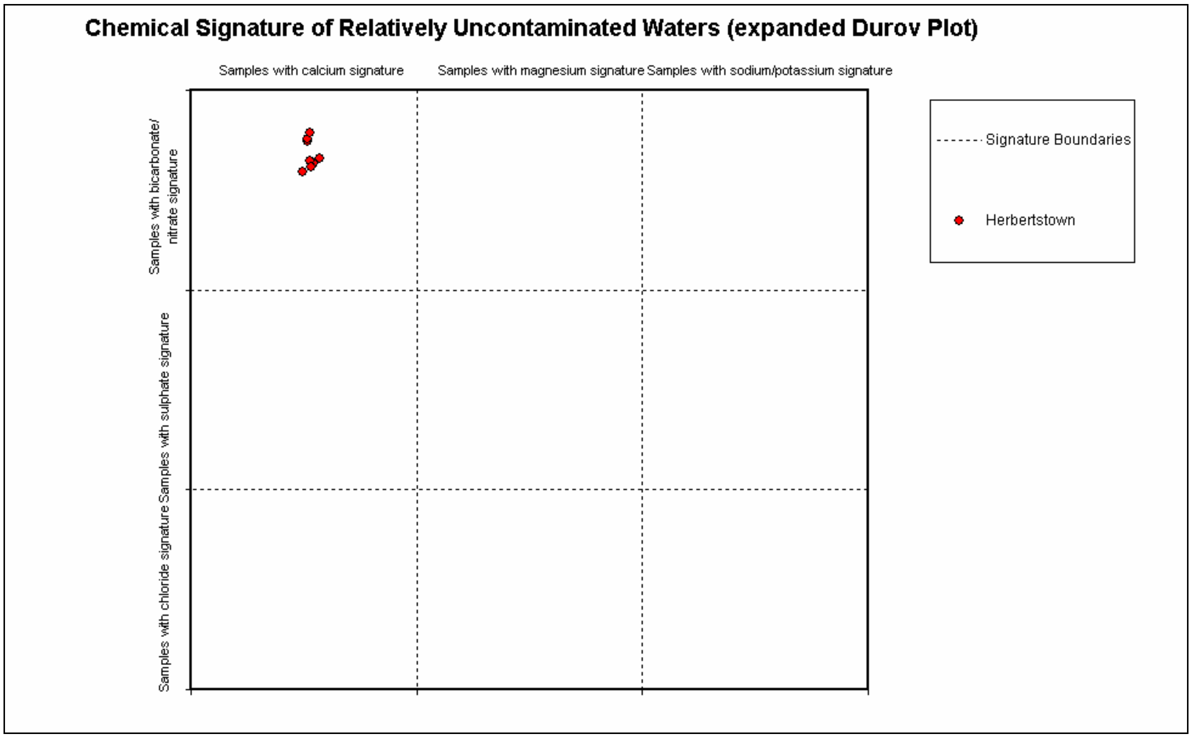
Knockroe East GWB: Summary of Initial Characterisation.

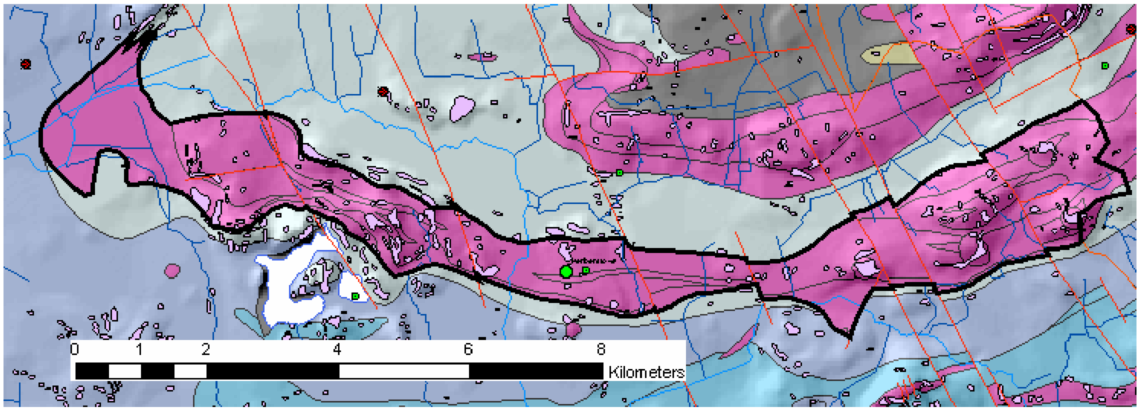
Hydrometric Area Local Authority		Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
24 - Maigue Limerick Co. Co.		Rivers: Camoge, Ballynamona.	None groundwater-dependent.	20
Topography	This body is narrow (≈1.5 km) and elongated roughly E-W. The terrain is hilly and steep, with ground elevations ranging from 60 mAOD in the west to more than 230 mAOD at Derk Hill on the eastern boundary. Generally, elevation increases most rapidly from the southern boundary to the north, and more gently from the west to the east of the GWB. There are several hills along the GWB whose tops are generally above 150 mAOD. Drainage within the GWB is generally good, although ponding can occur in the hills, and there are drainage ditches in lower-lying areas. Minor streams flow both north and south; the Camoge River flows north- and then westwards across this GWB and adjacent GWBs.			
Geology and Aquifers	Aquifer categories	The majority of the rocks are currently classified as **Ll:** Locally important aquifers which are moderately productive only in local zones. A very small area of pure bedded limestone in the east is **Lm:** Locally important aquifer which is generally moderately productive. The small volcanic plugs (Trachytes) are also currently classified as **Lm** aquifers.		
	Main aquifer lithologies	The GWB comprises Basalts and other Volcanic Rocks. There is a tiny area of Dinantian Pure Bedded Limestones in on the eastern boundary of the GWB.		
	Key structures	The main structures influencing groundwater flow are both primary (formed during deposition) and secondary (created by subsequent deformation). When the lavas solidified, cooling joints formed at right angles to the surface of the flow in some parts of the succession. The rocks are on the southwestern limb of a large boat-shaped syncline whose axis is orientated ENE-WSW. Strata are tilted at 15-25^o angles to the north and ENE. NNW-SSE trending major faults separated by about 2.5 km cross-cut the fold. Movements during the folding would also have caused some fracturing and jointing of the rocks. Deakin (1995) considers that fracturing and jointing in the area may provide high transmissivity zones in a north-south direction.		
	Key properties	Transmissivity in the Volcanic rocks in this area is thought to be variable: in some zones, columnar cooling joints provide a connected pathway for groundwater flow. In other parts, alteration of the rocks during their emplacement in shallow seas, or subsequent weathering during subaerial exposure in a tropical environment have clogged potential flow pathways (both cooling joints and tectonic fractures) with clays. At Herbertstown WS, transmissivity is about 100 m^2/d. However, there are failed wells known in this rock unit group. In the cherty Pure Bedded Limestones, transmissivity is likely to be in the range 10-100 m^2/d, with most values probably in the lower half of the range. Although the aquifers are generally moderate transmissivity, the high relief of the ground means that groundwater gradients will typically be quite high (up to 0.05), except in the area around the Camoge River, and in the west, where topography is flatter (around 0.01 in this area). *(data sources: Rock Unit Group Aquifer Chapters, Source reports, see references)*		
	Thickness	In general, the effective thickness of this aquifer is likely to be ≤ 15-20 m, comprising a weathered zone of a few metres and a connected fractured zone below this. However, more isolated water-bearing joints or faults can be intercepted at greater depths.		
Overlying Strata	Lithologies	GSI mapping records clayey Limestone Tills, with areas of silty Alluvium alongside the surface water courses. In the low-lying area in the west of the GWB, the subsoil comprises Peat deposits.		
	Thickness	The subsoil is very shallow, with typical thicknesses of 0-2 m, and a range of 0–6 m. Areas of outcropping rock are quite extensive and distributed across the whole GWB. A subsoil thickness of 23 m is recorded in the very west of the GWB, so subsoils may be thicker in this lower-lying area.		
	% 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 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. The drainage density indicates that a significant proportion of effective rainfall does recharge the aquifer. In the lower-lying areas, a high proportion of the recharge will discharge rapidly to surface watercourses via the upper layers of the aquifer.		
	Est. recharge rates	*[Information will be added at a later date]*		
Discharge	Springs and large known abstractions (m^3/d)	Herbertstown WS (306 m^3/d – GSI database; 318 m^3/d – EPA database); Kilteely WS (145 m^3/d – GSI database; 146 m^3/d – EPA database. GSI records that borehole yield declines to 70 m^3/d in dry weather); Golden Vale Co-Op (Herberstown) (45 m^3/d – EPA database); Grange Lough Gur GWS (205 m^3/d – EPA database). Other Kilteely WS records (91 m^3/d – EPA database – not sure if this is extra supply source, or alternative). *[More information may be added at a later date]*		
	Main discharge mechanisms	The main discharges are to the streams and rivers crossing the aquifer. There may be a small volume of cross-flow from this GWB to the Fedamore GWB to the south and west.		

	Hydrochemical Signature	The limited data available for this GWB indicate a calcium–bicarbonate signature. Groundwaters are Moderately Hard (210-250 mg/l as $CaCO_3$) with corresponding alkalinities of 145-165 mg/l as $CaCO_3$ and neutral pHs of 7-7.5. Conductivities are relatively high, normally ranging between 480 and 550 μS/cm. These parameters indicate an influence by carbonate dissolution processes. This may be an influence of either the limestone-dominated subsoil cover or perhaps limestones interbedded with the volcanic rocks at depth. Iron may be a problem due to the weathering of the rock forming minerals in the volcanic rocks. Due to the clayey weathering products, suspended solids can be a problem in some wells. Groundwater in the pure bedded limestone will be very hard with high alkalinities and electrical conductivities. Background chloride concentrations in the aquifers will 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 fractures, joints and faults. Where clayey weathering products or alteration minerals occur, this can block the flow conduits, unless they have been flushed from the system by high groundwater gradients in the hilly terrain. In the zones where the fractures and joints are not clogged with clays, transmissivities can be relatively high. Groundwater is unconfined; the water table is 4.5–33 m below ground level, and follows the topography; significant unsaturated zones occur in elevated areas. In general, flows in the aquifer are likely to be concentrated in a thin zone near the top of the rock; the weathered zone may be up to 3 m thick, with a connected fractured zone a further 15-20 m, below which is a generally poorly fractured zone. However, there may be deeper inflows associated with zones of primary columnar jointing or tectonic fracturing and faulting. There may be limestones interbedded between the individual lava flows contributing to the flowing intervals. Groundwater flow paths are relatively short (up to 500 m), especially in the hilliest areas, with groundwater discharging locally to the streams and small springs. The general groundwater flow direction is southwards down-slope and westwards to the Camoge River.
Groundwater & Surface water interactions		The streams crossing the aquifer will be gaining. There are no data to assess the amount of baseflow contributed by the aquifer to the rivers. Groundwater discharges to the Camoge and Barnakyle Rivers and to small springs.
Conceptual model		• The groundwater body is elongated E-W. It is bounded to north by the contact with the pure limestones of the Herbertstown GWB, to the west and south by the contact with the karstified limestones of the Fedamore GWB. The eastern boundary coincides with a surface water divide. • The GWB comprises low-moderate transmissivity rocks. Localised zones of enhanced permeability occur in the Volcanics due to columnar jointing and tectonic fracturing. However, these zones may be clogged by weathering products, reducing permeability. The Dinantian limestones have low-moderate transmissivity. Aquifer storativities are low. • Recharge occurs diffusely through the subsoils. Potential recharge may be rejected where the water table is high. • The aquifers are unconfined. The water table is from 1-15 m below ground level and follows topography. Groundwater flows along fractures, joints and major faults. Most groundwater flow occurs near the surface in a narrow zone comprising a weathered zone of a few metres and a connected fractured zone below this. Deeper inflow levels will occur where isolated fractures/faults or jointed zones are intercepted. North-south fracturing and faulting may cause anisotropy. Flow path lengths are relatively short, and in general are less than 500 m. • The rock units of this GWB may act as a confining layer to the karstified limestones of the underlying Fedamore GWB. • Groundwater discharges to the streams crossing the aquifer and to small springs. Unconfined flow directions are controlled by local topography. Overall, flow directions are southwards, down-slope, and westwards to Camoge River; along part of the southern boundary there may be some cross-flow from this GWB to the Fedamore GWB.
Attachments		Hydrochemical signature (Figure 1).
Instrumentation		EPA Representative Monitoring borehole: Herbertstown GWS (LIM 55).
Information Sources		Deakin, J. (1995) *Herbertstown Public Supply, Groundwater Source Protection Zones*. Geological Survey of Ireland Report to Limerick Co. Co., 6 pp. Deakin, J., Daly, D. and Coxon, C. (1998) *County Limerick Groundwater Protection Scheme*. Geological Survey of Ireland Report to Limerick Co. Co., 72 pp. Aquifer chapters: Basalts and other Volcanic rocks; Dinantian Pure Bedded Limestones.
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



NB: this plot also contains data from the adjacent Knockroe SW GWB, where the Herbertstown WS abstracts groundwater from volcanics interbedded with limestones.



Rock units in GWB

Rock unit name and code	Description	Rock unit group
Knockroe Basalt Lava Flow Member (KRb)	Basaltic lava flows	Basalts & other Volcanic rocks
Knockroe Lithic Tuff Member (KRl)	Lithic tuff & agglomerate	Basalts & other Volcanic rocks
Knockroe Trachyte Lava Flow Member (KRt)	Trachytic lava flows	Basalts & other Volcanic rocks
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
Lough Gur Formation (LR)	Pale cherty crinoidal limestone	Dinantian Pure Bedded Limestones