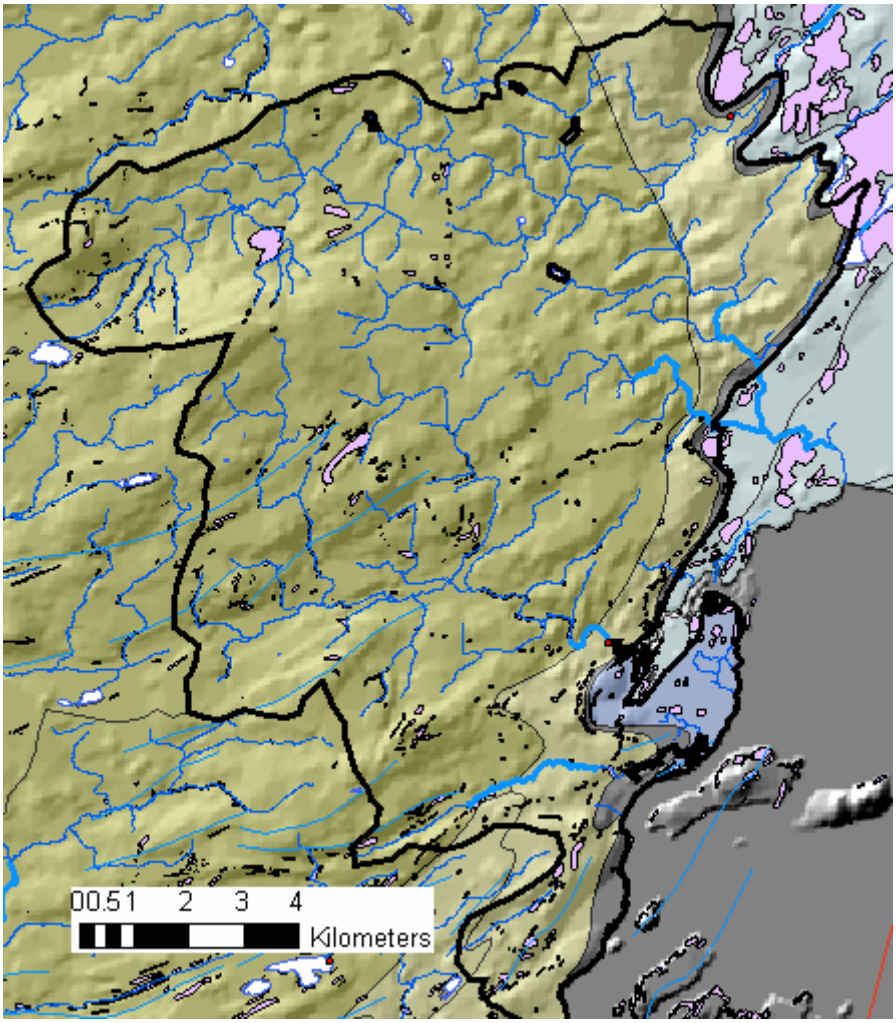
Lissycasey GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystems	Area (km^2)
27 - Fergus Catchment/ Estuary Clare Co. Co.	Rivers: Inch, Clareen, Owenslieve, Ballynacally, Rathkerry, Furoor, Kilmaley. Loughs: Gortaganniv, Balleen, Lisborneen, Killone, Ballymacooda, Pilbrum, Ballynaglass.	Fergus Estuary and Inner Shannon, North Shore (002048).	146

Topography	The GWB is situated in the west of the Fergus River catchment, to the west of the limestone lowlands and north of the Fergus Estuary. In plan view, it is shaped like an upside-down triangle. Ground elevation ranges from sea level to over 260 mAOD. The lowest ground is found along the coast and adjacent to the limestone lowlands of the Ennis GWB. The highest elevations occur on the western boundary of the GWB, at Ben Dash (267 mAOD), and at Slaghbooly (220 mAOD). Most of the GWB is between 70-120 mAOD. Ground elevation generally decreases from the west and north. Surface drainage is generally from west to east and southeast. There is a topographic 'grain' in the NW-SE direction, which to a certain extent influences the drainage pattern (in the higher areas in the west); the 'grain' is controlled by the folding of the rocks.	
Geology and Aquifers	Aquifer category(ies)	The vast majority of the GWB comprises **Ll** : Locally important aquifers which are moderately productive only in local zones. Along the east of the GWB, a strip of Namurian Shales (Clare Shales) is classified as a **Pu:** Poor aquifer which is generally unproductive.
	Main aquifer lithologies	The GWB is dominated by rock units from the Undifferentiated Namurian rock unit group. Areas of Namurian Sandstones are found in a narrower zone in the east of the GWB. Very narrow areas of Namurian Shales (Clare Shales) occur along the eastern margin of the GWB. In the south of the GWB, Dinantian Pure Unbedded and Dinantian Upper Impure Limestones occur.
	Key structures	The rocks are folded into relatively small folds with wavelengths of about 3 km. The intensity of folding dies out northwards. The fold axes trend WSW-ENE; strata dip at right angles to the fold axes at angles from 10-50^{o}. Faults are not mapped in this GWB but are likely to exist, and are probably parallel to the fold axes. Fractures and jointing may be more open on the fold axes.
	Key properties	Transmissivities in the Undifferentiated Namurian rocks and the Namurian Sandstones are generally in the range 2–20 m^2/d, although higher values may be achieved in faulted zones. South of the Shannon Estuary at Glin WS, a pumping test gave a transmissivity of 14 m^2/d [estimate range 7-27 m^2/d]. Transmissivities in the Pure Unbedded and Upper Impure Limestones will be similar. The Namurian Shales will have very low transmissivities. Aquifer storativities for all rock unit groups will be low. At Glin WS (south of the Shannon Estuary in the same rock unit group), estimated groundwater gradients in the Namurian rocks are 0.04 - 0.05. Over most of the GWB, they are likely to be in the range 0.02 – 0.05. *(data sources: Rock Unit Group Aquifer Chapters, Clare GWPS and Source Reports, see references)*
	Thickness	In general, the effective thickness of the upper part of the aquifer is likely to be about 10-15 m, comprising a weathered zone of a few metres and a connected fractured zone below this. However, deep water strikes (30-100+ m) are noted in this aquifer, and are associated with better yields and productivities; wells are often overflowing. Permeable zones are met at deeper levels than in other rocks. In a 3 km deep exploration borehole drilled by Ambassador Oil near Doonbeg (in the adjacent Kilrush GWB), water was struck at 107 m and then intermittently until a depth of 610 m.
Overlying Strata	Lithologies	*[Information to be added at a later date]*
	Thickness	Subsoil thickness data for this GWB are sparse. Outcrop is mainly confined to along the courses of the upland streams, where the rivers have incised into the rock, and to the ENE-WSW ridges between rivers in the highest areas within the GWB.
	% area aquifer near surface	*[Information to be added at a later date]*
	Vulnerability	Vulnerability ranges from Low to Extreme. Over most of the GWB, it is Extreme. Vulnerability is High along some of the river and stream valleys, in the areas where the surface water has not incised recently into the bedrock aquifer. Along the Inch and Clareen River valleys, vulnerability ranges from High to Low.
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. Due to the generally low permeability of the aquifers within this GWB, a high proportion of the recharge will then discharge rapidly to surface watercourses via the upper layers of the aquifer, effectively reducing further the available groundwater resource in the aquifer.
	Est. recharge rates	*[Information to be added at a later date]*

Discharge	Important springs and high yielding wells (m^3/d)	E Weeland, Paradise Estate (Ballynacally) (yield 440 m^3/d – GSI database) Lissycasey Creamery (yield 1090-1310 m^3/d – GSI database) Kilrush Creamery (164 m^3/d – GSI database) Newmarket Dairy Co. Ltd (157 m^3/d – GSI database) *[More information may be added at a later date]*
	Main discharge mechanisms	The main discharges are to the streams crossing and incising into the sandstone and shale rock units. Small springs and seeps are likely to issue at the stream heads and along their course. Minerals in the shales give rise to acidic surface runoff which has a high eroding capacity by the time it reaches the adjacent, lower-lying limestones of the Ennis GWB. The boundary between the two rock types is typified by a series of swallow holes and collapses where surface waters can get direct rapid access to the limestone groundwater system.
	Hydrochemical Signature	No data are currently available for this GWB. Groundwaters in the Ballylongford GWB (on the south side of the Shannon Estuary) are moderately hard (120-270 mg/l $CaCO_3$) and have moderate alkalinities (170-240 mg/l as $CaCO_3$). Measured electrical conductivity ranges from ~440-560 µS/cm. Spring waters (Tarbert WS) have a calcium bicarbonate signature. Groundwater sampled from a borehole (Glin WS) has a signature varying from Ca-HCO_3 to Na/K-HCO_3 and alkalinities greater than total hardness. This is typical of confined waters where ion exchange has occurred. Reducing conditions may also occur. Both iron and manganese can exceed allowable concentrations, these components coming from the shales. Phosphates occur naturally in the Clare Shales and can wash out into the local watercourses, resulting in elevated, but naturally-occurring concentrations. Groundwaters from the limestone aquifers will have calcium-bicarbonate signatures, will be Hard and alkaline and have electrical conductivities in the range 500-650 µS/cm. Iron and manganese can be a problem in the Impure Limestones. Background chloride concentrations will be higher than in the Midlands, due to proximity to the sea.
Groundwater Flow Paths		The Namurian rocks are devoid of intergranular permeability; groundwater flow occurs in fractures, joints and faults. Zones of high permeability can be encountered near fault zones and in areas of intensive fracturing. Generally, groundwater levels are 0-15 m below ground level (mode ~6 mbgl), and follow the topography. Deeper water levels, of more than 60 mbgl are observed in other GWBs, however, which indicate that there may be zones that are hydraulically isolated from the rest of the aquifer. Unconfined groundwater flow paths are short (30-300 m), with groundwater discharging to seeps, small springs and streams. Groundwater also discharges to the Fergus Estuary and Inner Shannon. Local groundwater flows are determined by the local topography. There is no regional flow system in these unconfined aquifers. Artesian conditions and deep inflow levels indicate that the deeper part of the Namurian Sandstone/ Undifferentiated rock aquifer is confined by shales in the succession. Groundwater travel times in this zone are relatively slow and flow path lengths may be considerably longer than in the unconfined zone. Surface waters flowing off Namurian bedrock onto the lower-lying limestones of the Ennis GWB will sink partially or completely into the karst network in the limestones. Within the Dinantian Pure Bedded Limestones and Upper Impure Limestones, groundwater is unconfined, flow paths are short and determined by local topography. Permeabilities in the upper few metres are often high although they decrease rapidly with depth. In general, groundwater flow is concentrated in the upper 15 m of the aquifer. Areas underlain by Pure Unbedded Limestones are typically well-drained, except where the ground is very low-lying. This is due to the probable presence of an epikarstic layer.
Groundwater & Surface water interactions		Due to the component of shallow groundwater flow in this aquifer the groundwater and surface waters are closely linked. The aquifer discharges readily to the overlying (gaining) streams. Specific dry weather flows in the Abbeyfeale GWB on the south of the Shannon are low (0.1 to 0.5 $l/s/km^2$ at 5 stations), indicating that the Namurian aquifers have low storage. Small springs and seeps contribute to river flows. The chemistry of the groundwater in this GWB influences the surface water, which in turn influences both the surface and groundwaters in the lowland karst Ennis GWB. The Namurian Shales of this GWB are thought to be the source of iron in groundwaters in the adjacent limestone GWB.

Conceptual model	• The GWB is shaped like an upside-down triangle. The groundwater body is bounded to the east by the contact with the karstic limestones of the Ennis GWB. The northern and western boundaries are surface water catchment divides, which are implied groundwater highs within the unconfined part of the aquifer. The southeastern boundary is formed by the Fergus Estuary/ Inner Shannon Estuary. The terrain is hilly and drainage densities are low. • The groundwater body is composed primarily of siliceous rocks that are low permeability, although localized zones of enhanced permeability do occur along faults and in coarser layers. There are smaller areas of pure unbedded and impure limestone aquifers. Groundwater flows along fractures, joints and major faults. In the pure unbedded limestones, there may be an epikarstic layer at the top of the aquifer. • Recharge occurs diffusely through the subsoils and via outcrops. The amount of recharge is determined by the slope, subsoil permeability, and by the ability of the aquifer to accept potential recharge. • The aquifers within this GWB are both unconfined and confined. Most flow in this aquifer will occur near the surface; the effective thickness of the unconfined part of 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 typically from 0-6 m below ground level and follows topography. Deep inflow levels and artesian wells indicate confined conditions in higher permeability Namurian strata from which better yields can be obtained. Unconfined flow path lengths are relatively short, and in general are between 30 and 300 m. Confined flow paths may be significantly longer. • Groundwater discharges to the numerous small streams crossing the aquifer, and to the springs and seeps. Local unconfined flow directions are oblique to the surface water channels. There is no regional unconfined groundwater flow. Overall, surface drainage is to the east and southeast. • Surface waters flowing off the Namurian bedrock onto lower-lying limestones of the Ennis GWB will sink partially or completely into the karst network in the limestones. The boundary between the two rock types is typified by swallow holes or collapses. • Phosphates occur naturally in the Clare Shales and can wash out into the local water courses, resulting in elevated, but naturally-occurring concentrations. Phosphate-rich waters have the potential to travel rapidly large distances in the karst system of the adjacent GWB, emerging at surface water features. Iron from the Namurian rocks also influences the hydrochemistry of adjacent limestone aquifers.
Attachments	None.
Instrumentation	Stream gauges: 27001, 27008.
Information Sources	Deakin, J. and Daly, D. (2000) *County Clare Groundwater Protection Scheme*. Geological Survey of Ireland Report to Clare Co. Co., 67 pp. Hudson, M. (1995) *Glin WS: Groundwater Source Protection Zones*. Geological Survey of Ireland Report to Limerick Co. Co., 8 pp. Aquifer chapters: Namurian Undifferentiated, Sandstone and Shale; Dinantian Pure Bedded Limestones; Dinantian Upper Impure 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



Rock units in GWB

Rock unit name and code	Description	Rock unit group
Central Clare Group (CCG)	Sandstone, siltstone & mudstone	Namurian Undifferentiated
Gull Island Formation (GI)	Grey siltstone and mudstone	Namurian Sandstones
Tullig Sandstone (TS)	Thick-bedded pale sandstone	Namurian Sandstones
Clare Shale Formation (CS)	Mudstone, cherty at base	Namurian Shales
Parsonage and Corgrig Lodge Formation (PA)	Fine laminated and muddy limestones and shales	Dinantian Upper Impure Limestones
Mudbank limestones (mk)		Dinantian Pure Unbedded Limestones
Slievenaglasha Formation and Mudbank limestones (SLmk)		Dinantian Pure Bedded Limestones