Killarga South GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
35 Leitrim / Sligo Co. Co.	**Rivers**: Scardan, Skeanada, Owenmore, Killanummery. **Streams**: Cashel. **Lakes**: Munakill More, Munakill Beg, Belhavel.	None	55

Topography		The GWB occupies an area orientated NE-SW, located between the L. Allen Uplands to the south and the Ox mountains to the north, located to the south of Killarga. The location and boundaries are given in Figure 1. To the north of Killarga the land surface is characterised by an upland area, with elevations ranging from 90-450 mAOD. The land surface is characterised in the southern half of the GWB by an area of high relief sloping to the north, with elevations ranging from 70-120 mAOD. It is bounded to the north and south by the poor aquifers of the Belhavel Lough and Killarga- GWB's. The boundaries at either end are topographic divides which act as surface water divides, and include the divide between the Western and Borders RBD areas. The GWB is drained by rivers and streams that ultimately flow in a northwesterly direction toward Lough Gill.
Geology and Aquifers	**Aquifer categories**	**Rk^c:** Regionally important karstified aquifer dominated by conduit flow. The 'c' signifies conduit flow. There is approximately 4.5 km^2 of **Ll**, **Lm**, **Pl** and **Pu** in the northernmost part of the GWB (see table 1).
	Main aquifer lithologies	Dinantian Pure Unbedded Limestones, Dinantian Pure Bedded Limestones, Dinantian Sandstones, Dinantian Mixed Sandstones, Shales and Limestones, Dinantian Shales and Limestones, Dinantian Upper Impure Limestones, Namurian Sandstones, Namurian Shales.
	Key structures	The key structural trend is SW-NE, parallel to the northern and southern boundaries, with the beds striking NE-SW and dipping 2-5° to the SE. Faults trending E-W cross the GWB toward the northern end and faults trending NW-SE cross the GWB toward the southern end.
	Key properties	Karstification is evident from four caves located in the northern side of the GWB. The caves are described in Coleman (1965). This is only considered to represent only a fraction of existing features. There are no data available for the GWB. Transmissivities are expected to be variable in the Dinantian Pure Bedded Limestones, ranging from 1 to greater than 2000 m^2/d. Storativity is likely to be low - approximately 0.01-0.02. The northern and southern parts of the GWB are topographic highs and groundwater velocities were calculated for the Bricklieve upland karst area in the neighbouring Ballymote GWB, thus similar groundwater velocities are expected of 25-51 m/hr (Thorn *et al*, 1990). General flow directions are likely to be across the GWB toward the river Bonet under hydraulic gradients that are expected to be greater than 0.0005 on the low lying areas. Transmissivities are expected to be low in the areas occupied by the Namurian rocks and the Impure Limestones. Gradients are expected to be steeper in the northern part of the GWB, occupied by the Namurian Sandstones and Shales.
	Thickness	Most groundwater flow is likely to be in an epikarstic layer a couple of metres thick and in a zone of interconnected solutionally-enlarged fissures and conduits that extends approximately 30 m below this. Deeper inflows can occur in areas associated with faults or dolomitisation.
Overlying Strata	**Lithologies**	Subsoil data are available for the southwestern most tip of the GWB where till is the dominant subsoil type.
	Thickness	There are no depth to bedrock data available. Rock outcrops are present on the areas of higher relief, in particular on the northern half of the GWB where the caves are present.
	% 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 occurs via rainfall percolating through permeable subsoil and rock outcrops. Point recharge to the underlying aquifer occurs via the caves, for example Coleman (1965) reports that the Scardan River flows into Glenboy Cave. Swallow holes are expected to be present also.
	Est. recharge rates	*[Information to be added at a later date]*
Discharge	**Large springs and high yielding wells (m^3/d)**	None identified
	Main discharge mechanisms	The main discharges are to springs, streams, rivers and lakes. Stream density is greater in the northern part of the GWB over the Namurian Sandstones and Shales.

Hydrochemical Signature

There are no data available for the Dinantian Pure Bedded Limestones, though it is expected to have a $CaHCO_3$ signature. Alkalinity, electrical conductivity and hardness are expected to be high and similar to that of the Ballymote GWB. The range and median values are given below for two sources in the Ballymote GWB.

	Carrowagark (n=14)	Achonry (n=7)
Alkalinity (mg/l CaCO3)	238-428, 360	404-416, 412
Hardness (mg/l CaCO3)	364-436, 388	404-456, 440
Conductivity (microsiemens/cm)	684-827, 731	837-889, 863

Data available for the Namurian Sandstones and Shales are given below. The groundwater demonstrates a Mg-$NaHCO_3$ signature and indicates dissolution and mixing are taking place.

	Tawnyfeacle (n=12)
Alkalinity (mg/l CaCO3)	4-12, 10
Hardness (mg/l CaCO3)	11-31, 21
Conductivity (microsiemens/cm)	76-786, 85

Groundwater Flow Paths

These rocks are generally devoid of intergranular permeability. Groundwater flows through fissures, faults, joints and bedding planes. In pure bedded limestones these openings are enlarged by karstification which significantly enhances the permeability of the rock. Karstification can be accentuated along structural features such as fold axes and faults. Groundwater flow through karst areas is extremely complex and difficult to predict. As flow pathways are often determined by discrete conduits, actual flow directions will not necessarily be perpendicular to the assumed water table contours. Groundwater can flow across surface water catchment divides and beneath surface water channels. Flow velocities can be rapid and variable, both spatially and temporally. Overall groundwater flow will be towards the rivers and lakes, generally to the north, but the karstified nature of the bedrock means that locally, groundwater flow directions can be highly variable.

Groundwater & Surface water interactions

Generally, there is a high degree of interconnection between groundwater and surface water in karstified limestone areas. The karst features represent the close interaction between surface water and groundwater. The stream density is relatively high, which is due to the relatively low permeability subsoils. Any contamination of surface water is rapidly transported into the groundwater system, and vice versa.

Conceptual model

- The GWB occupies an area orientated NE-SW, located between the L. Allen Uplands to the south and the Ox mountains to the north, located to the south of Killarga. To the north of Killarga the land surface is characterised by an upland area, with elevations ranging from 90-450 mAOD, and to the south by an area of high relief sloping to the north, with elevations ranging from 70-120 mAOD.
- It is bounded to the north and south by the poor aquifers of the Belhavel Lough and Killarga- GWB's. The boundaries at either end are topographic divides which act as surface water divides, and include the divide between the Western and Borders RBD areas. The GWB is drained by rivers and streams that ultimately flow in a northwesterly direction toward Lough Gill..
- The aquifer is a Regionally important karstified aquifer (**Rk^c**).
- Several caves recorded, but this is thought to only represent a fraction of the existing karst features.
- Transmissivities are expected to be variable, ranging from 1 to greater than 2000 m^2/d. Storativity is likely to be in the range of 1-2%.
- Most groundwater flux is likely to be in the upper part of the aquifer.
- Recharge occurs via point and diffuse mechanisms. Point recharge to the underlying aquifer occurs by means of caves.
- The main discharges are to springs, streams, rivers and lakes.
- The groundwater across the majority of the GWB is expected to have calcium bicarbonate signature.
- There is a high degree of interconnection between groundwater and surface water.

Attachments	Table 1, Figure 1.
Instrumentation	**Stream gauges:** None **EPA Water Level Monitoring boreholes:** None **EPA Representative Monitoring points:** (LEI 037)

Information Sources	Coleman, J.C. (1965) *The Caves of Ireland.* Tralee MacDermot, C.V. Long C.B. and Harney S.J (1996) *Geology of Sligo-Leitrim: A geological description of Sligo, Leitrim and adjoining parts of Cavan, Fermanagh, Mayo and Roscommon, to accompany bedrock geology 1:100,000 scale map, Sheet 7, Sligo - Leitrim.* With contributions from K. Carlingbold, G. Stanley, D. Daly and R. Meehan. Geological Survey of Ireland, 100pp. Thorn, R., Drew, D. and Coxon, C. (1990). *The Hydrology and Caves of the Geevagh and Bricklieve Karsts, Co. Sligo. Irish Geography* 23(2) (1990) 120-135. Geographical Society of Ireland, Dublin. Thorn, R. (1987). The Geevagh Karst. *Irish Speleology.* Journal of the Speleological Union of Ireland. Vol. 4 No. 1 1987. Thorn, R., Doyle, M., Henry, H. (1986). *The Groundwater Resources of South County Sligo – A Preliminary Appraisal.* Sligo Regional Techincal College. Report Number 86/1. ISBN 0 948870 01 X.
Disclaimer	Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae.z

Table 1. List of Rock units in GWB

StratCode	UnitName	Description	RockUnit	Aquifer Class
BE	Bellavally Shale Formation	Grey micrite, shale, laminite evaporite	Dinantian Mixed Sandstones, Shales and Limestones	Ll
mkBKl	Bricklieve Limestone Formationlower& Mudbank lime	Bioclastic cherty limestone	Dinantian Pure Unbedded Limestones	Ll
CN	Carraun Shale Formation	Grey/black shale with minor limestone	Dinantian Shales and Limestones	Pl
DA	Dartry Limestone Formation	Dark fine-grained cherty limestone	Dinantian Pure Bedded Limestones	Rkc
mkDA	Dartry Limestone Formation& Mudbank limestone	Dark fine-grained cherty limestone	Dinantian Pure Unbedded Limestones	Rkc
DE	Dergvone Shale Formation	Shale & minor turbiditic sandstone	Namurian Shales	Pu
GD	Glenade Sandstone Formation	Pale orthoquartzitic sandstone	Dinantian Sandstones	Lm
GC	Glencar Limestone Formation	Dark fine limestone & calcareous shale	Dinantian Upper Impure Limestones	Ll
DEln	Lacoon Flagstone Member	Interbedded sandstone & thin shale	Namurian Sandstones	Pl
ME	Meenymore Formation	Shale, laminated carbonate, evaporite	Dinantian Mixed Sandstones, Shales and Limestones	Ll

Figure 1 Location and Boundaries of GWB