Carrowmore West GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
35 Sligo Co. Co.	**Rivers**: Ballysodare. **Lakes**: Pollanima, Punchbowl, Cloverhill, Corhawnagh, Cooney, Doonyneill.	Ballysadare Bay (000622), Corhawnagh Lough (001902)	37

Topography	The GWB occupies an area on the eastern side of Ballysadare Bay. The GWB includes an area that includes Ballysadare due its proximity and similar aquifer properties. The land surface is generally low lying apart from Knocknarea, a hill on the northwestern side of the GWB. Elevations range from 0-327 mAOD. The GWB is bounded to the west by the coast. The northern and southern boundaries are the poor aquifers of the Collooney and Strandhill GWB's. Figure 1 illustrates the location and boundaries. Surface drainage is minimal, with some streams located to the southern side of the GWB.	
Geology and Aquifers	**Aquifer categories**	**Rk^c:** Regionally important karstified aquifer dominated by conduit flow. The 'c' signifies conduit flow.
	Main aquifer lithologies	Dinantian Pure Bedded Limestones, Dinantian Pure Unbedded Limestones.
	Key structures	The GWB is located to the north of the Ox Mountain Inlier. A major NE-SW trending fault (Ox Mountains-Pettigoe Fault) bounds the southern side of the GWB. A syncline runs through the GWB with the rocks on both limbs dipping approximately 5^o.
	Key properties	Karstification is widespread, and recorded features include swallow holes and springs. Drilling carried out in the early 1970's by the GSI to locate high yielding wells was unsuccessful (Daly, 1975). However, spring yields (Tobernaveen and Carrowgobadh) are estimated to be in the order of 30,000 m^3/d in total (Higgins, 1987). Transmissivities are expected to be variable, ranging from 1 to greater than 2000 m^2/d. Storativity is expected to be low - approximately 0.01-0.02. Positive traces are reported between the Tonesfortes sink and the Tobernaveen and Carrowgobadh springs (Higgins, 1987). However, no groundwater velocities are reported but are expected to be in the order of 20-50 m/hr. General flow directions are likely to be to the north and west under hydraulic gradients that are expected to be greater than 0.0005.
	Thickness	Most groundwater 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**	Till is the dominant subsoil type.
	Thickness	Data are sparse (n=3) and indicate that the thickness are less than 3 m.
	% 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**	Both point and diffuse recharge occur. Diffuse recharge occurs via rainfall percolating through permeable subsoil and rock outcrops. Point recharge to the underlying aquifer occurs by means of swallow holes.
	Est. recharge rates	*[Information to be added at a later date]*
Discharge	**Large springs and high yielding wells (m^3/d)**	Tobernaveen and Carrowgobadh springs are estimated to yield in the order of 30,000 m^3/d (Higgins, 1987).
	Main discharge mechanisms	The main discharges are to springs, streams, rivers and lakes.
	Hydrochemical Signature	The groundwater is very hard and has $CaHCO_3$ signature. Higgins (1987) carried out water sampling and the results for selected parameters are given below for six samples. Elevated chloride indicate that the groundwater is brackish (Higgins, 1987). Alkalinity (mg/l as $CaCO_3$): 113-163. Total Hardness (mg/l): 302-430. Conductivity (μS/cm): 580-725. Chloride (mg/l): 24-35.

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. A tracer test carried out by Higgins (1987) illustrates that the positive trace from Tonafortes sink to Carrowgobadh spring crosses a surface water catchment. Flow velocities can be rapid and variable, both spatially and temporally. Rapid groundwater flow velocities indicate that a large proportion of groundwater flow takes place in enlarged conduit systems. Flow path lengths can be up to a several kilometres in length. Overall groundwater flow will be towards the rivers and lakes, generally to the west toward L. Gill, 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. Any contamination of surface water is rapidly transported into the groundwater system, and vice versa.
Conceptual model	• The GWB occupies an area on the eastern side of Ballysadare Bay. The GWB includes an area that includes Ballysadare due its proximity and similar aquifer properties. The land surface is generally low lying apart from Knocknarea, a hill on the northwestern side of the GWB. Elevations range from 0-327 mAOD. • The GWB is bounded to the west by the coast. The northern and southern boundaries are the poor aquifers of the Collooney and Strandhill GWB's. • The aquifer is a Regionally important karstified aquifer (**Rk^{c}**). • Several karst features are recorded. • 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. • Till is the dominant subsoil type. • Recharge occurs via point and diffuse mechanisms. Point recharge to the underlying aquifer occurs by means of swallow holes. • The main discharges are to springs, streams, rivers and lakes. • The groundwater has a calcium bicarbonate signature. • There is a high degree of interconnection between groundwater and surface water.
Attachments	Table 1 and Figure 1.
Instrumentation	**Stream gauge:** 35039, 35040, 35041. **EPA Water Level Monitoring boreholes:** None **EPA Representative Monitoring points:** None
Information Sources	Daly, E. (1975) *Report on the groundwater potential of the area around Sligo town*. Geological Survey of Ireland. Higgins, T. (1987) *An Assessment of the Impact of Human activity on groundwater quality in the Carrowmore area of County Sligo*. BSc thesis. Sligo Regional Technical College. 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.

Table 1. Rock units in GWB.

Rock unit name and code	Description	Rock unit group	Aquifer Classification
Dartry Limestone Formation (DA)	Dark fine-grained cherty limestone	Dinantian Pure Bedded Limestone	Rkc
Dartry Limestone Formation and Mudbank Limestone	Dark fine-grained cherty limestone	Dinantian Pure Unbedded Limestone	Rkc

Figure 1 Location and Boundaries of GWB.