Rhode GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority		Associated surface water bodies	Associated terrestrial ecosystems	Area (km^2)
14 – Barrow Offaly Co. Co.		Esker Stream, Daingean, Figile.	None	437
Topography		This groundwater body lies at the northern boundary of the SERBD. The highest elevations are to the north, at Rhode (150m OD) but the great majority of the area is low-lying bog with a very flat surface. The surface drainage direction is to the southeast to the Philipstown River and also the tributaries of the Cushina River.		
Geology and Aquifers	Aquifer type(s)	**Lm**: Generally moderately productive fractured aquifer. **Rk** : Regionally important karstified aquifer		
	Main aquifer lithologies	AWed : Edenderry Oolite Member - Oolitic Limestone AW: Allenwood Formation – Mainly pale grey, pure massive limestone, commonly dolomitised. WA: Waulsortian Formation – Massive unbedded limestone		
	Key structures.	Structural alterations of the bedrock do not appear to have a significant impact on the hydrogeology of the main body of the groundwater body area. There is evidence that the NE – SW trending fault at the extreme NW of the body at Toberdaly has increased the permeability of the bedrock in that area.		
	Key properties	As this is pure limestone, a relatively high permeability could be expected. However, the available evidence suggests that this is not always the case, perhaps because bedding is poorly developed. Kelly (2001): Permeability = 10-20 m/d, Porosity = 0.02 Hudson (1996): The permeability for the upper limestone layers is estimated at 5-10 m/d.		
	Thickness	The available geophysical information suggests permeable bedrock down to at least 30 metres in the area around the springs of Toberdaly.		
Overlying Strata	Lithologies	The main lithology of the overlying strata is the peat of the Bog of Allen. This is surrounded by till, which is derived from limestone. To the south some of the till has a significant limestone gravel component. The matrix comprises silty sand with frequent angular gravels and sandy clay with frequent angular limestone gravels. There is also a gravel aquifer in the northeastern area of the body.		
	Thickness	The bedrock in this area is covered by a subsoil which is mostly greater than 5m thick. There are some isolated localities of thinner subsoil or outcrops. The uppermost 3-5 metres are generally dominated by clay till and the lower 5-12 metres are a combination of sand/gravel and clayey till units. The area of bog to the northwest is being cut for use at Rhode power station		
	% area aquifer near surface	The percentage of outcrop area is very low.		
	Vulnerability	Mostly LOW with some local areas of higher vulnerability		
Recharge	Main recharge mechanisms	The temperature of the groundwater from Toberdaly Springs is approximately 2° warmer than the average expected groundwater temperature, suggesting a geothermal origin for some of the groundwater. There may be recharge to the western strip of Allenwood Limestone from the volcanic hills to the west. Hudson (1996) proposed to explain the discrepancies in water balance calculations for the springs at Toberdaly, suggesting that the elevated temperature of the springs is evidence that water flows from the volcanic hills (e.g. Croghan Hill) underground, confined beneath the Calp, then rising to the surface at the contact with the Allenwood Fm via an unseen major fault. For the greater part of the aquifer the recharge is more likely to occur where subsoil thickness is lowest or where the permeability of overlying subsoil is highest e.g. the gravel deposits to the northeast and the till-with-limestone gravel to the south.		
	Est. recharge rates	*[Recharge estimates will be added at a later date*		
Discharge	Springs and large known abstractions (m^3/d)	Toberdaly(2500), Walsh Island (Ballaghassan) (410), Clonbulloge (270), Rhode WS		
	Main discharge mechanisms	The discharge mechanisms at Toberdaly are a composite of deep and shallow groundwater flow. The shallow groundwater originates to the north of Toberdaly in the raised areas near Rhode. This follows the topographic gradient underground in karstic conduits. On reaching the contact between the Calp and the Allenwood it is forced to the surface via the spring at Toberdaly. There is also a deep groundwater component which discharges at the contact between the volcanics of Croghan Hill and the Calp. Because both discharge points are coincidental this would imply the same fault is the responsible discharge mechanism. Over the rest of the groundwater body it is more likely that groundwater flows to the south and southeast and discharges to the associated streams. There is also a spring used for public supply at Clonbulloge. It is most likely that the recharge area for this spring is the till east of the peat. The discharge at the spring is not large which implies that the spring does not drain the whole area of the aquifer. It is also interesting that it is located in the same area where the major surface stream exits the aquifer. This would concur with the idea of the groundwater drainage system mimicking the surface water drainage.		

	Hydrochemical Signature	The hydrochemical analyses at Coolagarry show that the water is very hard with total hardness values in excess of 350 mg/l. (as $CaCO_3$) and electrical conductivity values ranging 590-634 µS/cm, indicating that the groundwater has a calcium bicarbonate hydrochemical signature. These values are typical of groundwater from limestone rocks. The chemical analyses for Toberdaly Springs indicate hard water (251 - 350 mg/l as CaCO3), with a relatively high alkalinity (270 - 290 mg/l). Conductivity values are typical of groundwater from limestones (500 – 600 µS/cm), as are the pH values (7.0 - 7.7). The bedrock strata of this groundwater body are **Calcareous**.
Groundwater Flow Paths		Groundwater flows from north and west to the south and east. A regional groundwater system is unlikely across the width of the groundwater body because the aquifer is not a regional karstic aquifer. Although the aquifer is permeable to depths of 30m conduit systems my not be developed as in major karstic aquifer systems.
Groundwater and Surface water interactions		The canal feeder was dry to the north of Toberdaly during the site visit and according to a nearby landowner it has been dry in recent years. This could be due to increased abstraction from the springs or as a result of draining of the bog to the west.
Conceptual model	This groundwater body is defined to the north by the boundary of the SERBD and the ERBD. To the east and west the boundary of the AW & AWed formations and the Calp defines the boundary and to the south the contact with the Waulsortian Limestone. Where these rock units are overlain by permeable till with gravel the groundwater can be considered as unconfined. Where it is overlain by peat the groundwater is considered to be confined by the layer of impermeable marl that typically underlies bogs. For the main part of the aquifer it seems likely that groundwater recharges to the north in the areas of higher elevation and more permeable subsoils e.g. gravel. The flow of groundwater is to the south and southeast, probably within enlarged fractures in the upper layers of the bedrock. Groundwater will discharge to the surface water streams especially to the east at the contact with the Calp.	
Attachments		
Instrumentation	Stream gauge: 14037, 14046, 14103, Borehole Hydrograph: none EPA Representative Monitoring boreholes: Walsh Island WS (#27 – N522211) Rhode RWSS (#23 – N516317)	
Information Sources	Kelly, C. (2001). Walsh Island Water Supply Scheme, Coolagarry Borehole, Groundwater Source Protection Zones. Hudson, M. (1996) Toberdaly Water Supply Scheme Groundwater Source Protection Zones. Daly, D., Cronin, C., Coxon, C. and S.J. Burns, 1998. *County Offaly Groundwater Protection Scheme*. Geological Survey Report for Offaly County Council	
Disclaimer	Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae	