

Aran Islands GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km ²)
31 Galway Co. Co.	Rivers: None Lakes: An Loch Mor, Loch Ceann Gainimh, Loch an tsaile, An Turlough Mor, Loch Phort Churruch, Amurvy, Bhun Gabhla.	Inishmore, Inishmaan, Inisheer (O’Riain, 2004).	~ 45
Topography	The GWB comprises the three main islands of Aran; Inishmore, Inishmaan and Inisheer. The group are located 10-13 kilometres from the mainland. The landscape is dominated by karstified terraces (Pracht <i>et al</i> 2003). The largest island – Inishmore is linear, approximately 14 km long, trending NW-SE. Along the same trend, although not linear, Inishmaan and Inisheer are located southeast of Inishmore, as shown in Figure 1. Elevations range from 0-120mAOD, with the highest ground on Inishmore. The slopes are steeper on the northern side of each island. Sea cliffs are present on parts of the southern side of Inishmore. Figure 1 shows the location and boundaries of the GWB. There is virtually no surface drainage, but there are a number of lakes (some intermittent) mostly located at the northern margins of each island.		
	Geology and Aquifers	Aquifer categories	Lk: Locally Important Karst. Inishmore is the biggest island of the three, approximately 30 km ² , which satisfies one of the criteria necessary for a regionally important classification. However, poor aquifer properties and the danger of saline intrusion indicate that that the aquifer could not support a regionally important water supply. These reasons also apply to the smaller two islands, as well as being too small to be considered as regionally important aquifers. There are small generally shallow windblown sand deposits which provide groundwater locally, for instance on Inisheer.
Main aquifer lithologies		Dinantian Pure Bedded Limestones. A number of narrow shale bands occur within the limestone units.	
Key structures		The rocks are gently dipping to the southwest (Pracht, 2003). There is a strong N-S jointing pattern.	
Key properties		Karstification is widespread. The exposed bedrock terraces are karstified (Pracht, 2003). Solution hollows are frequent on Inishmaan (Daly, 1977). There is a disappearing stream located on Inishmaan (Daly, 1977) and a turlough recorded on Inishmore. Daly (1977) indicates that the karstification extends to a depth no more than 10m. Frequent cavities up to 4/5 m below ground are reported in the well logs for boreholes drilled on Inishmore and recorded up to 22 m below ground in one borehole (K.T. Cullen, 1992). The limestone is described as ‘highly’ fractured in the uppermost part of the logs, generally down to 5 m below ground. Transmissivity and Storativity: There are no known large well supplies or large springs. Well yields ranging from 240 m ³ /d to 700 m ³ /d are reported for a six wells drilled into the turlough on Inishmore (K.T. Cullen, 1992). Three trial wells were drilled at Killeany (Inishmore) and ‘bail testing indicated that there was no commercial supply within the area’ (K.T. Cullen, 1992). The GSI drilled three wells on Inishmaan, all of which were virtually dry. Test pumping by the GSI proved that they ran dry within minutes (Daly, 1977). Thus yields are variable as is expected in karst environments. Transmissivity is likely to be high in the upper part of the aquifer. Frequent small springs emerging from bedding planes are observed on Inishmaan (Daly, 1977) which range from less than 1 up to 3 m ³ /d. They occur every 3-4 m. On the northern side of Inishmaan, a number of springs are located where the shale bands intersect the surface (Daly, 1977). The discharge from four of these springs was measured for three months. Discharge ranged from less than 1 to 400 m ³ /d (Daly, 1977). The springs reflect low storativity as many of the spring flows rise and fall quickly in response to rainfall events. The public water supply on Inisheer is derived from a windblown sand deposit present on the northern side of the island. The maximum yield is approximately 60 m ³ /d (Daly, 1987). Investigation of windblown sand at Kilmurvy in Inishmore, shows that saline water is present and that the deposit is not a viable drinking water resource. Groundwater velocities were estimated to be approximately 8 m/hr on Inishmore (K.T. Cullen, 1992). It is likely that groundwater velocities increase in high water conditions and decrease in low flow conditions as observed in the Ballyvaughan uplands which is a similar karst environment. Groundwater gradients are expected to vary depending on the water level conditions but are likely to be greater than 0.005.	
Thickness		Most groundwater flows in an epikarstic layer (1-10 m depth) and in a zone of interconnected solutionally-enlarged fissures and conduits that extends approximately 30 m below this. Cavities are recorded up to 22 m below ground on Inishmore (K.T. Cullen, 1992).	
Overlying	Lithologies	Aeolian deposits, stratified gravels are present on Inishmaan (Daly, 1977). On the lower plateau areas of Inishmore, there isolated patches of subsoil and sand deposits along the coast (K.T. Cullen, 1992). Aeolian deposits are also present on Inisheer (Daly, 1987).	

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	Thickness	Over much of the upland areas depth to bedrock is generally less than 1m. Depth to rock investigations on parts of the low lying areas of Inishmore Kilmurvy and Turloughmore) varies from 2-10 m (K.T. Cullen, 1992). Windblown sand on the northern side of Inisheer is expected to be less than 3 m (Daly, 1987).
	% area aquifer near surface	<i>[Information to be added at a later date]</i>
	Vulnerability	<i>[Information to be added at a later date]</i>
Recharge	Main recharge mechanisms	Both point and diffuse recharge occur. Diffuse recharge occurs via rainfall percolating through the permeable subsoil and rock outcrops. Rainfall on the limestone pavements enters the groundwater system immediately as diffuse recharge. Point recharge occurs by means of swallow holes.
	Est. recharge rates	<i>[Information to be added at a later date]</i>
Discharge	Large springs and high yielding wells (m³/d)	None known <i>[Information to be added at a later date]</i>
	Main discharge mechanisms	Discharge occurs to the many small springs that occur on the islands.
	Hydrochemical Signature	Samples from the four springs on Inishmaan have a calcium bicarbonate signature (Daly, 1977). Concentrations of chloride are relatively high; 42 mg/l recorded in on sample from Inishmore (K.T. Cullen, 1992) and 74 mg/l recorded in the PWS on Inisheer (Daly, 1987).
Groundwater Flow Paths		Groundwater flow will be towards the sea, but the highly karstified nature of the bedrock means that locally groundwater flow directions can be highly variable. Shallow flow is occurring in the upper few metres of highly weathered and karstified limestone, commonly referred to as epikarst. On the southern side of the surface water divides, groundwater flows rapidly through the epikarst along the bedding planes (downdip) and joints and discharges to small springs dotted along the coastline. On the northern side of the surface water divides, groundwater flows until it meets the shale units. The largest springs on Inishmaan occur at these points. Groundwater may also flow laterally along the shale units toward the coast. Daly (1977) indicates discharge zones along the east and western coastlines of Inishmaan as evidence. Inishmaan and Inisheer are relatively small islands, thus groundwater flow paths are expected to be short, no more than several hundred metres. Inishmore is relatively long and narrow, with the flow directions assumed to be perpendicular to the NW-SE axis through the island. Therefore the flow paths are relatively short, generally expected to be less than one kilometre.
Groundwater & Surface water interactions		Generally, there is a high degree of interconnection between groundwater and surface water in karstified limestone areas.
Conceptual model	<ul style="list-style-type: none"> • The GWB comprises the three main Aran islands located 10-13 kilometres from the mainland. • Karstification is widespread. • The GWB is composed primarily of high transmissivity karstified limestone (Lk). Transmissivity and well yields are variable. Storativity is low. Gradients are dependent on the water level conditions, but are expected to be greater than 0.005. • Rapid groundwater flow velocities have been recorded through groundwater tracing (8 m/hr). • Recharge generally occurs via diffuse and point mechanisms. • There is a high degree of interaction between surface water and groundwater. • The groundwater has a calcium bicarbonate signature. 	
Attachments	Figure 1	
Instrumentation	Stream gauges: None EPA Water Level Monitoring boreholes: None EPA Representative Monitoring points: None	

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<p>Information Sources</p>	<p>Cullen, K.T. (1992). <i>Inishmore – Aran Islands. Water Supply Improvement Scheme. Groundwater Development</i>. Daly, D. (1987). <i>Inis Oírr: An Appraisal of the effect of a Proposed Fish Farming Development on the Public Water Source</i>. Geological Survey of Ireland, 9pp. Daly, E.P. (1977). <i>A Hydrogeological Investigation on Inishmaan, Aran Islands</i>. Geological Survey of Ireland Report. Internal Report no. 3. Groundwater Division. 35pp. O’ Riain, G., (2004). <i>Water Dependent Ecosystems and Subtypes Draft Report</i>. WFD Support Projects. Compass Informatics in association with National Wildlife and Parks Service (DEHLG). Pracht, M., Lees, A., Leake, B., Feely, M., Long, B., Morris, J., McConnell, B., (2003). <i>A geological description to accompany the Bedrock Geology 1:100,000 Scale Map Series, Sheet 14, Galway Bay</i>. Unpublished Geological Survey of Ireland Map Series Report.</p>
<p>Disclaimer</p>	<p>Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae.</p>

Figure 1. Aran Islands

