

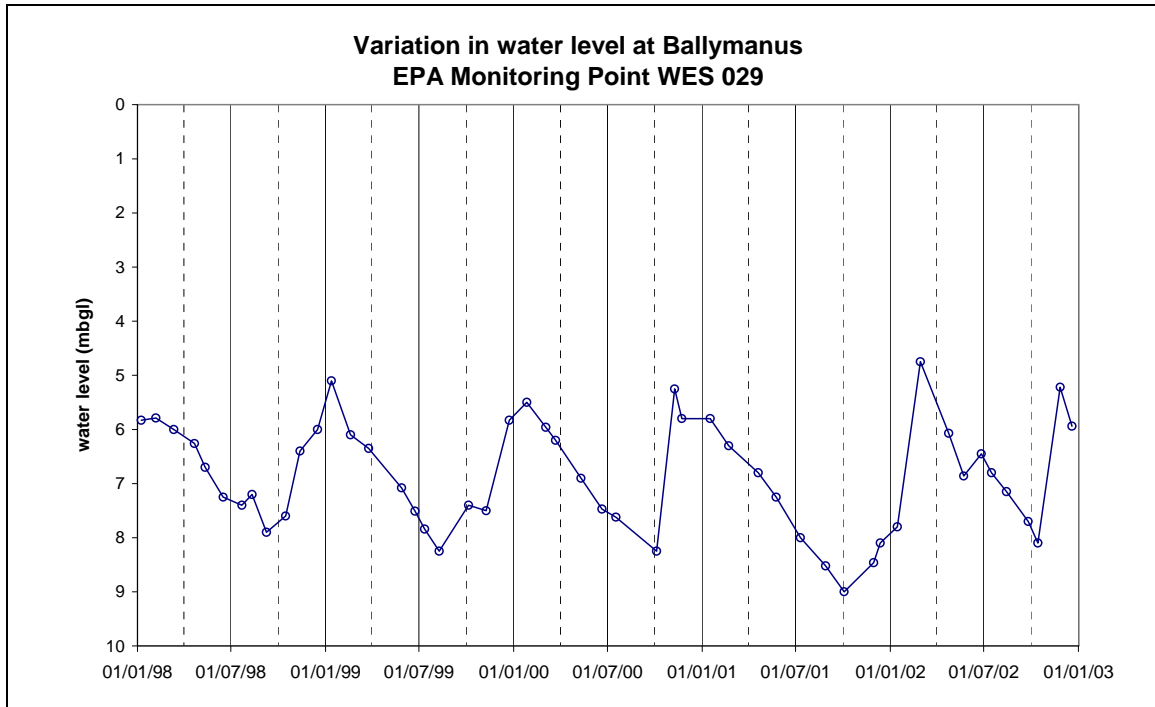
**BallymanusGWB: Summary of Initial Characterisation.**

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km <sup>2</sup> )
26 – Inny/Lough Ree  Meath, Westmeath & Cavan Co. Co.'s	<b>Rivers:</b> Inny, Glore. <b>Loughs:</b> Sheelin.	(000987) Lough Sheelin	48
<b>Topography</b>	The topography of the body is varied. In the centre of the body there are a series of distinctive hills which rise from 120 mAOD to peak heights ranging from 170-260 mAOD. These include the Rock of Curry, where there is a spectacular cliff, the Hill of Mael and the hills at Mullaghmeen. In the southeast of the body there is some hilly and hummocky terrain associated with areas of gravel deposits. In this area ground elevations range from 90-140 mAOD. In the north of the body near Lough Sheelin the ground is more flat and low-lying with ground elevations ranging from 70-110 mAOD. A low ridge runs from the hilly area in the centre of the body to Lough Sheelin in the north (80-100 mAOD). In the northeastern corner of the body, north of the Upper Inny River, most of the land is 70-80 mAOD. The highest point of the body is the northern summit of the hills at Mullaghmeen at 260 mAOD in the centre of the body. The lowest ground in the body, from 60-70 mAOD, is encountered on either side of the low ridge in the north of the body, and in the extreme southwest of the body, southwest of the Rock of Curry.		
	<b>Geology and Aquifers</b>	<b>Aquifer categories</b>	<b>Rkd:</b> Regionally important karstified aquifer dominated by diffuse flow
<b>Main aquifer lithologies</b>		Dinantian Pure Bedded Limestones.	
<b>Key structures</b>		There are three north northwest south south east trending faults mapped in this GWB.	
<b>Key properties</b>		This GWB consists of Dinantian Pure Bedded Limestones which are generally susceptible to karstification. Although few karst features are currently listed for this GWB, limestones of this type in other areas can be extensively karstified. The GSI manuscript maps (GSI, late 1800's) record karstic features at Ross Quarry, near Lough Sheelin, Co. Meath. George Du Noyer illustrates deep hollows and trenches in the surface of the limestone at Ross Quarry, which were later infilled with stiff brown clay and overlain by a gravelly limestone till. This illustration may represent a buried or infilled karst system, which is no longer in operation. No data on the hydrogeological properties specific to this GWB are currently available. Transmissivity in karstified aquifer can range from less than 1m <sup>2</sup> /d up to a few thousand m <sup>2</sup> /d, depending on whether or not the conduit flow system is intersected. Rapid groundwater flow velocities of < 100 m/hr have been recorded in other areas. Where Pure Bedded Limestones, such as those found in this GWB, are karstified, enlargement of the fracture network by solution, and the generally well connected and widespread fracture systems result in a highly permeable aquifer with rapid groundwater flow. Storativity in such aquifers will be low.	
<b>Overlying Strata</b>	<b>Thickness</b>	The Dinantian Pure Bedded Limestones in this region are generally over 100 m thick. At the disused Ross Quarry (GR N4660 8290), south of Lough Sheelin, over 20m of very thickly-bedded (1-3m) thick massive, pale grey and cream coarse-grained crinoidal limestones are exposed. Further to the south, at the Rock of Curry (GR N4450 7600), there is a prominent dip slope scarp section. This spectacular cliff provides continuous exposure of over 50m of well-bedded and thickly-bedded (1-2m thick), dark grey, mostly fine-grained cherty limestones, locally rich in crinoids and corals (Morris <i>et al</i> 2002). Most groundwater flow is thought to occur in the upper 30 m of the rock, in a highly weathered layer a couple of metres thick, and a zone of interconnected fissures below this. However deeper water strikes are possible.	
	<b>Lithologies</b>	A Teagasc Parent Material Map is not currently available for County Westmeath or County Meath. Information from the National Soil Survey, Soils of County Westmeath (An Foras Talúntais 1977) shows that the GWB is generally overlain by cherty limestone till. Two sand and gravel pits are located in the west of the body, in the townlands of Ardnagross (Plunket's Pit) and Carlanstown (Harstons Sand & Gravel) indicating that there are sand and gravel deposits in the area. The Meath Groundwater Protection Scheme Quaternary Geology Map identifies gravel deposits of variable sorting just south of Lough Sheelin along the River Inny, and a more extensive area of esker and fan gravels in the east of the body. The remainder of the GWB in Co. Meath is overlain by limestone till with frequent areas of rock outcrop or rock close to the surface.	
	<b>Thickness</b>	In this area subsoil thickness can be very variable. Information on depth to bedrock is limited. Small areas of rock outcrop are mapped throughout the GWB. There are larger areas of outcrop in the vicinity of the Rock of Curry, the Hill of Mael and Mullaghineen Hill. A broad area curving south and southwest in the centre of the body incorporating these areas is expected to generally have <3 m subsoil. Thicker deposits can be present in the valleys and lower ground. Depth to bedrock data points of 15-20 m have been recorded west and southwest of the Hill of Mael. In the portion of the GWB in County Meath, the gravel deposits described above are generally < 10 m thick.	
<b>% area aquifer near surface</b>	[Information to be added at a later date]		

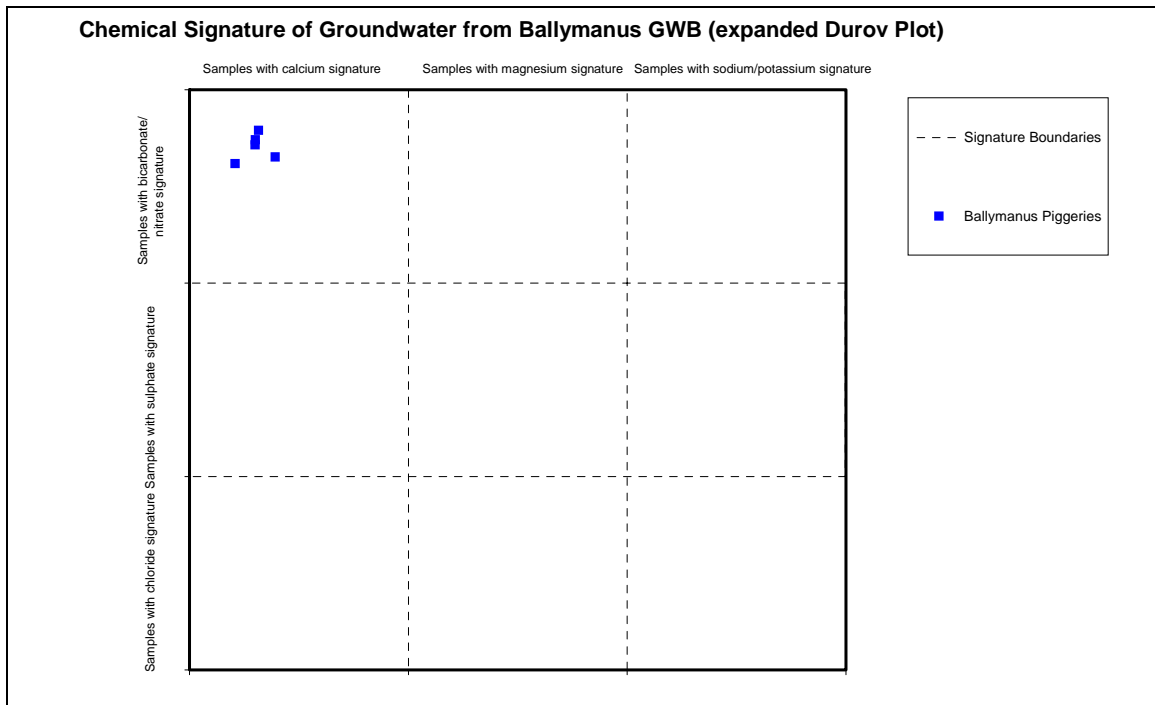
	<b>Vulnerability</b>	<p>A Groundwater Vulnerability map is not currently available for County Westmeath. It is probable that there are areas of Extreme vulnerability in the vicinity of the Rock of Curry, the Hill of Mael and Mulaghinean Hill. Categorising areas of High, Moderate and Low vulnerability is not possible in this area at present.</p> <p>A Groundwater Vulnerability Map has been prepared as part of the County Meath Groundwater Protection Scheme. The portion of this GWB in County Meath is designated High vulnerability with some small areas of Extreme Vulnerability in the vicinity of areas of outcrop and shallow rock.</p>
<b>Recharge</b>	<b>Main recharge mechanisms</b>	<p>Diffuse recharge will occur throughout this GWB 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. The highest amount of diffuse recharge will occur at rock outcrop and where subsoils are thinnest and most permeable. Subsoil permeability has not currently been mapped in detail in County Westmeath. In County Meath the limestone derived tills were considered to have a 'moderate' permeability while the sand and gravel deposits were considered to have a 'high' permeability, which would generally not restrict percolation of recharge to the underlying aquifer. In the centre of the body around Mullaghineen Hill there is a general lack of surface drainage demonstrating that potential recharge readily percolates into the groundwater system. Although few karst features are currently listed for this GWB, limestones of this type in other areas have been found to be extensively karstified. Point recharge can occur in karstified regions via swallow holes and collapse features. Where gravels overlie the karstic aquifer they provide a permeable pathway for recharge to the underlying aquifer. They can also act to augment storage in the aquifer.</p>
	<b>Est. recharge rates</b>	<i>[Information to be added at a later date]</i>
<b>Discharge</b>	<b>Large springs and high yielding wells (m<sup>3</sup>/d)</b>	None recorded
	<b>Main discharge mechanisms</b>	The main discharges are to the streams and rivers crossing the body.
	<b>Hydrochemical Signature</b>	Hydrochemical information is available for one point within this GWB at the Ballymanus Piggeries. Analogy with other limestones would suggest that water drawn from bedrock in this GWB will have a calcium-bicarbonate signature hard waters with high electrical conductivity values. The hydrochemical signature of groundwater from the Ballymanus Piggeries borehole is demonstrated in an expanded Durov plot in Figure 1 below.
<b>Groundwater Flow Paths</b>	<p>The bedrock in this GWB is generally devoid of intergranular permeability. Groundwater flows through fissures, joints and along bedding planes. In pure bedded limestones, the fissures and joints can be enlarged by karstification which significantly enhances the permeability of the rock. Groundwater flow velocities can be rapid and variable, both spatially and temporally. In this GWB, by analogy with other areas with similar bedrock, the aquifer is classified as a regionally important karstified aquifer. In general these limestone aquifers support regional scale groundwater flow. Flow path lengths can be up to several kilometres in length. Overall groundwater flow in the north of the GWB will be to the northwest towards Lough Sheelin and in the south of the body to the south and southwest towards the River Glone. However locally groundwater flow directions can be highly variable where the limestone has been karstified. Groundwater in this aquifer is generally unconfined. Static water levels range from 2.4m-19m below ground level. Water levels in karstified limestone, generally show rapid response to rainfall. Water level data from a well within this GWB are shown in Figure 1 attached. As the water levels are not measured continuously, the quicker responses to rainfall may not be reflected adequately in the hydrograph. Some gravel deposits overlay the bedrock in this GWB. The gravel deposits in the County Meath part of the GWB were not judged to be sufficiently thick to constitute gravel aquifers. In County Westmeath there is currently too little information available on the gravel deposits to judge whether they constitute gravel aquifers. These gravels will however provide a permeable pathway for recharge to the underlying bedrock aquifer and where saturated may provide an element of storage for the underlying bedrock.</p>	
<b>Groundwater &amp; Surface water interactions</b>	<p>Where limestone bedrock is karstified there is generally a high degree of interaction between groundwater and surface water. The general lack of surface drainage in the centre of the body around Mullaghineen Hill demonstrates that potential recharge readily percolates into the groundwater system.</p>	

<b>Conceptual model</b>	<ul style="list-style-type: none"> <li>• This GWB occurs just south of Lough Sheelin. The body is bounded to the east, west and north by the contact with the low permeability Dinantian Upper Impure Limestones (Lucan Formation) of the Inny GWB. It is bounded to the southeast by the contact with the more permeable Derravaragh Cherts of the Derravaragh GWB.</li> <li>• The topography of the body is varied. There are steep sided hills in the centre of the body (120-260 mAOD), hilly and hummocky terrain in the southeast of the body (90-140 mAOD) and relatively flat low-lying ground in the extreme northeast and northwest of the body (60-70 mAOD).</li> <li>• The GWB is composed of Dinantian Pure Unbedded Limestones, typically a high transmissivity karstified limestone. Groundwater flows through fissures, joints and along bedding planes which may be enlarged by solution, enhancing the permeability of the limestone. Where karstification occurs, flow can be concentrated in solutionally enlarged conduits, enabling rapid groundwater flow over flow paths of up to a few kilometres in length.</li> <li>• Diffuse recharge will occur throughout this GWB via rainfall percolating through the subsoil. As limestones of the type found in this GWB are typically karstified, it is possible that there is also point recharge to this aquifer via swallow holes and collapse features, although no such features are currently recorded in this area. The lack of surface drainage in the centre of this GWB indicates that potential recharge readily percolates into the groundwater system. Groundwater in this body generally shows a rapid response to recharge.</li> <li>• The groundwater in this body is generally unconfined. Most of the groundwater flow will be concentrated in the upper epikarstic layer and in a zone of interconnected fissures, which are likely to be enlarged by karstification, generally extending to a depth of 30 m. Deep water strikes in more isolated faults/fractures can be encountered.</li> <li>• Some areas in this GWB are of Extreme groundwater vulnerability due to the thin nature of the subsoil. Groundwater storage in karstified bedrock is low and the potential for contaminant attenuation in such aquifers is limited.</li> <li>• Typically Dinantian Pure Bedded Limestones, such as those founding this GWB, have a degree of interconnection between fractures zones and they generally support regional scale flow systems. Flow paths can potentially be several kilometres in length.</li> <li>• Groundwater discharges to the streams and rivers crossing the body.</li> <li>• Where limestone bedrock is karstified there is generally a high degree of interaction between groundwater and surface water.</li> <li>• Overlying gravels provide a permeable pathway for recharge to the karstic aquifer and where saturated may provide an element of storage for the underlying bedrock.</li> </ul>
<b>Attachments</b>	Groundwater hydrographs (Figure 1); Hydrochemical Signature (Figure 2)
<b>Instrumentation</b>	<p><b>Stream gauges:</b> 26058, 26101.</p> <p><b>EPA Water Level Monitoring boreholes:</b> Ballycomyle (WES 029).</p> <p><b>EPA Representative Monitoring points:</b> Ballymanus Piggeries (WES 17).</p>
<b>Information Sources</b>	<p>An Foras Talúntais. Soils of Co. Westmeath. National Soil Survey of Ireland, 1977.</p> <p>McConnell, B., Philcox, M. and Geraghty, M., 2001. <i>Geology of Meath: A geological description to accompany the bedrock geology 1:100,000 scale map series, Sheet 13, Meath.</i> With contributions from J. Morris, W. Cox, G. Wright, and R. Meehan. Geological Survey of Ireland. 77 p.</p> <p>Morris J.H., Somerville I.D. and MacDermot C.V. (2002). <i>Geology of Longford-Roscommon. A Geological Description to Accompany the Bedrock Geology 1:100,000 Bedrock Series Sheet 12.</i> With contributions by D.G. Smith, M. Geraghty, B. McConnell, K. Carlingbold, W. Cox, D. Daly. Geological Survey of Ireland, 121pp. (Publication Pending)</p> <p>Woods, L., Meehan, R. and Wright, G. R., 1998. <i>County Meath Groundwater Protection Scheme. Main report. Final report to Meath County Council.</i> Geological Survey of Ireland. 54 p.</p>
<b>Disclaimer</b>	Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae

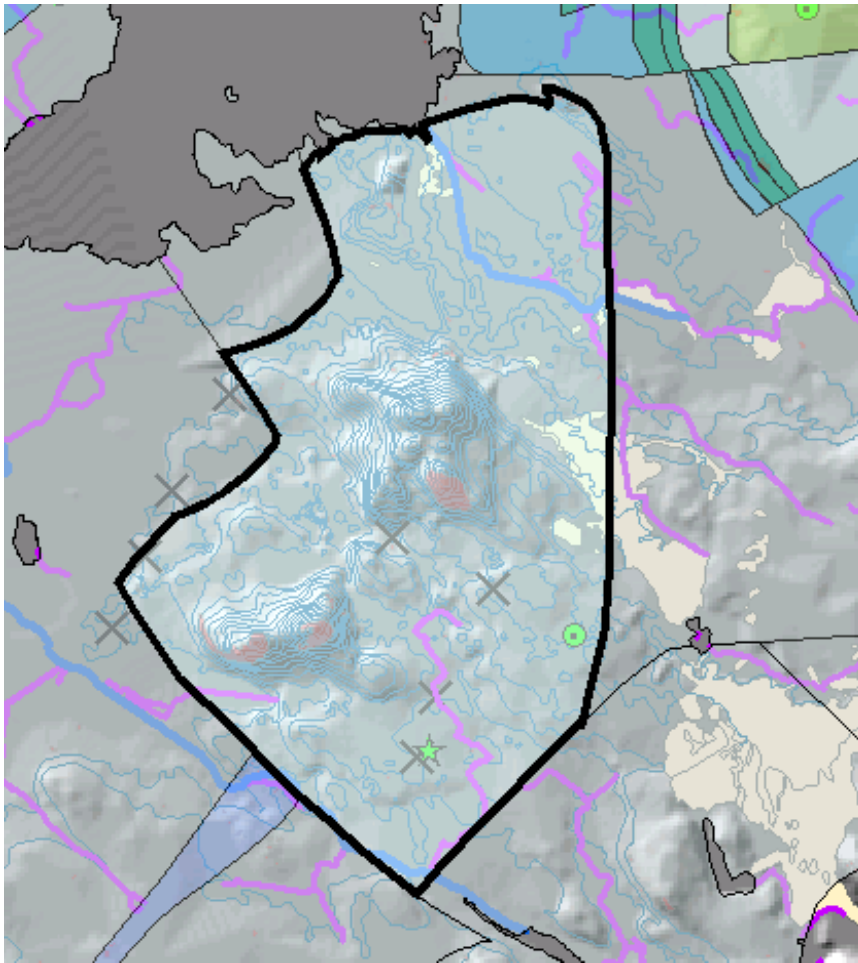
**Figure 1: Groundwater hydrographs  
(EPA Groundwater Level Monitoring)**



**Figure 2: Hydrochemical signature**



**Ballymanus GWB (For Reference)**



**List of Rock units in Ballymanus GWB**

<b>Rock unit name and code</b>	<b>Description</b>	<b>Rock unit group</b>
Viséan Limestones (undifferentiated) (VIS)	Undifferentiated limestone	Dinantian Pure Bedded Limestones

## **NOTES on Ballymanus GWB**

**WES029 Ballymanus** is a spring.

### **From Bedrock Booklet for Sheet 12 (pp72-73)**

An outlier of Visean shallow water shelf limestone is developed on the southern margin of the Longford-Down Massif, southeast of Lough Sheelin in the east of the map area (Fir.24). These rocks may interfinger with, or pass laterally into the deeper water basinal facies further to the west and south. Similar shelf limestones are known just off the map, to the east, in Sheet 13 in the Oldcastle area (Brand and Emo 1986, McConnell *et al.* 2001). These rocks are mainly dolomitic crinoidal limestones with chert, similar to the Oakport Limestone Formation at the top of 2780/1 borehole at Newtown Forbes (Strogen *et al.* 1996).

At the disused Ross Quarry (GR N4660 8290), south of Lough Sheelin, over 20m of very thickly-bedded (1-3m) thick massive, pale grey and cream coarse-grained crinoidal limestones are exposed. These exhibit rare small-scale cross-bedding with foresets inclined to the south-southwest. These rocks are shown on the map as undifferentiated Visean limestones and although they can not be readily assigned to any formation typical of the Carrick-on-Shannon succession, they may represent a section within the Oakport Limestone formation.

Further to the south, at the Rock of Curry (GR N4450 7600), there is a prominent dip slope scarp section. This spectacular cliff (Front cover) provides continuous exposure of over 50m of well-bedded and thickly-bedded (1-2m thick), dark grey, mostly fine-grained cherty limestones, locally rich in crinoids and corals..... This section represents some of the youngest strata within the undifferentiated Visean limestones in the east of the map and can be confidently assigned, by comparability in the lithofacies and the coral faunas, to the Bricklieve Limestone Formation. It thus forms a southeastward extension of the shelf facies from the Cavetown Lough area in the northwest of the map.

### **From Meath GWPS**

#### ***1.1.1 Regionally Important Aquifers - fissure flow dominant (Rf)***

The remainder of the **shallow water limestones** which are found in east Meath, just south of Drogheda, **and in the west around Lough Sheelin**, are classified as having fissure flow dominant (Rf on the map), as the evidence available at present does not indicate extensive development of karst.

The presence of fissuring within these limestones at Drogheda is shown in boreholes at Drybridge, Co. Louth, (drilled as part of the investigation by the North East Regional Development Organisation (NERDO) in 1981), where 8m out of the 16m of borehole which was calliper logged had a diameter greater than the drill bit size. Trial wells at Mell, County Louth also showed cavities up to 10% of the total rock penetrated. The porosity is estimated at 5% at Mell Quarries and 10% at Platin Quarry (NERDO 1981).

Recent borehole records from the site investigation for the Northern Motorway in these limestones have recorded cavities/fissures with a vertical depth up to 3m (BMA 1995). Evidence from the Platin Quarries in Co. Meath also suggests karstic solution of fissures has developed within this limestone.

The GSI manuscript maps record karstic features at Ross Quarry, near Lough Sheelin, Co. Meath. George Du Noyer illustrates deep hollows and trenches in the surface of the limestone at Ross Quarry, which were later infilled with stiff brown clay and overlain by a gravelly limestone till. This illustration (on the cover of this report) may represent a buried or infilled karst system, which is no longer in operation.

From the well records six locations indicate well yields in excess of 100m<sup>3</sup>/d. The highest yield was at Platin Quarry, with a present pumping rate of 3,600m<sup>3</sup>/d. A sand filled fissure was encountered in Production Well No.2 between -17m O.D, and -19m O.D. The specific capacity at the end of the pumping test was 230m<sup>3</sup>/d/m, while the transmissivity ranged from 80-150 m<sup>2</sup>/d.

Based on the geology, evidence for fissure flow and the presence of 'good' wells, these shallow water limestones are classified as a Regionally Important Aquifer - fissure flow dominant (Rf on the map).