Suck South GWB: Summary of Initial Characterisation.

NB: Amendment of EPA catchment boundary: The Suck Catchment boundary in the south east of the body need to be changed to reflect the ZOC of Killeglan Tobermore PWS, Co Roscommon – needs to be moved to the east slightly so as to encompass all of the Killeglan ZOC in the Suck Catchment.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
26 – Suck Roscommon & Galway Co. Co.'s	Rivers: Suck, Island, Springfield, Smaghraan, Derryhippoo, Killian, Shiven, Castlegar, Ahascragh, Killeglan, Termon, Laragh, Clonbrock, Ballyglass, Bunowen Streams: Termon, Cuileen. Loughs: Dooloughan, Coolcam, Pollnacreeve, Namucka, Corralough, Doo, Anargid, Peter's, Gormly, linbaun, Acre, Nasaggart, Ouver, Creevin, Fergus, Slye, Lurgeen, Ballaghdacker, Ernual, Attidavock, Summerville, Aunaculskey, Croan, Coolagarry, Feacle, Goats, Nahinch, Nacreeva, Boggaun, Callow, Gore.	(00222) Suck River Callows, Castlecoote-Shannonbridge; (00588) Ballinturly Turlough; (00609) Lisduff Turlough; (001637) Four Roads Turlough; (000592) Bellanagare Bog; (001624) Carrowreagh Turlough; (000221) Moorfield Bog/Farm Cottage; (000221) Moorfield Bog/Farm Cottage; (000613) Rathnalulleagh Turlough; (000220) Lough Namucka Bog; (001646) Newtown Turlough; (000218) Coolcam Turlough; (000610) Lough Croan Turlough; (001645) Feacle Turlough; (000598) Castleplunket Turlough; (002110) Corliskea/Trien/Cloonfelliv Bog; (000235) Bracklagh Bog; (000218) Coolcam Turlough; (000255) Croaghill Turlough; (000285) Kilsallagh Bog; (001319) Summerville Lough; (000281) Keeloges Bog; (001227) Aughrim Bog; (001279) Kilkerrin Turlough; (000310) Lough Lurgeen Bog/ Glenamaddy Turlough; (000267) Funshin Bog; (000283) Kilmore Bog; (000256) Curraghlehanagh Bog; (000292) Leaha Bog; (000254) Crit Island West; (000296) Lisnageeragh Bog and Ballinastack Turlough; (000326) Shankill West Bog; (000240) Camderry Bog; (001239) Callow Lough; (001283) Killure Bog; (001244) Castlefrench East; (001242) Carrownagappul Bog.	1099

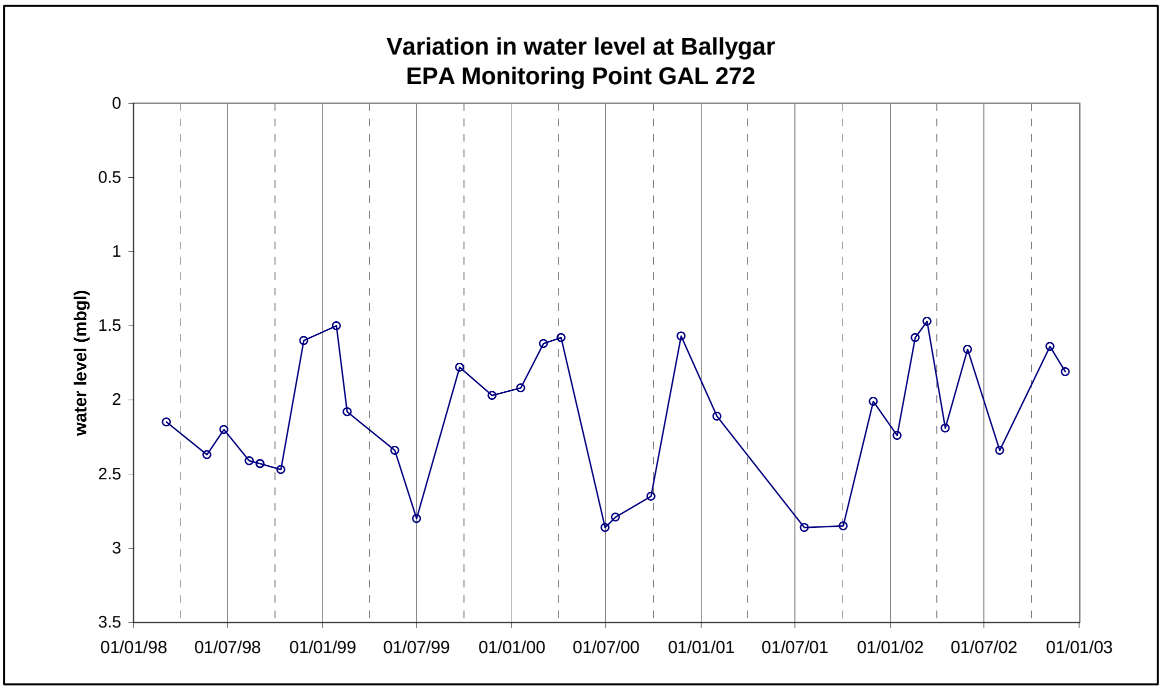
Topography		This GWB is generally flat and low-lying. Elevations are lowest (40-70 mAOD) in the south of the body and along the River Suck. Elevations of 70-90 mAOD are encountered in the north and southwest of the body. Higher elevations are encountered on the ridges that form the catchment boundaries, however elevations greater than 100 mAOD are rare and confined to small isolated hills, mainly in the northern half of the body and near the catchment divides. In the extreme northwest of the body there is the random hummocky topography characteristic of gravel deposits as well as long sinuous ridges of esker gravels. In many areas surface drainage density is low, as a high proportion of drainage is underground in solutionally-enlarged fissures and conduits. Several artificial drainage channels have been constructed within this area to carry water to the surface water drainage system and ultimately to the River Suck.
Geology and Aquifers	**Aquifer categories**	The main aquifer category in this GWB is: **Rk^c:** Regionally important karstified aquifer dominated by conduit flow. There are some very small areas (along the western boundary of the body) with an aquifer category of: **Ll:** Locally important aquifer which is moderately productive only in local zones
	Main aquifer lithologies	This GWB is composed primarily of Dinantian Pure Bedded Limestones. There are some very small areas (along the western boundary) of Dinantian Upper Impure Limestones, Dinantian Lower Impure Limestones, Dinantian Pure Unbedded Limestones and Dinantian Mixed Sandstones, Shales and Limestones.
	Key structures	Few faults are mapped in this area; this may reflect the poor exposure and the lack of major variation in the rock lithology. Major faults are mapped in the vicinity of the Castlerea inlier and the Mount Mary inlier near Ballygar. The dips over the GWB area are generally less than 10^o, except near faults, where steeper dips result from fault drag.
	Key properties	Karstification is widespread in this GWB. Current records of karst features are considered to represent only a fraction of existing features. As with most karstic systems, permeability and transmissivity data are very variable. Transmissivity in karstified aquifers with conduit flow can range up to a few thousand m^2/d. A pumping test carried out within this GWB at Ballinlough estimated a bulk transmissivity of 80 m^2/d to 90 m^2/d although the transmissivity of the intensely fractured zone is estimated as 400 m^2/d (K.T. Cullen & Co., 1999). The aquifer supports a large number of high and intermediate yielding springs. Rapid groundwater flow velocities have been recorded. Tracer tests carried out within this GWB recorded minimum velocities ranging from 68 to 107 m/hr between several connections east of Castlerea (Longford and Silver Island Springs multiple tracer test, GSI, 2001) and 70 m/hr and 110 m/hr recorded in the Killeglan Springs tracer test (Roscommon County Council, 1991 and 1994). Rapid velocities recorded for groundwater in these areas imply flow through relatively sizeable conduits. Surface geophysical work, which was carried out east of Castlerea, infers the presence of at least seven large conduits in that area (McGrath, 2001). In karstified Pure Bedded Limestone such as that found in this GWB, 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 this aquifer will be low. *(data sources: Rock Unit Group Aquifer Chapters, Roscommon GWPS and Source Reports, see references)*

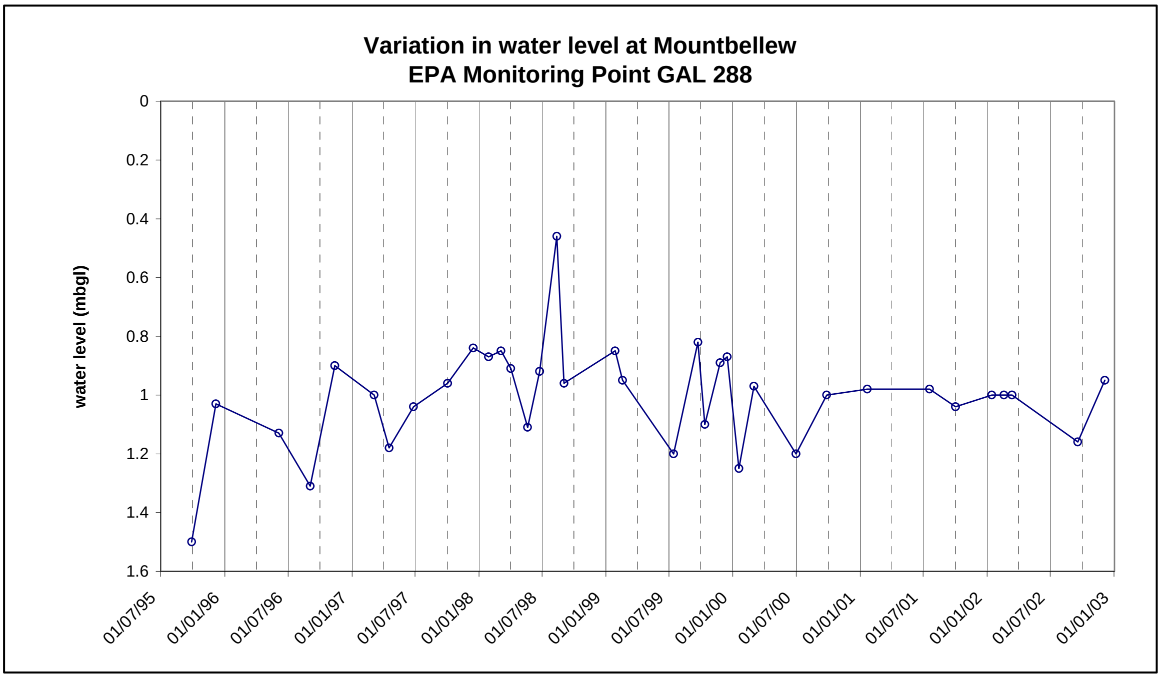
	Thickness	The Dinantian Pure Bedded Limestones are generally well over 100 m thick. Most groundwater flows in an epikarstic layer a couple of metres thick and in a zone of interconnected solutionally-enlarged fissures and conduits that extends approximately 30 m below this. Deeper inflows can occur in areas associated with faults or dolomitisation.
Overlying Strata	**Lithologies**	There are large areas of Cut Peat along the River Suck and to the west of the River Suck. Most of the till cover is a Limestone Till. Sandstone Till is primarily confined to the north of the body, with a smaller occurrence around Mount Mary. Most of the outcrop of karstified limestone is mapped in the east of the body. There are fluvioglacial sand/gravel deposits in the northwest of the body, southwest of Ballinlough. A large proportion of the sand/gravel forms a random hummocky topography, however long sinuous, braided ridges of sand/gravel (eskers) have also been deposited. *Subsoil Types identified in body by Teagasc Parent Material Mapping: Alluvium (A), Esker (Bas Esker), Cut Peat (Cut), Gravels – Devonian Sandstone & Limestone (GDSs, GLs), Rock outcrop and rock close to surface (Rck), Karstified Limestone outcrop & Karstified Limestone close to surface (KaRck), Lake sediment (L), Till – Devonian/Carboniferous Sandstone and Shale Till (TDCSsS) & Devonian Sandstone Till (TDSs) & Limestone Till (TLs).* *[Information to be added at a later date]*
	Thickness	Isolated areas of outcrop occur throughout this GWB, although outcrop is more frequent on the east of the River Suck. There are large areas with < 3 m subsoil east of the River Suck, the remaining areas east of the river have generally 3-10 m subsoil. West of the River Suck depth to bedrock data are more limited. Areas of outcrop are somewhat less frequent than east of the river, however large areas of < 3 m subsoil are expected in the vicinity of areas of outcrop. Remaining areas are likely to have 3-10 m subsoil, however over 20 m of subsoil has been recorded in some places. Isolated points where subsoil is >10 m can be encountered as a result of large in filled cavities in the karstified limestone.
	% area aquifer near surface	[Information to be added at a later date]
	Vulnerability	There are large areas of Extreme vulnerability particularly in the east of the body. Most of the rest of the eastern half of the body is an area of High vulnerability. There are some areas of Moderate and Low vulnerability south of Castlerea and in vicinity of the River Suck. Groundwater vulnerability has not been mapped in detail in the west of the body (County Galway). Vulnerability is expected to be similar to that mapped in County Roscommon given the similar subsoil lithologies. The area of rock outcrop however is less extensive and may result in a similarly less extensive area of Extreme Vulnerability. A Groundwater Vulnerability Map has been prepared for County Roscommon as part of a Groundwater Protection Scheme. [Information to be added at a later date]
Recharge	**Main recharge mechanisms**	Both point and diffuse recharge occur in this GWB. Swallow holes and collapse features provide the means for point recharge. Diffuse recharge will occur over the entire GWB via rainfall percolating through the subsoil. The lack of surface drainage in several parts of this GWB indicates that potential recharge readily percolates into the groundwater system. Except for the extreme north of the body, some areas along the River Suck and smaller isolated areas within the body, the subsoil is primarily of 'moderate' permeability which will generally not restrict percolation of recharge though it. Subsoils of 'low' permeability occur in remaining areas and may restrict the percolation of recharge. In this highly permeable aquifer there can be some rejected recharge in low-lying areas with a high water table where a proportion of the effective rainfall is rejected due to lack of storage space in the aquifer. Groundwater in this body generally shows a rapid response to recharge. *Note: Subsoil permeability has only been mapped in detail in the part of the GWB in County Roscommon where a Groundwater Protection Scheme has been prepared.*
	Est. recharge rates	*[Information to be added at a later date]*
Discharge	**Springs and large known abstractions (m^3/d)**	Killeglan WSS (Tobermore Spring) (6000-9000 m^3/d), Castlerea WSS (Longford Spring) 2700-3200 m^3/d, Castlerea WSS (Silver Island Spring) 1350 m^3/d, Ballinlough (3600-4500 m^3/d), Mount Talbot WSS (3540 m^3 /d), Mountbellew WS (Meelick) – GAL73 (1270m^3/d); Kilkerrin-Moylough RWS (Shankhill) – GAL59 (1100m^3/d); Ahascragh WS – GWL2 (655m^3/d) *[This information is not complete –data need to be updated from County Council records]*
	Main discharge mechanisms	The main discharges are to the streams and rivers crossing the body and to the large springs found within the body. In winter groundwater will discharge to the many turloughs found in the area.

Hydrochemical Signature	The hydrochemistry of the carbonate rocks, especially pure limestones, is dominated by calcium and bicarbonate ions. Hardness can vary from slightly hard to very hard (typically ranging between 380–450 mg/l). Spring waters tend to be softer, as throughput is often quicker with less time for the dissolution of minerals into the groundwater. Groundwater alkalinity is variable, but can be high. Alkalinity is generally less than hardness indicating that ion exchange (where calcium or magnesium are replaced by sodium) is not a significant process. Lime-scale can be problematic. Like hardness and alkalinity, electrical conductivities (EC) can vary greatly. Typical limestone groundwater conductivities are of the order 500–700 µS/cm. Lower values for EC suggest that the residence times of some of the sources are very short. For example, at the Ballyvaughan public supply in North Co. Clare, a rapid response to rainfall is indicated by low measured conductivities. A study of five springs in the Galway–Mayo–Roscommon area by Doak (1995) found that the ECs fluctuated strongly over the year, and that elevated conductivities (of about 850–950 µS/cm) were coincident with the end of the summer (non-recharge) period. In the same springs, the lowest conductivities (of 450–550 µS/cm) were measured during the highest rainfall month (January 1993) of the study period. In some springs and boreholes in karst areas, high turbidity occurs after heavy rainfall. This is caused where (a) sediment that has collected in fissures and cavities is washed out at the start of recharge events, and (b) where there is a direct link between the source and a swallow hole into which surface water containing sediment is flowing. The hydrochemical signature of groundwater from a number of public supplies within this body is demonstrated in an expanded Durov plot in Figure 2 below.
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, as shown by several tracing studies (Drew and Daly, 1993). Flow velocities can be rapid and variable, both spatially and temporally. The rapid groundwater flow velocities recorded in this body indicate that a large proportion of groundwater flow takes place in enlarged conduit systems. The large number of high yielding springs in this body indicate that the permeability of the rock unit is high enough to permit the throughput of significant quantities of groundwater. They are indicative of regional-scale flow systems. Flow path lengths can be up to a several kilometres in length. Overall groundwater flow will be towards the River Suck, but the highly karstified nature of the bedrock means that locally groundwater flow directions can be highly variable. The low permeability rocks that are identified as GWBs within and at the boundaries of this GWB (Castlerea, Rabbitburrow, Mount Mary, Ballygar, Castleffrench and Athlone West GWBs) may locally act as barriers to flow from the karstified limestone of the surrounding Suck GWB. Groundwater is generally unconfined in this GWB. Water levels in karstified limestone which is dominated by conduit flow, generally show rapid response to rainfall. Water level data from three wells within this GWB are shown in Figure 1 attached.
Groundwater & Surface water interactions	There is a high degree of interconnection between groundwater and surface water in this GWB. Numerous karst features such as turloughs, swallow holes, sinking streams, sparse or intermittent streams, limestone pavements, caves and large springs are evident. Surface streams sink frequently, draining through karst features into the groundwater system, providing rapid recharge to groundwater. Streams re-emerge as springs, after flowing as groundwater for some distance, to once again form significant surface streams. Many turloughs (seasonal lakes which are fed by groundwater as the watertable rises in winter) occur in this body. These turloughs support sensitive ecosystems which are highly dependant on groundwater. Because of the close interaction between surface water and groundwater in karstified aquifers, surface water and groundwater quality are also closely linked. Any contamination of surface water is rapidly transported into the groundwater system, and vice versa. There are a large number of terrestrial ecosystems within this GWB, many of which are highly dependant on groundwater.

Conceptual model	• This GWB occupies a broadly rectangular north south trending area north of Ballinasloe. It is bounded to the east and west by groundwater divides and topographic highs which coincide with surface water catchment boundaries. It is bounded to the south by the contact with the Dinantian Upper Impure Limestones and Dinantian Pure Unbedded Limestones of the Athlone West GWB. It is bounded to the north by the contact with the Dinantian Mixed Sandstones Shales and Limestones of the Castlerea and Rabbitburrow GWBs. The smaller Mount Mary, Ballygar and Castleffrench GWBs are located within this GWB. • The area is relatively flat and low-lying with large areas of bog cover adjacent to the River Suck, west of the River Suck and in the extreme north and north east of the body. There are some low hills and esker ridges. The inlier that comprises the Mount Mary GWBs is an ridge that forms isolated upland area within the body. • The GWB is composed primarily of high transmissivity karstified limestone. Groundwater flows through a network of solutionally enlarged fissures and conduits. A large number of karst features such as dolines, swallow holes and turloughs occur within the body. Small areas of low permeability impure limestones and sandstones are incorporated with this GWB • Groundwater flows along interconnected fractures, joints, faults and bedding planes, many of which have been enlarged by solution. Much of the groundwater flow is concentrated in conduits. Rapid groundwater flow velocities have been recorded through groundwater tracing. • Recharge to this GWB is both point, though swallow holes and collapse features, and diffuse via rainfall percolating through the subsoil. The lack of surface drainage in several parts of this GWB indicating that potential recharge readily percolates into the groundwater system. Groundwater in this body generally shows a rapid response to recharge. • The groundwater in this body is generally unconfined. Much of the groundwater flow will be concentrated in the upper epikarstic layer and in a zone of interconnected fissures, enlarged by karstification, generally extending to a depth of 30 m. Deep water strikes in more isolated faults/fractures can be encountered. • In general in karstic aquifers, the degree of interconnection between fractures zones is high and they support regional scale flow systems. Flow paths can potentially be several kilometres in length. • Some areas in this GWB are of extreme groundwater vulnerability due to the thin nature of the subsoil, as well as the frequency of karst features. Groundwater storage in karstified bedrock is low and the potential for contaminant attenuation in such aquifers is limited. • Groundwater discharges to the streams and rivers crossing the body and to the large high yielding springs, many of which are used for water supply. • There is a high degree of interaction between surface water and groundwater in this GWB. Groundwater supports many sensitive terrestrial ecosystems, including turloughs, which are highly dependant on groundwater.
Attachments	Groundwater hydrographs (Figure 1); Hydrochemical Signature (Figure 2)
Instrumentation	Stream gauges: 26001, 26002, 26003, 26004, 26005, 26006, 26007, 26031, 26032, 26035, 26036, 26105, 26112, 26140, 26201, 26246, 26247, 26248, 26302, 26303, 26309, 26310, 26311, 26313. EPA Water Level Monitoring boreholes: Ballygar (GAL 272), Caltra Village (GAL 276), Mountbellew (GAL 288), Scoil Baile a Moinin (GAL 290), Turrock (ROS 082), Dundonnell (ROS 084). EPA Representative Monitoring boreholes: Mountbellew (GAL 73), Ballinlough (ROS 10), Castlerea WS (ROS 16), Mount Talbot RWSS (ROS 32), South Roscommon RWSS (ROS 42).
Information Sources	Drew D.P. and Daly D. (1993) *Groundwater and Karstification in Mid-Galway, South Mayo and North Clare.* A Joint Report: Department of Geography, Trinity College Dublin and Groundwater Section, Geological Survey of Ireland. Geological Survey of Ireland Report Series 93/3 (Groundwater), 86 pp Doak, M. (1995) *The Vulnerability to Pollution and Hydrochemical Variation of Eleven Springs (Catchments) in the Karst Lowlands of the West of Ireland*. Unpublished M.Sc. thesis, Sligo Regional Lee, M. and Kelly, C. (2003) Ballinlough Water Supply Scheme (Ballybane Springs), Groundwater Source Protection Zones. Geological Survey of Ireland Report to Roscommon Co. Co., 14 pp. Lee, M. and Kelly, C. (2003) Killeglan Water Supply Scheme (Tobermore Springs), Groundwater Source Protection Zones. Geological Survey of Ireland Report to Roscommon Co. Co., 12 pp. Lee, M. and Kelly, C. (2003) Castlerea Water Supply Scheme (Longford Spring and Silver Island Spring), Groundwater Source Protection Zones. Geological Survey of Ireland Report to Roscommon Co. Co., Lee, M. and Kelly, C. (2003) Mount Talbot Water Supply Scheme (Cloonlaughnan Springs), Groundwater Source Protection Zones. Geological Survey of Ireland Report to Roscommon Co. Co., 12 pp. Lee, M. & Daly D. (2003) *County Roscommon Groundwater Protection Scheme*. Main Report. Roscommon County Council & Geological Survey of Ireland, 54pp. McConnell, B., Philcox, M. and Geraghty, M., 2001. *Geology of Meath: A geological description to accompany the bedrock geology 1:100,000 scale map series, Sheet 13, Meath.* With contributions from J. Morris, W. Cox, G. Wright, and R. Meehan. Geological Survey of Ireland. 77 p. (Publication Pending) McGrath R. (2001). *Microgravity on Roscommon Karst*. Unpublished GSI Report. Morris J.H., Somerville I.D. and MacDermot C.V. (2002). *Geology of Longford-Roscommon.* A Geological Description to Accompany the Bedrock Geology 1:100,000 Bedrock Series Sheet 12. With contributions by D.G. Smith, M. Geraghty, B. McConnell, K. Carlingbold, W. Cox, D. Daly. Geological Survey of Ireland, 121pp. (Publication Pending) K.T. Cullen & Co., 1999. *Report on the Drilling and Testing of Two Trial Wells at Ballinlough, Co. Roscommon.* Report for Roscommon 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

Figure 1: Groundwater hydrographs
(EPA Groundwater Level Monitoring)





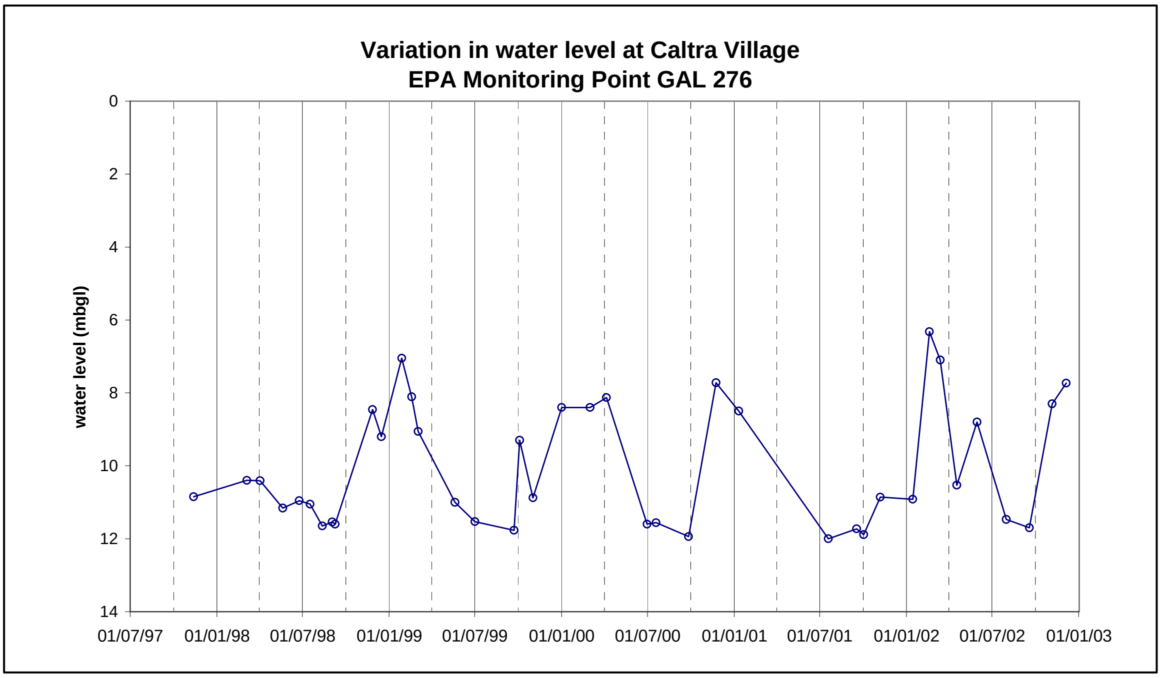
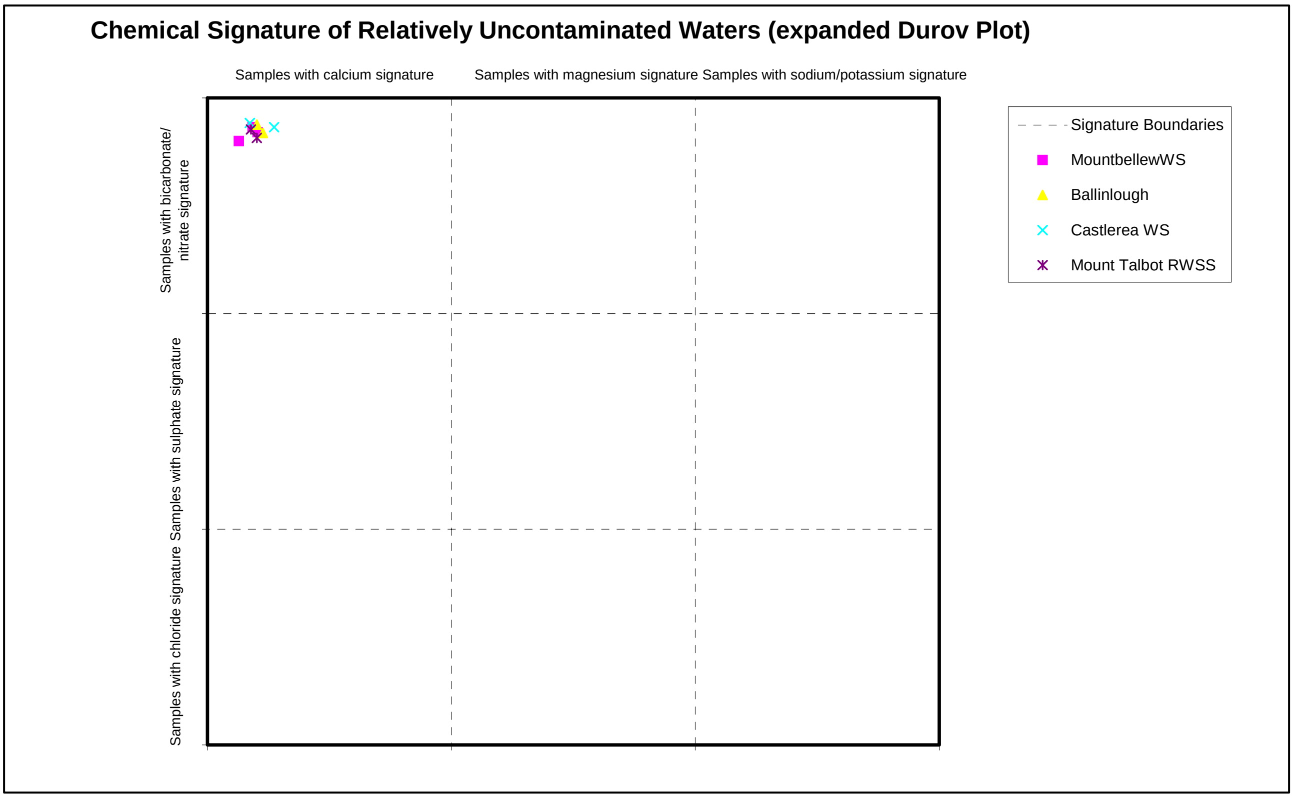
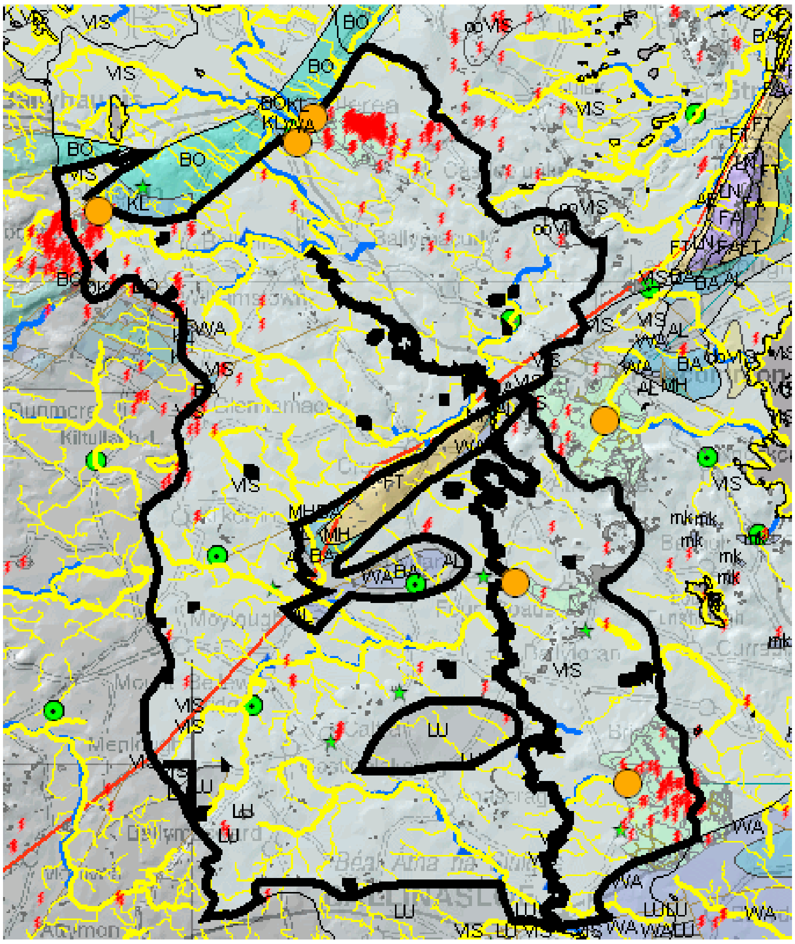


Figure 2: Hydrochemical signature (EPA Representative Monitoring)



SUCK GWB (For Reference)



List of Rock units in Suck GWB

Rock unit name and code	Description	Rock unit group
Lucan Formation (LU)	Dark limestone & shale (Calp)	Dinantian Upper Impure Limestones
Argillaceous Limestones (Visean) (AL)	Dark limestone & shale, chert	Dinantian Upper Impure Limestones
Oakport Limestone Formation (OK)	Pale grey massive limestone	Dinantian Pure Bedded Limestones
Visean Limestones (Undiff & oolitic Limestone) (ooVIS)	Undifferentiated limestone	Dinantian Pure Bedded Limestones
Visean Limestones (undifferentiated) (VIS)	Undifferentiated limestone	Dinantian Pure Bedded Limestones
Kilbryan Limestone Formation (KL)	Dark nodular calcarenite & shale	Dinantian Lower Impure Limestones
Ballysteen Formation (BA)	Dark muddy limestone, shale	Dinantian Lower Impure Limestones
Waulsortian Limestones (WA)	Massive unbedded lime-mudstone	Dinantian Pure Unbedded Limestones
Boyle Sandstone Formation (BO)	Sandstone, siltstone, black mudstone	Dinantian Mixed Sandstones, Shales and Limestones