Longford Ballinalee Groundwater Body: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
26 – Camlin/Rinn Leitrim & Longford Co. Co's	Rivers: Ballinlough, Camlin, Corbaun, Rhine, Black (Leitrim), Creeloughta, Clooncoose, Fallan Streams: Aghnashannagh, Loughs: Mullandarragh, Keeldra, Clooncose, Fearglass, Sallagh, Annagh, Ballin, Kileen, Cloonfin, Listraghee, Gorteen, Loughanagower, Currygrane	(000447) Derrymore Bog; (001450) Mount Jessop Bog; (001818) Lough Forbes Complex; (001822) Carrickglass Demense; (002069) Ardagullion Bog; (002103) Royal Canal.	340

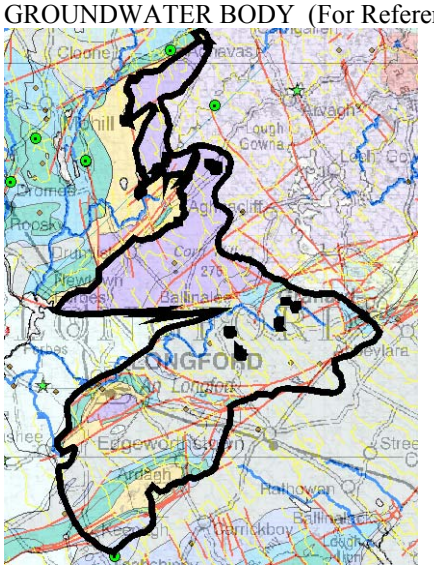
Topography	This groundwater body has varied topography. Upland areas with some steep slopes occur in the north of the body. In the south of the body, slopes are more gradual, with occasional areas of higher ground coinciding with the cores of the Longford Town and part of the Keel Inliers. The lowest ground (50 mAOD) is along the boundary with the Newtown Forbes GWB. Most of the body has ground elevations ranging from 50-100 mAOD. The highest ground (>100 mAOD) occurs in the extreme north of the body, further south in the vicinity of Corn Hill, in the extreme east of the body and along the southeastern boundary of the body. The highest point in the body is at 270 mAOD at the summit of Corn Hill.	
Geology and Aquifers	Aquifer categories	The main aquifer categories are: **Ll:** Locally important aquifer which is moderately productive only in local zones **Pl:** Poor aquifer which is generally unproductive except for local zones *In the north east of the body there is an extremely small area of Dinantian Sandstones is classified as:* ***Lm:** Locally important aquifer which is generally moderately productive (0.001km^2)*
	Main aquifer lithologies	The main aquifer lithologies are Ordovician Metasediments, Dinantian Upper Impure Limestones, Dinantian (early) Sandstones, Shales and Limestones, Dinantian Lower Impure Limestones and Dinantian Sandstones. There are also some tiny areas of Dinantian Pure Bedded Limestones and Silurian Metasediments & Volcanics within the body. The Dinantian Rocks occur in the south of the body, the Ordovician rocks occur in the north of the body, with the exception of a small area of Ordovician rocks in the center of the Longford Town Inlier.
	Key structures	The main structural features in this body have a northeast and east-northeast trend. There are a number of major northeast-southwest trending faults with northwest trending cross faults. North east of Longford town there is a small, approximately east-west trending synclinal basin, the 'Ballinalee Basin', which is occupied mostly by Visean basinal rocks. It is bound on its northern margin by the major east-west trending Newtown Forbes Fault, which brings Visean platform and basinal rocks against Lower Palaeozoic rocks. The Longford Town Inlier and part of the Keel Inlier occur in this GWB. These inliers which are northeast trending anticlines with a core of Lower Palaeozoic rocks, are bound to the southeast by steeply dipping northeast trending normal faults. The body is separated from the Dinantian (early) Sandstones, Shales and Limetones of the Mohill GWB by a thin layer of Dinantian Sandstones which unconformably overly the Ordovician rocks of this GWB.
	Key properties	No data on hydrogeological properties specific to this groundwater body are available. The Ordovician Metasediments in the north of the body are considered to be a poor aquifer. Transmissivity is presumed to be low (<6 m^2/d). Well yields from this aquifer are rarely good. Storativity in these rocks will be low. A variety of Dinantian rocks occur in the south of the body. Aquifer properties of the Dinantian Upper Impure Limestones vary across Ireland influenced by lithological variations and variations in the extent of deformation. In this area transmissivity in the Dinantian Upper Impure Limestones is expected to be low. A pumping test at Lorrha WS, in the Nenagh GWB southwest of Lough Derg, indicates an aquifer permeability of 5 m/d in the Upper Impure Limestones. The borehole there intercepts a large fissure, so this value is at the high end of what would be expected for this rock unit group. Transmissivities are typically in the range of 2-20 m^2/d. The Banagher WS, abstracting from the same rock unit group in the Banagher GWB, has similar characteristics: a single large fault zone supplies the source, resulting in a transmissivity estimate of 45-70 m^2/d. An aquifer permeability of 20 m/d was estimated from the thin flowing interval at the source. Within the Dinantian Lower Impure Limestones, transmissivities are likely to be in the range 2-20 m^2/d, with most values at the lower end of the range. Dinantian (early) Sandstones, Shales and Limestones aquifer properties are expected to have similarly low permeabilities however more frequent areas of enhanced permeability could be encountered in the Meath Formation (ME), a limestone which is generally described as having a lower shale content than other Dinantian (early) Sandstones, Shales and Limestones. Overlying deposits of gravels that occur in some parts of the body will increase the storativity of the aquifer.
	Thickness	In the low permeability rocks which make up this GWB most groundwater flow is expected to occur within 15 m of the top of the rock, comprising a weathered zone of a few metres and a zone of interconnected fissures below this of about 10 m thick. Deeper flow can occur in areas that have undergone a high degree of structural deformation and faulting, where the resulting fissures have remained open. In the Ordovician Metasediments in particular most flow will be concentrated near the top of the rock.

Overlying Strata	Lithologies	In the north of the body overlying the Ordovician rocks there are frequent areas of blanket and cut peat, separated by areas of glacial till, most frequent to the north of the high ground at Corn Hill.. There are frequent areas of rock outcrop or shallow rock, in particular along the northwestern boundary of the body, at Corn Hill north of Esker and along stream channels southeast of Corn Hill. In the south of the body there are again frequent areas of cut peat separated by glacial till. Rock outcrop and shallow rock are common particularly on the higher ground around the margins of the body, across the body between Longford and Edgeworthstown and in the south of the body at Bawn Mountain and Castlerea Mountain on the Keel Inlier. Gravel deposits are mapped in the east of the body just southwest of Granard and in the southwest of the body north of Keenagh. *Subsoil Types identified in body by Teagasc Parent Material Mapping: Cut Peat (Cut); Blanket Peat (BkPt); Fen Peat (FenPt); Till (TCh, TDCSs, TDCSs, TDSs, TLPDSs, TLPSsS, TLs); Rock outcrop and rock close to surface (Rck); Karstified Limestone outcrop & Karstified Limestone close to surface (KaRck), Gravels (GDSs, GLPSsS, GLs), Esker (BasEsk, AcEsk) and Alluvium (A),* *[Information to be added at a later date]*
	Thickness	There are no point data on depth to bedrock currently available for this GWB. As areas of outcrop and shallow rock are common it is expected that there will be extensive areas of shallow subsoil (<3 m) within this GWB, particularly on the higher ground.
	% area aquifer near surface	*[Information will be added at a later date]*
	Vulnerability	Groundwater Vulnerability Maps are not currently available for County Longford or County Leitrim. Areas of Extreme Vulnerability are expected to be common due to the high frequency of rock outcrop and shallow rock in this GWB, however categorizing areas of High, Moderate and Low Vulnerability is not possible at this time. The large areas of cut peat in of the body would be expected to have Moderate or Low vulnerability due to the peat cover and the underlying lacustrine clay and marl that are generally found beneath large areas of peat in this region, however the vulnerability rating will be dependant on the thickness of the subsoil.
Recharge	Main recharge mechanisms	Diffuse recharge will occur over the entire 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. Percolation of recharge will be restricted in parts of the body due to the extensive covering of peat and the typically associated underlying lacustrine clay or clayey till. Subsoil permeability has not currently been mapped in detail in County Longford or County Leitrim but the sub peat subsoil would be expected to be of 'low' permeability. The steep slopes, particularly in the north of the body will lead to high runoff thereby reduce the effective rainfall recharging the aquifer. The gravel deposits in the east and southwest of the body will provide permeable pathways for the percolation of recharge. *Note: Subsoil permeability has not currently been mapped in detail in County Longford or County Leitrim.* *[Information to be added at a later date]*
	Est. recharge rates	*[Information will be added at a later date]*
Discharge	Large springs and high yielding wells (m^3/d)	There are no large springs in this GWB. There are five recorded wells with yields of 100-164 m^3/d and one well with a reported yield of 546 m^3/d (GSI Well Database & EPA Groundwater Sources List). *[More information to be added at a later date]*
	Main discharge mechanisms	The main discharges will be local, to the main rivers and their tributaries crossing the groundwater body.

	Hydrochemical Signature	No relevant hydrochemical data are available in this GWB for assessment. The underlying bedrock geology of this GWB is divided into two main types. The Ordovician Metasediments in the north of the body and the various Dinantian Impure Limestones and Dinanatian (early) Sandstones, Limestones and Shales in the south. Groundwaters from Ordovician Metasediments elsewhere in the country have been found to be quite variable in hydrochemistry. Hardness ranged from 'soft' to 'moderately hard', with a hydrochemical signature of calcium bicarbonate to calcium magnesium bicarbonate. The groundwater chemistry in the Ordovician Metasediments can be influenced by the mineralogy of the subsoil, with some areas showing slightly higher hardness and alkalinity, where the overlying tills include limestone clasts which chemically alter the recharging waters. Groundwater from the Dinantian rocks in this body has a calcium-bicarbonate signature. Hardness, alkalinity and electrical conductivities vary between the different rock unit group aquifers, however. In the Dinantian (early) Sandstones, Limestones and Shales and the Lower Impure Limestones, groundwaters are Hard to Very Hard (typically ranging between 380–450 mg/l), and high electrical conductivities (650–800 μS/cm) are often observed. Alkalinity is also high, but less than hardness (250-370 mg/l as $CaCO_3$). Within the Impure Limestones, iron and manganese concentrations frequently fluctuate between zero and more than the EU Drinking Water Directive maximum admissible concentrations (MACs). Hydrogen sulphide can often reach unacceptable levels. These components come from the muddy parts of these rock units and reflect both the characteristics of the rock-forming materials and the relatively slow speed of groundwater movement through the fractures in the rock allowing low dissolved oxygen conditions to develop.
Groundwater Flow Paths		These rocks are devoid of intergranular permeability; groundwater flow occurs in fractures and faults. Permeability is highest in the upper few metres of bedrock, but decreases rapidly with depth. In general groundwater flow is concentrated in the upper 15 m of the aquifer. Local zones of high permeability can be encountered near fault zones and in areas of intensive fracturing. Typically zones of enhanced permeability will be more common in the south of the body, in the various Dinantian rocks. In the north, in the Ordovician Metasediments, most groundwater flow will be concentrated in the upper few metres of rock where weathering and fracturing are likely to be most intense. Groundwater flow in this body will be of a local nature. Groundwater flow paths are generally short, with groundwater discharging to small springs, or to the streams and rivers that traverse the aquifer. Flow directions are expected to approximately follow the local surface water catchments. In general groundwater is unconfined in this groundwater body but may become partially confined in some areas beneath the extensive areas of peat and underlying low permeability subsoil. Water level data suggest that the water table is generally within 5m of the surface.
Groundwater & Surface water interactions		Groundwater and surface water interactions require special attention where terrestrial ecosystems are dependant on a sustainable balance between the two. A number of bogs and lakes are recorded in this groundwater body which have varying dependence on groundwater.
Conceptual model		• This body is bounded to the east, southeast and southwest by topographic highs and groundwater divides that coincide with surface water catchment boundaries. The western boundary is formed in part by the contact with the Dinantian Pure Bedded Limestones of the Newtown Forbes GWB and in part by the contact with the Dinantian Sandstones of the Annaghmore GWB. The Newtown Forbes GWB forms a wedge shaped area which intersects the body from the west. • This groundwater body has varied topography. Upland areas with some steep slopes occur in the north of the body with more gradual slopes in the south of the body. Ground elevations range from 50-170 mAOD. • This groundwater body is composed primarily of low permeability rocks, although localised zones of enhanced permeability can occur along faults and in the vicinity of fault zones. The Ordovician Metasediments in the north constitute a poor aquifer while the various Dinantian rocks in the south are considered a locally important aquifer. Groundwater flows along fractures joints and major faults. Storativity in the aquifers will be low, however overlying deposits of gravel in the east and southwest of the body can provide additional storage. • Recharge occurs diffusely over the entire GWB via rainfall percolating through the subsoil. Percolation of recharge can be restricted due to the steep slopes in the north of the body and in some areas due to 'low' permeability subsoil. The gravel deposits in the east and southwest of the body will provide permeable pathways for the percolation of recharge. • The most groundwater flow will occur within the top 15 m of the bedrock, comprising a weathered zone of a few metres and a connected fractured zone below this. Deep-water strikes in more isolated faults/fractures can be encountered. Groundwater flow in this body will be of a local nature. Groundwater flow paths will generally be short. • In general groundwater is unconfined in this groundwater body but may become partially confined in some areas beneath the extensive areas of peat and underlying low permeability subsoil. • Groundwater will discharge to the streams and rivers crossing the body. • A number of bogs and lakes are recorded in this groundwater body which have varying dependence on groundwater.
Attachments		None
Instrumentation		Stream gauges:26020 (Argar, Camlin) 26076, 26133, 26134, 26135, 26136, 26137, 26143, 26144, 26145, 26214, 26215, 26216, 26217, 26218, 26219, 26222, EPA Water Level Monitoring boreholes: None EPA Representative Monitoring Points: None

Information Sources	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). Aquifer Chapters: Dinantian (early) Sandstones, Shales and Limestones; Dinantian Upper Impure Limestones; Dinantian Lower Impure Limestones; Ordovician Metasediments
Disclaimer	Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae

GROUNDWATER BODY (For Reference)



List of Rock units in Longford Ballinalee Groundwater Body

Rock unit name and code	Description	Rock unit group
Lucan Formation (LU)	Dark Limestone & shale (calp)	Dinantian Upper Impure Limestone
Argillaceous Limestone (Visean) (AL)	Dark limestone & shale, chert	Dinantian Upper Impure Limestone
Visean Limestones (Undifferentiated) (VIS)	Undifferentiated Limestones	Dinantian Pure Bedded Limestones
Waulsortian Limestone (WA)	Massive unbedded lime mudstone	Dinantian Pure Unbedded Limestone
Mudbank Limestones (mk)	Massive grey micritic limestone	Dinantian Pure Unbedded Limestone
Argillaceous Limestone (Visean) & Mudbank Limestones (mkAL)	Dark limestone & shale, chert	Dinantian Pure Unbedded Limestone
Ballysteen Formation (BA)	Dark muddy limestone, shale	Dinantian Lower Impure Limestone
Moathill Formation (MH)	Limestone, calcareous sandstone, shale	Dinantian (early) Sandstones, Shales and Limestones
Meath Formation (ME)	Limestone, calcareous sandstone	Dinantian (early) Sandstones, Shales and Limestones
Fearnaght Formation (FT)	Pale conglomerate & red sandstone	Dinantian Sandstones
Basal Clastics (BC)	Sandstone, siltstone, conglomerate	Dinantian Sandstones
Finnalaghta Formation (FA)	Blue-grey greywacke & black argillite	Ordovician Metasediments
Coronea Formation (CA)	Turbidite, red shale, minor volcanic	Ordovician Metasediments
Corn Hill Formation (CH)	Shale, greywacke & volcaniclastics	Ordovician Metasediments
Aghaward Formation (AD)	Black pyritic shale	Silurian Metasediments & Volcanics
Carrickateane Formation (CT)	Greywacke with argillite & black shale	Ordovician Metasediments
Glen Lodge Formation (GE)	Shale, minor sandstone & lava	Ordovician Metasediments
Glen Lodge Formation & Mafic volcanics (mvGE)	Shale, minor sandstone & lava	Ordovician Volcanics
Red Island Formation (RI)	Greywacke, conglomerate & argillite	Ordovician Metasediments
Slieve Glah Formation (SG)	Siltstone, mudstone & thin turbidite	Silurian Metasediments & Volcanics