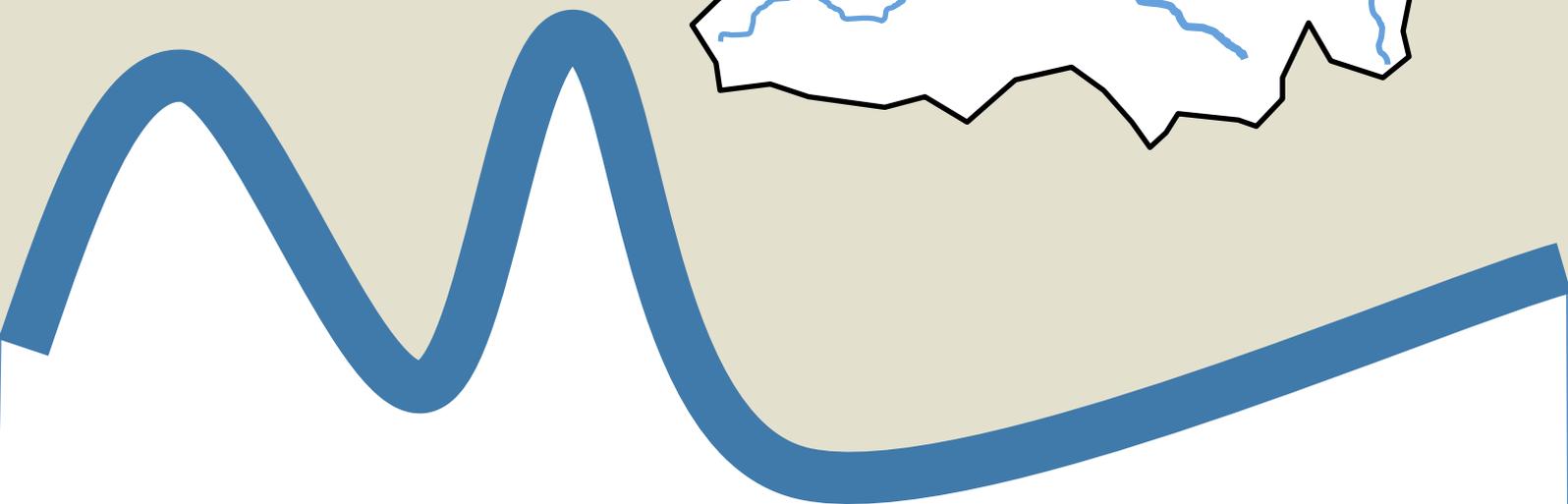




# Maigue River Catchment Characterisation



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## 1. Physical setting

The Maigue River *An Mháigh*, meaning 'river of the plain' rises in north County Cork, and drains in a northwest direction through County Limerick into the Shannon estuary. The majority of the catchment is in Limerick with just 4.7% percent in north Cork and 4.4% in east Tipperary. The catchment is part of Environment Protection Agency (EPA) water management unit Shannon Estuary South and the Office of Public Works (OPW) hydrometric area no. 24, which also comprises the catchments of the rivers Deel and Feale. The Maigue catchment has a land area of 1122km<sup>2</sup> and encompasses 1296.7km of river channel (Figure 1). The Maigue has six subcatchments including the Loobagh, Morningstar, Drumcomogue/Comoge, Clonshire/Grenagh, Barnkyle as well as the Maigue itself (Figure 1).

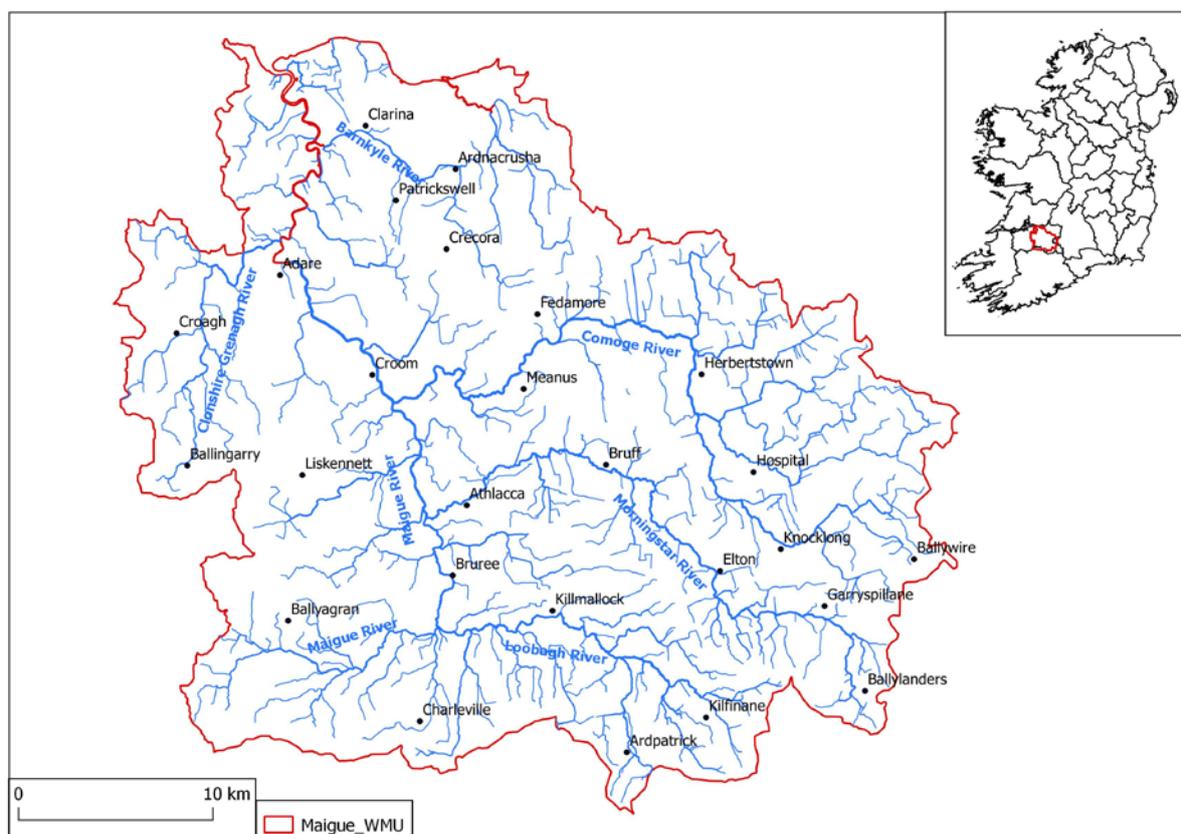


Figure 1: Location of Maigue catchment with river network and towns.

## 2. Geology & Topography

The bedrock geology of Co. Limerick comprises primarily sedimentary (limestones, sandstones and shales) with some igneous (basalt) rocks (Figure 2). Carboniferous limestone underlies most of the Maigue catchment area while volcanic basalt bedrock occurs within the limestone in the area northeast of Bruff and around Herbertstown. Sandstone bedrock predominates in the southwest of the catchment. The erosional and depositional effects of

the last glaciation have largely modified the landscape generating a low relief topography known geologically as the Limerick Basin (Finch & Ryan 1966). Most of the undulating lands lie less than 75 m above sea level surrounded by a rim of hills. The highest point in the catchment is Seefin Mountain at 528m and from here the catchment slopes in a northwards direction. The Maigue, Deel and Feale rivers drain this central Limerick low-lying basin or plain. The basin is surrounded to the south west by the Mullaghareirk Mountains, to the south east by the Ballyhoura Hills and Galty Mountains and to the east/north-east by the Slievefelim, Arra and Slieve Bernagh mountains. The low lying plain topography has just two east-west trending ranges of hills (>200m) near Ballingarry in Co. Limerick in the west of the catchment.

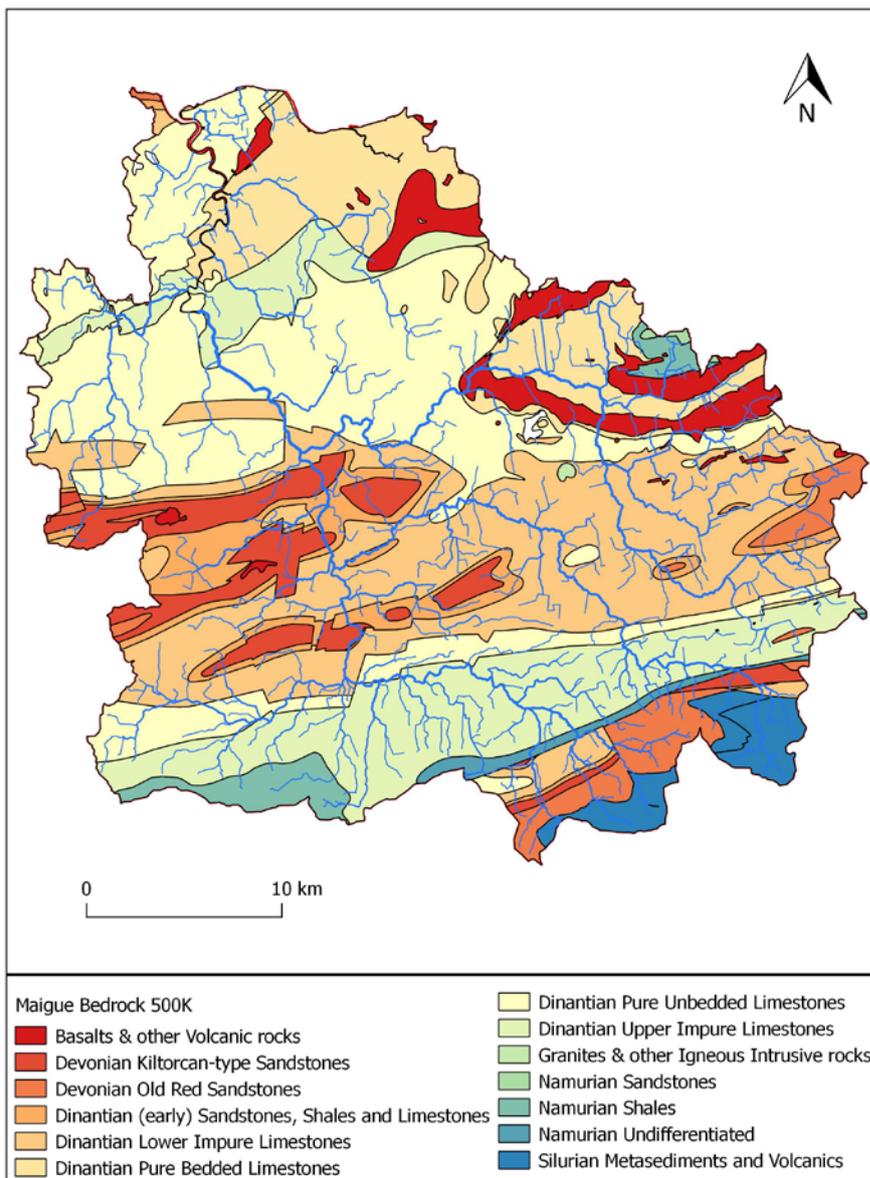


Figure 2: Bedrock geology of the Maigue catchment.

### 3. Soils & Subsoils

The catchment soils are predominantly deep well drained mineral soils in areas overlying limestone while poorly drained soils occur in sandstone areas (Figure 3). The predominant catchment subsoils include glacial tills. Minor peat deposits and glacial sands and gravels occur along with extensive deposits of alluvium from river overflow are typically found along the outer edges of river channels particularly in the region north of Adare.

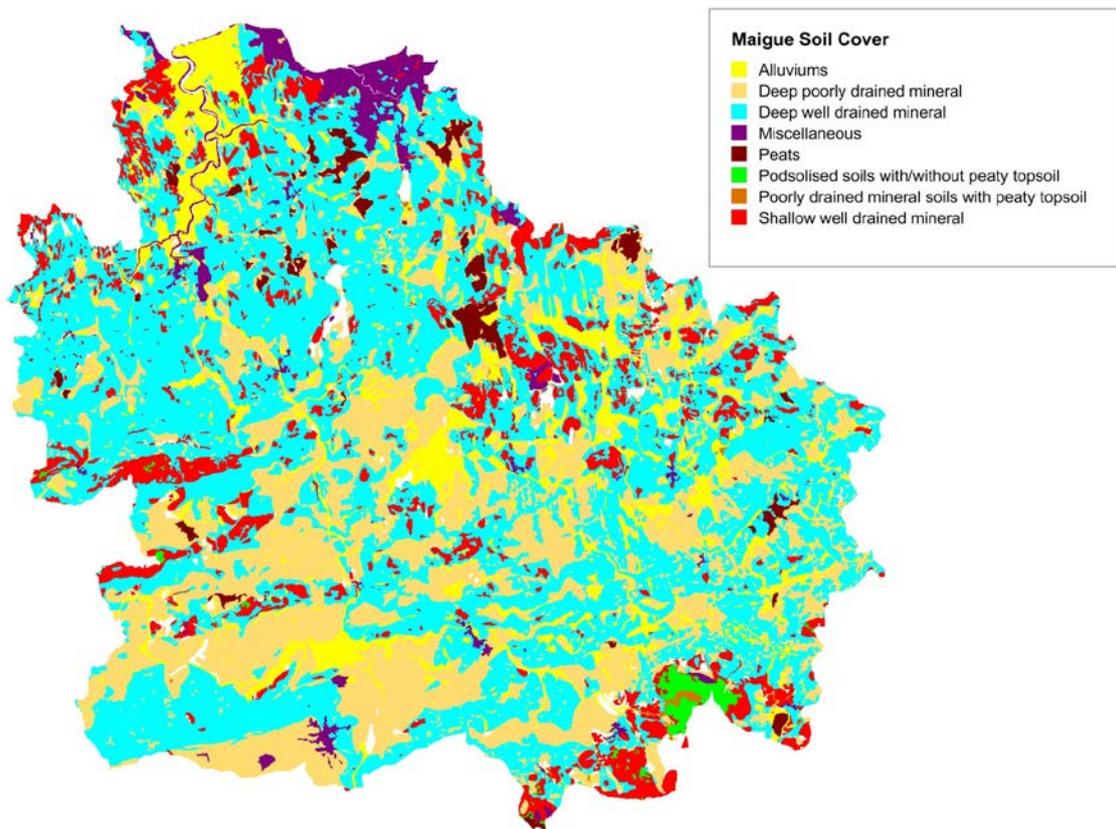


Figure 3: Soils in the Maigue catchment.

### 4. Hydrogeology

Eight groundwater aquifer (permeable rock) categories are defined by the Geological Survey of Ireland based on hydrogeological characteristics. The majority of the Maigue catchment is underlain by three groundwater bodies reflecting regionally or locally important aquifers (Figure 4) (Deakin et al. 1998). The majority of the catchment is underlain by Locally Important Aquifer (LI) or bedrock which is moderately productive but only in local zones. This aquifer class is found in the Kilfinnane, Kilmallock, Bruff and Hospital regions. The second most prominent is aquifer of Regionally Important Karstified (Rkd - d denotes diffuse

or slow groundwater flow) which incorporates areas around Rathkeale and Croom and circumnavigates the igneous outcrop near Lough Gur. This is followed by Regionally Important Fissured bedrock (Rf) found underlying the hills near Ballingarry and Bruree. The region north of Adare extending from Kildimo to Foynes is underlain by a Regionally Important Aquifer - Karstified (Rkc - c denotes conduit or faster groundwater flow). Finally, LM is a Locally Important Aquifer, which is generally moderately productive. This aquifer circles Lough Gur and underlies Limerick city and environs.

The groundwater in Co. Limerick and the Maigue catchment is influenced by the dominant limestone geology and overlying glacial tills and soils and thus is hardwater in nature (classed as calcium bicarbonate  $\text{Ca}(\text{HCO}_3)_2$ ). Groundwater quality problems result from the permeable nature of the fissured and karstic aquifers and human activities, which result in nutrient inputs and faecal contamination (Deakin et al. 1998).

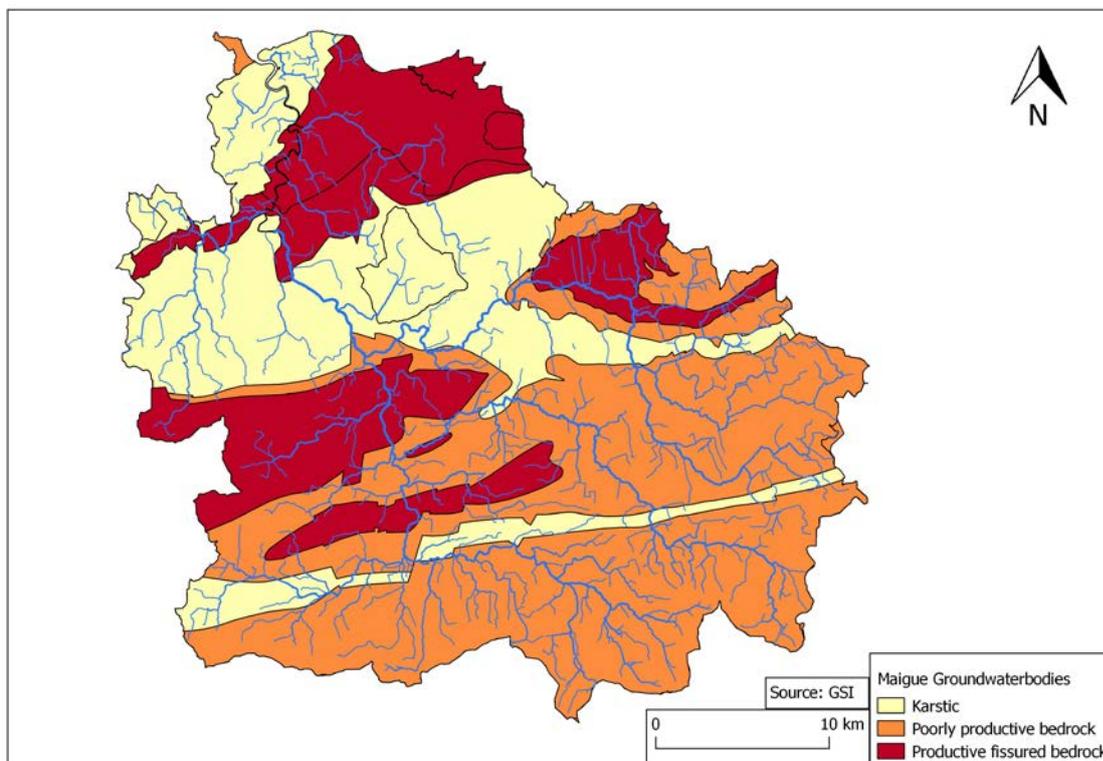


Figure 4: Groundwater bodies of the Maigue catchment.

## 5. Landcover

Military reports from the Maigue region in the 1600s describe “Woods stretched eastwards from Rathkeale to link up with the long tract of forest that lay between Charleville and Kilmallock in the south of county Limerick and reached the Shannon at Pallaskerry... while...Northwards of Croom there were intermittent woods and bogs to Limerick (McCracken (1959: p. 279). A very changed landscape today is evident in the Maigue catchment with land cover derived using CORINE 2012 Landcover data (Table 1; Figure 2).

Agriculture is the dominant land use in the catchment with pasture farming the main activity (82%). Artificial surfaces principally residential and industrial, are the next highest at 6.4% while forest, semi-natural areas, wetlands and waterbodies comprise just 8% of the catchment area.

Table 1: Summary table of CORINE landcover in the Maigne catchment (2012).

<b>CORINE land type Level 1</b>	<b>Km<sup>2</sup></b>	<b>% Catchment</b>
Artificial surfaces	71.87	6.4
Agricultural Areas	963.42	85.83
Forest and semi natural areas	48.37	4.31
Wetlands	24.57	2.19
Water Bodies	14.29	1.27
<b>Total</b>	<b>1122.53</b>	<b>100</b>

The Maigne catchment is a predominantly rural area. The main urban centres within the catchment area are Charleville (population 3919: 2016 census) located on the Charleville Stream, Kilmallock (population 1668) situated on the upper reaches of the River Loobagh, and Croom (population 1159) and Adare (population 1129) located on the main Maigne channel in its middle and lower reaches.

## 6. Protected Areas

The Maigne catchment has six Special Areas of Conservation (SACs) which include priority (Annex 1) habitats designated under the EU Habitats Directive (Table 3; Figure 5). These include Curraghchase Woods, Tory Hill, Glen Bog, Ballyhoura Mountains, Lower River Shannon and the Askeaton Fen Complex. Additionally the River Shannon Estuary in receipt of Maigne inflow waters is designated as a Special Protection Area (SPA) while Ballyhoura Mountains are also a designated National Heritage Area (NHA).

Table 2: Protected areas in the Maigne Catchment

<b>Site Name</b>	<b>Status</b>	<b>Area(ha)</b>	<b>Conservation Priority</b>
Curraghchase Woods	SAC	358.21	Alluvial forests, Yew woodland, Lesser Horseshoe Bat
Tory Hill	SAC		Orchid-rich Calcareous Grassland, Cladium Fens, Alkaline Fens
Glen Bog	SAC	28.49	Alluvial Forests
Ballyhoura Mountains	SAC, NHA		Complex of heath (wet and dry), and active blanket bog with relict oak stands.
Lower River Shannon	SAC, SPA		Large estuarine and wetland complex. Of international importance for wintering and migrating waterfowl.

Askeaton Fen Complex	SAC	284.77	Calcareous (Cladium) and alkaline fens
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Other notable proposed natural heritage areas (pNHAs) in the catchment area include: 1. Loughmore Common turlough a habitat located southeast of Mungret and about 3km from the Shannon Estuary known for its wintering birds. The habitat originally measured some 30ha and has been much modified by drainage and some tree planting; 2. Herbertstown Fen on Stramus Island, located 2km northeast of Foynes, is a large wet fen of good botanical and ecological interest; 3. Adare woodlands are composed of dry, broadleaved woodlands, believed to be amongst the oldest in the country; 4. Two woodlands found at Skoolhill have a mixture of native tree species such as ash, hazel, hawthorn and oak as well as exotics like beech and sycamore. This site is the only known location in Ireland of the grass *Festuca heterophylla*; 5. Bleach and Dromore Loughs are almost entirely groundwater fed and are surrounded by alkaline fens; 6. Graigue Wood is a 29 ha Coillte owned native drumlin and lakeside woodland 1 km southwest of Adare. It has been clear felled in the past and is now dominated by a relatively young population of tall ash trees; and 7. Lough Gur is groundwater fed lake perched above the water table. Gur is also Limerick's largest lake and is situated in an internationally important archaeological landscape and consequently is an important asset to the county historically, aesthetically and economically.

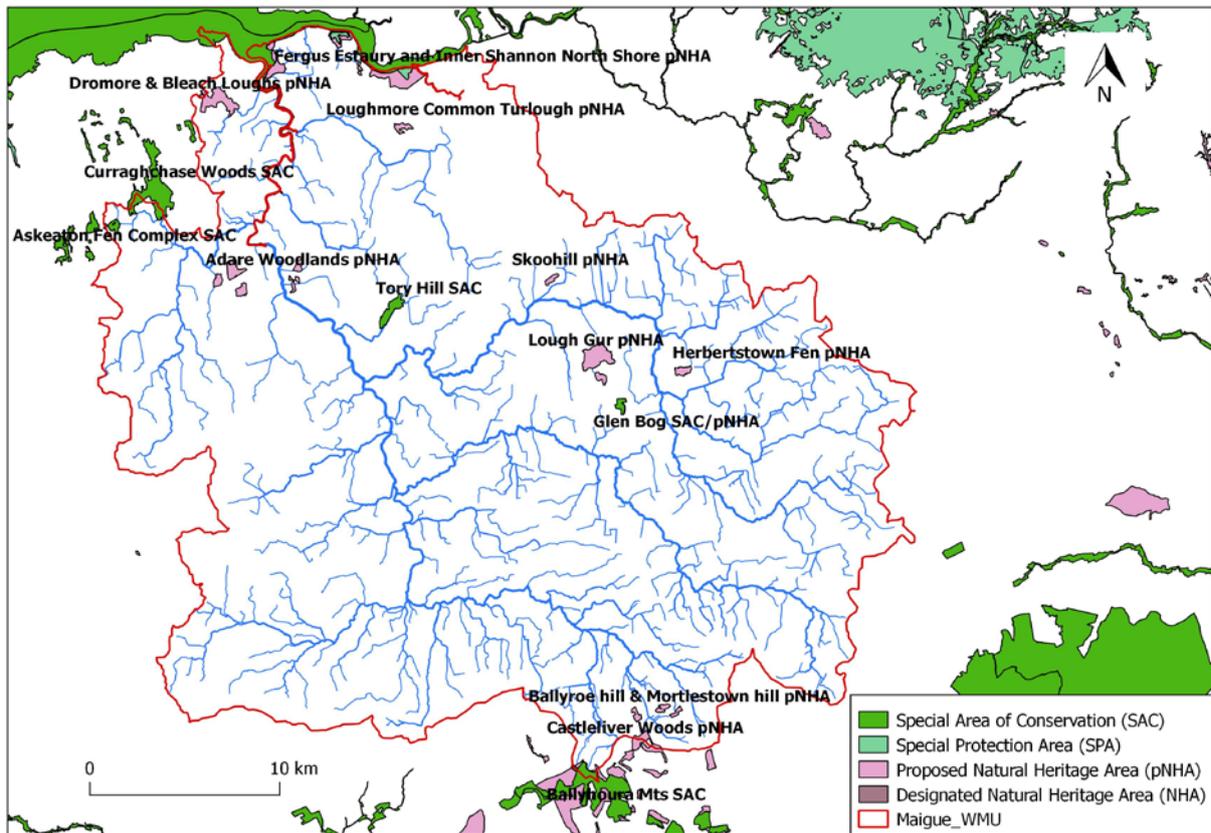


Figure 5: Special Areas of Conservation and proposed Natural Heritage Areas in the Maigue catchment.

## 7. Maigue Catchment Surface Waters

The Maigue drains the limestone lowlands northwards to the Shannon estuary and forms a branching (dendritic) pattern. The upper river reaches (Loobagh, Upper Maigue, Morningstar) rise in the Ballyhoura Mountains which reach altitudes of 528 m OD. The Maigue river catchment has six key subcatchment areas, the Comoge, Clonshire/Grenagh, Loobagh, Morningstar, the Maigue itself and the Barnkyle which rises near Crecora and drains into the tidal River Maigue (Figure 1). The catchment rivers encompass six stream orders - a method for identifying and classifying types of streams based on their numbers of tributaries. 77% of the Maigue catchment rivers are 1st order streams, 11% are 2nd order while 5.5%, 3.2%, 1.3% and 1% are 3rd, 4th, 5th and 6th orders respectively. First order streams therefore have a profound influence in the Maigue catchment and land use adjacent to these small headwater streams would have a disproportionately large impact on on shaping downstream water quantity and water quality. The higher the stream order, the more streams that feed into it and the larger the size of the stream. Higher stream orders are more likely to be influenced by events occurring higher upstream.

Turloughs are temporary ponds or lakes found overlying karstified Carboniferous limestone. Most turloughs are found in Counties Galway, Mayo and Clare but some feature also in the karstic areas of the Maigue catchment (Reynolds 2014). These include Lough Selleher and

Graigues Lough, both in the northern limestone area of the county on private property, and Loughmore Common, near Limerick City.

## 7.1 Hydrology & Groundwater

### *Hydrometric gauges*

River water levels and water flow are measured by the OPW along the Maigue river and its tributaries at 27 hydrometric stations along 11 different waterbodies (Table 3). Sixteen station gauges are active and 12 inactive (with graduated staff gauges only) while thirteen are automated transmitting data in real time (<http://waterlevel.ie/hydro-data/home.html>). Eight stations record flow, 12 record waterlevel and flow, and 6 record water level only. Principal tributaries including the Morningstar (140km<sup>2</sup>) had a mean annual flow of 2.3m<sup>3</sup>/s and a dry weather flow of 0.11m<sup>3</sup>/s, the Maigue catchment (240km<sup>2</sup> at Bruree) had a mean annual flow 4.6m<sup>3</sup>/s, while the catchment area downstream at Croom (estimated to be 774km<sup>2</sup>) had a mean annual flow of 12.8m<sup>3</sup>/s and a dry-weather flow of 1.3m<sup>3</sup>/s (ARUP 2008).

### *Water abstraction*

There are two municipal water treatment plants in Adare and Kilmallock, and which derive their water from the Maigue and Loobagh respectively. Pallaskenry/Kildimo used to be supplied from Bleach Lough, but was decommissioned a few years ago and the area is now supplied by the Shannon Estuary Scheme which takes water from the River Deel. Additionally there are 123 public and private group water schemes in Co. Limerick, of which almost 80% are from groundwater supplies (Deakin et al. 1998). Source protection schemes are in place in Bruff, Fedamore, Croom, Herbertstown, Hospital, Ballingarry, Mortlestown, and Ballynagran.

Table 3: OPW Hydrometric Stations Maigue Catchment

<b>Station No.</b>	<b>Station Name</b>	<b>Waterbody</b>	<b>Guaged Catchment Area km<sup>2</sup></b>	<b>Hydrometric Data Available</b>
24001	Croom	Maigue	770.2	Water Level and Flow
24002	Gray's Br.	Camoge	243.6	Water Level and Flow
24003	Garroose	Loobagh	129.2	Water Level and Flow
24004	Bruree	Maigue	242.1	Water Level and Flow
24005	Athlacca	Morningstar	131.9	Water Level and Flow
24006	Creggane	Maigue	83.1	Water Level and Flow
24007	Caherass	Maigue	798.2	Flow Measurements
24008	Castleroberts	Maigue	806.0	Water Level and Flow
24009	Adare Manor	Maigue	839.4	Water Level Only

24016	Kilmallock	Loobagh	80.6	Water Level and Flow
24022	Hospital	Mahore	41.2	Water Level and Flow
24023	Knocklong	Drumcamoge	39.2	Water Level and Flow
24024	Garryspillane	Morningstar	18.6	Flow Measurements
24025	Bruff	Morningstar	91.5	Flow Measurements
24026	Kilfinnane	Loobagh	5.9	Flow Measurements
24027	Doorlus	Maigue Trib.	19.1	Flow Measurements
24028	Ballynabanoge	Maigue Trib.	30.1	Flow Measurements
24034	Riversfield Weir	Loobagh	54.6	Water Level and Flow
24039	Ballylanders	Morningstar	5.6	Flow Measurements
24044	Rylanes	Clonshire	6.3	Flow Measurements
24061	Ferry Br.	Maigue Est.	983.5	Water Level Only
24062	Adare Quay	Maigue Est.	844.7	Water Level Only
24067	Normoyle's Br.	Greanagh	83.6	Water Level Only
24081	Currachase	Currachase	0.5	Water Level Only
24082	Islandmore	Maigue	762.8	Water Level and Flow
24083	Tooreen	Camoge	264.8	Water Level Only
24084	Kilmallock Creamery	Maigue	76.3	

## 7.2 Aquatic Ecology

### *Flora*

The Maigue catchment supports a diverse range of both aquatic and terrestrial flora. Aquatic flora can be found in river and streams around the catchment and also in Lough Gur. Instream vegetation includes Caltriche sp., water crowfoot *Ranunculus* sp., emergent Branched Bur-reed (*Sparganium erectum*), river moss *Fontinalis* sp. and fool's watercress *Apium nodiflorum*. Bankside vegetation includes yellow iris *Iris pseudacorus*, nettle *Urtica dioica* and bramble *Rubus* sp.. Triangular club-rush (*Schoenoplectus triquetter*), a species of brackish mud in estuaries and tidal rivers, is found only in the upper part of the Shannon Estuary below Limerick City at the confluence of the River Maigue.

Riparian zone scrub and woodland vegetation includes White Willow (*Salix alba*), Grey Willow (*Salix cinerea*), mature Ash (*Fraxinus excelsior*) with an understorey of Hawthorn (*Craetagus monogyna*) and Elder (*Sambucus nigra*) and Alder (*Alnus glutinosa*).

### *Fauna*

The Maigue catchment and its tributaries have records of protected aquatic species including the salmon, lamprey, white-clawed crayfish, otter. Details on fish are outlined in 'Fish stocks in the River Maigue Catchment'. Three-spined stickleback *Gasterosteus aculeatus* are abundant in the Maigue and its tributaries. The white-clawed crayfish

(*Austropotamobius pallipes*) is legally protected under Annex II and V of the EU Habitats Directive.

Typical mammalian fauna are present in this rural agricultural catchment including species protected under the Wildlife Acts; Badger (*Meles meles*), Bat species, Hare (*Lepus timidus hibernicus*), Otter (*Lutra lutra*), Stoat (*Mustela erminea*) and Hedgehog (*Erinaceus europaeus*). Others such as Wood Mouse (*Apodemus sylvaticus*), Pygmy Shrew (*Sorex minutus*), Brown Rat (*Rattus norvegicus*), Fox (*Vulpes vulpes*) and Rabbit (*Oryctolagus cuniculus*) are also likely to be present. Additionally Annex II bat species, Lesser Horseshoe Bat use the river as a feeding habitat while otter can be found along the whole of the river and also in the saltwater of the estuary, feeding on eels, salmonids and crayfish.

### 7.3 Water Quality

Waterbodies in the Maigne catchment are monitored four times per year by the EPA as part of a national operational monitoring programme. Limerick City and County Council have historically and continue to provide investigative river monitoring. Each river is assigned an overall status based quality elements including general physico-chemical elements, hydromorphology, fish, macroinvertebrates, macrophytes (plants) and diatoms (algae). The classification scheme for water quality includes five classes: high, good, moderate, poor and bad. Three cycles of assessment have been undertaken in recent years 2007-2009, 2010-2012 and 2010-2015 (Table 4). Assessments carried out between 2007 and 2009 characterized the rivers of the Maigne catchment as follows: 0 bad, 15% poor, 25% moderate, 26% good status with 34% of the catchment unassigned. The second cycle of the WFD (2010-2012) aimed to collect more accurate data and separated river water bodies into segments and saw revised classifications with increases in poor quality status (19%), declines in moderate (18%), and increases in the good category (29%). The most recent EPA assessments (2010-2015) saw no change in the poor category (19%), declines in Moderate (17%), and increases again in terms of good water quality (31%) representing 1153 km of water channel.

A 'Pressure and Impact Assessment' was undertaken on Maigne catchment water bodies for the period between 2010-2015 (Table 5). This assessment reviews the impact of human activity on surface waters and ground waters and identifies water bodies that are at risk of failing to meet the EU Water Framework Directive's environmental objectives. Therefore, 'At Risk' means that the Pressure and Impact assessment shows that there is a likelihood that a water body will fail to meet the Directive's environmental objectives unless appropriate management action is taken. Exactly half (50%) of the Maigne river water bodies were 'At risk', with approximately a quarter 'Not at Risk' (22%). A further quarter of the water bodies need to be reviewed (24%), while a small number remained unassigned (4%). Additionally a characterization tool has been developed to produce Pollution Impact Potential (PIP) maps that show the potential critical source areas for agricultural diffuse nutrients in water bodies and rank the relative risk areas. The PIP maps combine soil

drainage characteristics and bovine stocking rate to determine the risk of nutrient loss to surface and groundwaters.

The Maigue river estuary has been classed as ‘moderate’ quality throughout each of these assessment cycles. The estuary generally exhibits high nutrient concentrations and thus has an intermediate trophic classification and is classified as ‘At risk’.

Lough Gur, the only significant lake in the Maigue catchment, has had a range of water quality problems over the years. It has been described as a eutrophic and hypereutrophic lake with unsightly algal blooms in a series of studies (King and O’Grady, 1994; Ball, 2004; McGarrigle et al. 2010). In the most recent EPA monitoring programme 2012-15 Lough Gur was classified with ‘poor’ water quality and ‘at risk’.

Table 4: WFD Pressure and Impact assessments of river water bodies percentage of channel length (km) in each risk category in 2010-2015 in the Maigue catchment.

River Sub Basin	At risk	Not at Risk	Review	Unassigned	Length (Km)
Greanagh	84.4		37.0	3.2	124.7
Ballynaclogh	122.0		24.5		146.5
Drumcomoge (1)	76.9				76.9
Drumcomoge (2)	72.7	34.3	40.8		147.8
Maigue (1)	54.3			43.9	98.2
Maigue (2)	45.0	67.9	67.1		179.9
Maigue (3)	68.9	27.5	41.6		138.0
Maigue (4)	51.1	43.1	47.7		141.9
Maigue (5)	74.8	15.6	57.2		147.6
Morningstar		95.2			95.2
<b>Total (km)</b>	<b>650.2</b>	<b>283.6</b>	<b>315.8</b>	<b>47.1</b>	<b>1296.7</b>
<b>%</b>	<b>50</b>	<b>22</b>	<b>24</b>	<b>4</b>	<b>100</b>

Invertebrate surveys of the river Maigue and its tributaries have been carried out by the EPA on a continuous basis at approximately 30 sites every three years since 1971. A macro-invertebrate survey of 33 sites in the Maigue catchment in 2012 derived quality (Q) values and estimated 45% with good Q4 status, 18% moderate, 33% poor and 3% with bad status (EPA 2012). Sensitive species such as Stonefly and Mayfly (e.g. *Ephemera*) larvae are found in cleaner tributaries and are absent from polluted rivers where more tolerant species such as blood worms and leaches are found (Table 6). The most recent round of monitoring covered the period 2013 to 2015 saw a decline in quality when most of the catchment was given a Q3-4 and Q3 rating, which means that is slightly or moderately polluted in most areas.

Table 5: Invertebrates and biological classification of river quality (EPA).

Most tolerant	Very Tolerant	Pollution Tolerant	Less Sensitive	Sensitive
Tubificidae <i>Chironomus</i> sp. <i>Eristalis</i> sp.	Asellidae <i>Crangonyx</i> sp. <i>Physa</i> sp. Sphaeriidae	Gammaridae (excl. <i>Crangonyx</i> sp.) Gastropoda (excl. Ancyliidae, <i>Physa</i> sp.) Simuliidae Uncased Caddis Chironomidae (excl. <i>Chironomus</i> sp.)	Leuctridae Cased Caddis, Ancyliidae	Plecoptera (excl. Leuctridae.) Heptageniidae <i>Ameletus</i> sp. <i>M. margaritifera</i>

## 8. Pressures

### Channel modifications

Land reclamation and river modifications around the Shannon Estuary are thought to have commenced as early as 1100 AD with small scale works in place by the 1300s (Healy & Hickey 2002). The Down Survey Maps suggests that the Shannon estuary had experienced some reclamation by the mid-1600s. The development of inland navigation began in Ireland in 1715, with the improvement of the Maigue River. Government-led reclamation schemes began in the early 1800s, with the first known survey in 1822 and the first Shannon Navigation Act in 1834. Three main areas were targeted for reclamation, the Fergus in Clare, Limerick on the Shannon and the Maigue River. In the Maigue catchment some 2000 hectares, extending 10 kilometres inland from the estuary were reclaimed through embankments and drainage works from the mid-1800s onwards.

More recently the river was subject to major arterial drainage in the 1970 and 1980s, including channel-straightening works, affecting some 30,500 acres. Additionally The OPW installed 10 concrete weirs as part of an effort to enhance fisheries and restore angling pools on the Lower River Maigue. Remnants of these works are evident in the river channel today with canalisation, culverting, gabions, weirs and embankments (levees) all present.

### Pollution

Pressures identified for the Maigue catchment in the 1<sup>st</sup> cycle of the River Basin plans (DCELG, 2012) included diffuse pollutant sources from agricultural activities, and onsite septic tank systems, as well as point sources including wastewater treatment plant and industrial discharges, quarries mines and landfills. In 2008 it was estimated that 61% of

nutrient inputs (in the form of total phosphorus) came mainly from agriculture (52%) and sewage waste (12%). Point pressures in the catchment include 23 wastewater treatment plants, three waste facilities, 4 IPPC licenced facilities, three Section-4 operations and three drinking water treatment plants. The catchment additionally has nine quarries and 13 landfills. A total of 15,300 septic tanks were enumerated with almost 5500 located in areas vulnerable to runoff contamination (DCELG, 2012).

## **9. Sub-catchments of the Maigue**

### Loobagh River Catchment

The source of the River Loobagh is in the Ballyhoura Mountains specifically Keale Mountain at approximately 240m. From here the river flows north west through Kilfinane, Balinanima and Kilmallock before joining the Maigue River south of Bruree (Figure 6). The river has a total catchment area of 129.6km<sup>2</sup> and 172.6km of river channel with three tributaries entering the river downstream. The Flemingstown tributary flows through Ardpatrick before it joins the Loobagh downstream after Balinanima and has retained a good water quality since 2007. The Fairyfield Glebe tributary joins the Loobagh just before Fairyfield. This tributary has had poor and moderate water quality since 2010. The Ballysallagh tributary joins the Loobagh downstream of Kilmallock before it connects with the Maigue River. This stream has moderate water quality. Four monitoring sites along the Loobaghs main river channel indicate the river currently has good water quality following a pollution incident just up-stream of Kilmallock in August 2014. The proportion of high Pollution Impact Potential (PIP) areas is low in the upper section but becomes high further downstream due to an increase in the proportion of poorly drained soils .

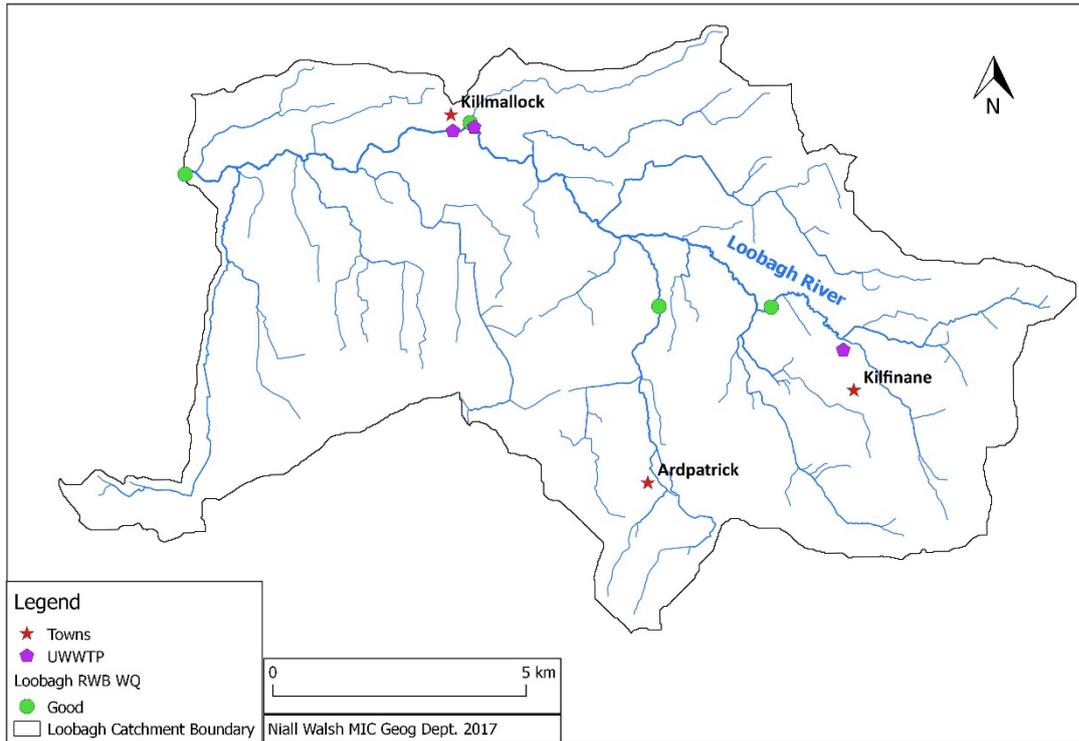


Figure 6: Loobagh river catchment.

### Morningstar River Catchment

The source of the Morningstar River is in the Ballyhoura Mountains at approximately 200m. From here the river flows north west through Ballylanders, Garryspillage, Elton and Bruff after which it alters course to flow west and south west through Athlacca before joining the Maigue (Figure 7). The catchment covers an area of 135.5km<sup>2</sup> and has 165.2km of river channel with one main tributary Goat Island stream which flows into the Morningstar after Banogue. The Morning star has good water quality in its upper reaches from Garryspillage to Banogue. Moderate water quality is recorded down stream of Bruff before returning to good water quality before Athlacca. Goat Island tributary which is reported to have Extensive Moderate PIP joins the Morningstar between Banogue and Bruff (no Q value reported). From Banogue to Athlacca extensive areas of moderate PIP are reported due to the nature of the soils.

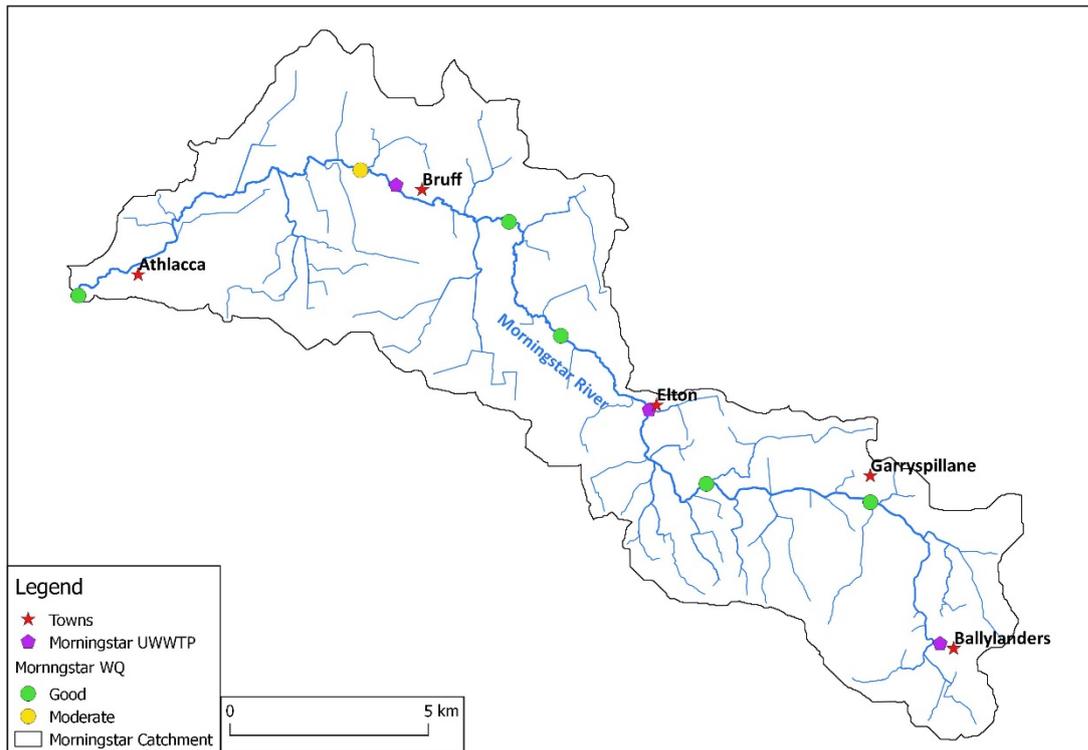


Figure 7: Morningstar river catchment.

### Drumcomoge/Comoge River Catchment

The source of the Drumcamoge River which subsequently becomes the Camoge River is in Ballywire on the border of Co. Limerick and Co. Tipperary at 160m (Figure 8). The Drumcomoge/Camoge catchment covers an area of 265.1km<sup>2</sup> and has 284.9km of river channel. From Ballywire the river flows north west into Co. Limerick through Knocklong, Ballyclough and Knockaing. Upstream of Knockainy two tributaries the Mahore and Ballyamona join together before joining Drumcamoge which subsequently becomes the Camoge River. The Camoge River then flows north through Herbertstown after this it alters course west and then south west arching around to the north of Lough Gur Lake. Ballycullane tributary joins the Camoge River before Meanus and then joins the Maigue downstream of Meanus. The Drumcomoge River has 20.4km of river channel with no operational monitoring site therefore water quality status is unassigned. The Mahore tributary has two operational monitoring sites along its course which reported good water quality in 2015. Ballynamona tributary is at risk of pollution from agricultural activities and arterial drainage, however no water quality status assigned. Water quality in the Camoge River downstream of Herbertstown is moderate with high PIP coming from agricultural activities. The both the surface and subsurface outflows from Lough Gur flow in to the Ballycullane tributary. The Ballycullane has areas of high PIP due to a high proportion of poorly drained soils. Water quality at Meanus is poor. Downstream of Meanus the water quality is also poor.

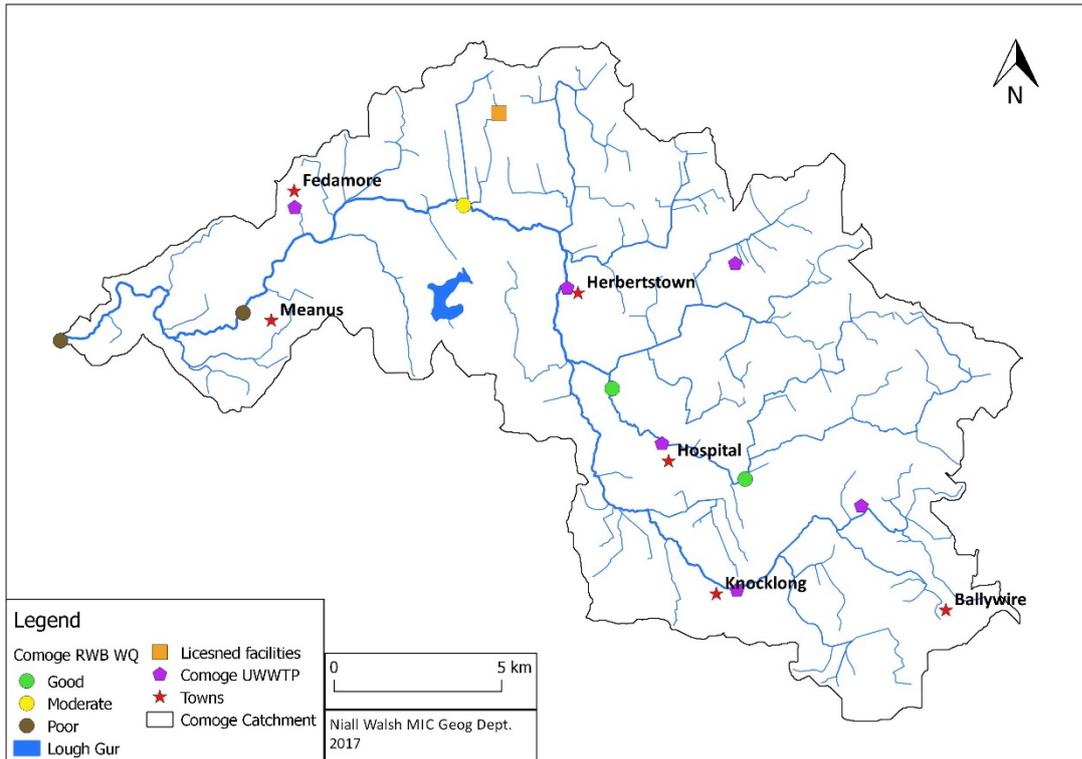


Figure 8: Camoge river catchment.

### Maigue Main River Catchment

The source of the Maigue River occurs along the border between Co. Cork and Co. Limerick south west of Ballyagran at 200m (Figure 9). The catchment covers a total area of 362.4km<sup>2</sup> and has 336.7km of river channel. Initially the headwaters have poor water quality but then turn to good water quality as it flows east. Charleville stream, which has poor water quality, joins the Maigue to the north of Charleville. The Loobagh River then joins the Maigue south of Bruree. The river flows north through Bruree where the water quality turns to moderate. North of Bruree, Ballyania tributary and the Morningstar River join to the Maigue. Water quality continues to be moderate downstream and improves to good condition south of Croom as Liskennett tributary and the Camoge River join the Maigue. Water quality continues to be good as the Maigue flows through Croom but turns moderate south of Adare. In total the catchment contains 7 Urban Waste Water Treatment plants and has 2 licensed industrial discharges. Significant pressures on the Maigue include a WWTP at twice its capacity and industrial discharge from a creamery on Charleville stream. Further downstream agriculture is the main pressure.

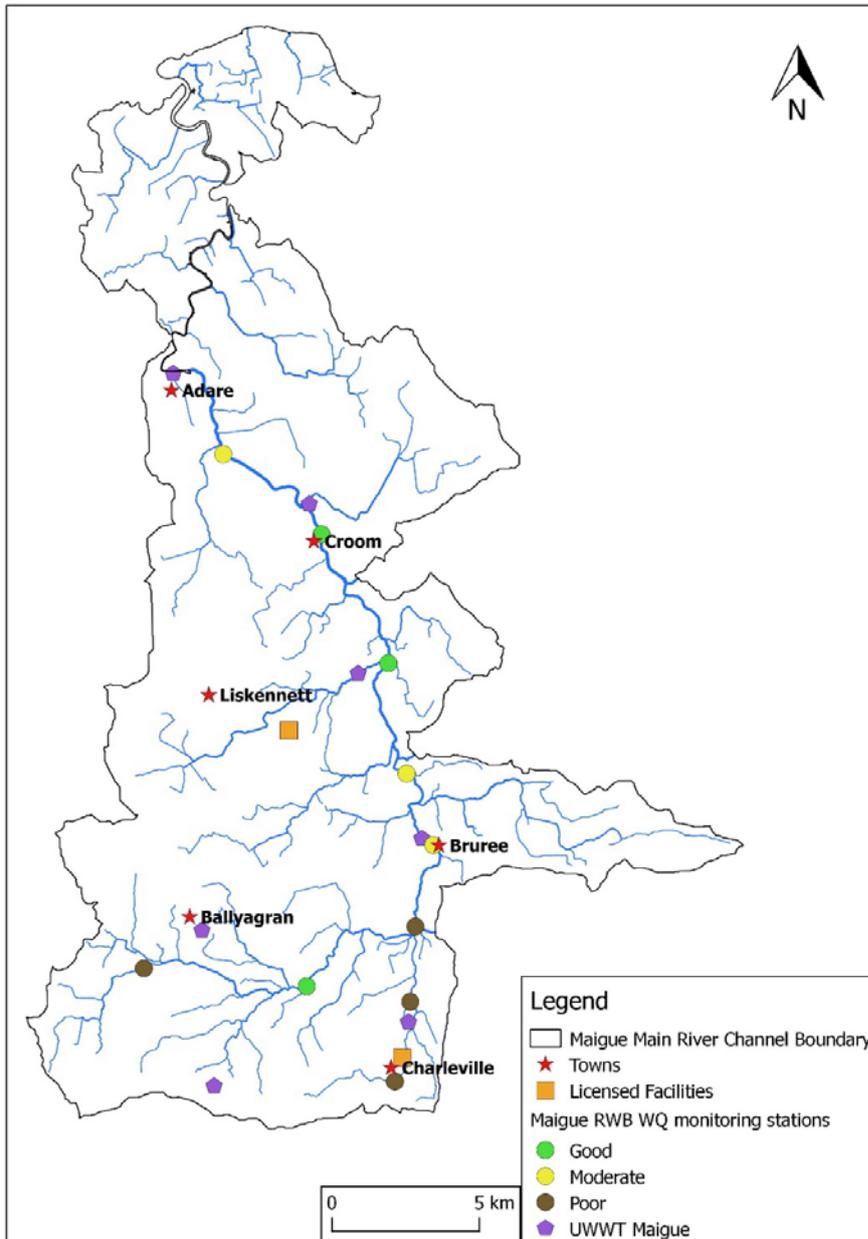


Figure 9: Maigue main river channel catchment.

#### Clonshire/Grenagh River Catchment

The source of the Clonshire stream is just south of Ballingarry at 100m. From here the stream flows north towards Croagh where the Grenagh stream tributary joins it (Figure 10). North of Croagh the Clonshire flows into the Grenagh River which subsequently joins the Maigue at Adare. The catchment covers 104.5km<sup>2</sup> and has 70.7km of river channel. Both the Clonshire and the Grenagh have poor water quality throughout the course of their river channel. Point and diffuse pollutant sources are present with Ballingarry UWWTP, agriculture activities and septic tanks.

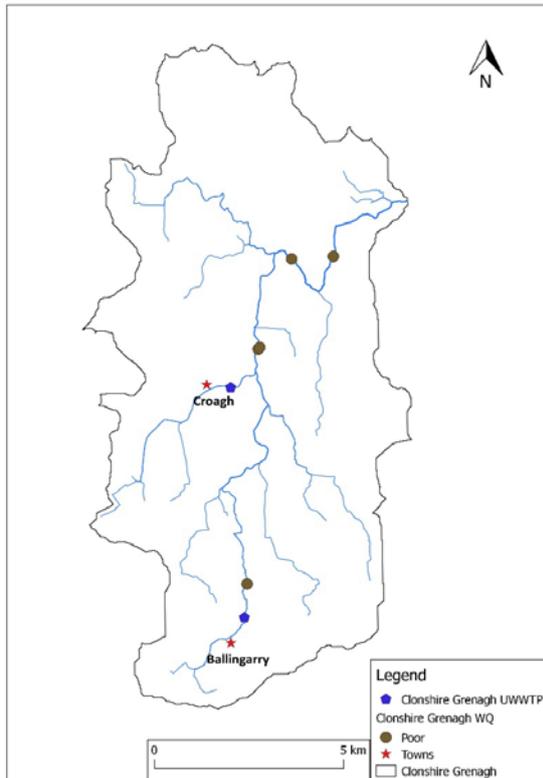


Figure 10: Clonshire/Grenagh river catchment.

### Barkyle River Catchment

The source of the Barkyle River is just north of Fedamore at 100m. The river then flows north west past Crecora, Ardnacrusha, Patrickswell before joining the Maigue estuary after Clarina (Figure 11). The catchment covers 53.7km<sup>2</sup> and has 17.9km of river channel. The river has poor water quality in its upper reaches, improving to good downstream of Patrickswell before deteriorating again to poor before it joins the Maigue near Clarina. In the upper levels diffuse runoff from agriculture has been suggested as a possible cause of the poor water quality. Patrickswell WWTP is pumped into Limerick city wastewater system.

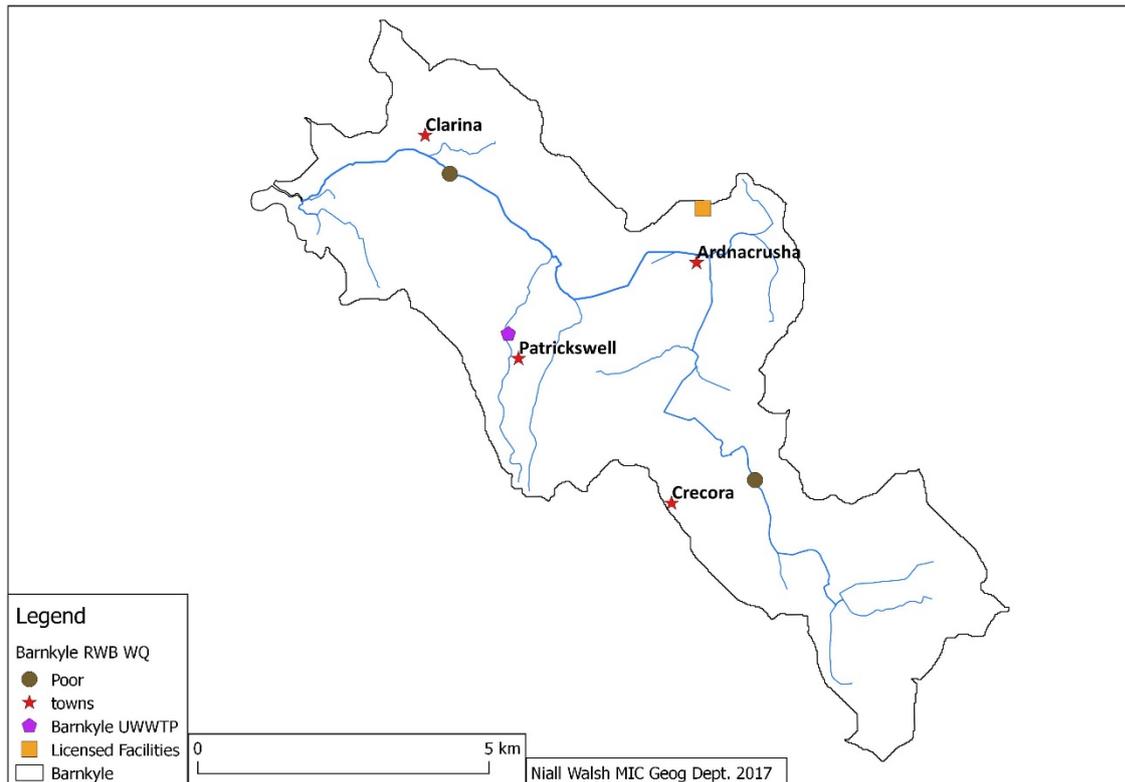


Figure 11: Barnkyle river catchment.

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