



Awbeg (Kilbrin) Demonstration Catchment

Desk Study

April 2023



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Information sources consulted

- EPA Eden App
- www.npws.ie
- Geohive maps
- www.gsi.ie – groundwater body reports
- NFGWS, 2020. A Handbook for Source Protection and Mitigation Actions for Farming. Published by the National Federation of Group Water Schemes.

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Summary

The Awbeg (Kilbrin) Demonstration Catchment comprises a tributary of the Blackwater (Munster)_090 waterbody (known locally as the Awbeg river) and the Lisduggan_North_010 waterbody which flows into the Awbeg to the south of Castlemagner.

There are no monitoring data available for the rivers and streams in the demonstration catchment. There is a WFD operational monitoring station at the outlet of Blackwater (Munster)_090 (Roskeen Bridge) which is monitored for biology and chemistry. Data for the Blackwater (Munster)_090 waterbody are included in the desk study for information purposes but are reflective of a much larger river system as Blackwater (Munster)_090 is downstream of the Allow, Owentaraglin, Glen (Banteer), Finow (Blackwater) and the upper Blackwater (Munster).

The main channel of the Munster Blackwater is an SAC with many qualifying interests including Otter, Salmon, Lamprey, Twaite Shad and Freshwater pearl mussel among others. The SAC includes the lower 2-3km of the Awbeg before it joins the Blackwater.

The Blackwater (Munster)_090 has a High status objective and is currently achieving Good status while the Lisduggan_North_010 has a Good status objective. This waterbody is not monitored under WFD but has been assigned ecological status by the EPA. Status was High for 2013-2018 (based on grouping).

In the absence of monitoring data within the demonstration catchment, no conclusions can be drawn on issues or potential issues impacting on water quality. EPA PIP maps indicate that both phosphate and nitrate may be issues here. A nutrient load modelling exercise undertaken for the desk study suggests that annual average phosphate levels may be below the mean High status EQS but that nitrate levels are likely to be well above the High status surrogate limit of 0.9mg/l-N. Natural sediment accumulation maps show moderate levels of natural sediment accumulation along much of the river channel in Awbeg (Kilbrin) and on the lower reaches of Lisduggan_North_010. This suggests that levels of suspended fine sediment could be relatively high after extreme rainfall events.

EPA initial characterisation predicted significant pressures on the Blackwater (Munster)_090 waterbody to potentially include nutrient pollution from agriculture and hydromorphology (embankments). Urban waste water was also listed as a pressure although not a significant one. From this desk-based assessment, potential pressures on the demonstration catchment itself include urban waste water (Castlemagner wastewater treatment plant), other point sources and agriculture. Hydromorphology and forestry also need to be assessed as potential pressures in the local catchment assessment process.

Geology in the catchment is mixed, consisting of sandstone, mudstone and karst areas with large areas of locally and regionally important aquifer.

Drainage is mixed with both well and poorly draining areas and generally acid mineral soils.

Pathways are similarly mixed with surface runoff in poorly draining areas, shallow to deep subsurface flow in areas of well draining soils depending on the fracturing of bedrock or presence of karst and potential for direct inputs via karst features.

1 Introduction

1.1 Background to Catchment

The Waters of LIFE is an EU LIFE Integrated Project (IP) which aims to help reverse the deterioration of Ireland's high status objective (Blue Dot) waterbodies. The Project will operate in five demonstration catchments nationally to test measures aimed at the protection and restoration of High Status in Blue Dot rivers. The five demonstration catchments were selected from WFD subcatchments defined by the EPA. The selection process considered a number of criteria, including number and extent of significant pressures, status history and Q value amongst others. The project also includes one control catchment (the Sheen), which was selected on the basis that it consistently achieved High Status in the past and is currently *Not at Risk* of failing to meet its WFD objectives. See [Demonstration Catchment Selection Report](#) for further information on the catchment selection process.

The Awbeg (Kilbrin) Demonstration Catchment, in County Cork, is so named to differentiate it from the much larger Awbeg River which flows through nearby Buttevant. It was selected primarily due to the co-occurrences of agricultural pressures on High Status Objective rivers and the absence of the new ACRES Cooperation Project Areas.

The Awbeg (Kilbrin) demonstration catchment, was selected using data for the Blackwater (Munster)_SC_060 sub-catchment. The Blackwater (Munster) SC 060 comprises a single water body, the Blackwater (Munster) 090. This waterbody incorporates the river known locally as the Awbeg, along with a section of the main channel of the Blackwater River.

The demonstration catchment comprises the Awbeg River element of the Blackwater (Munster) 090 waterbody along with another river waterbody, the Lisduggan North_010, known locally as the Kertaghy River. The Lisduggan_North_010 was added to the demonstration catchment because, although assigned to the neighbouring sub-catchment (Blackwater (Munster)_SC_090), the Lisduggan_North_010 flows into the Awbeg River and can therefore affect water quality in the demonstration catchment. A map of demonstration catchment, along with the sub catchments and waterbodies mentioned above is included in Figure 1.

Blackwater (Munster)_090 is a High status objective waterbody, currently at Good ecological status, with WFD risk in *Review*. The Lisduggan_North_010 is not monitored under WFD. It has a Good status objective, but was assigned High ecological status for the 2013-2018 reporting period, based on grouping and categorised as *Not at Risk*.

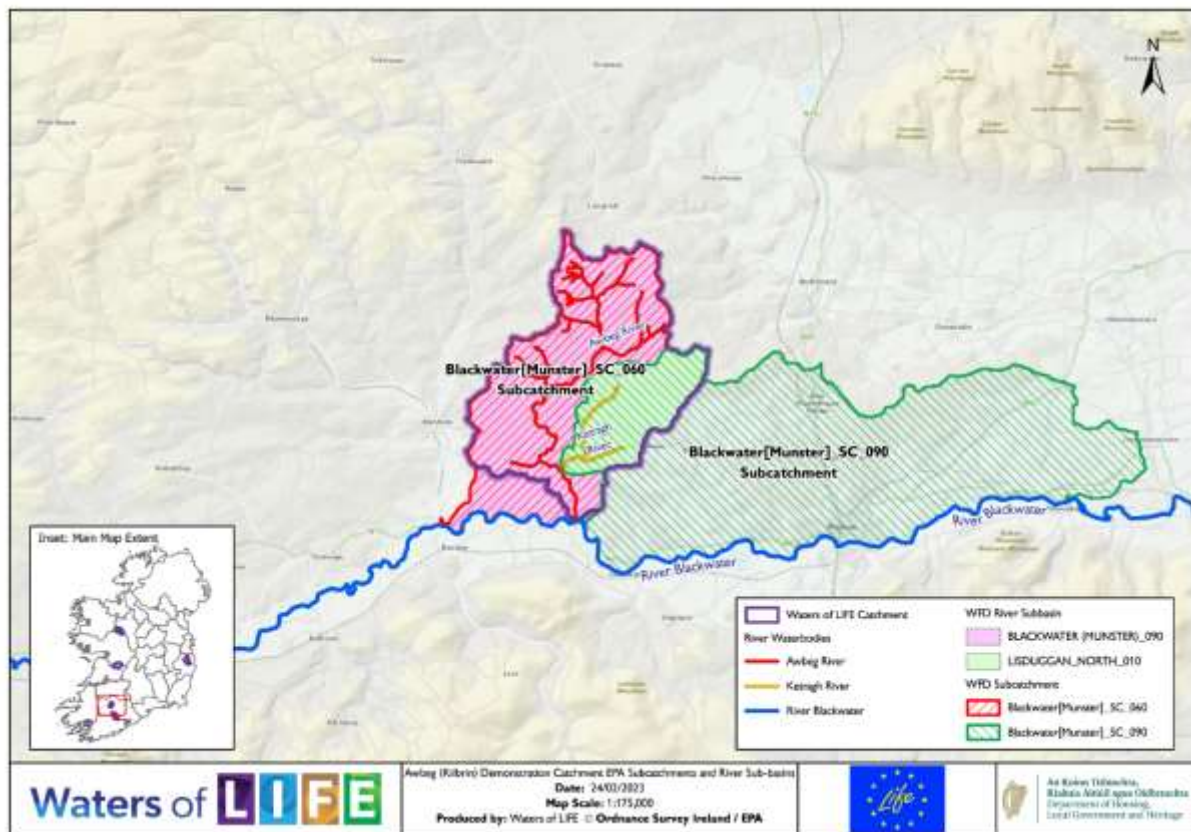


Figure 1: Relationship between Awbeg(Kilbrin) Demonstration Catchment and relevant WFD Sub Catchments and Waterbodies

1.2 Summary information

A schematic of the demonstration catchment is provided in **Figure 2**: Schematic drawing of the catchment

. **Figure 3** shows the location of the catchment, 2013-2018 ecological status for Lisduggan_North_010 and Blackwater (Munster)_090 and WFD monitoring locations on Blackwater (Munster)_090. Summary information on WFD risk, ecological status, known pressures and associated significance for both waterbodies is presented in **Table 1**. However, as outlined elsewhere in this report, the information provided for Blackwater (Munster)_090 reflects the entire waterbody and a significant upstream river system including the Allow, Owentaraglin, Glen (Banteer), Finow (Blackwater) and the upper Blackwater (Munster) and is not necessarily reflective of water quality status, risk or pressures in the Awbeg (Kilbrin) river.

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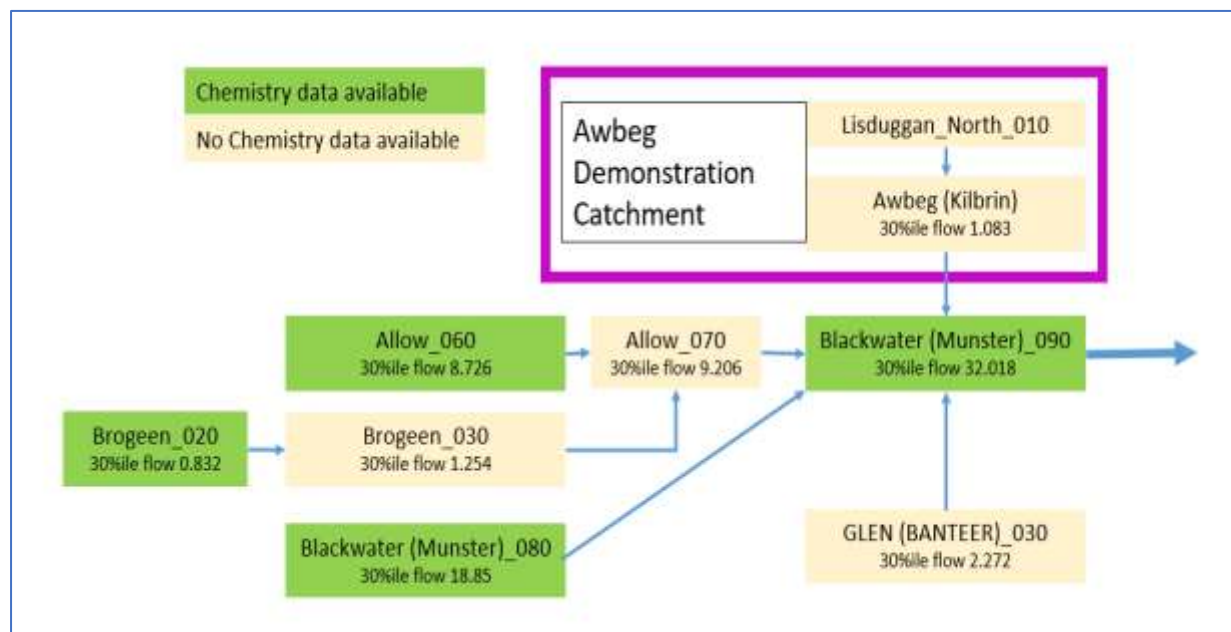


Figure 2: Schematic drawing of the catchment

Table 1: Summary of ecological status and pressures for demonstration catchment.

Name	WB Code	Risk	High status obj.	Ecological Status				Pressure Category	Pressure Sub-category	Sig. Pressure
				2007 – 2009	2010 – 2012	2010 – 2015	2013 – 2018			
Blackwater (Munster)_090	IE_SW_18 B021200	Review	Yes	HES	GES	GES	GES	HYMO	Embankments	Yes
								UWWTs	Banteer and Environs	No
								Agriculture	Agriculture	Yes
Lisduggan_North_010	IE_SW_18 L450760	NAR	No	U	U	U	HES	N/A	N/A	N/A

RWB = River water body, NAR = Not at Risk, HES= High Ecological Status, GES = Good Ecological Status, U = Unassigned, Hymo = Hydromorphology, UWWT = Urban Wastewater Treatment

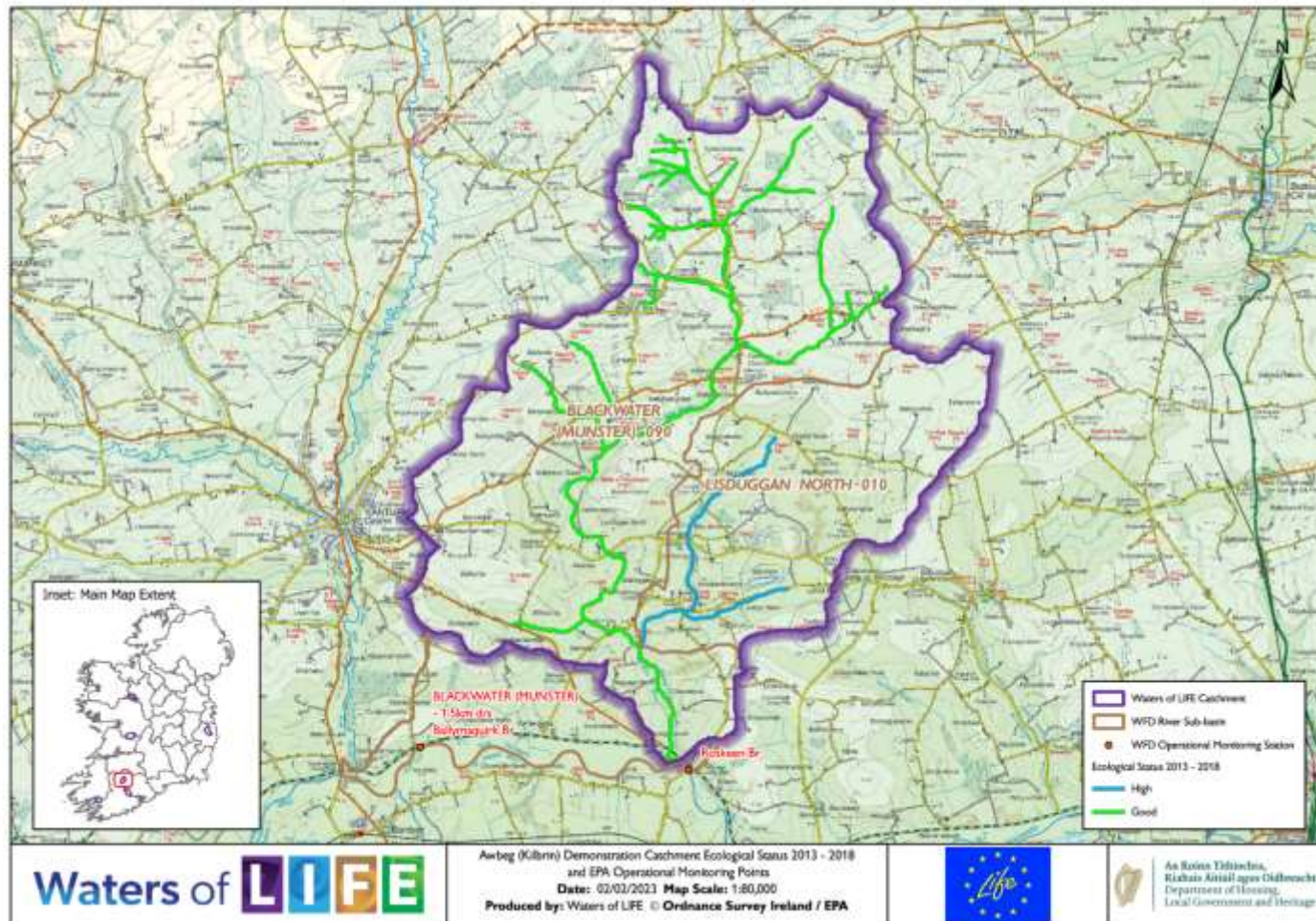


Figure 3: Overview map of catchment showing 2013-2018 ecological status and WFD monitoring locations.

Note that the demonstration catchment only incorporates the upper part of the Blackwater (Munster)_090 river waterbody. 2013-2018 ecological status shown on the map is for the entire waterbody. 2013-2018 status for Lisduggan_North_010 was assigned based on grouping as this waterbody is not monitored under WFD.

2 Receptor information & assessment

The Awbeg (Kilbrin) Demonstration Catchment comprises the Lisduggan_North_010 river waterbody and the northern tributary of the Blackwater (Munster)_090, known locally as the Awbeg (Kilbrin) river, which flows into the main Blackwater (Munster) river channel approximately 200m upstream of Roskeen Bridge.

There are no water quality monitoring data available for the demonstration catchment itself. Lisduggan_North_010 is not monitored under WFD. There are two WFD monitoring stations on Blackwater (Munster)_090, 'BLACKWATER (MUNSTER) - 1.5km d/s Ballymaquirk Br', upstream of the demonstration catchment and 'Roskeen Bridge' at the waterbody outlet. While the Roskeen Bridge station is downstream of the confluence with the Awbeg (Kilbrin) and thus downstream of the demonstration catchment, it is also downstream of several significant river systems, including the Allow, Owentaraglin, Glen (Banteer), Finow (Blackwater) and the upper Blackwater (Munster). Monitoring results for Roskeen Bridge therefore are representative of conditions in a much larger river system than the Awbeg (Kilbrin) tributary.

WFD monitoring results for the Blackwater (Munster)_090 are included for information purposes in Appendices I and II of this report.

2.1 Context and setting

Blackwater (Munster)_090 is a Blue Dot waterbody, which means it has a High ecological status objective under WFD. As the Awbeg (Kilbrin) forms part of the Blackwater (Munster)_090, High status is also an appropriate objective here. Lisduggan_North_010 has a Good status objective.

Blackwater (Munster)_090 is not meeting its High status objective for the 2013-2018 reporting period, requiring mitigation measures to restore to High status. Cycle 3 risk is in *Review*. Lisduggan_North_010 is not monitored under WFD but has been assigned High status for 2013-2018, based on grouping. Risk category is *Not at Risk*. If field assessments confirm Good status here, this waterbody will be considered for protection measures by Waters of Life. If assessments indicate that status is less than good, mitigation measures will be required.

The main channel of the Munster Blackwater is an SAC with many qualifying interested including Otter, Salmon, Lamprey, Twaite Shad and Freshwater Pearl Mussels among others. The SAC includes the lower 2-3km of the Awbeg (Kilbrin) before it joins the Blackwater.

2.2 Biological data

There are no monitoring data available for the demonstration catchment. There are two WFD operational monitoring points on Blackwater (Munster)_090. 'BLACKWATER (MUNSTER) - 1.5km d/s Ballymaquirk Br' and 'Roskeen Bridge'. Both stations are outside the demonstration catchment. The Roskeen Bridge monitoring point is located at the waterbody outlet. Q results for both stations are included for information purposes in Appendix II.

2.3 Hydrochemistry

2.3.1 Load apportionment in the catchment

Chemistry monitoring is only carried out at the Roskeen Bridge monitoring point on the main channel of the Blackwater and thus reflects the contribution from the combination of rivers in the demonstration catchment (Awbeg and Lisduggan North) and all rivers further upstream in the Blackwater (Munster) catchment. It is therefore not possible to determine with certainty from the desk if there are nutrient issues affecting the Awbeg Demonstration Catchment.

It is possible however to calculate some estimates using modelled flow data and measured nutrient concentration averages. **Figure 2:** Schematic drawing of the catchment

shows a schematic of the catchment contributing to the Roskeen Bridge monitoring point downstream of the demonstration catchment and highlights the waterbodies which are monitored for nutrients. When a river is monitored, information on all upstream rivers is also captured. By assuming that the nutrient load in Blackwater (Munster)_090 is the sum of all inputting rivers, we can subtract those where nutrients are monitored to estimate the unaccounted for load and estimate the concentration in the demonstration catchment.

Areas where nutrient load can be calculated are highlighted in green in **Figure 4**. These are subtracted from the total (red border) to leave the load generated in the yellow section which includes the demonstration catchment.

The waterbodies of most interest are Blackwater (Munster)_080, Glen (Banteer)_030 and Allow_070 as these combine with the demonstration catchment to form the Blackwater (Munster)_090 (**Figure 2:** Schematic drawing of the catchment

). Of these, only the Blackwater (Munster)_080 is monitored for nutrients. Though the Allow_070 is not monitored, inputting rivers the Allow_060 and Brogeen_020 are (Brogeen_030 is not).

Using average concentrations for phosphate and nitrate from 2019 – 2021 (inclusive) and the 30th percentile flow from the EPA HydroTool, the contribution of the monitored rivers to the load measured in the Blackwater (Munster)_090 was calculated. This allowed the load from the unmonitored rivers to be estimated. The data indicate that the remaining river sub-basins including those in the demonstration catchment have an estimated average phosphate concentration of 0.018 mg/l P and nitrate of 2.8 mg/l N or 5.66 and 877.12 kg/day respectively. Comparing these estimated averages with the phosphate mean High status EQS of 0.025mg/l-P and the nitrate surrogate limit of

0.9mg/l-N, suggests that nitrate is a potential significant issue impacting water quality in the demonstration catchment but that phosphate is potentially less of an issue here.

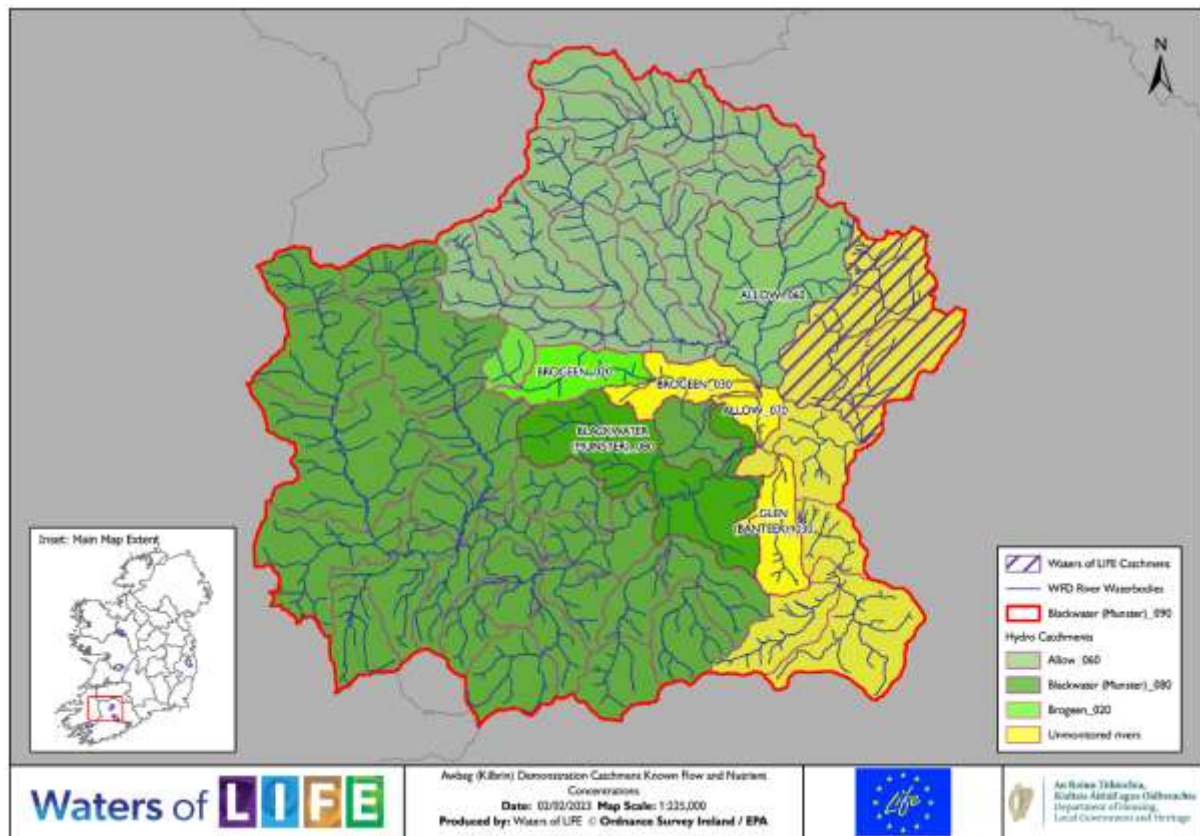


Figure 4: Areas of known flow and nutrient concentrations contributing to Blackwater_090.

Note that Hydro Catchments are styled and named according to the lowest waterbody e.g. Allow_060 is all rivers that contribute to the Allow_060.

2.3.2 Blackwater (Munster)_090

Chemistry monitoring data are available for the Roskeen Bridge WFD monitoring point on Blackwater (Munster)_090 but as outlined earlier, results for this station reflect the contribution of all rivers upstream in the Blackwater (Munster) catchment, of which the demonstration catchment comprises only a small part. Orthophosphate, nitrate, ammonium and BOD results at Roskeen Bridge are graphed for information purposes in Appendix III (i) to III (iv) and briefly discussed below.

Orthophosphate levels are elevated at Roskeen Bridge. Annual average results exceeded the mean High status EQS in 2014, 2017 and 2020 and for 2022 to date. Individual results have frequently been above the mean EQS but the 95%ile limit was exceeded on only three occasions. Nitrate concentrations have been consistently above the surrogate limit for high status (0.9mg/l) since monitoring began. Annual average ammonium results have been below the mean High status EQS

since monitoring commenced and the 95%ile limit has not been exceeded. Individual BOD results exceeded the 95%ile limit on six occasions since monitoring commenced and annual average results were above the mean High status EQS in 2014, 2017, 2021 and in 2022 to date.

3 Significant pressure information

3.1 EPA initial characterisation

The demonstration catchment comprises the Lisduggan_North_010 waterbody and the Awbeg (Kilbrin) river which forms part of the Blackwater (Munster)_090 waterbody. EPA initial characterisation was not undertaken for the Lisduggan_North_010 as this waterbody was not considered to be *At risk* of not achieving its WFD Good status objective. Initial characterisation for Blackwater (Munster)_090 predicted Hydromorphology (Embankments) and Agriculture as potential significant pressures here (see Appendix IV). Hydromorphology was identified as a pressure due to the presence of embankments downstream of Ballymaquirk bridge, outside the demonstration catchment and therefore not relevant to this desk study. However hydromorphology should be assessed in the field as a potential pressure. MQI scores are mainly Good across the study area, apart from High scores along the lower reaches of the Awbeg (Kilbrin) from approximately 5.6km down to 1.4km upstream of the catchment outlet (**Figure 8**). Agriculture is also a potential pressure, considering the extent of high PIP areas for both N and P in the catchment. There are several point sources requiring field assessment, including two urban wastewater treatment plants, a developer provided infrastructure system and several quarries.

Potential pressures are discussed below.

3.2 Urban waste water

There are two urban wastewater treatment plants (WWTPs) in the demonstration catchment, Kilbrin and Castlemagner, the locations of which are shown in **Figure 6**. Both facilities operate under EPA Certificates of Authorisation (COAs), Kilbrin under [A0340-01](#) and Castlemagner under [A0324-01](#).

The pollution risk posed by these discharges at the outlet of the demonstration catchment was assessed by determining headroom utilisation under 95%ile flow conditions. Results are presented in **Table 2**. Data used in the calculations is as follows:

- River flow was based on the EPA HydroTool estimated 95thile flow at the outlet of the Awbeg (HydroTool seg code 18_1933) which includes the Lisduggan_North_010 flow contribution.
- As no monitoring data were available on final effluent quality from either facility, LAWPRO's Urban Waste Water (UWW) assessment methodology was used to determine an estimated effluent loading from each, based on Population Equivalent (PE). Kilbrin loading estimate was based on a PE of 213 and secondary treatment. The inspector's report for the Castlemagner COA application (2011) states that the Castlemagner agglomeration P.E. at that time was 50,

with primary treatment only. This figure was used to determine the Castlemagner effluent loading estimate.

- In order to allow assessment of the contribution of each COA effluent in isolation, notional clean water values were assumed for upstream water quality in the calculations.
- Headroom utilisation was assessed against 95%ile EQSs for High status: BOD, 2.2mg/l-O₂; orthophosphate, 0.045mg/l-P; ammonium, 0.09mg/l-N.

Under LAWPRO's UWW assessment methodology, headroom utilisation greater than 50% is considered indicative of potential pollution risk. This precautionary approach is taken to allow for errors in river 95%ile flow estimates.

Table 2 Headroom utilisation at outlet of Awbeg from Kilbrin and Castlemagner COAs at 95thile flow

	Kilbrin			Castlemagner		
	Load (kg/day)	D/S concentration (mg/l)	% Headroom Used	Load (kg/day)	D/S concentration (mg/l)	% Headroom Used
B.O.D.	4.473	0.7	22	2.10	0.47	11
PO ₄ -P	0.213	0.026	52	0.11	0.016	27
NH ₄ -N	0.464	0.05	111	0.20	0.03	48

The calculations show that the Kilbrin discharge is of concern in low river flows, potentially utilising more than 100% of the available headroom for ammonium and over 50% of the available headroom for phosphate at 95%ile flow (**Table 2**). This indicates that the potential impact of the discharge should be investigated in the field in low river flows.

Despite its limited treatment, the low PE loading to the Castlemagner COA plant results in estimated BOD and phosphate concentrations at the demonstration catchment outlet well below the relevant high status EQSs at 95%ile flow, with headroom utilisation of 11% and 27% respectively. Headroom utilisation for ammonium is marginally below 50%.

The Castlemagner COA discharge was also assessed as a potential pressure at the outlet of the Lisduggan_North_010 waterbody under 95%ile flow conditions (HydroTool seg code 18_2444). Results, shown in **Table 3**, indicate that there is a potential pollution risk in low flow conditions, with ammonium headroom utilisation at 120% and phosphate at 67%. Field investigation in low river flow is required to confirm. There is also a potential proximity issue here which requires field investigation upstream and downstream of the discharge.

Table 3: Headroom utilisation at outlet of Lisduggan_North_010 from Castlemagner COA at 95%ile river flow

	Upstream conc (notional clean) (mg/l)	Final D/S Conc mg/l	Percentage Headroom utilised
BOD	0.260	0.775	27
MRP	0.005	0.032	67
NH4N	0.008	0.106	120

3.3 Other point sources

In addition to the two WWTPs discussed above, there is a Developer Provided Infrastructure (DPI) WWTP for a large estate (approx. 72 dwellings) at Castlemagner which discharges to the river approx. 400 meters downstream of the Castlemagner UWWTP. There are no monitoring data available for the DPI, making desk-based assessment difficult for this potential pressure. The PE loading to this system will be significantly higher than for the Castlemagner plant. Therefore, depending on the level of treatment and on how the system is managed, there is a potential pollution risk. This risk should be assessed by field investigation in low river flow conditions.

There are several active and inactive quarries in the catchment as well as in the Lisduggan_North_010 sub basin. An unusual potential pressure from one of these former quarries is the non native crayfish *Cherax destructor* (Yabbie) which is native to Australia. This former quarry is currently used as an activity centre and is in close proximity to the river in Lisduggan_North_010 (**Figure 7**). This is under investigation by Sweeny Consultancy and at the time of writing no records exist outside of the former quarry lakes.

There is also a possible point source near the top of the Awbeg catchment on the NW side, which should be assessed in the field.

3.4 Agriculture

Agriculture in the catchment is quite variable with large areas of tillage in the centre of the catchment where well drained soils are more common. Pasture based enterprises dominate to the north and south on deeper, more poorly draining soils (**Figure 5**).

There are high risk areas (rank 1 to 3) for both N and P in the demonstration catchment (**Figure 10** and **Figure 11**). Approximately 31% of the demonstration catchment is under PIP-P rank 1 to 3 and 21% under PIP-N rank 1 to 3. There is potential for both diffuse N and P loss to waters from agriculture in the catchment.

Sediment from agriculture is difficult to estimate from the desk and little data are available from within the demonstration catchment given the location of the monitoring point on the main channel. However, tillage is reasonably common in the catchment and soils though generally better draining are a complex mosaic in the centre of the catchment providing opportunities for sediment loss (**Figure 5**). Note that natural sediment accumulation maps show moderate natural sediment accumulation along much of the Awbeg (Kilbrin) main river channel and on the lower reaches of Lisduggan_North_010 (**Figure 16**).

3.5 Hydromorphology

Hydromorphology is a potential pressure here. MQI maps show that most reaches have a good MQI score apart from three high scoring reaches (approximately 4.7km in total length) along the lower Awbeg (Kilbrin) river, upstream and downstream of the confluence with Lisduggan_North_010 (**Figure 8**). The high impact MQI indicators on the Awbeg (Kilbrin) river are related to channel morphology in the upper reaches and riparian condition for the lower c.1.6km reach upstream of the catchment outlet. The c.3km reach on Lisduggan_North_010 (upstream of the outlet) has a good MQI score. There are no high impact indicators along this reach. Medium impact indicators are related to riparian condition (F12 and F13, width and linear extent of functional riparian vegetation) and longitudinal connectivity (F1, due to the presence of a bridge within the reach). MQI is a desk-based assessment. Field assessments are needed to confirm hydromorphological condition on the ground, to identify areas with local impact and also to determine whether sediment is an issue.

3.6 Forestry

There is some commercial forestry mainly around the northern headwaters of the Awbeg (Kilbrin) river (**Figure 15**). Considering the relatively small area of the demonstration catchment under forestry, it is unlikely to be a significant pressure here but should be kept in mind as a potential pressure during local catchment assessment, particularly where forest management activities are underway.

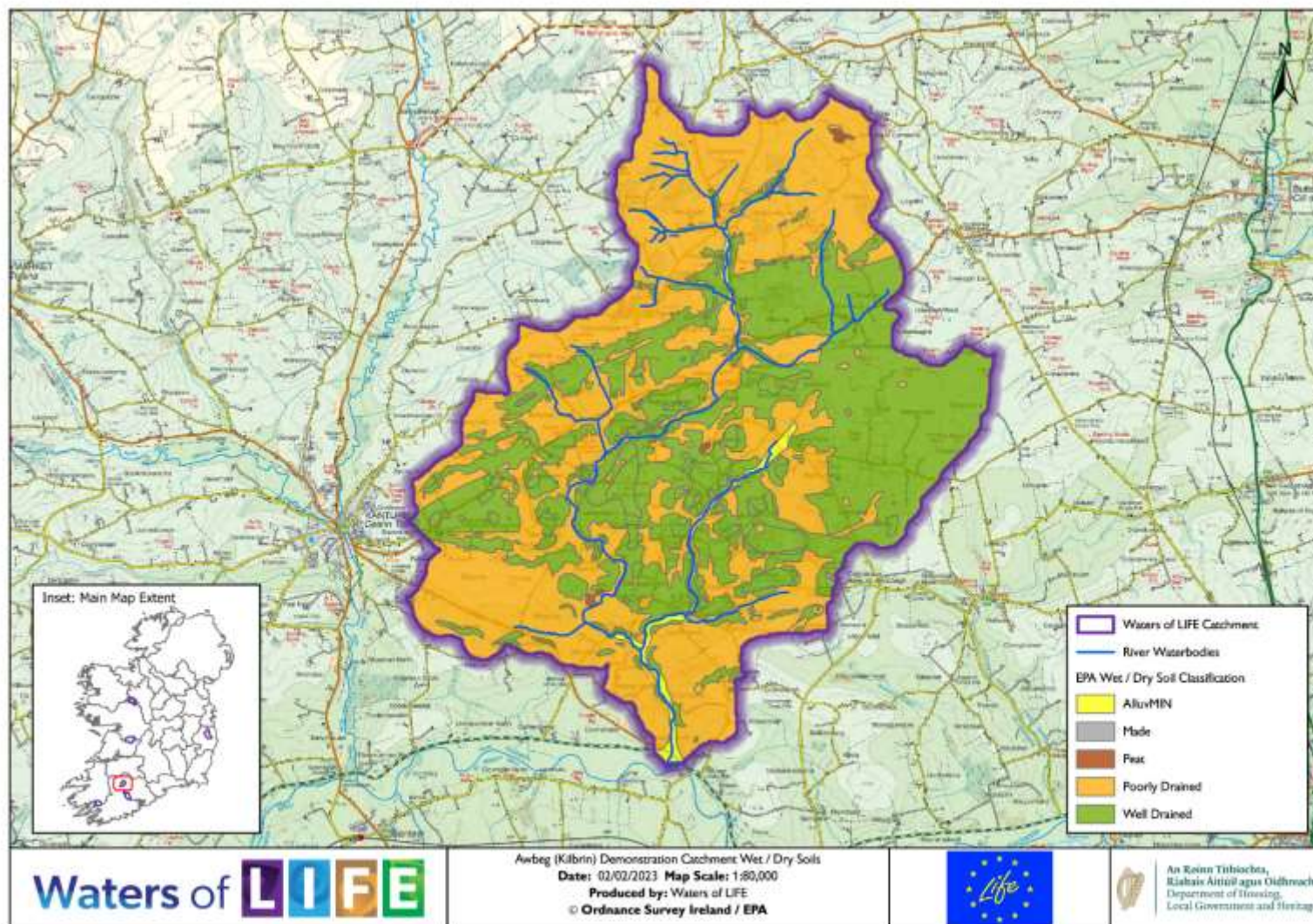


Figure 5: Wet Dry soils in the Awbeg (Kilbrin) Demonstration Catchment

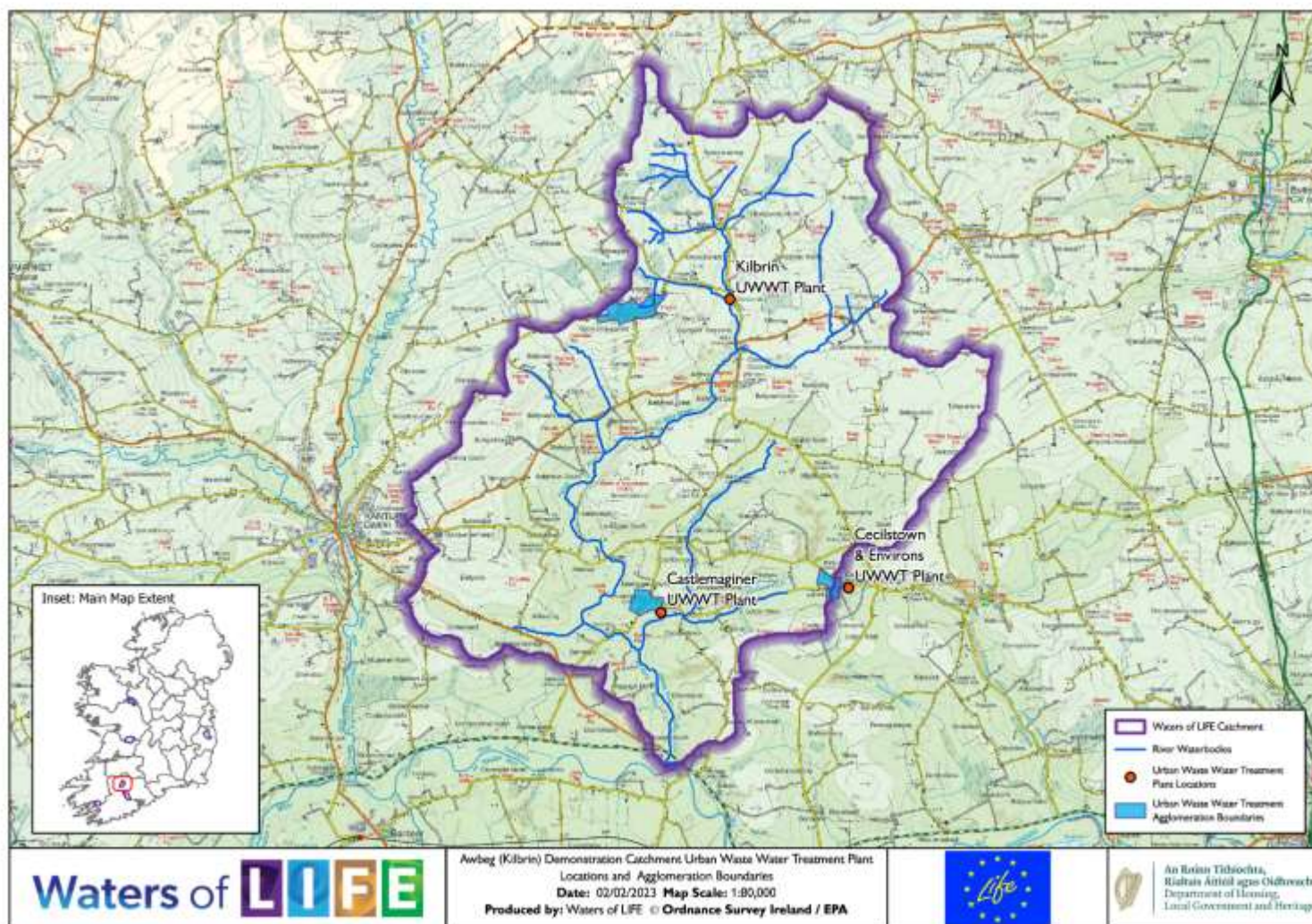


Figure 6: Locations of Agglomerations and Associated WWTPs in the demonstration catchment

3.7 Conclusion on significant pressures

It is difficult to conclude on the significant pressures that may be affecting the Awbeg (Kilbrin) as the available monitoring data are taken downstream of the confluence between this and the main channel of the Blackwater and may therefore be reflective of pressures arising upstream on the Blackwater. Biological monitoring is required to determine where the rivers and streams in the demonstration catchment are not achieving High biological condition and, where impacts are identified, chemistry sampling and sediment assessment will be required to determine the issue/s.

Modelled estimates referred to in Section 2 (see **Figure 4**) suggest that nitrate is a potential issue here, with agriculture as a potential pressure. Approximately 21% of the catchment is under PIP-N rank 1 to 3 (high risk) areas. 31% of the catchment is under PIP-P rank 1-3 areas, suggesting that phosphate from agriculture is also a potential issue here, requiring field investigation to confirm.

Two agglomerations exist in the area, one on the Awbeg (Kilbrin) with a PE of 260 and secondary treatment. The treatment plant is located at the confluence of two tributaries and it is unclear which one it discharges to. The other, Castlemagner, has an agglomeration PE of 50 with primary treatment only but well within its design PE of 100. Headroom assessment calculations indicate that the Kilbrin discharge poses a potential pollution risk at the demonstration catchment outlet in low flow conditions (**Table 2**). While Castlemagner does not appear to pose a risk at the catchment outlet, it is a potential pressure on Lisduggan_North_010.

There are point source pressures in the catchment which require field investigation to determine whether they are causing an impact, including a discharge from a DPI system in Castlemagner and several quarries.

Hydromorphology is a potential pressure requiring field investigation. MQI scores are generally good throughout most of the reaches in the catchment, except for three high scoring reaches upstream and downstream of the confluence with Lisduggan_North_010. MQI scores are a desk based assessment and require local field investigation to confirm.

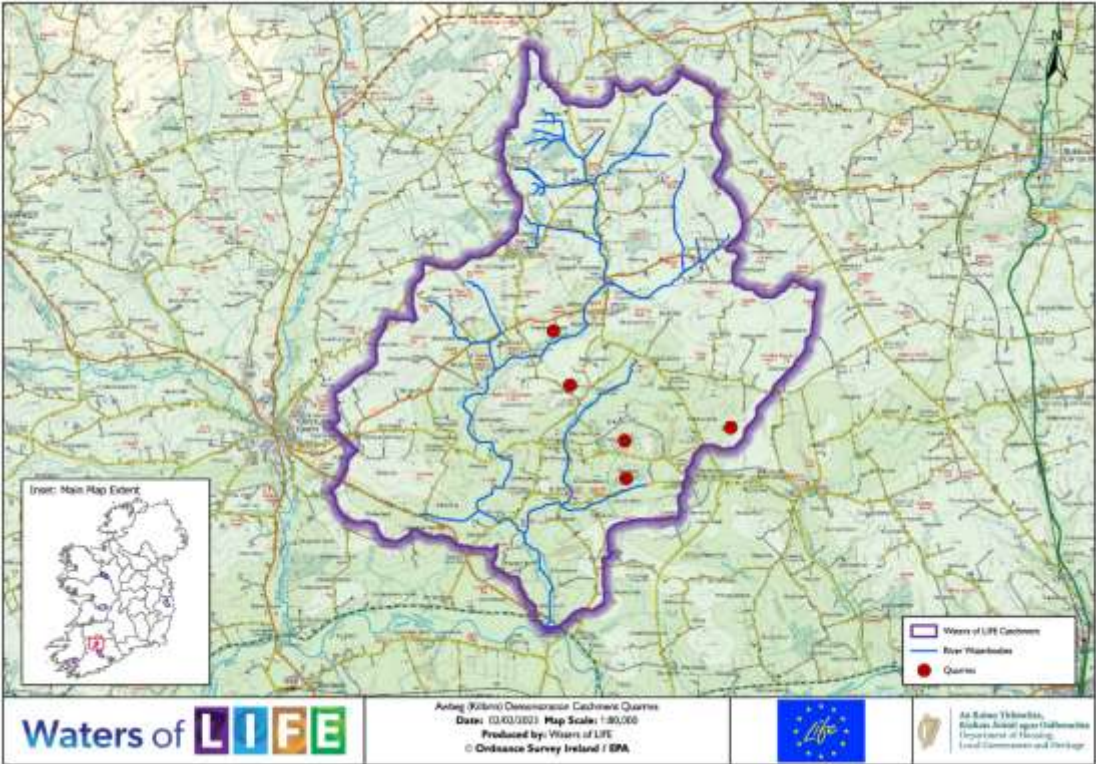


Figure 7: Demonstration catchment showing locations of active and former quarries



Figure 8: Demonstration catchment showing Morphological Quality Index Classes

4 Pathway information & analysis

4.1 Conceptual model development

The demonstration catchment is underlain by multiple groundwater bodies including Banteer, Glenville, Kilmaclenine, Mitchelstown and Rathmore. These are of mixed character but Banteer and Mitchelstown are both Karstic while the others are generally dominated by sandstone with some shale (**Table 4**).

The area has been separated into 3 compartments (**Figure 9** and **Table 4**):

- Compartment 1 is karstic with a mix of well and poorly draining soils. Pathways will include overland flow in areas of poorly draining soil and shallow to deep groundwater flow in well draining areas. Particular attention will be required around swallow holes and springs (**Figure 9**). Tracing has not been undertaken by GSI and so tracing karst related pathways could prove difficult.
- Compartment 2 is characterised by well draining soil and mostly locally important aquifers (**Figure 9**) generally of mudstone and siltstone. Pathways will generally be shallow subsurface with some deeper pathways possible where faults occur.
- Compartment 3 is characterised by poorly draining soils and mostly locally important aquifers generally of mudstone and siltstone (**Figure 9**). Pathways will generally be overland with phosphate loss likely the biggest nutrient concern in these areas.

Table 4: Summary of conceptual model and pathways information

	Compartment 1 (Karstic)	Compartment 2 (Well Draining)	Compartment 3 (Poorly Draining)
Location	See Figure 9	See Figure 9	See Figure 9
Direct	Unknown	Unknown	Unknown
Aquifer type	Mostly regionally important aquifer – karstified diffuse Some locally important aquifer – Bedrock which is moderately productive only in local zones Very small amount of poor Aquifer – Bedrock which is generally unproductive (Figure 12).	Mostly locally important aquifer – Bedrock which is moderately productive only in local zones. Small amount of poor Aquifer – Bedrock which is generally unproductive (Figure 12).	Mostly locally important aquifer – Bedrock which is moderately productive only in local zones. Some poor Aquifer – Bedrock which is generally unproductive (Figure 12)
Topography	Flat to undulating	0-200m	Upland plateau, general elevation 160-240m
Groundwater body (GwB)	Mitchlestown and Banteer	Glenville and Kilmaclenine	Rathmore
Gwb flowpath	Most of groundwater flow likely through karstic diffuse flow with some through faults in sandstone areas	Generally through fractures in upper layers of sandstone	Generally through fractures in upper layers of sandstone
Subsoil permeability	Low to moderate or subsoil <3m (Figure 14).	Low to moderate (extensive areas moderate) or subsoil <3m (Figure 14)	Mostly moderate with some areas <3m (Figure 14)
Soil drainage	Mix of Well and Poorly Draining	Well Draining	Poorly Draining
Groundwater vulnerability	Large areas extreme or rock at or near surface/karst	Mixed but significant areas high with some extreme and rock at or near surface	Very mixed, large areas low but some high to extreme
PO₄ susceptibility	Mixed	Low	High
NO₃ susceptibility	Moderate to low	Moderate to low	Low
Po₄ PIP surface water	Mixed, limited areas high (Figure 11)	Low (Figure 11)	Mixed, some areas high (Figure 11)
NO₃ PIP surface water	Mixed, limited areas high (Figure 10)	Mostly low with limited areas in the east of Lisduggan_010 sub-basin high (Figure 10)	Low (Figure 10)
Flowpaths	Mostly subsurface, with mixture of shallow subsurface through well draining soils and through deeper karstic features. Some potential for surface runoff in limited areas of poorly draining soil	Subsurface, through soil, subsoil or shallow groundwater via faults	Surface

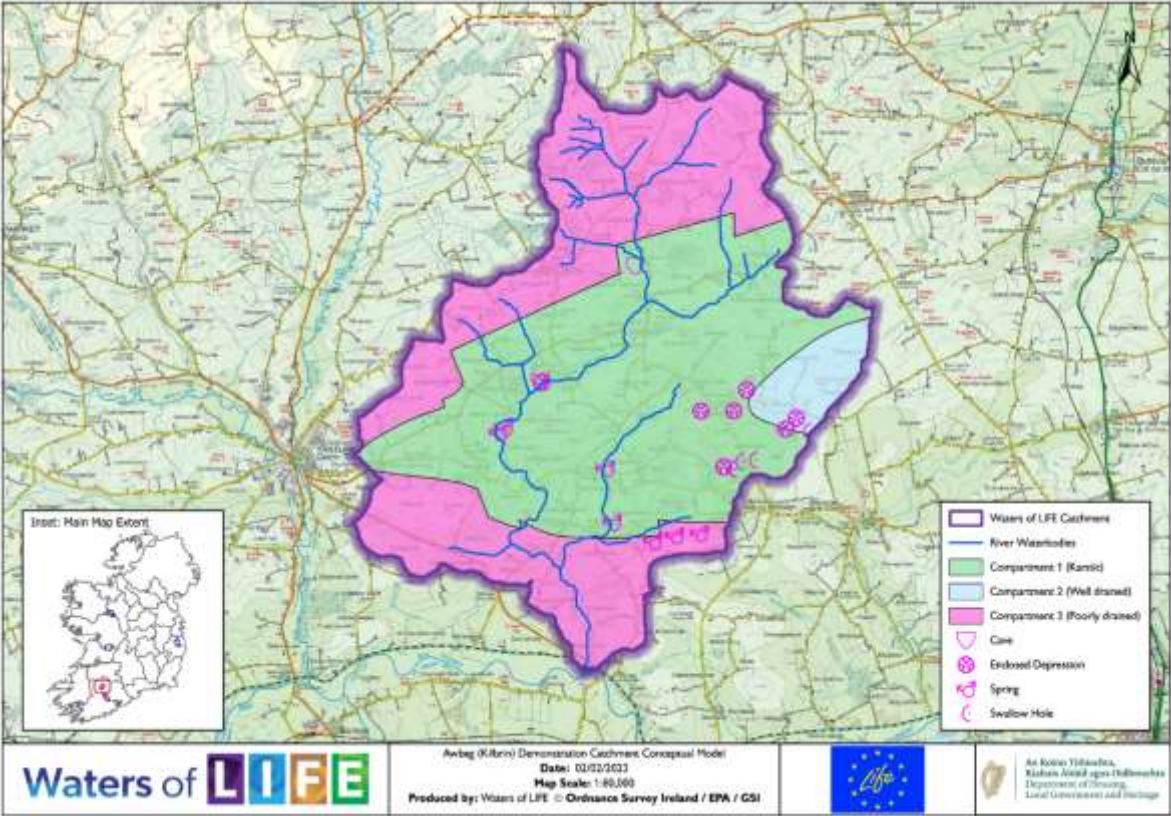


Figure 9: Demonstration catchment compartments for conceptual model

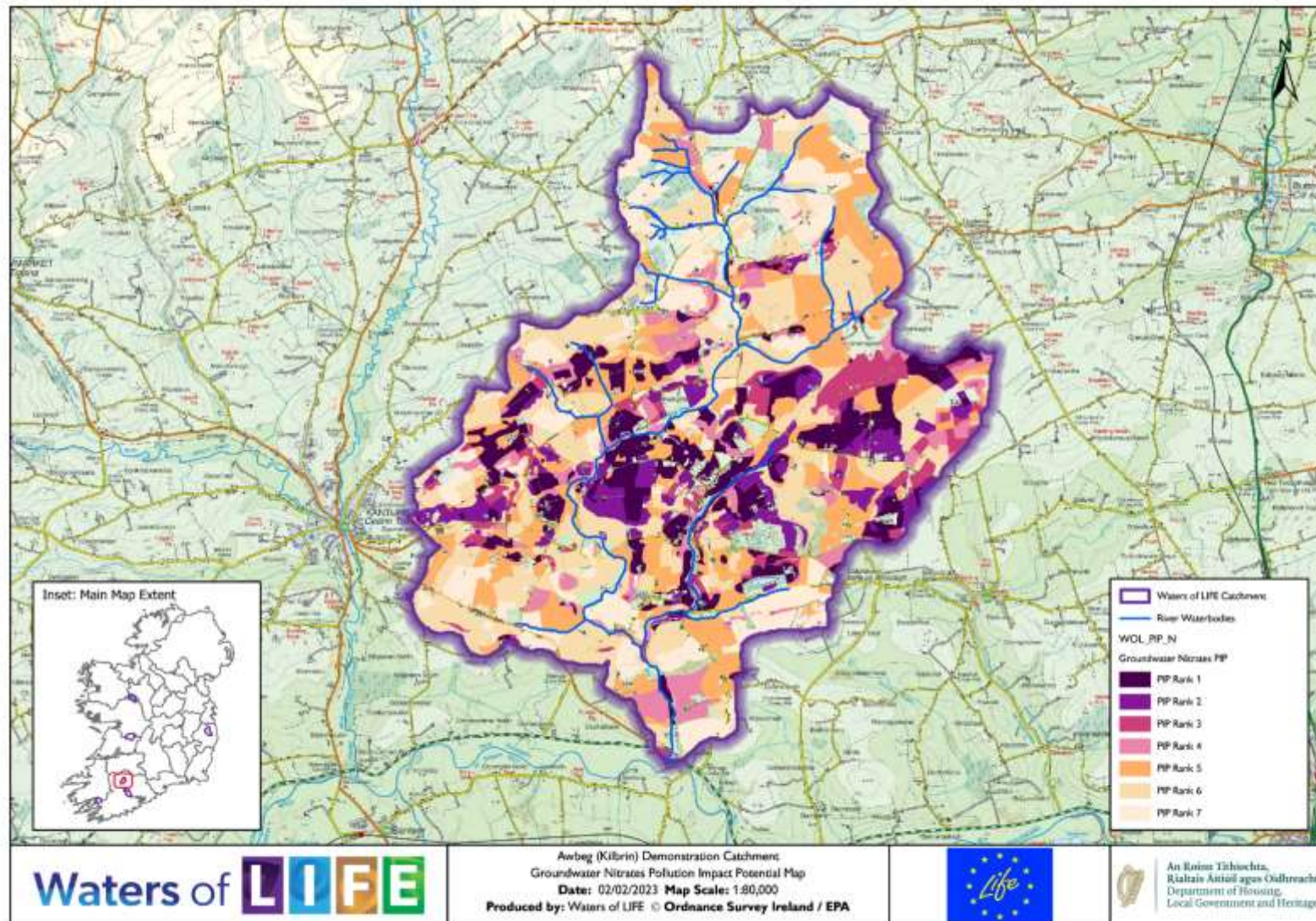


Figure 10: Demonstration catchment nitrate to surface water PIP map

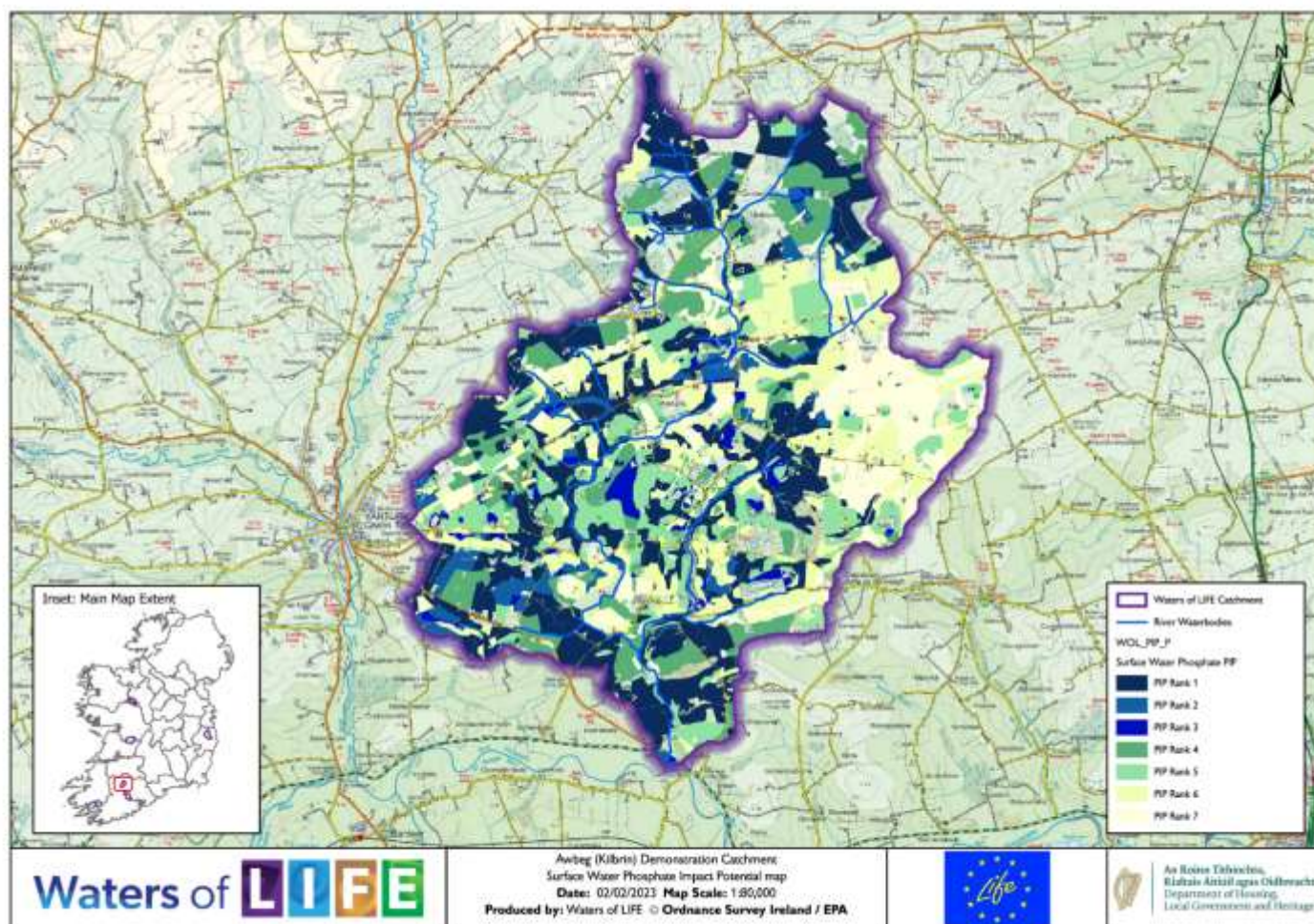


Figure 11: Demonstration catchment phosphate to surface water PIP map

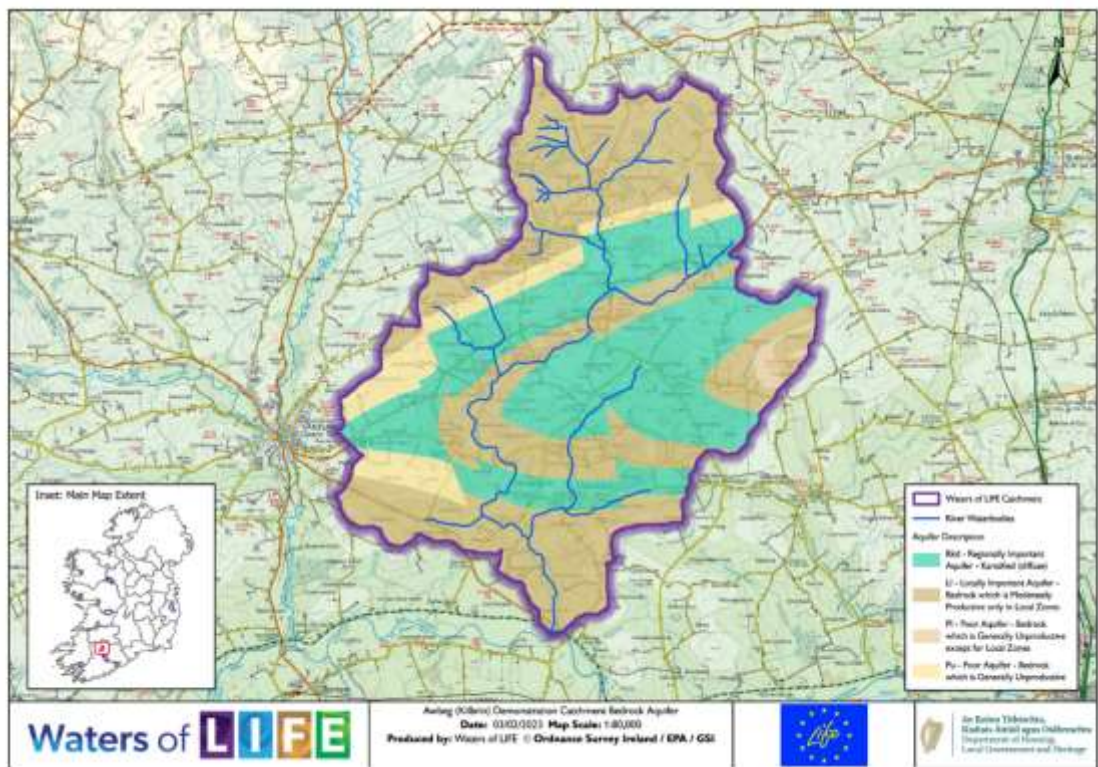


Figure 12: Demonstration catchment bedrock aquifer map

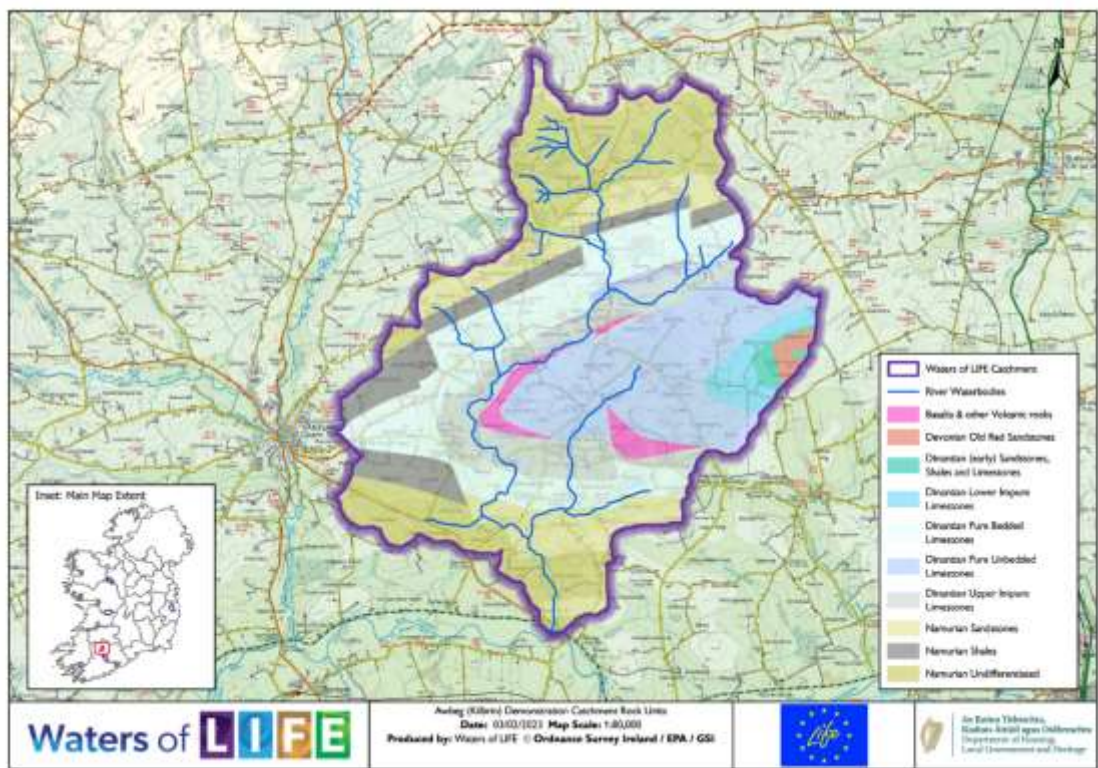


Figure 13: Demonstration catchment bedrock map

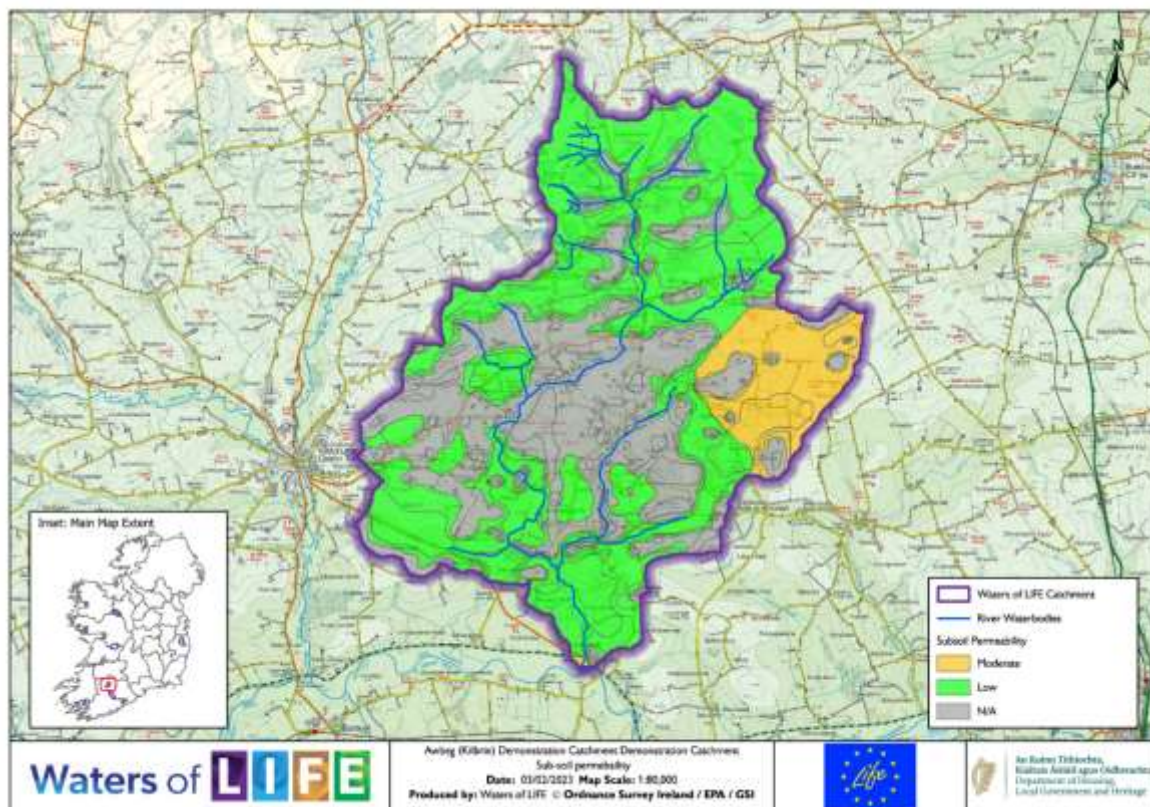


Figure 14: Demonstration catchment subsoil permeability.

5 Interim story of demonstration catchment

The Awbeg (Kilbrin) Demonstration Catchment is modified from the Blackwater[Munster]_SC_060 subcatchment which comprises part of a single river waterbody, the Blackwater(Munster)_090 (High status objective). The subcatchment consists of a tributary of the Blackwater (the Awbeg (Kilbrin) river) as well as a section of the main Blackwater (Munster) river channel from Ballymaquirk Br to Roskeen Br. As improving water quality on the main channel of the Blackwater (Munster) is beyond the scope of the Waters of Life project, the demonstration catchment comprises only the Awbeg (Kilbrin) tributary of the Blackwater (Munster)_090 and the Lisduggan_North_010 waterbody, which lies in adjacent subcatchment Blackwater[Munster]_SC_090 and which discharges to the Awbeg (Kilbrin) downstream of Castlemagner.

The Awbeg (Kilbrin) river is not monitored under WFD. The WFD monitoring point at Roskeen Bridge on Blackwater (Munster)_090 is downstream of the confluence with the Awbeg (Kilbrin) but also downstream of several significant river systems so results at this site may not be representative of the Awbeg (Kilbrin) itself. Blackwater(Munster)_090 is currently at Good ecological status and *At Risk* as

it has a High status objective. High status is also an appropriate objective for the Awbeg (Kilbrin) as this river forms part of the Blackwater (Munster)_090.

Lisduggan_North_010 is not monitored under WFD. From information in the WFD App, it was assigned High ecological status for the 2013-2018 reporting period, extrapolated based on grouping, and is *Not at Risk*.

Nutrients and BOD levels are slightly elevated at the Roskeen Br WFD monitoring point on Blackwater (Munster)_090, downstream of the demonstration catchment but it is not clear whether the source of these is from the Awbeg or upstream on the Blackwater or one of its tributaries. This will have to be established by LCA work.

If nutrients are confirmed to be an issue in the demonstration catchment, potential pressures include WWTP and/or agriculture. There are two UWW discharges from two small agglomerations, one on the Awbeg and another on the Lisduggan_North_010, which will need to be assessed during LCA. Phosphate PIP maps show that approximately 31% of the demonstration catchment is under PIP-P rank 1 to 3 (**Figure 11**). Nitrate PIP maps indicate that 21% of the catchment is under PIP-N rank 1-3 (**Figure 10**) If the nutrient enrichment is originating on the Awbeg and the WWTPs are not the major contributor then these along with karst features such as sink holes would be the areas to focus assessment and mitigation efforts on.

Hydromorphology is a potential pressure requiring field investigation. The MQI shows mainly Good condition throughout (**Figure 8**).

Other potential pressures include forestry and several point sources, the impact of which should be assessed during LCA work.

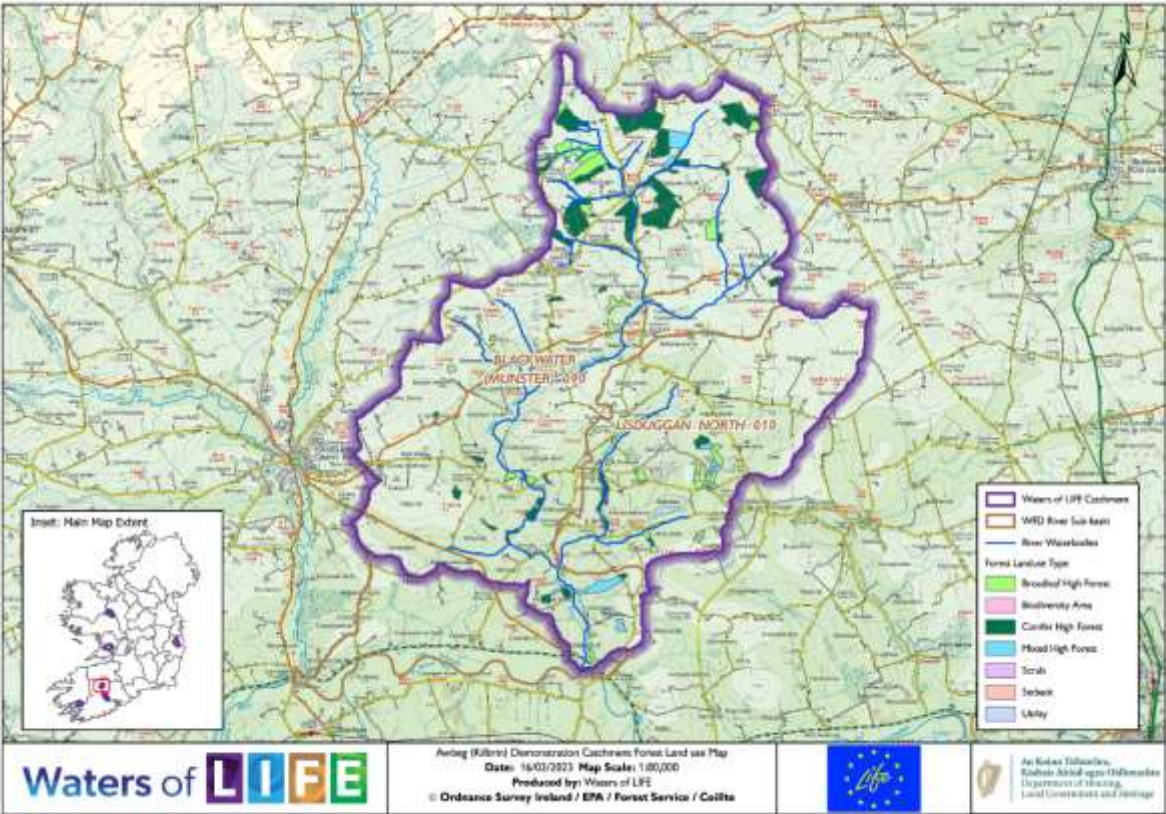


Figure 15: Forestry in the demonstration catchment

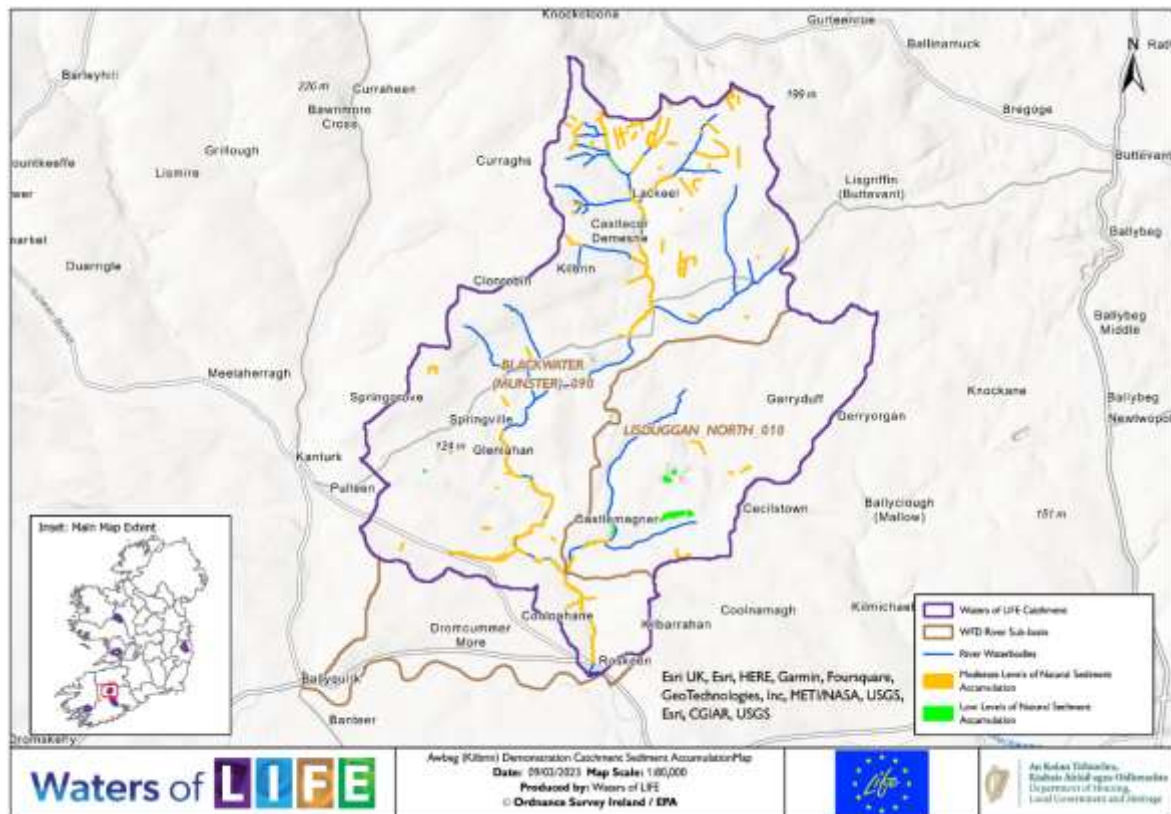


Figure 16: Natural sediment accumulation map, Awbeg (Kilbrin) Demonstration Catchment

6 Work plan

6.1 Local catchment assessment

Catchment assessment will include fairly extensive initial sampling to establish baseline Small Streams Impact Score/Rapid Assessment (SSIS/RA), chemical and hydromorphological condition and to inform further catchment assessment. Assessment locations are shown in **Figure 17** & **Figure 18**. Site 1 is located at pre WFD monitoring station AWBEG (KANTURK) – Bridge u/s Blackwater river. This appears to be an accessible location immediately downstream of the demonstration catchment.

- Sites 2 and 3 were chosen to assess impact on the Awbeg (Kilbrin) from the Lisduff_North_010.
- Site 4 is on the Lisduff_North_010 close to the waterbody outlet and downstream of the Castleknock COA discharge.
- Sites 8 and 9 were chosen to examine whether the quarry between these points is having any impact.

- Sites 12 and 13 were chosen to establish whether there is an impact from the Kilbrin COA discharge and to see if either tributary is impacted. It is unclear which of these tributaries the WWTP discharges to and so LCA will establish which will require an upstream assessment. It is important that the UWW assessment is undertaken in low river flow conditions.
- Site 14 was chosen to identify whether there is a point source discharge upstream and if so, whether it is causing an impact.
- Sites 5, 6, 10, 11, 15 and 16 on the Awbeg (Kilbrin) were selected simply because the river splits into tributaries at these points and if one is impacted then the LCA work can be focussed on this area. One exception is site 6 which was included simply because there was a large distance between this and the next upstream and downstream sampling points.
- Site 17 was selected as it is upstream of the COA discharge. Assessment at Sites 4 and 17 should include monitoring in low flow conditions.
- Sites 18 and 19 were selected to assess water quality in the two Lisduggan_North_010 tributaries.
- The purpose of the stream walk between Sites 4 and 17 is to identify the location of the discharge from the DPI system to the north. Assessments should be undertaken upstream and downstream of this point in low flow conditions to determine whether the discharge is impacting on water quality.

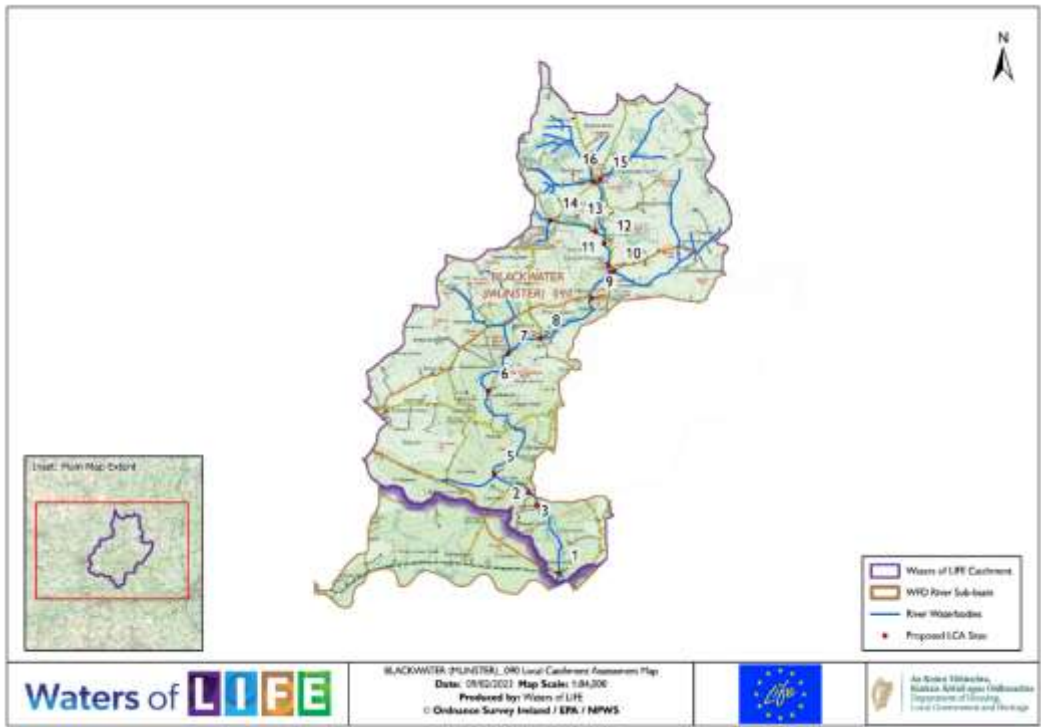


Figure 17: Field sites for initial sampling, Awbeg



Figure 18: Field sites for initial sampling, Lisduggan_North_010

7 Review of possible mitigation options

7.1 Agriculture

Agriculture is a potential significant pressure in the Awbeg (Kilbrin) Demonstration Catchment. Where local catchment assessment confirms agriculture to be a pressure, mitigation measures will depend on the issues and pathways. Soils in the demonstration catchment are a mix of poor and well draining and EPA PIP maps show high risk areas for nitrate and for phosphate loss to surface waters.

Where local catchment assessment identifies phosphate from agriculture as a significant issue, measures should include awareness raising re potential pathways from critical source areas (EPA P PIP maps) and measures to break the pathways for pollutants moving to the river (pathway interception measures), such as wetlands, expanding riparian margins etc.

If local catchment assessment identifies nitrate as a significant issue arising from agriculture on the well draining soils in the catchment, source control options are most effective. These could include reduction of nitrogen inputs, improved soil nutrient management and improving nutrient use efficiencies.

7.2 Urban wastewater and other point sources

Large point source pressures such as urban wastewater discharges, Section 4 licensed discharges or unauthorised discharges should be referred to the relevant licensing/permitting authority to address.

Appendix I: Monitoring Data and Status for Blackwater(Munster)_090 and Lisduggan North 010

Table I(i): Summary of Q-values and physico-chemical data for Blackwater (Munster)_090 and Lisduggan_North_010 river waterbodies

Waterbody		Blackwater (Munster)_090		Lisduggan_North_010
Risk Category 3 rd WFD cycle		Review		Not at Risk
WFD Objective		High		Good
Monitoring station		BLACKWATER (MUNSTER) - 1.5km d/s Ballymaquirk Br	Roskeen Br	N/A
Monitoring station type		Operational	Operational	N/A
Biological Status				
Q - values	2009		4-5	
	2012		4-5	
	2015	4	4	
	2018	4	4	
	2019		4-5	
	2020	4		
	2021		4	
Water chemistry				
PO4-P 2018			0.021	
PO4-P 2019			0.025	
PO4-P 2020			0.031	
PO4-P 2021			0.024	
NH4-N 2018			0.031	
NH4-N 2019			0.025	
NH4-N 2020			0.031	
NH4-N 2021			0.030	
NO3-N 2018			1.770	
NO3-N 2019			1.820	
NO3-N 2020			1.640	
NO3-N 2021			1.500	
Hydromorphology Information				
HYMO – RHAT		Not undertaken		
Ecological Status information				
Ecological Status (10 –15)		Good		Unassigned

Waterbody	Blackwater (Munster)_090		Lisduggan_North_010
Risk Category 3 rd WFD cycle	Review		Not at Risk
WFD Objective	High		Good
Monitoring station	BLACKWATER (MUNSTER) - 1.5km d/s Ballymaquirk Br	Roskeen Br	N/A
Unsatisfactory status driven by	Macroinvertebrates		NA
Ecological Status (13 –18)	Good		High ¹
Unsatisfactory status driven by	Macroinvertebrates		NA
EPA Biologist comments			
Protected Areas	Blackwater River (Cork/Waterford) SAC		

¹ Waterbody is not monitored under WFD. 2013-2018 ecological status was assigned based on grouping

Appendix II: Biological monitoring results for Blackwater(Munster)_090

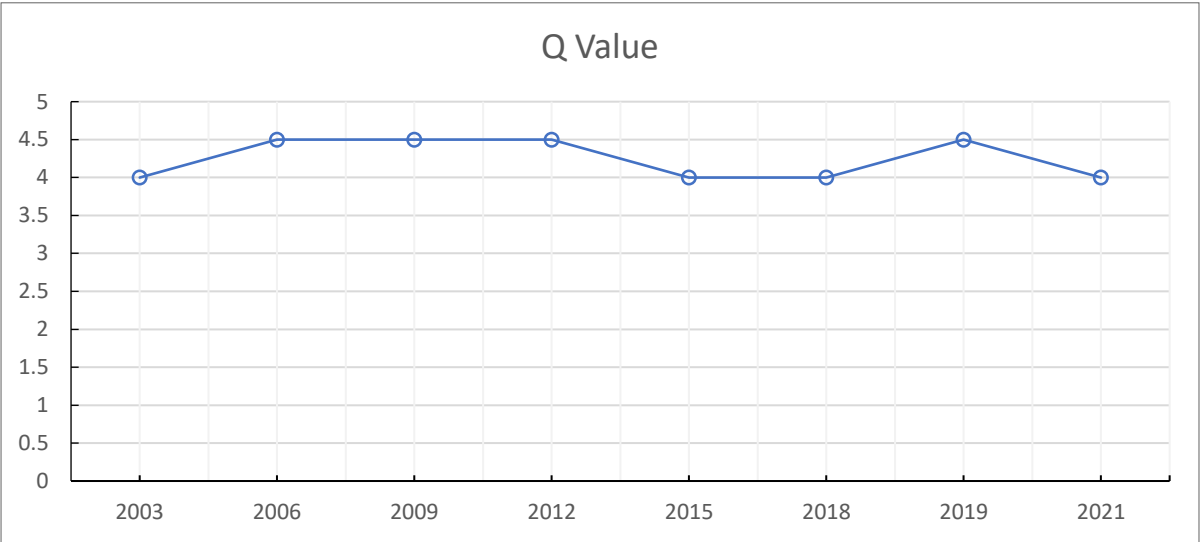


Figure II(i): Q Value monitoring data at Roskeen Br.

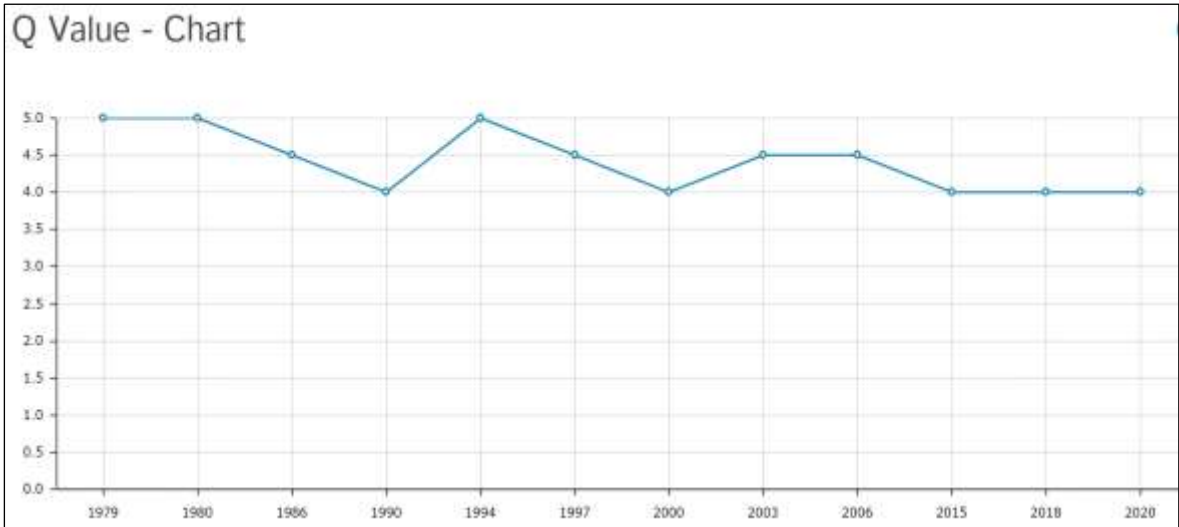


Figure II(ii): Q Value monitoring data at BLACKWATER (MUNSTER) - 1.5km d/s Ballymaquirk Br

Appendix III: Nutrient and BOD monitoring data for Blackwater (Munster)_090

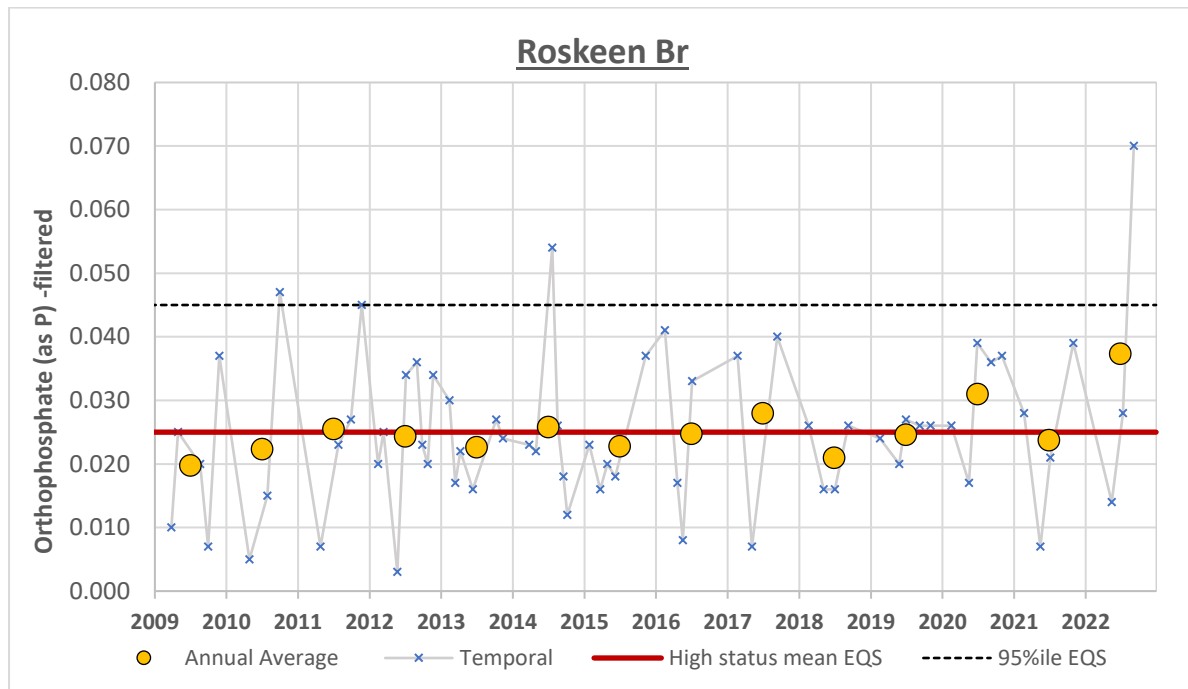


Figure III(i): Average annual orthophosphate (filtered) (mg/l-P) at Roskeen Br.

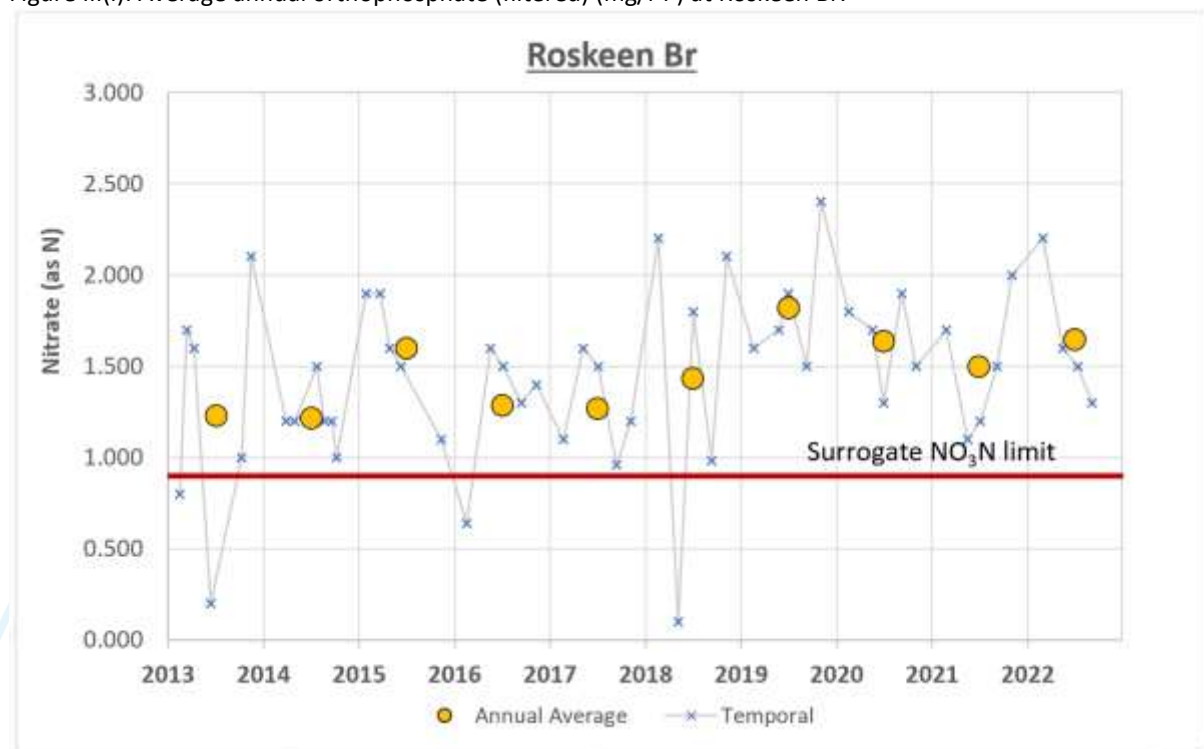


Figure III(ii): Average annual nitrate (mg/l-N) at Roskeen Br.

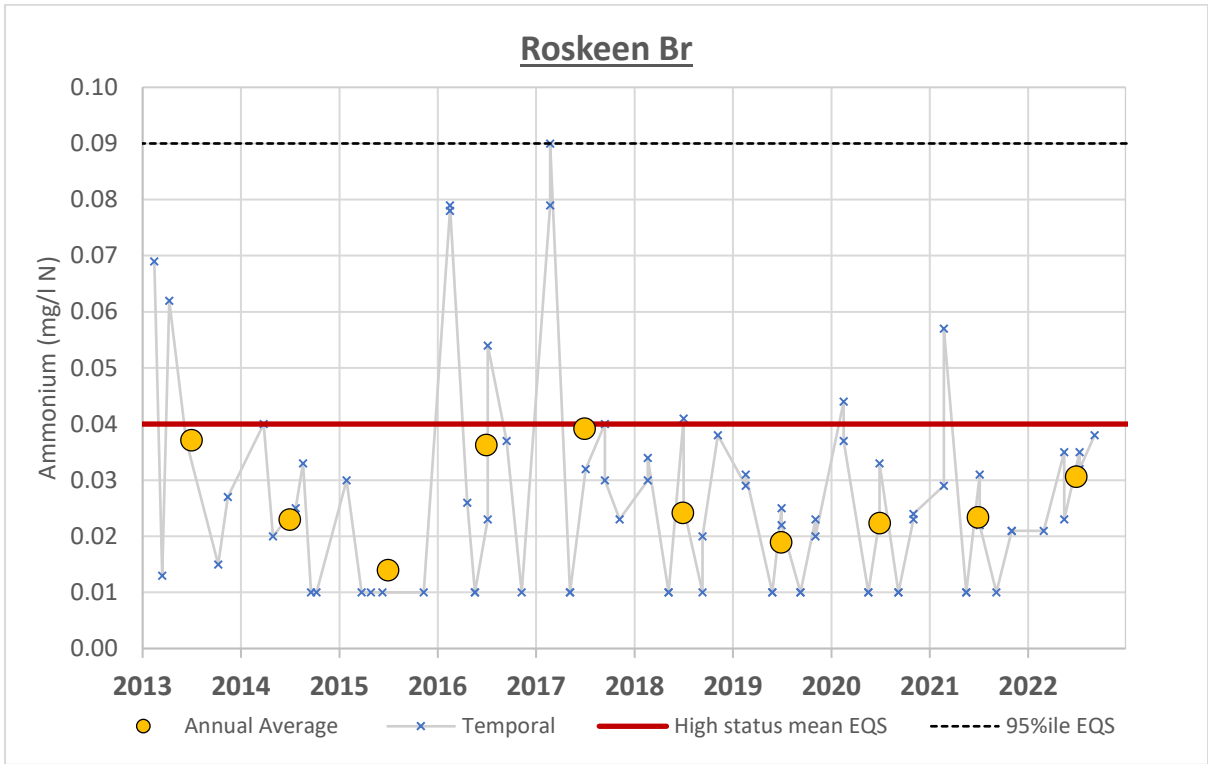


Figure III(iii): Average annual ammonium (mg/l-N) at Roskeen Br.

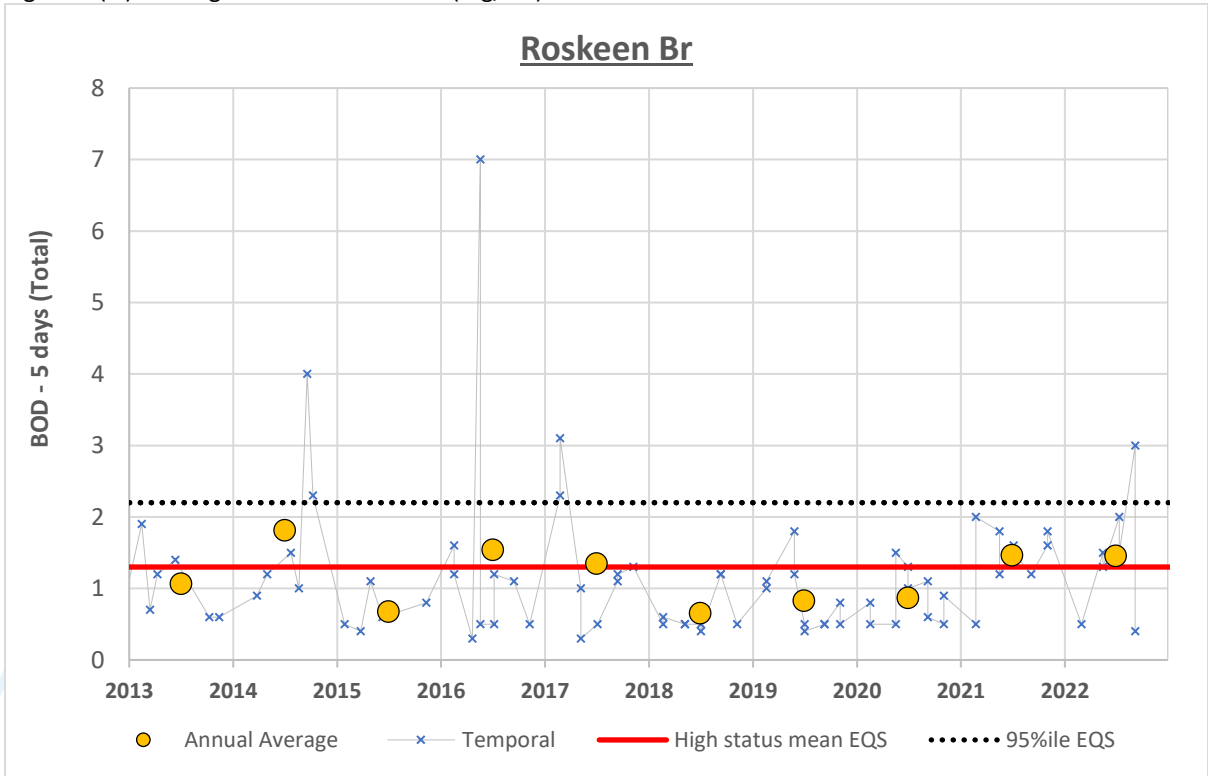


Figure III(iv): Average annual BOD (mg/l-O₂) (and temporal variation) at Roskeen Br.

Appendix IV: EPA initial characterisation information

Table IV(i): Initial EPA characterisation for Blackwater (Munster)_090 and Lisduggan_North_010

Water body Name	Identifier	Category	Sub Category	Name	Sig?	Comment
Blackwater (Munster)_090	WBP0005412	Urban Waste Water	Agglomeration PE of 500 to 1,000	Banteer and Environs	No	WWTP discharges into upstream Glen (Banteer)_030 which is a tributary of the main channel of the Blackwater and won't affect Awbeg tributary.
	WBP0005413	Agriculture	Agriculture	N/A	Yes	
	WBP0005719	Hydro-morphology	Embankments	N/A	Yes	
Lisduggan_North_010	N/A	N/A	N/A	N/A	N/A	