Shannon (Upper)
Catchment Assessment 2010-2015
(HA 26C)

Catchment Science & Management Unit

Environmental Protection Agency

December 2018

Version no. 3

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Preface

This document provides a summary of the characterisation outcomes for the water resources of the Upper Shannon (Upper) Catchment, which have been compiled and assessed by the EPA, with the assistance of local authorities and RPS consultants. The information presented includes status and risk categories of all water bodies, details on protected areas, significant issues, significant pressures, load reduction assessments, recommendations on future investigative assessments, areas for actions and environmental objectives. The characterisation assessments are based on information available to the end of 2015. Additional, more detailed characterisation information is available to public bodies on the EPA WFD Application via the EDEN portal, and more widely on the catchments.ie website. The purpose of this document is to provide an overview of the situation in the catchment and help inform further action and analysis of appropriate measures and management strategies.

This document is supported by, and can be read in conjunction with, a series of other documents which provide explanations of the elements it contains:

1. An explanatory document setting out the full characterisation process, including water body, subcatchment and catchment characterisation.
2. The Final River Basin Management Plan, which can be accessed on: www.catchments.ie.
3. A published paper on Source Load Apportionment Modelling, which can be accessed at: http://www.jstor.org/stable/10.3318/bioe.2016.22
4. A published paper on the role of pathways in transferring nutrients to streams and the relevance to water quality management strategies, which can be accessed at: http://www.jstor.org/stable/pdf/10.3318/bioe.2016.19.pdf
5. An article on Investigative Assessments which can be accessed at: https://www.catchments.ie/download/catchments-newsletter-sharing-science-stories-june-2016/

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1 Introduction

This catchment covers an area of 1,500 km². The lowland area is underlain mainly by limestones, some of which are karstified whilst the upland areas in the catchment are underlain variously by sandstones and metamorphic rocks. Surface water – groundwater interaction is highly developed in the karst areas of the catchment.

The Shannon enters this catchment from the north and passes though Lough Eidin, where it is joined by the Boyle River, before flowing past Carrick-on-Shannon and then through a drumlin area until reaching Lough Boderg. The Owenur River now joins the Shannon, draining the catchment around Strokestown, Tulsk, and Elphin. Downstream of Rooskey, the Shannon flows into the northern end of Lough Forbes, where it is joined by the Rinn River and its tributaries, the Cloone and Relagh Rivers.

Downstream of Lough Forbes, the Shannon continues south until it is joined by the Camlin River at Termonbarry. Downstream of Termonbarry, the Shannon is joined by the Feorish River before entering Lough Ree at Lanesborough.

The Upper Shannon catchment comprises 12 subcatchments (Table 1, Figure 1) with 58 river water bodies, 23 lake water bodies and 15 groundwater bodies. There is one artificial water body in the Upper Shannon Catchment (the Royal Canal (West of Lough Owel feeder) and there are no heavily modified water bodies.

Table 1. List of subcatchments in the Upper Shannon (Upper Shannon) catchment

Subcatchment ID	Subcatchment Name
26C_1	Shannon[Upper]_SC_080
26C_2	Black[SouthLeitrim]_SC_010
26C_3	Owenur_SC_010
26C_4	Cloone[LoughRinn]_SC_010
26C_5	Shannon[Upper]_SC_040
26C_6	Camlin_SC_010
26C_7	Shannon[Upper]_SC_060
26C_8	Shannon[Upper]_SC_070
26C_9	Shannon[Upper]_SC_050
26C_10	Eslin_SC_010
26C_11	Shannon[Upper]_SC_030
26C_12	Scramoge_SC_010

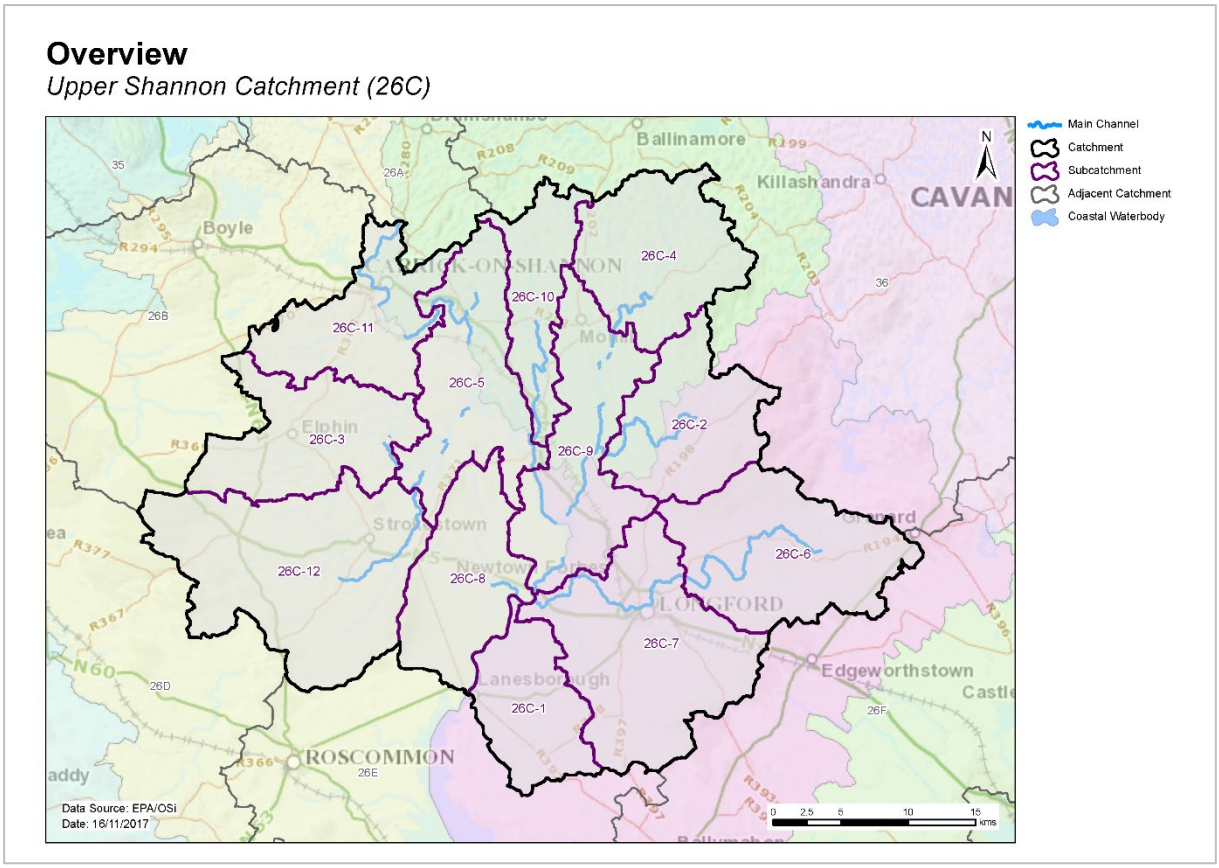

Figure 1. Subcatchments in the Upper Shannon catchment

2 Water body status and risk of not meeting environmental objectives

2.1 Surface water ecological status

2.1.1 Rivers and lakes

- There were 24 (30%) river and lake water bodies at Good or High status, and 33 (41%) at less than Good status in 2015 (Table 2 and Figure 2). Twenty-four (30%) river and lake water bodies are unassigned.
- There are no river or lake water bodies that have a high ecological status objective within Upper Shannon Catchment.
- The number of water bodies at each status class in 2007-09 and 2010-15 are shown in Figure 3 (rivers) and 4 (lakes).
- The status of 11 water bodies have improved and seven have deteriorated (Figure 5).
- The variation in nutrient concentrations and loads in the River Shannon and Camlin main channels are illustrated in Appendix 1.

Table 2. Summary of water body status and risk for surface water subcatchments

	Number of water bodies	2010-15						Risk Categories		
		High	Good	Mod	Poor	Bad	Unassigned	*Not at Risk*	*Review*	*At Risk*
Rivers	58	1	22	15	11	0	9	23	8	27
Lakes	23	0	1	7	0	0	15	3	13	7

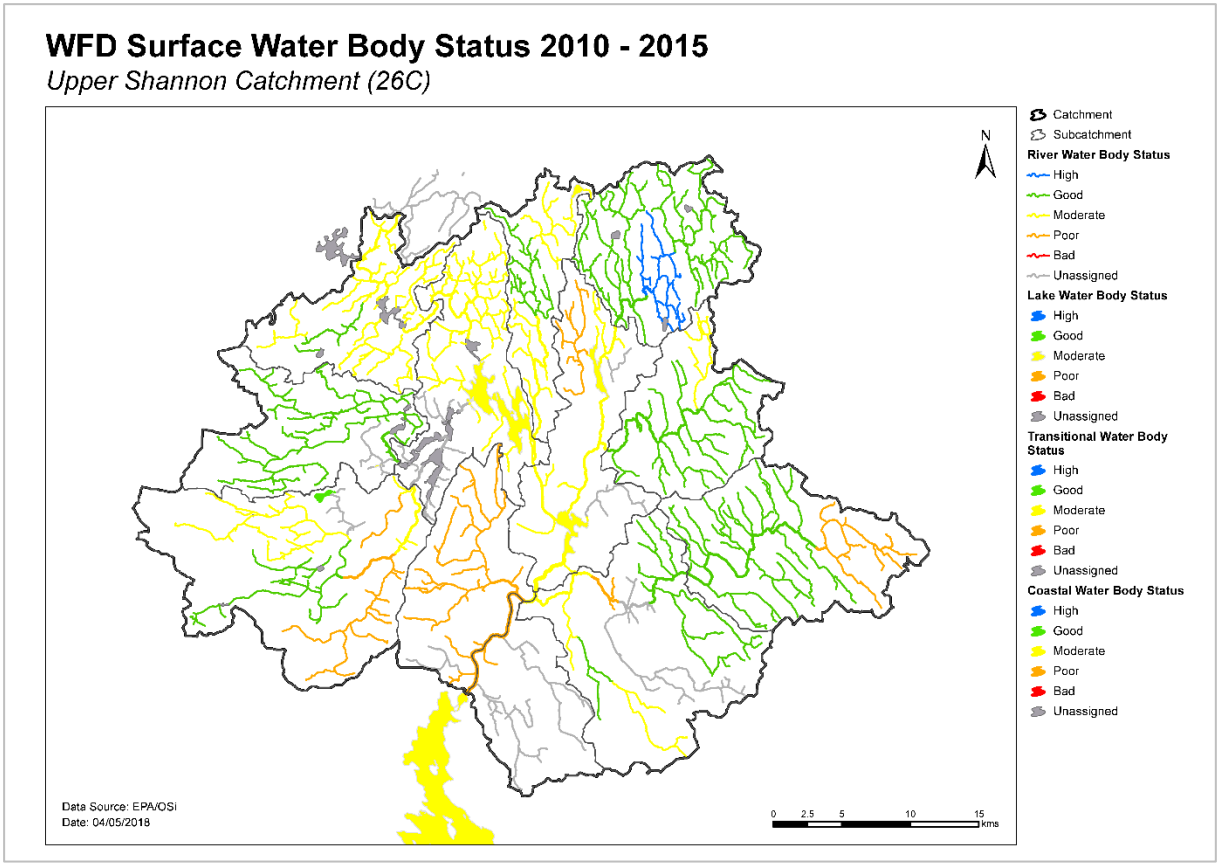

Figure 2. Surface water ecological status

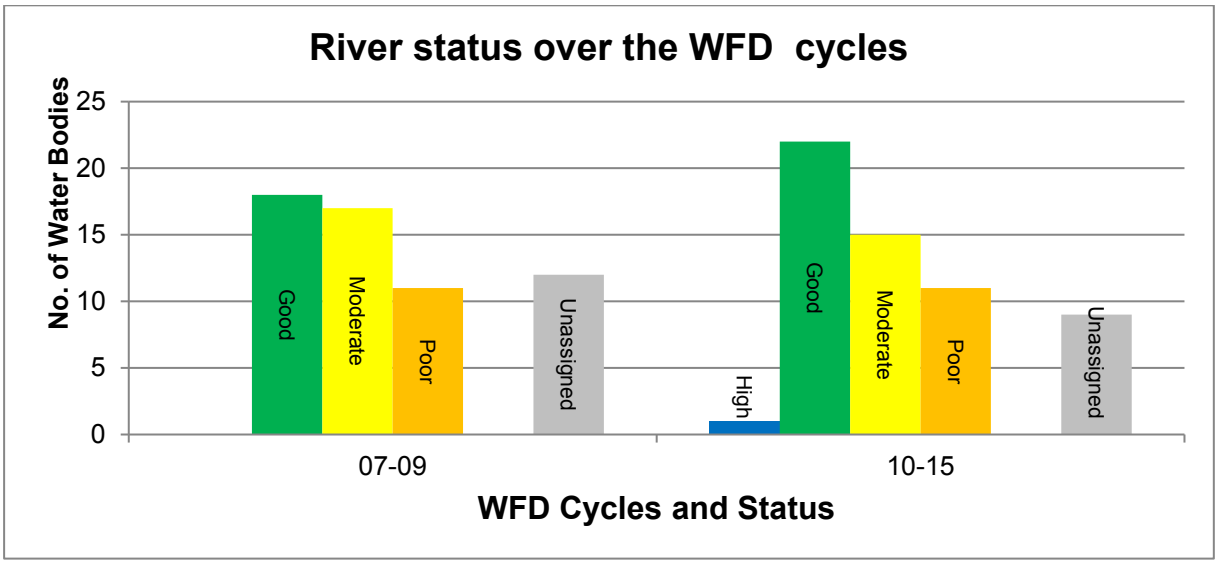

Figure 3. Number of rivers at each status class in 2007-09 and 2010-15

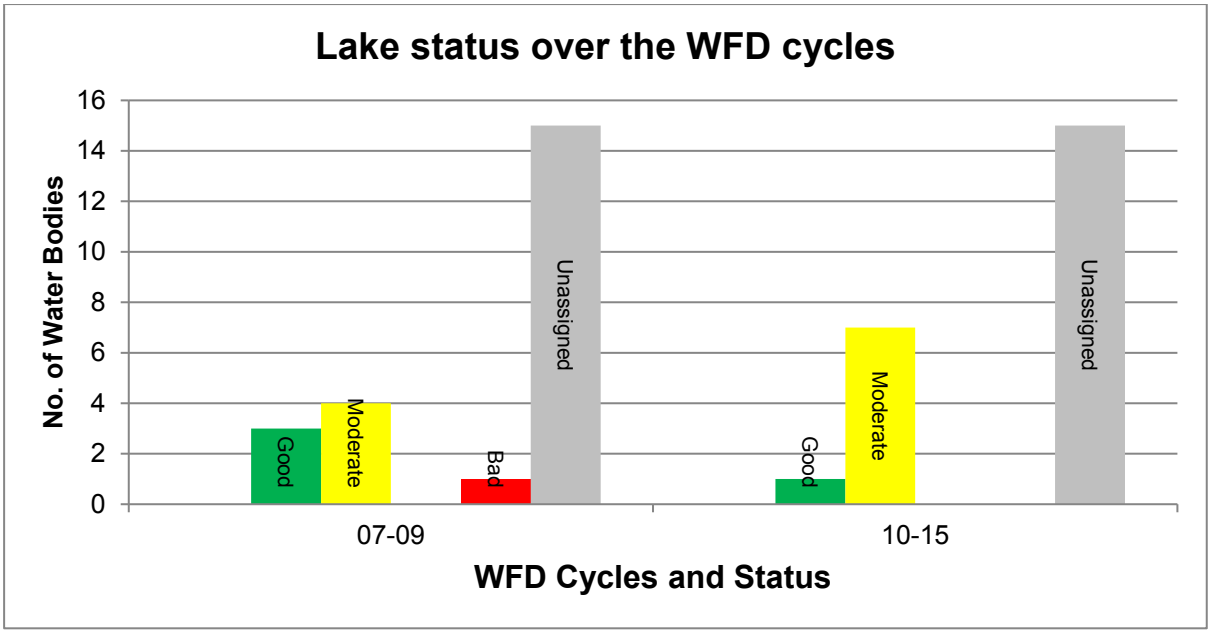

Figure 4. Number of lakes at each status class in 2007-09 and 2010-15

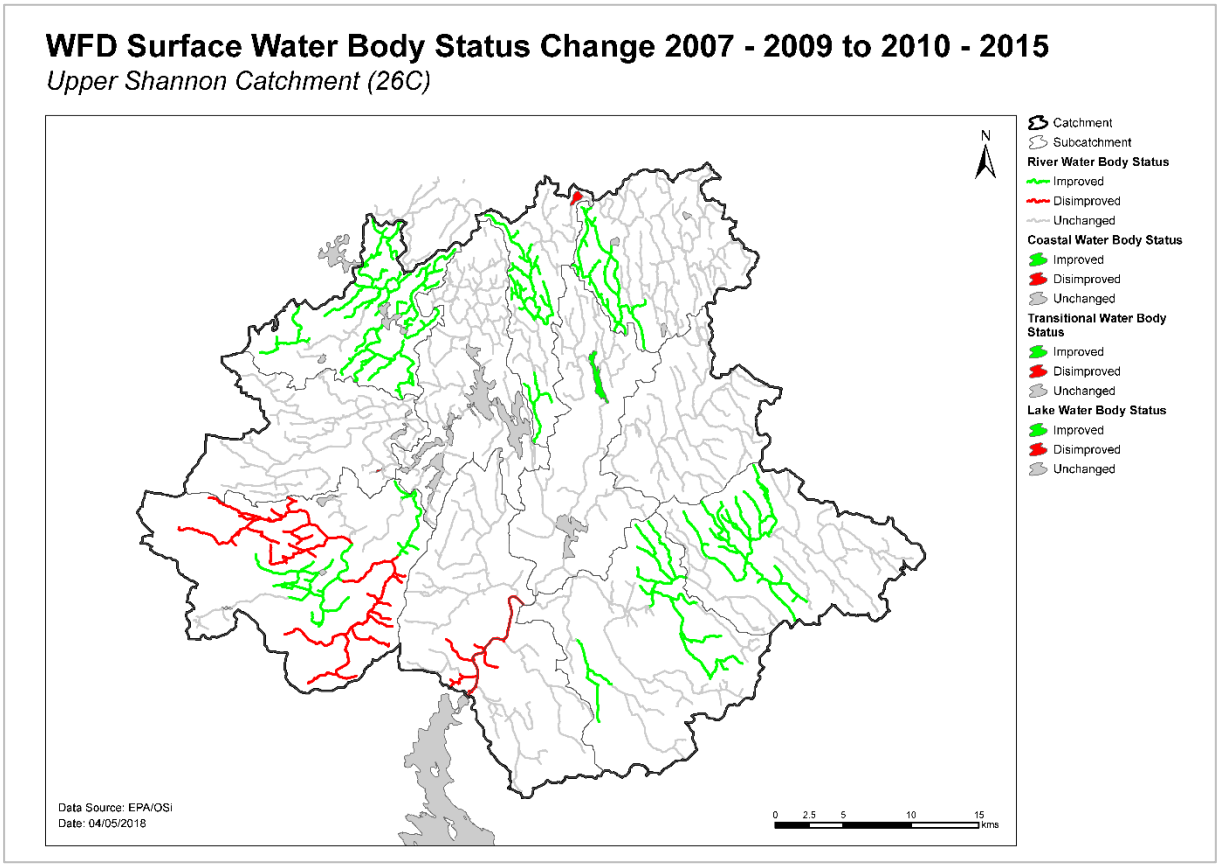

Figure 5. Surface water body status change from 2007-09 to 2010-15

2.2 Groundwater status

- There were 15 groundwater bodies at Good status in 2015 (Table 3).

Table 3. Summary of water body status and risk for ground waters

	Number of water bodies	2010-15		Risk Categories		
		Good	Poor	*Not at Risk*	*Review*	*At Risk*
Groundwater	15	15	0	8	6	1

2.3 Risk of not meeting surface water environmental objectives

2.2.1 Rivers and lakes

- Twenty-three river and three lake water bodies are *Not at Risk* (Figure 6, Table 2) and require no additional investigative assessment or measures to be applied, other than those measures that are already in place.
- There are eight river and 13 lake water bodies in *Review*. This applies to 20 water bodies where more information is required and one water body where measures have recently been implemented and improvements have not yet been realised.
- Twenty-seven river and seven lake water bodies in the catchment are *At Risk* of not meeting their water quality objectives. Measures will be needed in these water bodies to improve the water quality outcomes.

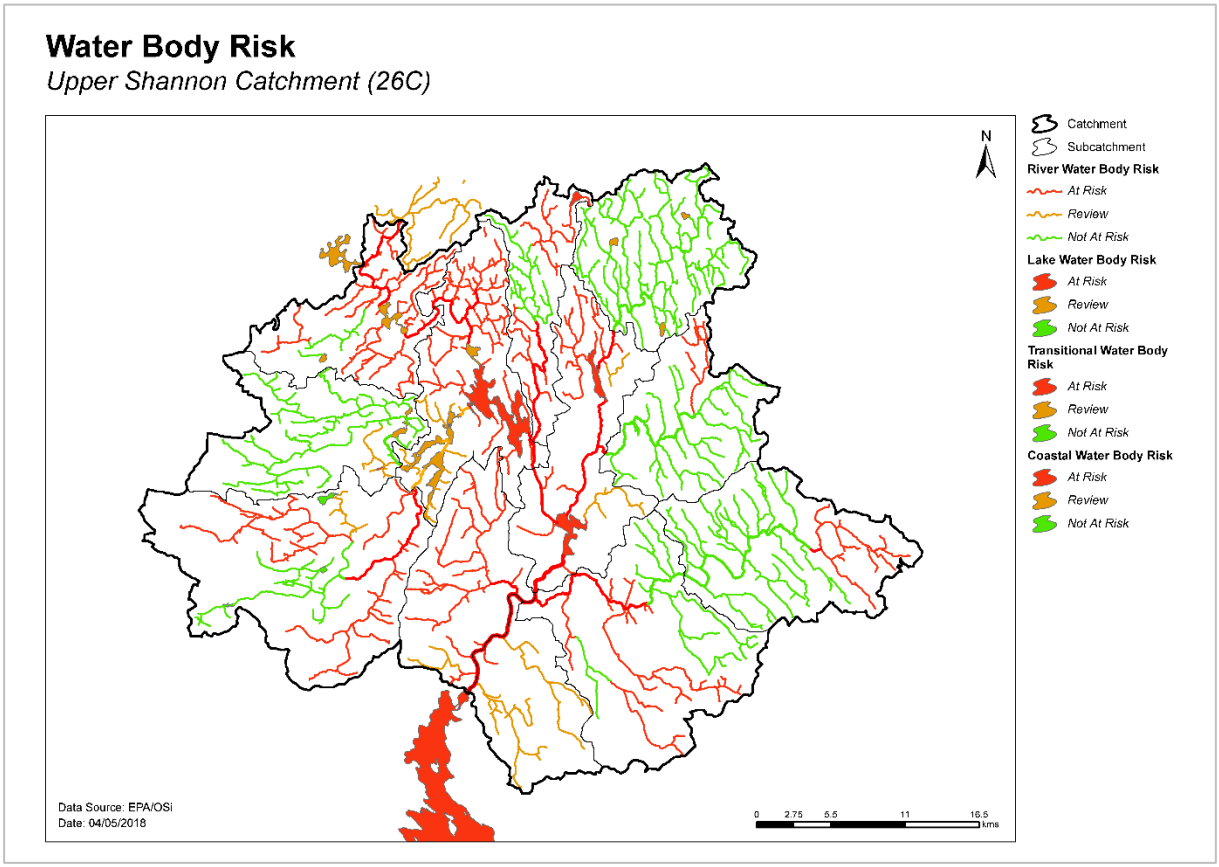

Figure 6. Surface water body risk

2.3 Risk of not meeting groundwater environmental objectives

- Eight groundwater bodies are *Not at Risk* (Figure 7, Table 3) and require no additional investigative assessment or measures to be applied, other than those measures that are already in place.
- Six groundwater bodies are in *Review.* Funshinagh and Inny groundwater bodies are in *Review* because they are hydrologically linked to surface waters that are not meeting water quality objectives where it is considered likely that groundwater is a contributing source of phosphorus(Figure7). The remaining four groundwater bodies (Cavan, Longford Ballinalee, Lough Ackrick and Slieve Bawn Telton) have nitrate concentrations for the group which are 0.75 times the drinking water threshold value of 37.5 mg/l NO_3.
- One groundwater body (Carrick on Shannon IE_SH_G_048) is *At Risk* due to potential groundwater contribution of phosphate to associated *At Risk* surface water bodies (Table 4).

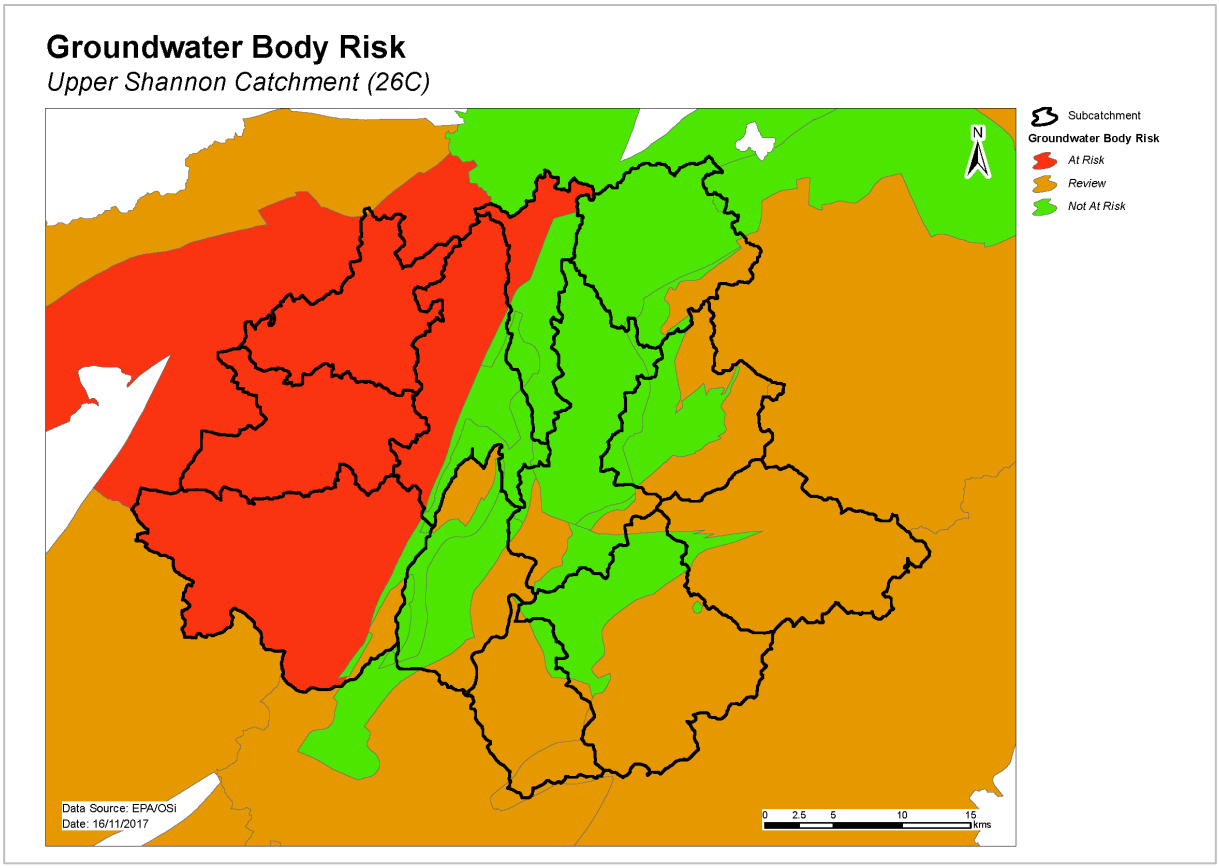

Figure 7. Groundwater body risk

Table 4. Summary of *At Risk* surface water bodies where phosphate from groundwater may contribute to an impact.

Groundwater body name	Receiving water body code	Receiving water body name
Carrick on Shannon	IE_SH_26E010100	ESLIN_010
Carrick on Shannon	IE_SH_26K020100	KILLUKIN_010
Carrick on Shannon	IE_SH_26L040500	LISSAPHOBBLE_010
Carrick on Shannon	IE_SH_26M030100	MOUNTAIN (ROSCOMMON)_010
Carrick on Shannon	IE_SH_26S010050	SCRAMOGE_010
Carrick on Shannon	IE_SH_26S010200	SCRAMOGE_020
Carrick on Shannon	IE_SH_26S021010	SHANNON (Upper)_060
Carrick on Shannon	IE_SH_26S021415	SHANNON (Upper)_070
Carrick on Shannon	IE_SH_26B080600	BREEDOGE_010
Carrick on Shannon	IE_SH_26O040100	OWENNAFOREESHA_010

2.4 Protected areas

2.4.1 Drinking water protected areas

- There are 24 abstractions in the Upper Shannon Catchment comprising two group water schemes; five public supply schemes; three private schemes and 14 other schemes (Appendix 3).
- Fifteen of the abstractions are from five groundwater bodies (Newtown Forbes, Longford Ballinalee, Inny, Funshinagh and Carrick On Shannon); four are from lakes (Shad Lough, Fin/ Strokestown Lake, Forbes Lake and Grange Lake), one is from the River Shannon (Upper)_060, and four are from small lake water bodies at the headwaters of four river water bodies (Scramoge_010, Doon 26_010, Owenur_010 and Camlin_030). The list of the public supplies and the associated water bodies is provided in Appendix 3.
- The WTP on Scramoge_010 was upgraded in 2012. Water quality had deteriorated but is starting to improve. There is also a GWS source beside Scramoge_010 which has been impacted by farm pollution.
- All sources were compliant with the standards for nitrate in 2015.
- Two sources were non-compliant for pesticides in 2015. Shannon (Upper)_060 for scheme 1700PUB1100, had one MCPA exceedance; and Forbes Lake for scheme 2000PB1010 had several MCPA exceedances.
- Twelve of the 14-drinking water protected areas had therefore met their objectives in 2015.

2.4.2 Bathing waters

- There is one designated freshwater bathing water in the catchment and it is in satisfactory condition (Table 5).

Table 5. Bathing waters in the catchment

Bathing water		Water body intersection		Objective met?	
Name	Code	Name	Code	Yes	No
Keeldra Lough	IESHBWL26_624_0100	Keeldra	IE_SH_26_624	✓	

2.4.3 Shellfish areas

- There are no designated shellfish areas in the catchment.

2.4.4 Nutrient sensitive areas

- There are no designated Nutrient Sensitive Areas in the catchment.

2.4.5 Natura 2000 sites

- There are six Special Areas of Conservation (SACs) in the catchment (Appendix 4), not all of which have water quality and/or quantity conservation objectives for their qualifying interests.
- One lake water body (Forbes) has been prioritised for action as the water conservation objective for its habitat and/or species is not being supported by ecological status (Appendix 4).
- There is one Special Protected Area (SPA) in the catchment:
    - Ballykenny-Fisherstown Bog SPA

  As there are no specific water quality and quantity supporting conditions identified in the site-specific conservation objectives for this SPA, the intersecting water bodies are not assigned priority action for WFD protected area purposes in the second cycle.

2.5 Heavily modified water bodies

- There are no designated heavily modified water bodies (HMWB) in the catchment.
- There is one designated artificial water body (AWB) in the catchment – Royal Canal (West of Lough Owel feeder).

3 Significant issues in *At Risk* water bodies

- Excess phosphates leading to eutrophication is the dominant issue in the rivers and lakes. Excess fine sediment which is impacting habitat quality is also a significant issue. Excess ammonia is also of concern; however, this is for only a limited number of water bodies.
- Groundwater bodies act as a pathway to surface waters and may be contributing some of the phosphate in places.
- Alteration of hydromorphological (or physical) conditions are also a significant issue in rivers in the catchment. This includes inputs of excess fine sediment and alteration of the morphology of the river channel, which in turn alter habitat conditions.

4 Significant pressures

4.1 Water bodies

- Where water bodies have been classed as *At Risk* by water quality or survey data, significant pressures have been identified.

4.1.1 Rivers and lakes

- The significant pressure affecting the greatest number of water bodies is agriculture, followed by hydromorphological pressures, other, urban waste water, peat, diffuse urban, domestic waste water, forestry and industry (Figures 8).
- Figures 8 shows a breakdown of the number of *At Risk* water bodies in each significant pressure category. Significant pressures have been identified through the initial characterisation process in 34 water bodies (27 rivers and seven lakes), 20 of which have multiple pressures. These significant pressures will be refined as further characterisation is carried out.

4.1.2 Groundwater

- The significant pressure affecting the Carrick on Shannon groundwater body IE_SH_G_048 is diffuse agriculture where concentrations of phosphate are an issue in the *At Risk* surface water bodies.

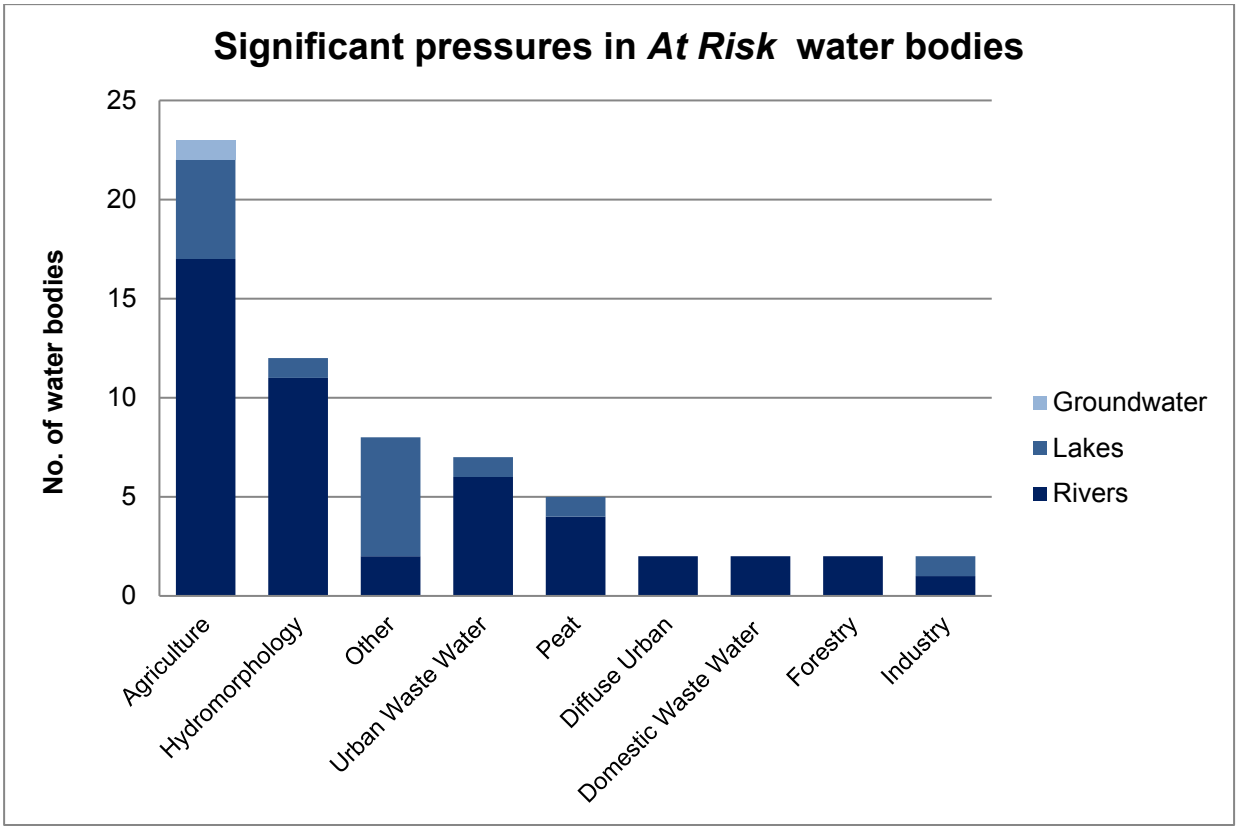

Figure 8. Significant pressures impacting on *At Risk* water bodies

4.2 Pressure Type

4.2.1 Agriculture

- Agriculture is a significant pressure in 17 river and five lake water bodies; the water bodies affected by farming are shown in Figure 9. The issues related to farming in this catchment are diffuse phosphorus loss to surface waters from, for example, direct discharges; or runoff from yards, roadways or other compacted surfaces, or runoff from poorly draining soils. Sediment can also be a problem from land drainage works, bank erosion from animal access or stream crossings. The pollution impact potential map showing areas of relative risk for phosphorus loss from agriculture to surface water is given in Appendix 5. The groundwater body IE_SH_G_048 Carrick-on-Shannon is impacted by diffuse agriculture.
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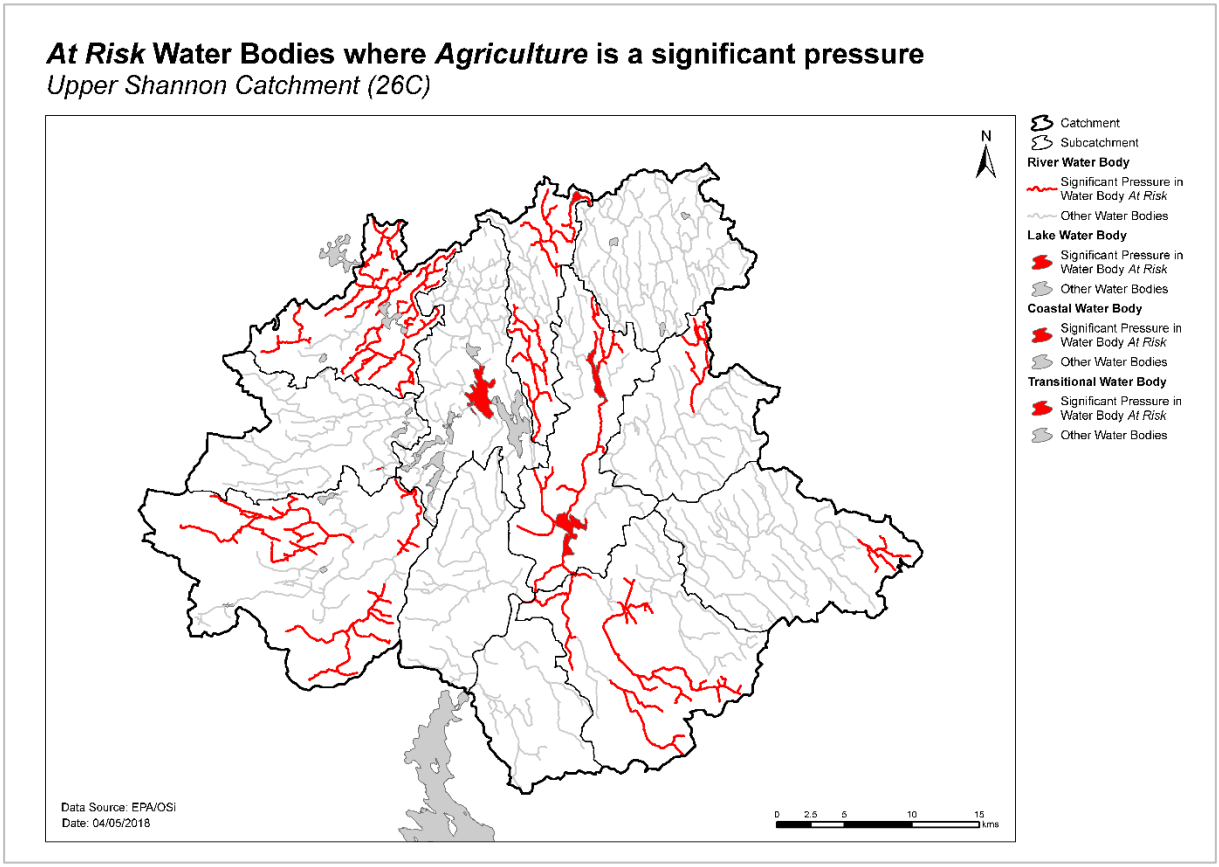


Figure 9. Water bodies that are *At Risk* and are impacted by agricultural activities

4.2.2 Hydromorphology

- A number of river water bodies (12) within the Shannon subcatchments are subject to extensive modification due to both historic dredging and the presence of drainage schemes. The presence of weirs are likely to be impacting on both the hydromorphological conditions and fish migration in two river water bodies within the Shannon subcatchments. A weir at the outlet of a lake water body within the Shannon [Upper] (SC26C_9) subcatchment is impacting hydrological conditions. See Figure 10 and Appendix 2 for information on these water bodies.

Table 5a – Hydromorphological pressures on the Upper Shannon Catchment.

Pressure	Sub-Catchment	Water body Code
Channelisation	Shannon [Upper] (26C_1)	Shannon (Upper)_100
	Shannon [Upper] (26C_2)	Fardrumman Stream_010
	Shannon [Upper] (26C_6)	Camlin_010
	Shannon (Upper)_ (26_12)	Lissaphobble_010
	Shannon (Upper)_ (26_12)	Scramoge_020
	Shannon (Upper)_ (26_12)	Scramoge_040
	Shannon (Upper)_ (26_12)	Strokestown_010
Land Drainage	Shannon [Upper] (26C_7)	Camlin_070
	Shannon (Upper)_ (26_10)	Eslin_010
	Shannon (Upper)_ (26_10)	Eslin_040
In River Structures	Shannon [Upper] (26C_1)	Shannon (Upper)_100
	Shannon [Upper] (26C_7)	Shannon (Upper)_090
	Shannon (Upper)_ (26_9)	Rinn

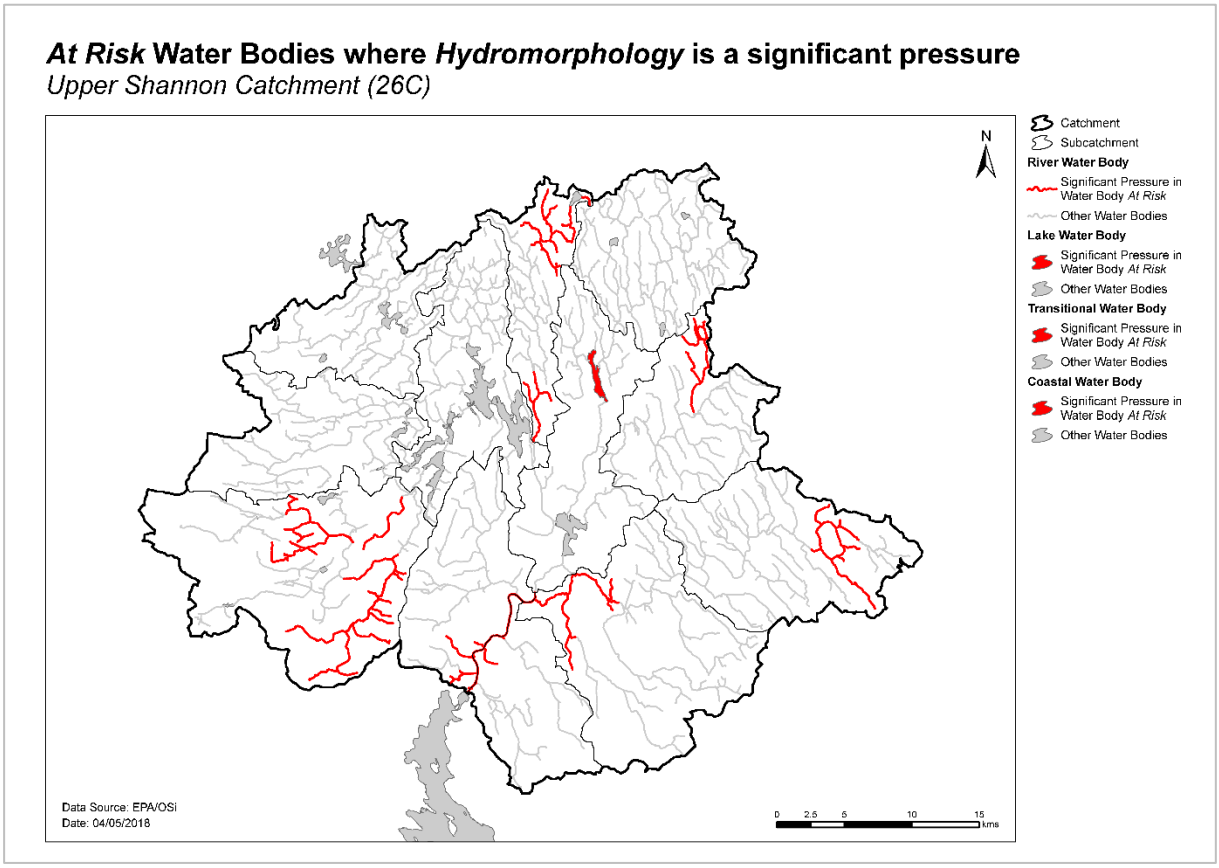


Figure 10. Water bodies that are *At Risk* and are impacted by hydromorphological pressures

4.2.3 Other significant pressures

- *Invasive species*

  Invasive species have been identified as a potentially significant pressure in one river and six lake water bodies across several subcatchments (Shannon (Upper)_100, Ree, Grange, Bofin LM, Boderg, Forbes and Rinn).

The invasive species present within lakes in the catchment are Zebra mussels; while one river has Asian Clam in addition to Zebra mussels where temperatures are elevated due to discharges from a power station. The invasive species impact nutrient levels and cause negative impacts on native species in water bodies (Figure 11).

- *Anthropogenic unknown*
  The significant pressure(s) on the Shannon (Upper)_070 water body, which failed due to invertebrate status, is unknown.
- *Contaminated Land*
  There is a historic landfill site present which has been identified as a potential significant pressure for Strokestown_010 river water body. It could cause elevated nutrients and pollution from organic matter.

4.2.4 Urban waste water treatment plants

- Urban Waste Water Treatment Plants (WWTPs) and agglomeration networks have been identified as a significant pressure in seven *At Risk* water bodies; details are given in Table 6 and Figure 12. Mohill WWTP, which impacts Rinn_010, is scheduled to be upgraded by 2019. The Carrick on Shannon agglomeration network was due to be upgraded in 2016, however, the WWTP, which is currently not specified in improvement plans, has also been identified as a significant pressure impacting Shannon (Upper)_060. The Longford agglomeration network is scheduled to be upgraded by 2024, however, the WWTP, which is currently not specified in improvement plans, has been identified as a significant pressure impacting Camlin_060 and Camlin_070.

4.2.5 Extractive industry

- *Peat*
  Peat drainage and extraction has been identified as a significant pressure in five water bodies in three subcatchments (Shannon (Upper)_100, Feorish (Tarmonbarry)_010, (Feorish (Tarmonbarry)_020, Curraghroe Stream_010 and Forbes lake). Eutrophication, likely from elevated nutrient concentrations, and sediment impacting habitat quality are the significant issues (Figure 13).

4.2.6 Diffuse urban

- Diffuse urban pressures, caused by misconnections, leaking sewers and runoff from paved and unpaved areas, have been identified as a significant pressure in two river water bodies in the Shannon[Upper]_SC_060 subcatchment (Camlin_060 and Camlin_070). Elevated concentrations of phosphates and ammonia are the significant issues (Figure 14).

4.2.7 Domestic waste water

Domestic waste water has been identified as a significant pressure in two river water bodies (Camlin_010 and Fallan_010). This is due to significant numbers of domestic waste water treatment systems in close proximity to the water bodies, which are on areas of poorly draining soils where there is inadequate soil percolation. The significant issues are a combination of excess nutrients, causing signs of enrichment (Figure 15).

Table 6. Waste Water Treatment Plants and agglomerations identified as Significant Pressures in *At Risk* water bodies and expected completion dates for associated upgrade works, where applicable

Facility name	Facility Type	Water Body	2010-15 Ecological Status	Expected Completion Date
Hodson Bay D0377	500 to 1,000 p.e.	Lough Ree	Moderate	*NA* [1]
Ballyleague D0229	1,001 to 2,000 p.e.	Lough Ree	Moderate	*NA* [1]
Carrick on Shannon D0154	2,001 to 10,000 p.e.	Shannon (Upper)_060	Moderate	*2016* [2]
Tulsk A0285	< 500 p.e.	Scramoge_010	Moderate	*NA*[1]
Granard D0187	2,001 to 10,000 p.e.	Rhine_010	Poor	*NA*[1]
Longford D0060	> 10,000 p.e.	Camlin_060	*Unassigned* [3]	*Complete* [4]
Longford D0060	> 10,000 p.e.	Camlin_070	Poor	*Complete* [4]
Mohill D0277	1,001 to 2,000 p.e.	Rinn_010	Poor	2019

4.2.8 Forestry

- Forestry has been identified as a significant pressure in two water bodies, which are within subcatchments 26C_6 and 26C_7. The significant issue is sedimentation resulting from clear felling and afforestation activities (Figure 16).

4.2.9 Industry

- Elevated temperatures resulting from an industrial discharge is the main issue of concern regarding Shannon (Upper)_100, while the nutrient and organic impacts from an industrial discharge are the issues of concern regarding Lough Rinn (Figure 17).

[1] *Currently not specified in improvement plans.*

[2] *The Carrick on Shannon agglomeration network was due to be upgraded in 2016, however, the WWTP, which is currently not specified in improvement plans, has also been identified as a significant pressure impacting Shannon (Upper)_060.*

[3] *Ecological Status is not available for Camlin_060, however, following discussions with Longford County Council, this water body was deemed to be At Risk of not meeting its environmental objectives.*

[4] *The Longford agglomeration network is scheduled to be upgraded by 2024, however, the WWTP, which is currently not specified in improvement plans, has been identified as a significant pressure impacting Camlin_060 and Camlin_070.*

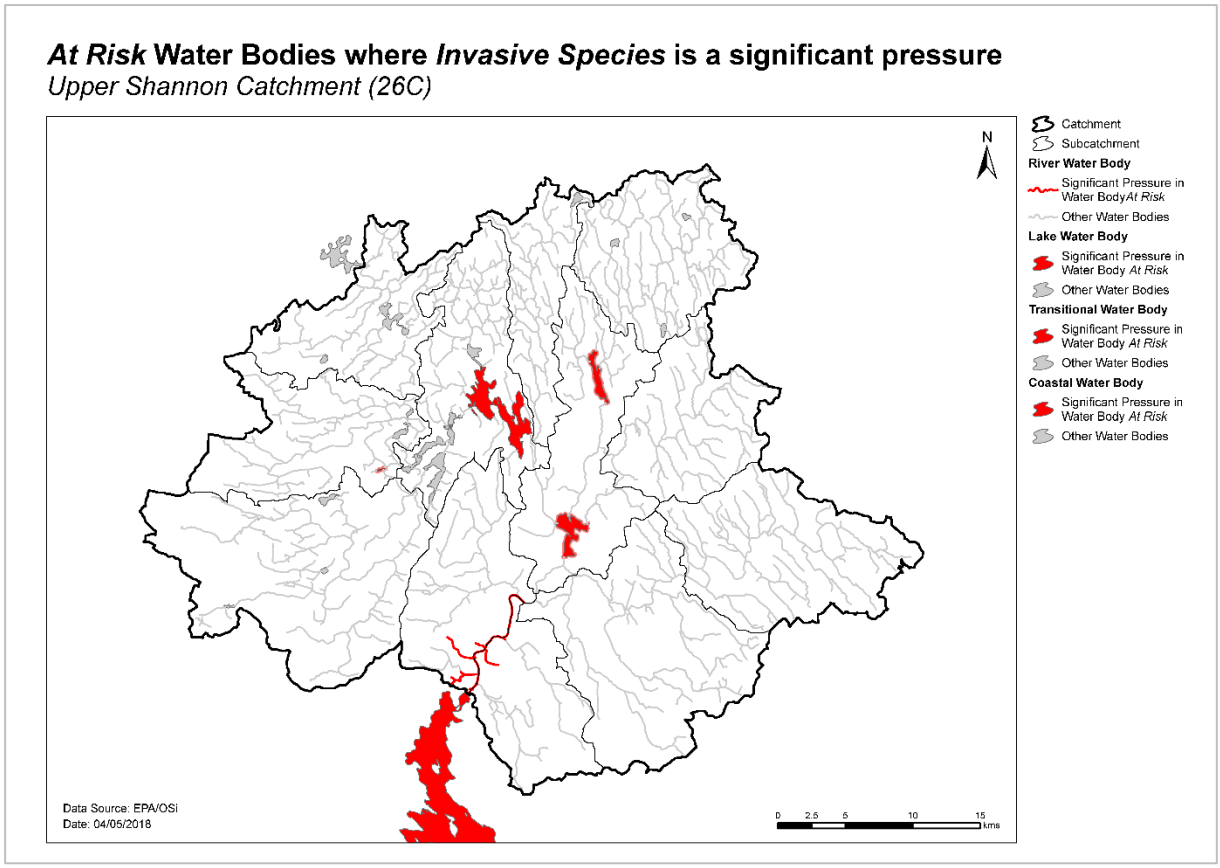


Figure11. Water bodies that are At *Risk* and are impacted by invasive species

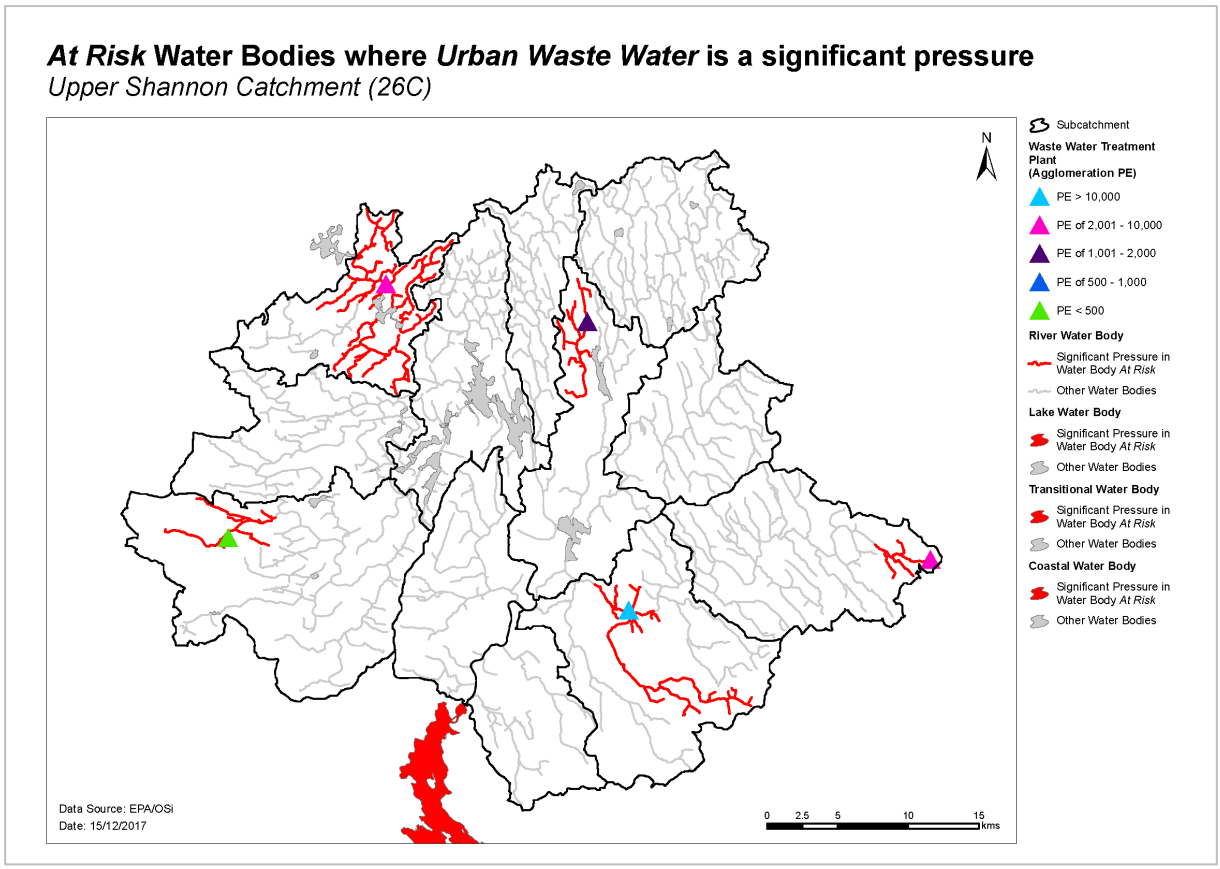


Figure 12. Water bodies that are *At Risk* and are impacted by urban waste water

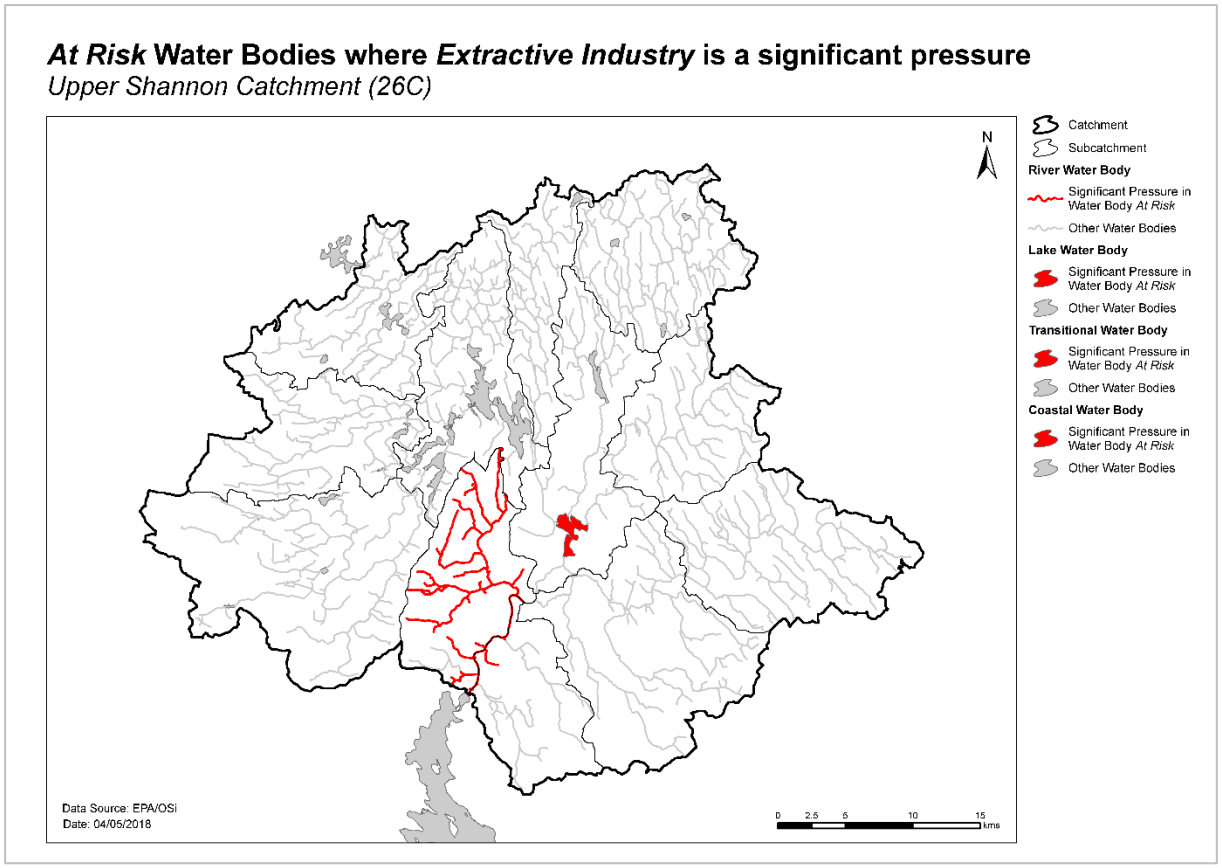


Figure 13. Water bodies that are *At Risk* and are impacted by the extractive industry

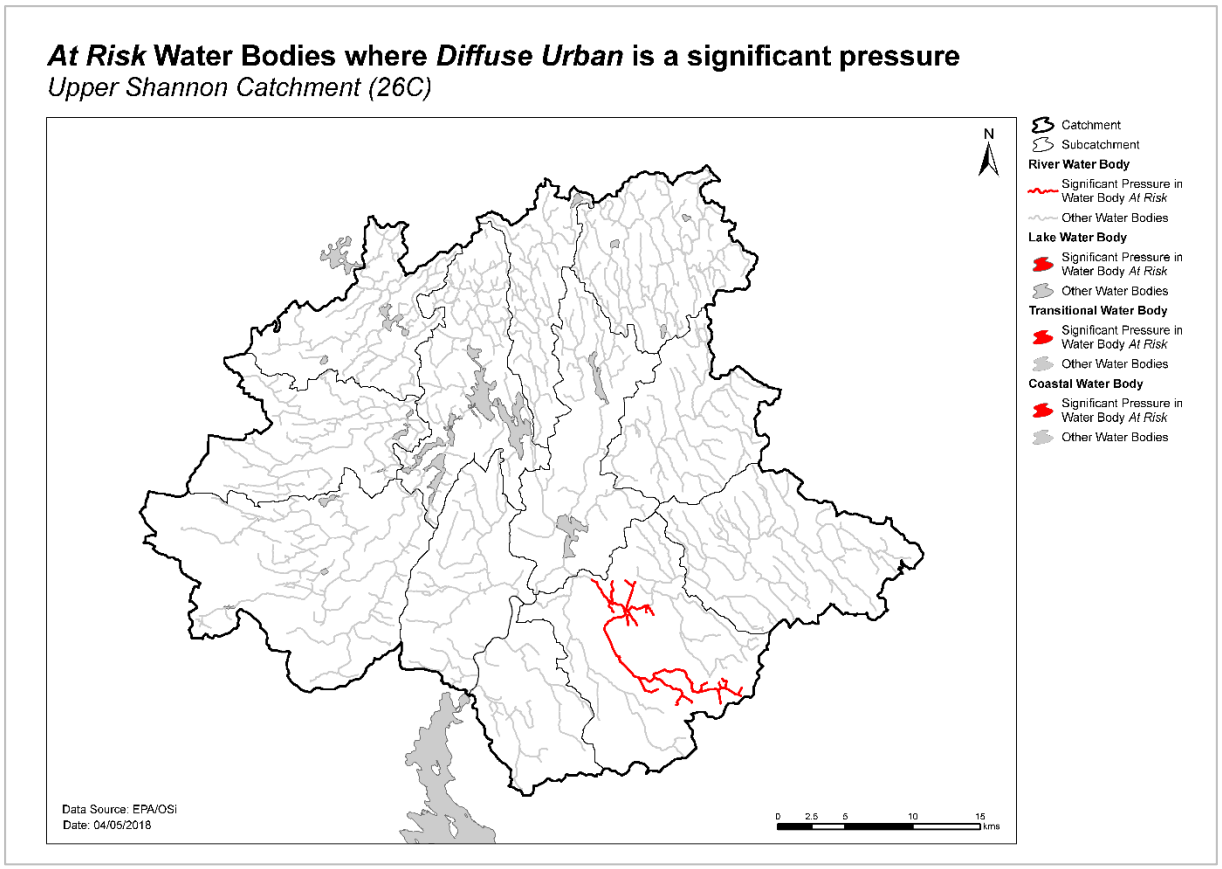


Figure 14. Water bodies that are *At Risk* and are impacted by diffuse urban

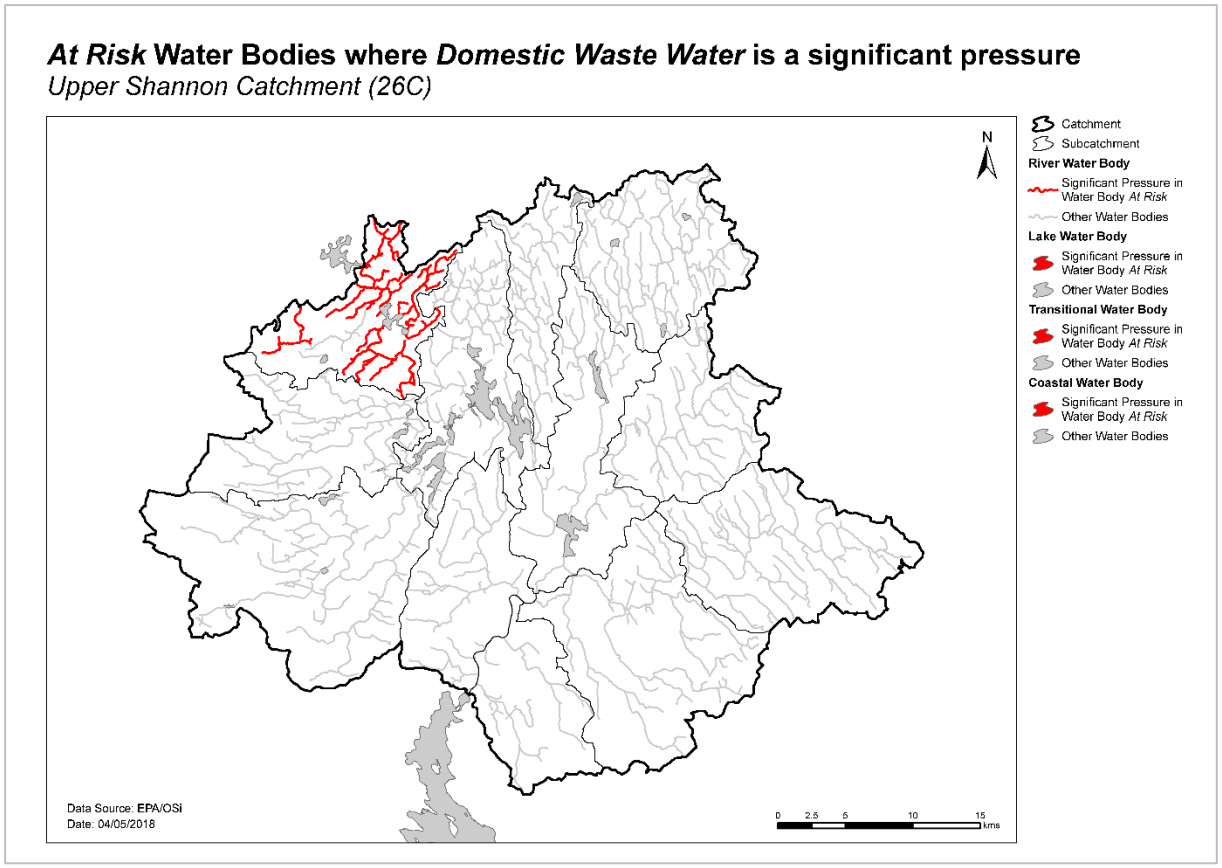


Figure 15. Water bodies that are *At Risk* and are impacted by domestic waste water

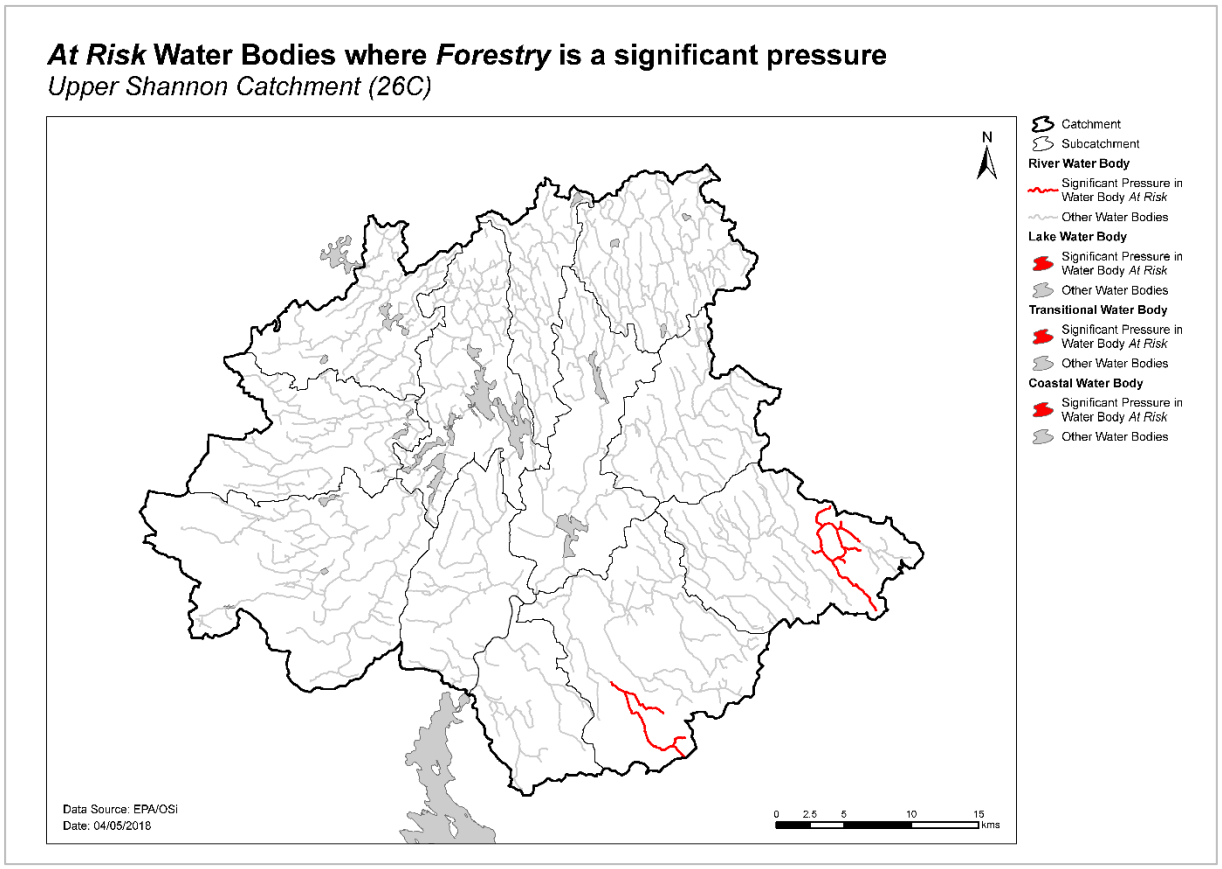


Figure 16. Water bodies that are *At Risk* and are impacted by forestry activities

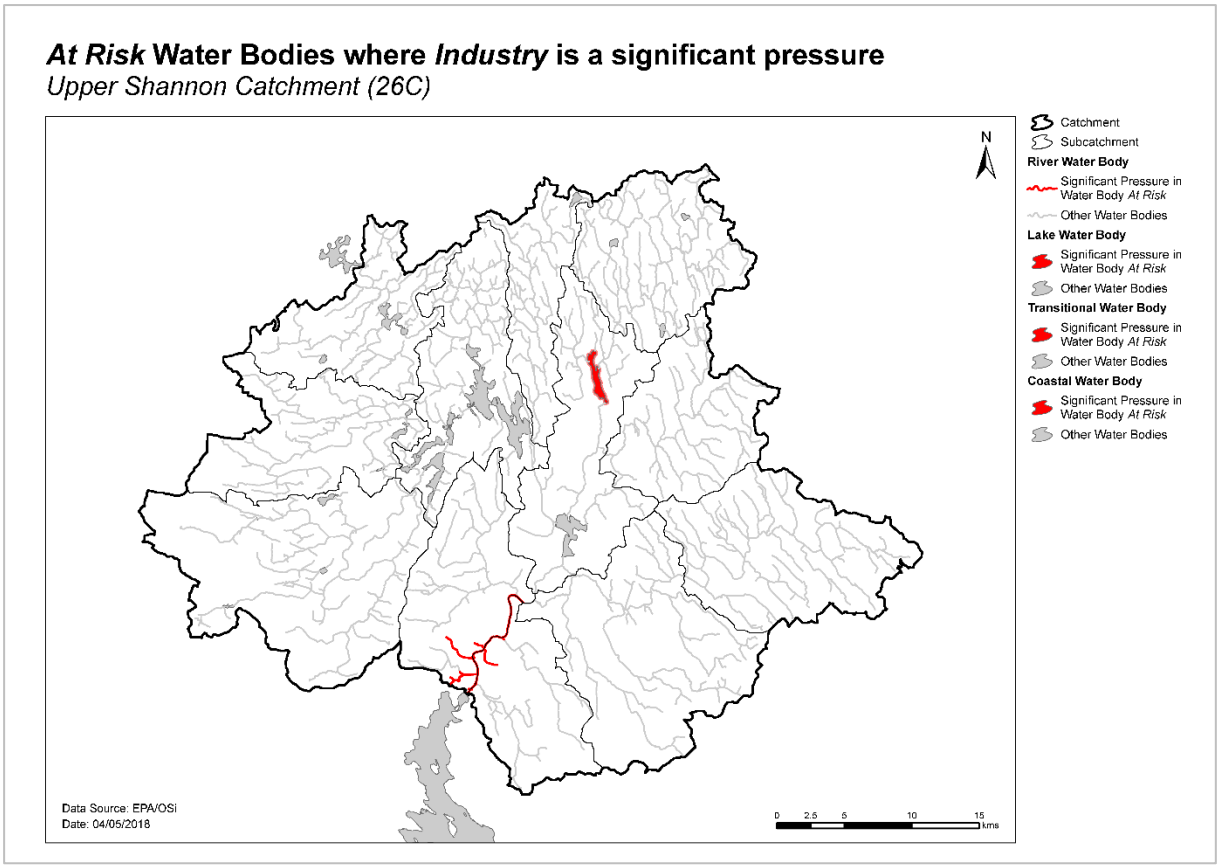


Figure 17. Water bodies that are *At Risk* and are impacted by industry

5 Load reduction assessment

5.1 River water body load reductions

- Phosphate is a main parameter influencing water quality in rivers in the catchment.
- For water bodies where phosphorus monitoring data are available, the reduction in P load that would be required to bring the mean concentration back to the EQS of 0.035 mg/l as P, can be estimated using a simple method based on the average 2013 to 2015 concentration and the average flow, or the estimated 30th percentile flow (Q30) where flow data are not available. The relative load reductions are ranked on a national scale from Very High (>1 kg/Ha/y), to High (0.5-1 kg/Ha/y), to Medium (0.25-0.5 kg/Ha/y) to Low (<0.25 kg/Ha/y). Note that P load reductions may also be required in other water bodies, but without chemistry monitoring data a quantitative estimate cannot be calculated.
- In the Upper Shannon catchment, water chemistry data are available for eight of the 58 water bodies. The available data indicate that load reductions are required in one river water body (Table 8).

Table 8. Relative load reductions required in monitored water bodies that are *At Risk*.

WATER BODY	P Load Reduction Required
CAMLIN_060	High

6 Further characterisation and local catchment assessments

- Further characterisation through local catchment assessments is needed in 34 of the *At Risk* water bodies to refine the understanding of the significant pressures at the site/field scale so that specific and targeted measures can be identified.
- Further characterisation through local catchment assessments is needed in 21 of the *Review* water bodies to refine the understanding of the significant pressures at the site/field scale so that specific and targeted measures can be identified.
- Brief definitions on the 10 IA assessment scenarios are given in Appendix 6 and the number of IAs required for each scenario are given in Table 9.

Table 9. Local Catchment Assessment Allocation for *At Risk* and *Review* River and Lake Water Bodies in the Catchment

Risk	IA 1	IA2	IA 3	IA 4	IA 5	IA6	IA 7	IA8	IA 9	IA10	Total
At Risk	16	0	4	0	2	2	18	0	6	0	**48**
Review	1	0	17	2	0	0	1	0	0	0	**21**
Note water bodies may have multiple categories of Local Catchment Assessments											

7 Catchment summary

- Of the 81 surface water bodies, 34 are *At Risk* of not meeting their WFD objectives.
- Excess nutrient loss, mainly phosphorus, leading to eutrophication is the dominant issue in the rivers and lakes in the catchment. The significant pressures relating to excess nutrients are primarily agricultural (diffuse and point), but also waste water (urban).
- Hydromorphological (or physical) conditions (including the input of high levels of fine sediment) and poor habitat quality are also major issues for several surface water bodies.
- There is one *At Risk* groundwater body, Carrick on Shannon IE_SH_G_048 in the catchment. The significant issue is due to potential groundwater contribution of phosphate to associated *At Risk* surface water bodies, and the potential significant pressure is agriculture.

8 Areas for Action

The characterisation outcomes described above have highlighted that there is significant work to do in the catchment to protect and restore water quality, and meet the objectives of the WFD. During the development of the draft river basin management plan it became apparent that there would be a need to prioritise areas for collective action so that the best return on investment could be achieved. 190 Areas for action have been selected nationally in a process as described below. There are 4 areas for action in the Upper Shannon (C) catchment.

8.1 Process of Selection

Following the publication of the draft river basin management plan in early 2017, the EPA and the Local Authority Waters and Communities Office (LAWCO) jointly led a collaborative regional workshop process to determine where, from a technical and scientific perspective, actions should be prioritised in the second cycle. The prioritisation process was based on the priorities in the draft river basin management plan, the evidence from the characterisation process, and the expertise, data and knowledge of public body staff with responsibilities for water and the different pressure types. The recommended areas for action selected during the workshops were then agreed by the Water and Environmental Regional Committees.

The recommended areas for action are an initial list of areas where action will be carried out in the second cycle. All water bodies that are *At Risk* still however, need to be addressed. As issues are resolved, areas for action will be removed from the list and new areas will be added. If additional monitoring shows that new issues have arisen, new areas may become a priority and may need to be added to the work programme.

The initial list of areas for action is not therefore considered as a closed or finite list; it simply represents the initial areas where work will be carried out during the second WFD planning cycle from 2018-2021.

8.2 Outcomes of process

The outcomes for the Upper Shannon catchment are summarised below.

- Four recommended areas for actions (Table 10, Figure 18) were selected.
- These are the Killukin/Shannon, Lough Rinn/Forbes, Camlin and Tulsk.
- These include 17 *At Risk* and six *Review* river water bodies.
- Two groundwater bodies, that are *At Risk* or *Review* due to groundwater contribution of nutrients to surface water bodies, intersect with three of the recommended areas for action, see Table 11. Actions taken to improve surface water will need to take account of the groundwater contribution to surface water.

A remaining 32 *At Risk* and *Review* surface water bodies were not included in the recommended areas for action for the second cycle. The distribution of these is presented in Figure 19. These include:

- thirty-two river and lake water bodies – 17 *At Risk* and 15 *Review*.

Table 10. Recommended Areas for Action in the Upper Shannon Catchment

Recommended area for action	Number of water bodies	SCs	Local authority	Reason for Selection
Killukin/ Shannon	4	26C_11	Leitrim	• Building on planned optimisation work at Carrick on Shannon WWTP. • Building on improvements in status, two water bodies improved from Poor to Moderate. • One water body didn't meet drinking water objective. • Headwaters
Lough Rinn/Forbes	8	26C_9	Leitrim	• Lough Rinn is a centre of excellence for rowing (1million euro invested). • Lough Rinn is important for Tourism. • Building on improvements: Lough Rinn has improved from Bad to Moderate. • Building on planned improvements at Mohill WWTP. • Lough Rinn is DWPA with MCPA issues. • River water bodies are headwaters to the Lough Rinn
Camlin	3	26C_6 26C_7	Longford	• Potential river restoration project. To be completed in collaboration with IFI. • Primary spawning area for Lough Ree and contributor to trout stock in Lough Ree. • Headwaters of the Camlin. • Socio economic value - the Camlin flows through Longford town. • One potential 'quick win'.
Tulsk	8	26C_12	Roscommon	• Building on Group Water Scheme work at Scramoge_010. • Building on recent WWTP (Tulsk and Environs) improvements. • Four deteriorated water bodies. • Headwaters to Scramoge_030, a Good status water body.

Table 11. Groundwater bodies intersecting with surface water bodies in recommended areas for action

Groundwater bodies			Intersecting surface water bodies		Recommended Area for Action
Code	Name	Risk	Code	Name	
IE_SH_G_048	Carrick on Shannon	At risk	IE_SH_26D100810	DOON_26_010	Tulsk
			IE_SH_26L040500	LISSAPHOBBLE_010	
			IE_SH_26M030100	MOUNTAIN (ROSCOMMON)_010	
			IE_SH_26S010050	SCRAMOGE_010	
			IE_SH_26S010200	SCRAMOGE_020	
			IE_SH_26S010600	SCRAMOGE_040	
			IE_SH_26S080200	STROKESTOWN_010	
			IE_SH_26_281	Nafulla	
			IE_SH_26K020100	KILLUKIN_010	Killukin/ Shannon
			IE_SH_26S021010	SHANNON (Upper)_060	
			IE_SH_26_582	Corbally	
			IE_SH_26_710	Corry	
IE_SH_G_091	Funshinagh	Review	IE_SH_26S021510	SHANNON (Upper)_080	Lough Rinn/Forbes
			IE_SH_26_723	Forbes	

9 Environmental Objectives

9.1 Surface Water

- Assuming resources are available and actions are taken in the recommended areas for action, of the 17 *At Risk* river water bodies, it is predicted that three (18%) will improve by 2021 and 14 (82%) will achieve their objective by 2027. For the six *Review* river water bodies, the absence of information on this water body means that there is no scientific basis to quantify an environmental objective date, and therefore a 2027 date is set for these water bodies, see Table 12.

Table 12. Environmental objective dates for water bodies in the Areas for Action

Risk Category	No. of Water Bodies	No. of WBs for 2021 Improvement	No. of WBs for 2027 Status Improvement
At Risk	17	3	14
Review	6	0	6
Total	23	3	20

- Twenty-six water bodies have met their 2015 environmental objective.
- As no action is yet planned to be taken in the remaining 17 *At Risk* surface water bodies, a 2027 date is applied to all these water bodies. For the 15 *Review* surface water bodies, the absence of information on these water bodies means that there is no scientific basis to quantify an environmental objective date and therefore a 2027 date is applied, see Table 13.

Table 13. Environmental objectives dates in the *At Risk* and *Review* surface water bodies not included in Areas for Action

Risk Category	No. of Water Bodies	No. of WBs for 2021 Improvement	No. of WBs for 2027 Status Improvement
Rivers			
At Risk	12	0	12
Review	5	0	5
Lakes			
At Risk	5	0	5
Review	10	0	10
Total	32	0	32

9.2 Groundwater

- All 15 groundwater bodies in the catchment are Good status and, therefore, have met their environmental objectives.

10 Acknowledgements

This Upper Shannon Catchment Assessment (Version 3) has been produced by the Catchment Science & Management Unit, EPA, with the assistance of the following:

- Roscommon County Council
- Leitrim County Council.
- Longford County Council.
- Inland Fisheries Ireland.
- Local Authorities Waters & Communities Office.
- Irish Water.
- RPS Group.
- Ecological Monitoring & Assessment Unit, EPA.
- Hydrometric & Groundwater Section, EPA.
- Informatics Section, EPA.
- Laboratories, EPA.
- Office of Environmental Enforcement, EPA.
- DAFM Agriculture.
- DAFM Forest Service.
- Coillte.
- Teagasc.
- Geological Survey Ireland.
- National Parks and Wildlife Service.
- Marine Institute.

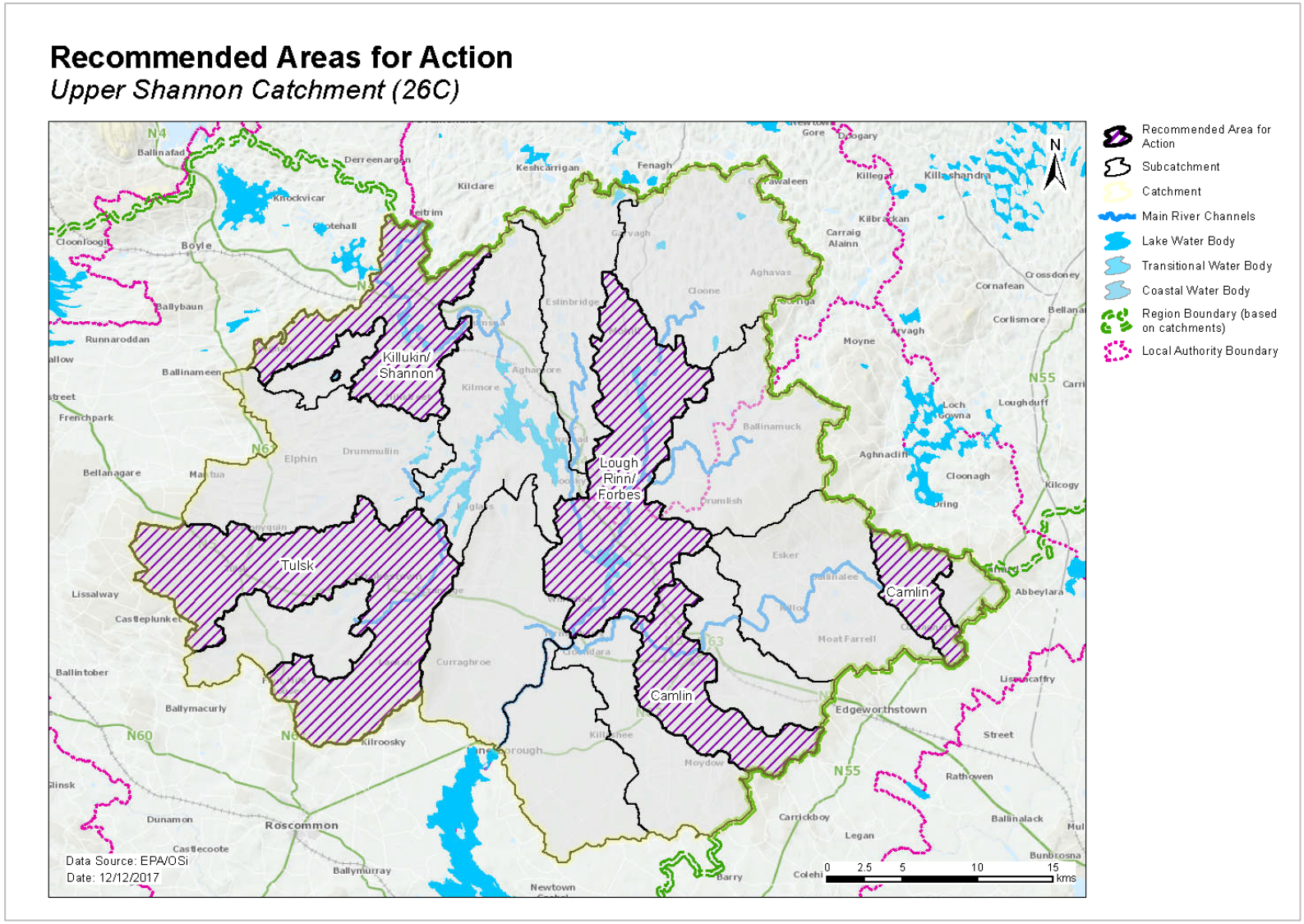


Figure 18. Location of Recommended Areas for Action in the Shannon Upper Catchment

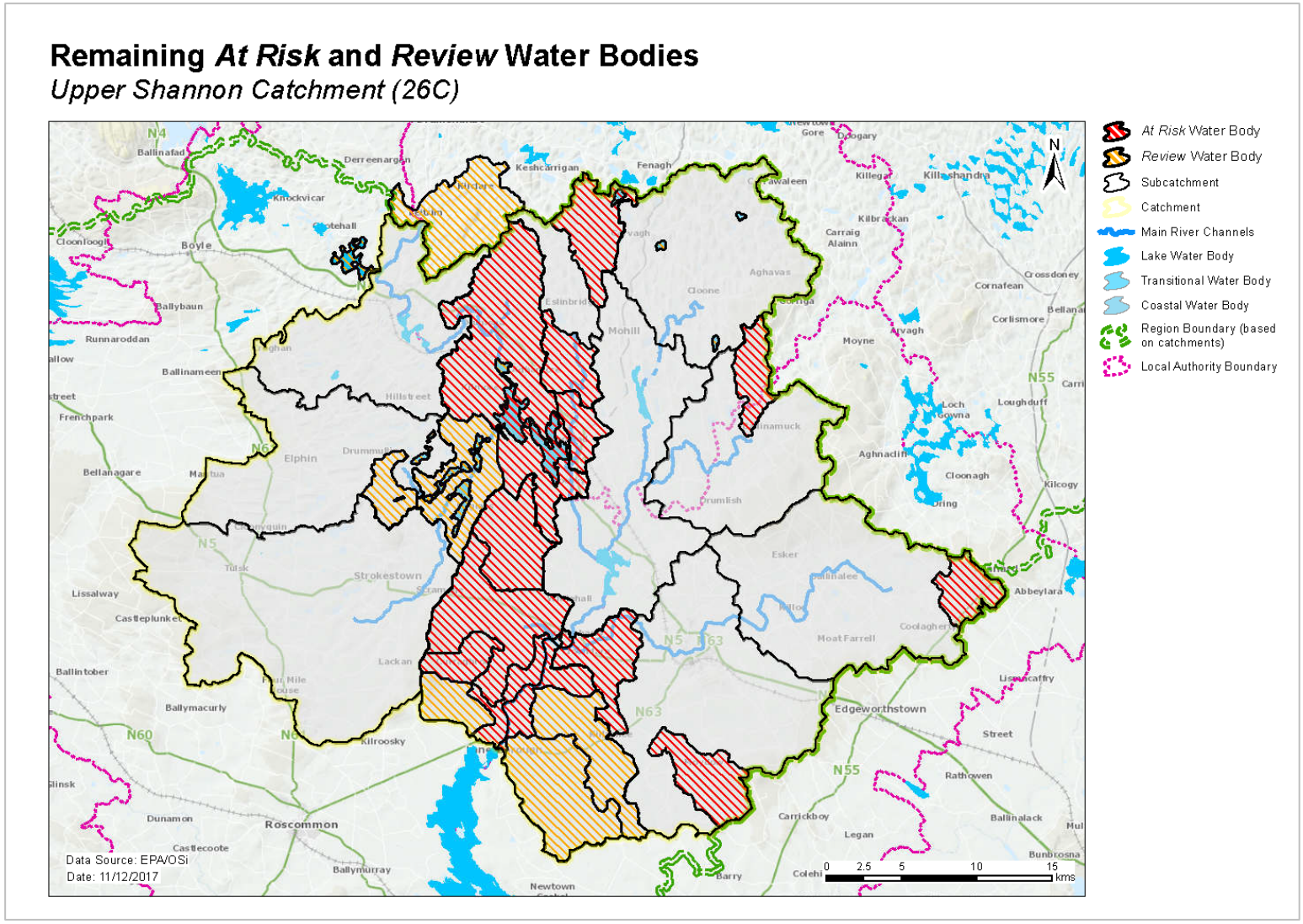


Figure 19. Location of *At Risk* and *Review* water bodies located outside Recommended Areas for Action in the Shannon Catchment

Appendix 1 Catchment Scale Nutrient concentrations and in-stream loads

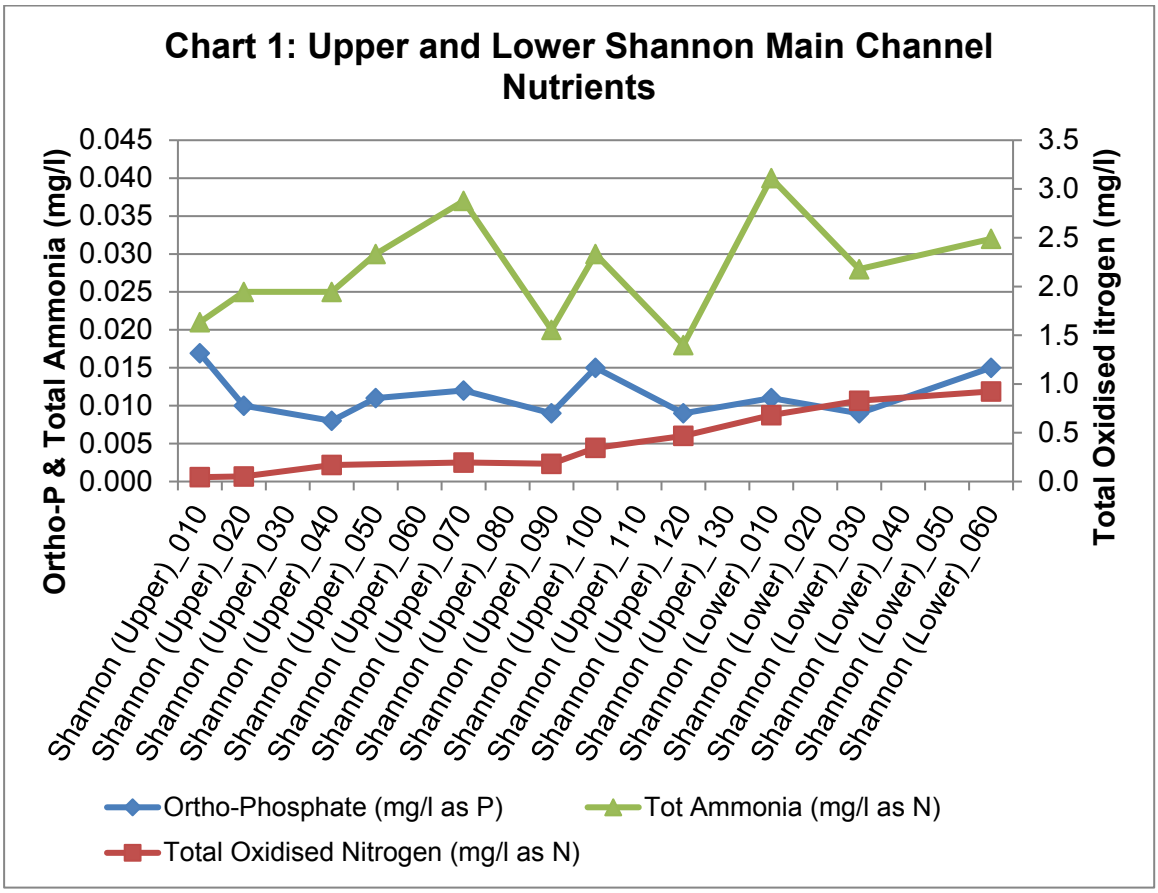
River Shannon Main Channel

The results of the instream water quality assessment for the Shannon (Upper and Lower) main channel are illustrated in Chart 1. The assessment is based on the mean concentrations between 2013 and 2015 at each site where data is collected. Only 12 of the 17 main channel water bodies have water quality data associated with them.

The results show that average nutrients concentrations in the Shannon main channel are below their corresponding threshold values. Concentrations of orthophosphate range from 0.008 to 0.017mg/l, with the highest concentration observed in the headwater SHANNON (UPPER)_010. Small spikes of orthophosphates are observed in the SHANNON (UPPER)_100, which receives water from the FEORISH (TARMONBARRY)_020 of poor ecological status, and the SHANNON (LOWER)_060 which is the receives the primary discharge from the Castleroy Waste Water Treatment Plant (WWTP).

Ammonia concentrations show no significant trend along the main channel and range from 0.018 to 0.037mg/l. The small concentration spikes of ammonia are observed in SHANNON (UPPER)_070 and SHANNON (LOWER)_010. The SHANNON (UPPER)_070 is the receiving water body for several small WWTPs including Dromod, Drumsna, Jamestown and Roosky & Environs. The SHANNON (LOWER)_010 is the receiving water body for the Banagher WWTP.

Total Oxidised Nitrogen (TON) concentrations are low at the head waters but increase from 0.018mg/l in the SHANNON (UPPER)_090 to 0.92mg/l in the SHANNON (LOWER)_060. TON remains well below the 2.6mg/l drinking water threshold value throughout the channel.

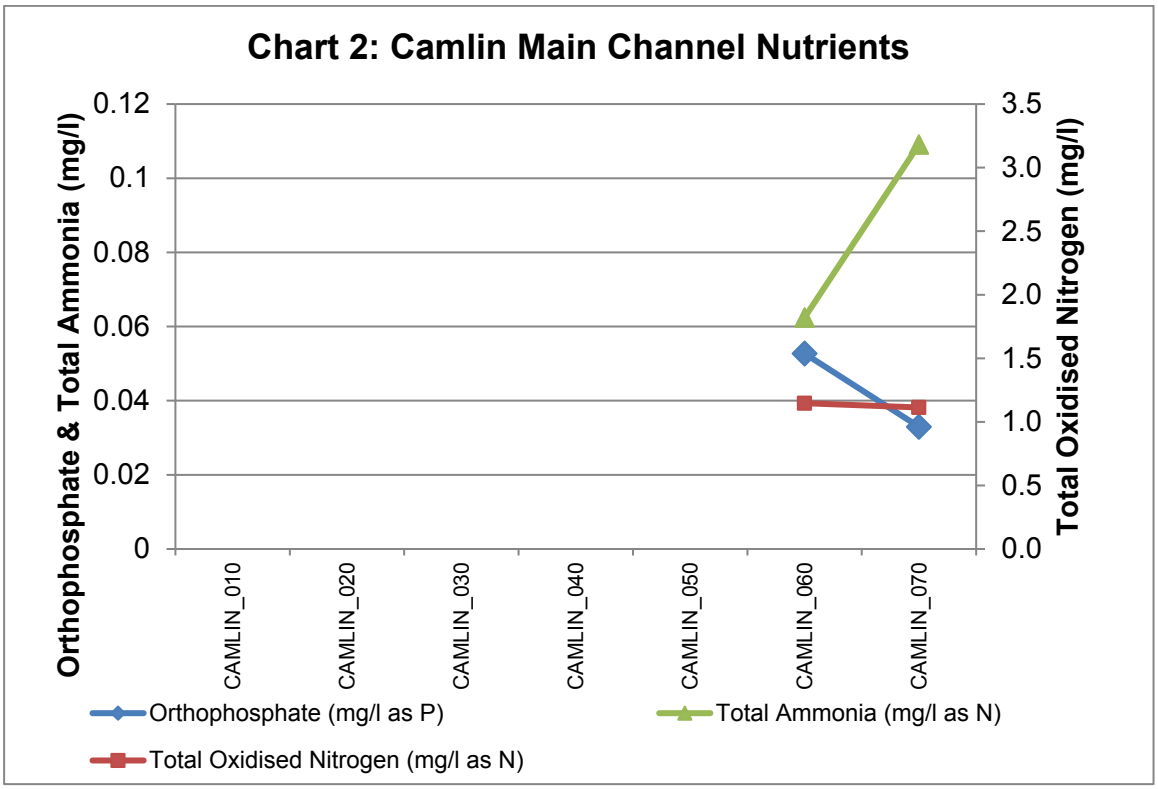


26C Upper Shannon Main Channel

Of the rivers with largest estimated Q30 flows, only the Camlin has associated water chemistry data. The results of the water quality assessment for the Camlin River are illustrated in Chart 1.

The Camlin River flows into the SHANNON (UPPER)_090 which is also the receiving water body for SHANNON (UPPER)_080 and FALLAN_020. Of the seven main channel water bodies, only two have baseline water chemistry data.

The results of the water quality assessment for the Camlin main channel are illustrated in Chart 2. Orthophosphate concentrations decrease between CAMLIN_060 and CAMLIN_070 from 0.053 to 0.033mg/l, with CAMLIN_060 exceeding the EQS (0.035mg/l). Ammonia concentrations are elevated at both water bodies, increasing from CAMLIN_060 to CAMLIN_070 which exceeds the EQS (0.065mg/l). TON concentrations are well below the TON threshold (2.6mg/l) at both water bodies.



Appendix 2 Summary information on *At Risk* and Review surface water bodies

Subcatchment code	Water body code	Water body name	Water body type	Risk	Ecological Status 07-09	Ecological Status 10-15	High Ecological Status Objective Water Body Y/N	Significant Pressures	Date to Meet Environmental Objective	Recommended Area for Action Name
26C_1	IE_SH_26_750a	Ree	Lake	At Risk	Moderate	Moderate	N	Other,UWW	2027	
26C_1	IE_SH_26B220790	Ballynakill_26_010	River	Review	Unassigned	Unassigned	N		2027	
26C_1	IE_SH_26L120100	Lough Bannow Stream_010	River	Review	Unassigned	Unassigned	N		2027	
26C_1	IE_SH_26S021600	Shannon (Upper)_100	River	At Risk	Moderate	Poor	N	Hymo,Ind,Other,Peat	2027	
26C_10	IE_SH_26_738	Rowan	Lake	At Risk	Good	Moderate	N	Ag	2027	
26C_10	IE_SH_26E010100	Eslin_010	River	At Risk	Moderate	Moderate	N	Ag,Hymo	2027	
26C_10	IE_SH_26E010400	Eslin_030	River	At Risk	Moderate	Moderate	N	Ag	2027	
26C_10	IE_SH_26E010500	Eslin_040	River	At Risk	Poor	Moderate	N	Ag,Hymo	2027	
26C_11	IE_SH_26_582	Corbally	Lake	Review	Unassigned	Unassigned	N		2027	Killukin/ Shannon
26C_11	IE_SH_26_710	Corry	Lake	Review	Unassigned	Unassigned	N		2027	Killukin/ Shannon
26C_11	IE_SH_26K020100	Killukin_010	River	At Risk	Poor	Moderate	N	Ag,DWW	2027	Killukin/ Shannon
26C_11	IE_SH_26S021010	Shannon (Upper)_060	River	At Risk	Poor	Moderate	N	Ag,DWW,UWW	2027	Killukin/ Shannon
26C_12	IE_SH_26_281	Nafulla	Lake	Review	Unassigned	Unassigned	N		2027	Tulsk
26C_12	IE_SH_26D100810	Doon_26_010	River	Review	Unassigned	Unassigned	N		2027	Tulsk
26C_12	IE_SH_26L040500	Lissaphobble_010	River	At Risk	Good	Poor	N	Ag,Hymo	2027	Tulsk
26C_12	IE_SH_26M030100	Mountain (Roscommon)_010	River	At Risk	Poor	Moderate	N	Ag	2027	Tulsk
26C_12	IE_SH_26S010050	Scramoge_010	River	At Risk	Good	Moderate	N	Ag,UWW	2021	Tulsk
26C_12	IE_SH_26S010200	Scramoge_020	River	At Risk	Good	Moderate	N	Ag,Hymo	2027	Tulsk
26C_12	IE_SH_26S010600	Scramoge_040	River	At Risk	Moderate	Poor	N	Hymo	2027	Tulsk
26C_12	IE_SH_26S080200	Strokestown_010	River	At Risk	Poor	Poor	N	Hymo	2027	Tulsk
26C_2	IE_SH_26F060400	Fardrumman Stream_010	River	At Risk	Moderate	Moderate	N	Ag,Hymo	2027	
26C_3	IE_SH_26_706	Grange	Lake	At Risk	Good	Moderate	N	Ag,Other	2027	
26C_3	IE_SH_26_751	Nablahy South	Lake	Review	Unassigned	Unassigned	N		2027	
26C_3	IE_SH_26_752	Nablahy North	Lake	Review	Unassigned	Unassigned	N		2027	
26C_3	IE_SH_26C240750	Cuilmore_26_010	River	Review	Unassigned	Unassigned	N		2027	
26C_4	IE_SH_26_624	Keeldra	Lake	Review	Unassigned	Unassigned	N		2027	
26C_4	IE_SH_26_734	Donogher	Lake	Review	Unassigned	Unassigned	N		2027	
26C_4	IE_SH_26_745	Adoon	Lake	Review	Unassigned	Unassigned	N		2027	
26C_5	IE_SH_26_746	Grange Lough	Lake	Review	Unassigned	Unassigned	N		2027	
26C_5	IE_SH_26_747a	Bofin LM	Lake	At Risk	Moderate	Moderate	N	Other	2027	

Subcatchment code	Water body code	Water body name	Water body type	Risk	Ecological Status 07-09	Ecological Status 10-15	High Ecological Status Objective Water Body Y/N	Significant Pressures	Date to Meet Environmental Objective	Recommended Area for Action Name
26C_5	IE_SH_26_747b	Boderg	Lake	At Risk	Moderate	Moderate	N	Ag,Other	2027	
26C_5	IE_SH_26_747c	Tap South	Lake	Review	Unassigned	Unassigned	N		2027	
26C_5	IE_SH_26_747d	Tap North	Lake	Review	Unassigned	Unassigned	N		2027	
26C_5	IE_SH_26_748	Kilglass	Lake	Review	Unassigned	Unassigned	N		2027	
26C_5	IE_SH_26_749	Grange North	Lake	Review	Unassigned	Unassigned	N		2027	
26C_5	IE_SH_26O060890	Owenur_030	River	Review	Unassigned	Unassigned	N		2027	
26C_5	IE_SH_26S021415	Shannon (Upper)_070	River	At Risk	Moderate	Moderate	N	Other	2027	
26C_6	IE_SH_26C010050	Camlin_010	River	At Risk	Unassigned	Poor	N	For,Hymo	2021	Camlin
26C_6	IE_SH_26R040700	Rhine_010	River	At Risk	Poor	Poor	N	Ag,UWW	2027	
26C_7	IE_SH_26C010900	Camlin_060	River	At Risk	Unassigned	Unassigned	N	Ag,DU,UWW	2027	Camlin
26C_7	IE_SH_26C011000	Camlin_070	River	At Risk	Poor	Poor	N	DU,Hymo,UWW	2027	Camlin
26C_7	IE_SH_26F010040	Fallan_010	River	At Risk	Moderate	Moderate	N	Ag,For	2027	
26C_7	IE_SH_26S021530	Shannon (Upper)_090	River	At Risk	Moderate	Moderate	N	Ag,Hymo	2027	
26C_8	IE_SH_26C150180	Curraghroe Stream_010	River	At Risk	Poor	Poor	N	Peat	2027	
26C_8	IE_SH_26F030200	Feorish (Tarmonbarry)_010	River	At Risk	Poor	Poor	N	Peat	2027	
26C_8	IE_SH_26F030400	Feorish (Tarmonbarry)_020	River	At Risk	Poor	Poor	N	Peat	2027	
26C_8	IE_SH_26G470700	Gortgallan_010	River	Review	Unassigned	Unassigned	N		2027	
26C_9	IE_SH_26_700	Rinn	Lake	At Risk	Bad	Moderate	N	Ag,Hymo,Ind,Other	2021	Lough Rinn/Forbes
26C_9	IE_SH_26_723	Forbes	Lake	At Risk	Moderate	Moderate	N	Ag,Other,Peat	2027	Lough Rinn/Forbes
26C_9	IE_SH_26A430910	Annaghcooleen_010	River	Review	Unassigned	Unassigned	N		2027	Lough Rinn/Forbes
26C_9	IE_SH_26D560860	Drumbad 26_010	River	Review	Unassigned	Unassigned	N		2027	Lough Rinn/Forbes

Subcatchment code	Water body code	Water body name	Water body type	Risk	Ecological Status 07-09	Ecological Status 10-15	High Ecological Status Objective Water Body Y/N	Significant Pressures	Date to Meet Environmental Objective	Recommended Area for Action Name
26C_9	IE_SH_26R020100	Rinn_010	River	At Risk	Poor	Poor	N	UWW	2027	Lough Rinn/Forbes
26C_9	IE_SH_26R020200	Rinn_020	River	At Risk	Moderate	Moderate	N	Ag	2027	Lough Rinn/Forbes
26C_9	IE_SH_26R020400	Rinn_030	River	At Risk	Moderate	Moderate	N	Ag	2027	Lough Rinn/Forbes
26C_9	IE_SH_26S021510	Shannon (Upper)_080	River	At Risk	Moderate	Moderate	N	Ag	2027	Lough Rinn/Forbes

Ag: Agriculture

DWW: Domestic Waste Water

For: Forestry

Hymo: Hydromorphology

Ind: Industry

M+Q: Mines and Quarries

Peat: Peat Drainage and Extraction

DU: Diffuse Urban

UWW: Urban Waste Water

Note: Significant Pressures for Review water bodies have not been included as they will need to be confirmed as part of an Investigative Assessment.

Protected Area: If a water body is one or more of the following: Drinking Water Protected Area; Bathing Water; Shellfish Area; Nutrient Sensitive Area or; a Natura 2000 site with a water dependent qualifying interest with a water quality and/or quantity conservation objective, then it has been highlighted as a protected area in this table.

Appendix 3 Drinking water supplies in the catchment

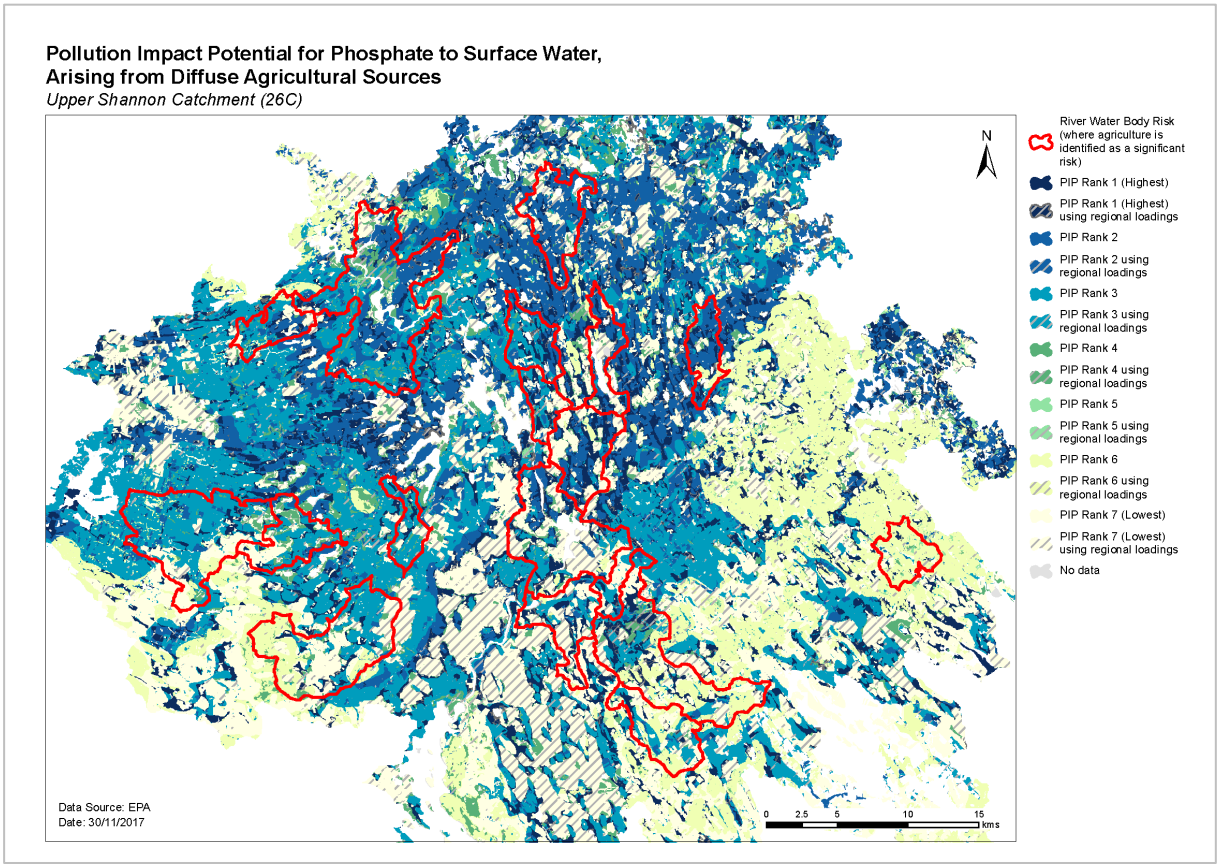
Scheme Code	Scheme Name	Water Body	Water Body Code	Objective met? Yes/ No	Reason why not met
2000PRI1036	Cloonmore/Kilmore GWS	Newtown Forbes	IE_SH_G_192	Yes	N/A
2000PRI1048	Fostra GWS	Longford Ballinalee	IE_SH_G_149	Yes	N/A
2000PUB1009	Lanesboro	Funshinagh	IE_SH_G_091	Yes	
2000PUB1010	Longford central Lough Forbes	Forbes Lake	IE_SH_26_723	No	MCPA
2600PUB1007	NERWSS - Strokestown/Elphin Lisheen Lake	Grange Lake	IE_SH_26_706	Yes	N/A
1700PUB1100	South Leitrim Regional Water Supply Scheme River Shannon	Shannon (Upper)_060	IE_SH_26S021010	No	MCPA
2000PUB1001	Currygrane Lough	Camlin_030	IE_SH_26C010600	Yes	N/A
2000PRI1109	Cloontaghmore Borehole	Inny	IE_SH_G_110	Yes	N/A
2000PRI1017	Ardagh	Longford Ballinalee	IE_SH_G_149	Yes	N/A
2000PRI1032	Clogher/Rynne	Newtown Forbes	IE_SH_G_192	Yes	N/A
2600PRI3012	Carane/Whitehall	Funshinagh	IE_SH_G_091	Yes	N/A
2600PRI3014	Carnalasson/Caggle	Carrick on Shannon	IE_SH_G_048	Yes	N/A
2600PRI3043	Grange Lower	Carrick on Shannon	IE_SH_G_048	Yes	N/A
2600PRI3044	Grange/Four-Mile-House	Carrick on Shannon	IE_SH_G_048	Yes	N/A
2600PRI3048	Ogulla/Tulsk	Carrick on Shannon	IE_SH_G_048	Yes	N/A
2600PRI3002	Ardkeenagh	Carrick on Shannon	IE_SH_G_048	Yes	N/A
2600PRI3006	Ballinderry/Rathmore/ Castlemine	Carrick on Shannon	IE_SH_G_048	Yes	N/A
2600PRI3024	Clooneyquinn	Carrick on Shannon	IE_SH_G_048	Yes	N/A
2600PRI3065	Polecat Springs Co-Op	Carrick on Shannon	IE_SH_G_048	Yes	N/A
2600PRI3054	Rathcroghan Lough Nafulla	Scramoge_010	IE_SH_26S010050	Yes	N/A
2600PRI3055	Shadlough	Shad Lough (IE_SH_26_611) Shad Lough Stream_010	IE_SH_26S130250	Yes	N/A
2600PRI3001	Annaghmore/ Corraslira Lake Nablasbarnagh	Doon 26_010	IE_SH_26D100810	Yes	N/A
2600PRI3021	Clooncullane/ Clooncunny Lough Clooncullane	Owenur_010	IE_SH_26O060300	Yes	N/A
2600PRI3037	Derryphatten Fin Lough	Fin Strokestown Lake (IE_SH_26_489) Scramoge_030	IE_SH_26S010300	Yes	N/A

Appendix 4 Prioritisation of water bodies with Natura 2000 site qualifying interests

SAC Name	Relevant Qualifying interests	Target status	Water body type	Water bodies	Status (risk)	Prioritise?	Code	Survey data?
Annaghmore Lough (Roscommon) SAC 001626	7230	Good GW level	Groundwater	Carrick on Shannon GWB	Good (AT RISK)	No	IE_SH_G_048	No
Ardagullion Bog SAC 002341	none							
Brown Bog SAC 002346	none							
Clooneen Bog SAC 002348	none							
Lough Forbes Complex SAC 001818	Potential 3150	Good	Lake	Forbes	Moderate (AT RISK)	Yes	IE_SH_26_723	Yes
Mullygollan Turlough SAC 000612	3180	Good GW level/quality	Groundwater	Carrick on Shannon GWB	Good (AT RISK)	No	IE_SH_G_048	No

Appendix 5 Pollution Impact Potential (PIP) Map for Phosphorus

For areas where agriculture is deemed as the significant pressure, areas of high risk to surface water can be targeted. The map below shows relative risk of loss of phosphorus to surface water. The risk of phosphorus losses is strongly correlated on whether the land is poorly draining or free draining and the loadings applied i.e. significant loadings applied on poorly draining areas result in a high potential risk to surface water. However, this figure does not imply that actual losses from these areas are occurring but is a useful tool for informing where resources should be focused (i.e. by allowing high risk areas to be identified and prioritised for further investigation). PIP maps are available online at a scale of 1:20,000 and can be accessed by public bodies via the EDEN process.



Appendix 6 Local Catchment Assessment Categories

Category	Assessment & Measures Evaluation Details
IA1	Further information provision (e.g. from IFI, LAs, EPA)
IA2	Point source desk-based assessment
IA3	Assessment of unassigned status water bodies, requiring field visit(s)
IA4	Regulated point sources, requiring field visit/s
IA5	Stream (catchment) walk to evaluate multiple sources in a defined (1 km) river stretch (used as the basis for estimating resource requirements)
IA6	Stream (catchment) walk in urban areas
IA7	Stream (catchment) walk along >1 km river stretches
IA8	Stream (catchment) walk along high ecological status (HES) objective rivers
IA9	Lakes assessment, requiring field visits
IA10	Groundwater assessments, requiring field visits