

Annalee Priority Area for Action

AFA0006 Desk Study Report

LAWPRO (Border Region)

Version F01



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Table of Contents

Disclaimer.....	ii
List of Tables	iv
List of Figures	iv
1. Background	1
2. Receptor Information and Assessment	7
2.1. Annalee_100	10
2.1.1. Monitoring Station – 0.2 km u/s Cavan River confluence	10
2.1.2. Monitoring Station – 0.2 km d/s of Cavan River confluence	11
2.2. Cavan_020.....	13
2.2.1. Monitoring Station – 0.2 km u/s of Annalee River confluence (St. 20400)	13
2.3. Cavan_010.....	15
2.3.1. Monitoring Station – Br. SE of Drumkeen house (Br d/s S) (St. 20300).....	15
2.3.2. Monitoring Station – Br. N of Killycannan (St. 20085)	17
2.3.3. Monitoring Station – Br. near Breffni Park (St. 10040).....	18
3. Significant Pressures	22
3.1. Pollution Impact Potential Maps	23
3.2. Urban Run-off	26
3.3. Cavan WWTP.....	27
3.4. Other Pressures – Butlersbridge WWTP	29
4. Pathway Information and Analysis	30
4.1. Overview of Pathways in the PAA.....	30
5. Interim ‘Story’ of the Priority Area for Action	34
5.1. Annalee_100 waterbody.....	34
5.2. Cavan_020 waterbody	34
5.3. Cavan_010 waterbody	34
6. Communications Plan	35
7. Work plan.....	35
7.1. Further Characterisation Action Assigned:	35
7.2. Further Information Required	35
7.3. Local Catchment Assessment.....	36
7.3.1. Annalee_100	36
8. Review of Mitigation Options	36
Appendix A.....	38
Appendix B	44
Appendix C	45

List of Tables

Table 1 Summary of waterbodies within the Annalee PAA.....	2
Table 2 Receptor information for the Annalee_100, Cavan_020 and Cavan_010 waterbodies.	7
Table 3 The associated aggregation table for the Ortho-Phosphate (as P mg/l) trend for monitoring St. 21350 (2007 – 2018).	11
Table 4 The associated aggregation table for the Ortho-Phosphate (as P mg/l) trend for monitoring St. 21400 (2007 – 2018).	12
Table 5 The associated aggregation table for Ammonia (as N mg/l) and Ortho-Phosphate (as P mg/l) trend for monitoring St. 20400 (2007 – 2015).	14
Table 6 The associated aggregation table for ammonia (as N mg/l), Ortho-Phosphate (as P mg/l) and Total Oxidised Nitrogen trend for monitoring St. 20300 (2007 – 2018).	16
Table 7 The associated aggregation table for the Ortho-Phosphate (as P mg/l) trend for monitoring St. 20085 (2007 – 2015).	18
Table 8 The associated aggregation table for the Ortho-Phosphate (as P mg/l) trend for monitoring St. 10040 (2007 – 2018).	19
Table 9 Summary of the 2018 trends for all available chemistry data at each of the monitoring station.	20
Table 10 Summary of chemistry data at each river monitoring station within the Annalee_100, Cavan_020 and Cavan_010 waterbodies.....	21
Table 11 Summary of waterbodies and pressure information on each waterbody within the Annalee_100 and Cavan River PAA.....	22
Table 12 Annual Environmental Report 2017 for the upstream (St. 20200) and downstream (St. 20300) monitoring point at the Cavan WWTP (Licence No. D0020-01).	28
Table 13 Conceptual model information for the pathways in the Annalee_100 PAA.	31
Table 14 Planned EPA monitoring for the Annalee_100 (2019 – 2021).....	36
Table 15 Conceptual model information for the pathways in the Cavan_020 and Cavan_010 waterbodies	38

List of Figures

Figure 1 Flow direction of the waterbodies within the Annalee PAA.	4
Figure 2 Monitoring stations located within the Annalee PAA.	5
Figure 3 Monitoring stations located within the Annalee PAA and the Cavan River not in the PAA.	6
Figure 4 The biological trend and data for monitoring St. 21350 (1986 – 2017).	11
Figure 5 The biological trend and data for monitoring St. 21400 (1980 – 2017).	12
Figure 6 Ortho-Phosphate (as P mg/l) trend chart for monitoring St. 21400 (2007 – 2018).	12
Figure 7 The biological trend and data for monitoring St. 20400 (1986 – 2017).	14
Figure 8 Ammonia (as N mg/l) trend chart for monitoring St. 20400 (2007 – 2015).	14
Figure 9 Ortho-Phosphate (as P mg/l) trend chart for monitoring St. 20400 (2007 – 2015).	15
Figure 10 The biological trend and data for monitoring St. 20300 (1989 – 2017).	16
Figure 11 Ammonia (as N mg/l) trend chart for monitoring St. 20300 (2007 – 2018).	16
Figure 12 Ortho-Phosphate (as P mg/l) trend chart for monitoring St. 20300 (2007 – 2018).	17
Figure 13 Total Oxidised Nitrogen (as N mg/l) trend chart for monitoring St. 20300 (2007 – 2018). .	17
Figure 14 The biological trend and data for monitoring St. 20085 (1989 – 2017).	18
Figure 15 Ortho-Phosphate (as P mg/l) trend chart for monitoring St. 20085 (2007 – 2015).	18
Figure 16 The biological trend and data for monitoring St. 10040 (1989 – 2017).	19
Figure 17 Ortho-Phosphate (as P mg/l) trend chart for monitoring St. 10040 (2007 – 2018).	19

Figure 18 Surface water receptor PO₄ PIP maps for the Annalee_100 waterbody..... 23

Figure 19 Surface water receptor NO₃ PIP maps for the Annalee_100 waterbody. 24

Figure 20 Groundwater receptor NO₃ PIP maps for the Annalee_100 waterbody. 24

Figure 21 Surface water receptor PO₄ PIP maps for the Cavan_020 and Cavan_010 waterbodies..... 25

Figure 22 Surface water receptor NO₃ PIP maps for the Cavan_020 and Cavan_010 waterbodies. ... 25

Figure 23 Groundwater receptor NO₃ PIP maps for the Cavan_020 and Cavan_010 waterbodies. 26

Figure 24 Urban area and UWWT Plant location in the Cavan_020 and Cavan_010 which are outside the PAA boundary. 27

Figure 25 Ammonia concentrations at the upstream (St. 20200) and downstream (St. 20300) monitoring points for Cavan WWTP. 29

Figure 26 Total Oxidised Nitrogen concentrations at the upstream (St. 20200) and downstream (St. 20300) monitoring points for Cavan WWTP. 29

Figure 27 The aquifer bedrock for the Annalee_100 waterbody. 30

Figure 28 The wet and dry soils for the Annalee_100 waterbody..... 31

Figure 29 The groundwater vulnerability map for the Annalee_100 waterbody..... 32

Figure 30 The near surface PO₄ susceptibility map for the Annalee_100 waterbody..... 32

Figure 31 The near surface NO₃ susceptibility map for the Annalee_100 waterbody. 33

Figure 32 The sub-surface NO₃ susceptibility map for the Annalee_100 waterbody. 33

Figure 33 The aquifer bedrock for the Annalee_100, Cavan_020 and Cavan_010 waterbodies..... 39

Figure 34 The wet and dry soils for the Annalee_100, Cavan_020 and Cavan_010 waterbodies. 39

Figure 35 The groundwater vulnerability for the Annalee_100, Cavan_020 and Cavan_010 waterbodies. 40

Figure 36 The near surface PO₄ susceptibility map for the Annalee_100, Cavan_020 and Cavan_010 waterbodies. 41

Figure 37 The near surface NO₃ susceptibility map for the Annalee_100, Cavan_020 and Cavan_010 waterbodies. 42

Figure 38 The sub-surface NO₃ susceptibility map for the Annalee_100, Cavan_020 and Cavan_010 waterbodies 43

Figure 39 The 2017 EPA biologist report for the Annalee_100. 44

Figure 40 Initial sampling locations for SSIS/RA analysis..... 45

1. Background

The Annalee_100 priority area for action (PAA) is located west of Ballyhaise in Co. Cavan and is 15 km in length (Figure 2). The source of the Annalee River (Abhainn na hEoghanach) is Lough Sillan near Shercock Co. Cavan, from which it flows westwards through Lough Tacker, and south of Cootehill, until it reaches the village of Butlersbridge. From there the Annalee River flows through a series of lakes before meeting up with the River Erne in the adjacent sub-catchment (Erne_080 in 36_21). There are two inputting surface waterbodies, the Annalee_090 which joins up with the Annalee_100 at Butlersbridge and the Cavan_020 which comes in upstream of the surveillance monitoring station (St 400) (Figure 1, Figure 3). The Cavan_020 is currently *At Risk* but not included in the priority areas for action.

There are total of ten waterbodies which make up the Annalee River (Table 1). The waterbodies between Lough Sillan and Ballyhaise Agricultural College Co. Cavan (Annalee_080; Annalee_070; Annalee_060; Annalee_050; Annalee_040; Annalee_030; Annalee_010) are not part of the PAA as they are currently *Not At Risk*. However, the status of the Annalee_090 is under *Review* due to elevated PO₄ concentrations and the Annalee_020 is *At Risk* although both of these waterbodies are not under investigation in the current river basin cycle.

Reason why the area for action was chosen:

- Single significant pressure identified in this waterbody.
- This is the only water body in this waterbody that is at less than Good Status.
- Fish status driving ecological status with all other determinants at Good.

Fishing in general within the Annalee Catchment is quite popular, with the river holding good stocks of perch, pike, roach, bream and trout. Deredis near Butlersbridge, situated within the Annalee_100, has been identified as a key fishing location. In 2010 - 2011 an area of pearl mussel (*Margaritifera margaritifera*) was identified approximately 13 km downstream from the discharge point of the Butlersbridge WWTP.

Conclusion from the initial characterisation has identified agriculture to be the significant pressure within the Annalee_100 waterbody. While urban runoff and urban waste water from the Butlersbridge waste water works, have also been identified as a pressure they are not considered to be significant. In addition, to the information from the initial characterisation the Cavan_020 may be a potential significant contributor.

The initial characterisation sub-catchment assessment has recommended that the following actions be undertaken:

Annalee_100:

- *“Confirm whether or not the decline in phosphate concentrations in Cavan_020 resulted in a decline in phosphate in Annalee_100.”*
- *“If no decline, complete IA7 on nutrient sources from agriculture. Start at the monitoring station, RS36A021400, walk upstream along the water body and its associated tributaries. Identify point pressures (drains, discharge pipes, farmyards, cattle access) and diffuse pressures (inadequate buffer strips) for sources of nutrients. Collect field parameters (dissolved oxygen, pH, temperature and conductivity). Use results to guide the selection of water quality and small stream risk scores in order to identify critical source areas for nutrients.”*

AFA0006_ Annalee PAA

Table 1 Summary of waterbodies within the Annalee PAA

WB Code	WB Name	WFD Risk	Status Objective (Good)	WFD Status				Bio 17	Bio 19	Pressure Category	Pressure Subcat.	Sig. Pressure	Impact	AA
				07-09	10-12	10-15	13-18							
IE_NW_36A020080	ANNALEE_010	Not At Risk	2021	M	G	G	M	3-4		N/A	N/A	N/A		N
IE_NW_36A020150	ANNALEE_020	At Risk	2027	P	P	P	M	3-4		Agriculture	Pasture	Yes		N
										Industry	IE			
										UWW	Agglomeration PE of 500 to 1,000			
IE_NW_36A020350	ANNALEE_030	Not At Risk	2021	G	G	G	G	4		N/A	N/A	N/A		N
IE_NW_36A020500	ANNALEE_040	Not At Risk	2021	M	G	G	G	4		N/A	N/A	N/A		N
IE_NW_36A020600	ANNALEE_050	Not At Risk	2021	M	M	G	G	4		N/A	N/A	N/A		N
IE_NW_36A020800	ANNALEE_060	Not At Risk	2021	G	G	G	G	4		N/A	N/A	N/A		N
IE_NW_36A020900	ANNALEE_070	Not At Risk	2021	M	G	G	G	4		N/A	N/A	N/A		N
IE_NW_36A021000	ANNALEE_080	Not At Risk	2021	M	M	G	G	4		N/A	N/A	N/A		N
IE_NW_36A021150	ANNALEE_090	Review	2021	U	G	G	G	4		UWW	Agglomeration PE of 500 to 1,000	No		N
										Agriculture	Pasture			
IE_NW_36A021400	ANNALEE_100	At Risk	2021	M	M	M	M	4 (u/s Cavan_020 Conf.)		Agriculture	Pasture	Y	Nutrient and Organic Pollution	Y
										Urban Run-off	Diffuse source run-off	N		
										UWW	Agglomeration < 500 PE	N		
IE_NW_36C020400	CAVAN_020	At Risk	2027	P	P	P	P	3		Agriculture, Urban-Run-off	Agriculture, Diffuse sources run-off	Yes		N

AFA0006_ Annalee PAA

WB Code	WB Name	WFD Risk	Status Objective (Good)	WFD Status				Bio 17	Bio 19	Pressure Category	Pressure Subcat.	Sig. Pressure	Impact	AA
				07-09	10-12	10-15	13-18							
IE_NW_36C020300	CAVAN_010	At Risk	2027	P	P	P	P	3 (Br. Near Breffni Park)	3-4 (Br. Near Breffni Park)	UWW	Agglomeration > 10000 PE	N	N	
								4 (Br N of Killycannon)		Urban Run-off	Diffuse sources run-off	Y		
								3 (Br d/s Cavan (Lisdarn))		Agriculture	Agriculture	Y		
								2-3 (Br. SE of Drumkeen house (Br d/s S))	3 (Br. SE of Drumkeen house (Br d/s S))					

AFA0006_ Annalee PAA

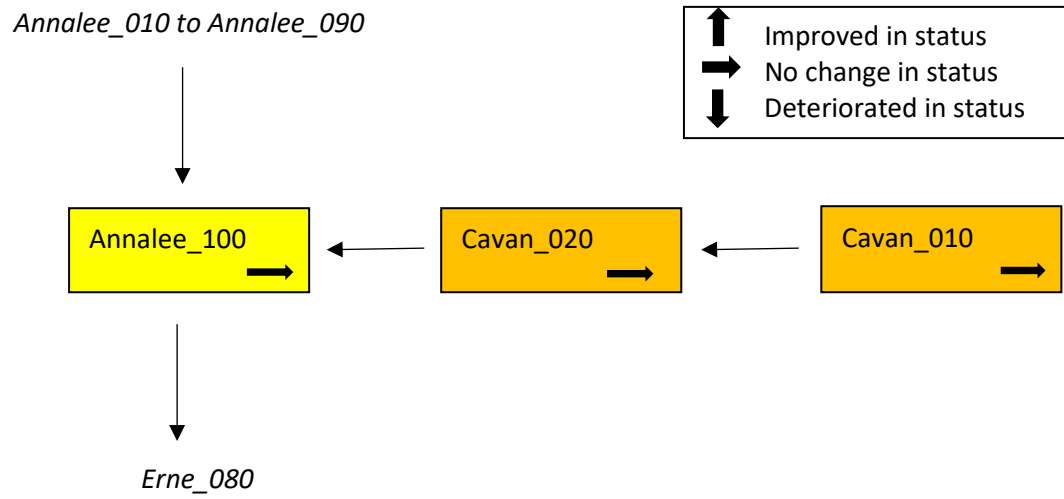


Figure 1 Flow direction of the waterbodies within the Annalee PAA

AFA0006_ Annalee PAA

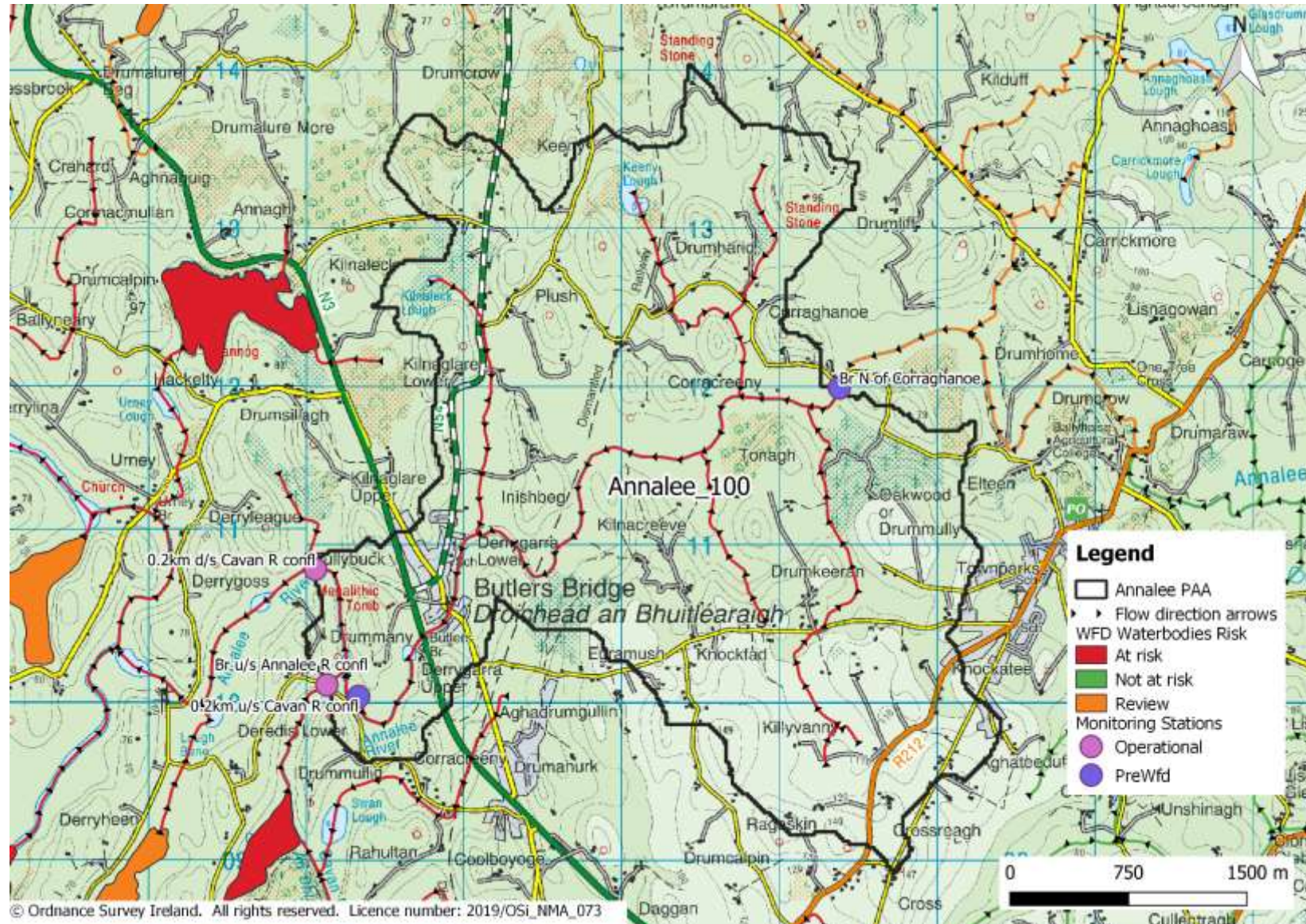


Figure 2 Monitoring stations located within the Annalee PAA.

AFA0006_ Annalee PAA

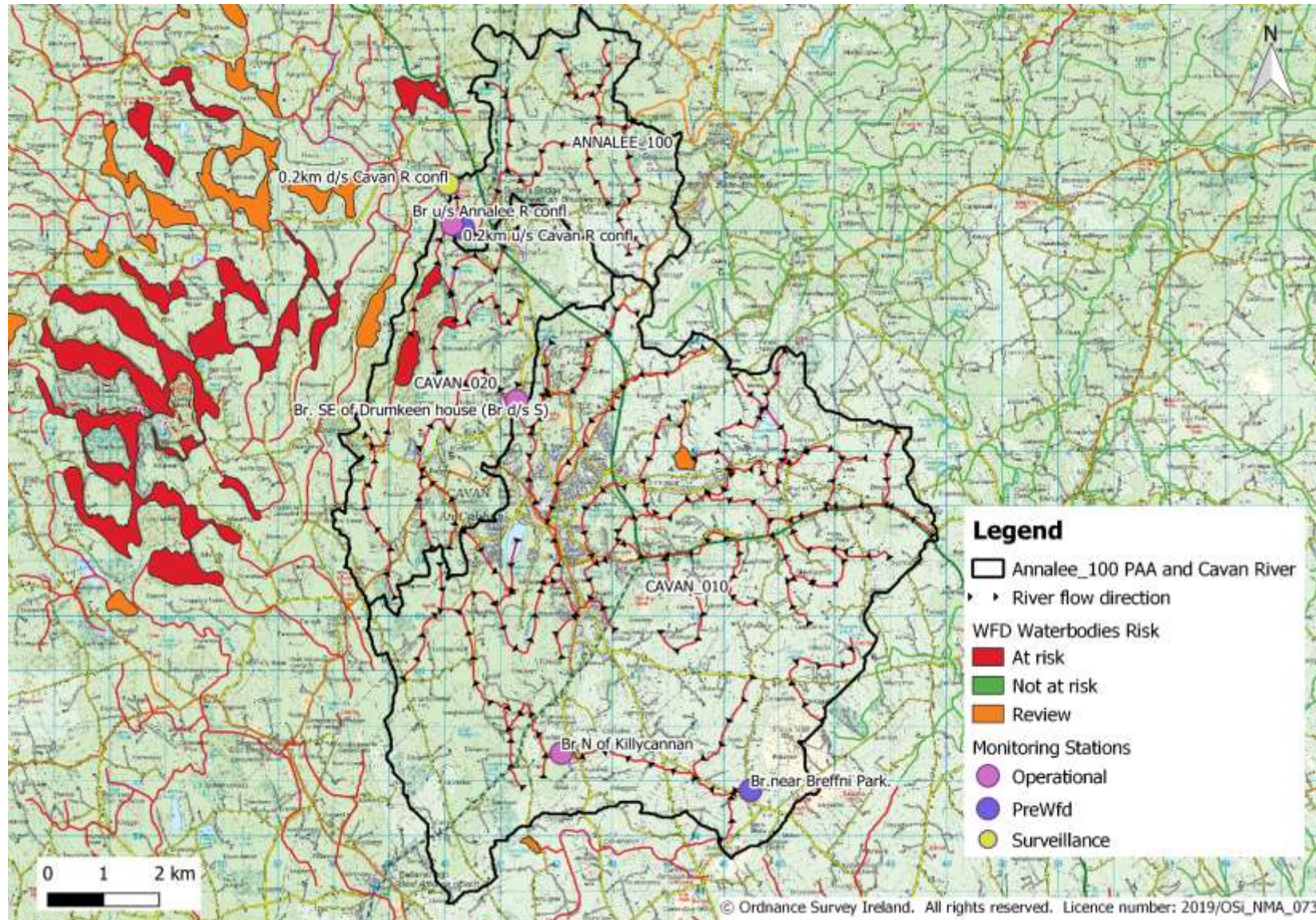


Figure 3 Monitoring stations located within the Annalee PAA and the Cavan River which is not part of the PAA.

2. Receptor Information and Assessment

There is one waterbody in the Annalee sub-catchment which is a PAA and has been identified as *At Risk* based on the reporting period 2010-2015. The biological status based on the latest Q-value assessment (2017), categorises the Annalee_100 as moderate ecological status (Table 1).

The monitoring stations within the Annalee_100 PAA, labelled in Table 2 will be identified as follows:

- 0.2 km u/s Cavan River confluence: St. 21350
- 0.2 km d/s Cavan River confluence: St. 21400

As seen in Table 1, the biological status upstream of the Cavan River confluence (St. 21350) was a Q 4 in 2017, while the biological status below the Cavan River confluence (St. 21400) was a Q 3-4. For the purpose of this desk study both the Cavan_020 and Cavan_010 will also be assessed. The purpose for their inclusion to the desk study is that the Cavan River which is currently of poor ecological status is an inputting waterbody to the Annalee_100 PAA over this short stretch of the Annalee River (approx. 400 m) and could be contributing to the reduction in status at the lower station St. 21400.

Additional monitoring stations being assessed which are in the Cavan_020 and Cavan_010 waterbodies, presented in Table 2 are as follows:

- Br. u/s Annalee River confluence: St. 20400
- Br. Near Breffni Park: St. 10040
- Br. N of Killycannan: St. 20085
- Br. SE of Drumkeen House: St. 20300

Table 2 Receptor information for the Annalee_100, Cavan_020 and Cavan_010 waterbodies.

Factor	Figures Tables	IE_NW_36A021400 (Annalee_100)	IE_NW_36C020400 (Cavan_020)	IE_NW_36C020300 (Cavan_010)
Risk Category	N	<i>At Risk</i>	<i>At Risk</i>	<i>At Risk</i>
Biological Status				
Monitoring Station(s) with Q values	Y	St. 21350 u/s Cavan R St. 21400 d/s Cavan R	St. 20400 Br. u/s Annalee R	St. 10040 Br. Near Breffni Park St. 20085 Br. N of Killycannan St.20300 Br SE of Drumkeen House
2009-2015 Status		St. 21350: Q 4 St. 21400: Q 3-4	St. 20400: Q 2-3	St. 10040: Q 3 St. 20085: Q 3-4 St. 20300: Q 2-3
Trends in Q value since 2009		St. 21350 increased from Q 3-4 to Q4. St. 21400 decreased from a Q4 to Q3-4.	St 20400 Increased from a Q 2-3 to Q 3.	St. 10040 Unchanged St. 20085 increased from a Q 3-4 to Q 4 St.20300 increased from Q 1-2 to Q 2-3
2016-2018 Q value data		St. 21350: Q 4 St. 21400: Q 3-4	St. 20400: Q 3 (2017)	St. 10040: Q 3 (2017) Q 3-4 (2019) St. 20085: Q 4 St. 20300: Q 2-3 (2017) Q 3 (2019)
Hydrochemistry Data				
Monitoring Station(s) with data	Y	St. 21350: NH ₃ , PO ₄ , TON St. 21400: NH ₃ , PO ₄ , TON	St. 20400: NH ₃ , PO ₄ , TON	St. 10040: NH ₃ , PO ₄ St. 20085: NH ₃ , PO ₄

Existing		Up to 2015 St. 21350 Up to 2018 St. 21400	Up to 2015 St. 20400	St. 20300: NH ₃ , PO ₄ Up to 2018 St. 20300 Up to 2015 St. 20085 Up to 2018 St. 10040
New		N/A	N/A	N/A
Summary & Trends in PO₄, NH₃ and NO₃ In App	Y	St 21350: PO ₄ down NH ₃ down TON down St 21400: PO ₄ up NH ₃ down TON down	St 20400: PO ₄ down NH ₃ down TON down	St 10040: PO ₄ up NH ₃ down TON down St 20085: PO ₄ down NH ₃ down TON down St 20300: PO ₄ up NH ₃ down TON up
All Available data	Y	Y	Y	Y
Other water quality data		St. 21350: BOD St. 21400: BOD	BOD	St. 10040: BOD St. 20085: BOD St. 20300: BOD, TN, TP
Baseline Concentration (mg/l)		St 21350: PO ₄ 0.030 NH ₃ 0.026 TON 0.481 St 21400: PO ₄ 0.063 NH ₃ 0.051 TON 0.558	St 20400: PO ₄ 0.070 NH₃ 0.090 TON 0.671	St 10040: PO ₄ 0.062 NH ₃ 0.050 TON 0.766 St 20085: PO ₄ 0.047 NH ₃ 0.031 TON 0.896 St 20300: PO ₄ 0.055 NH₃ 0.081 TON 1.461
Other relevant values		None	None	None
Distance to threshold		St 21350: PO ₄ Far NH ₃ Far TON Far St 21400: PO ₄ Far NH ₃ Near TON Far	St 20400: PO ₄ Far NH ₃ Far TON Far	St 10040: PO ₄ Far NH ₃ Far St 20085: PO ₄ Far NH ₃ Near St 20300: PO ₄ Far NH ₃ Far
Indicative Quality (mg/l)		PO ₄ 0.035 NH ₃ 0.040 TON 1.8	PO ₄ 0.035 NH ₃ 0.040 TON 1.8	PO ₄ 0.035 NH ₃ 0.065 TON 1.8
Supporting Conditions				
Chemical conditions?	N	None	None	None
Oxygenation conditions		2010-2015 BOD Moderate St. 21400: BOD fluctuates above 1.5 mg/l	St. 20400: BOD fluctuates above 1.5 mg/l	St. 20085, St. 10040, St. 20300: BOD fluctuates above 1.5 mg/l
Acidification conditions		None	None	None
Hydromorphology				
RHAT score	N	N/A	N/A	N/A
Evidence of arterial drainage		OPW have no recent drainage works. Poor soil drainage capacity may indicate land drains in the area.	OPW have no recent drainage works. Poor soil drainage capacity	OPW have no recent drainage works. High density of tributaries to the main river channel

			may indicate land drains in the area.	and aerial mapping indicates a lot of drains in the area.
Ecological Status (2010 – 2015)	Y	Moderate	Poor	Poor
Trends 2010 - 2015		<p>No change in status (2010 – 2015) Invertebrate Status Good Fish Status Poor</p> <p>IFI have identified a lower than expected abundance of indicator species: 1. brown trout present but densities relatively low, 2. salmon absent in all years surveyed, 3. eel present in 2008 and 2013, but not recorded in 2016. Other species present such as roach, perch, pike, bream, tench and gudgeon. Barrier d/s on the Erne River is causing fish passage issues. Competition with various species also a factor.</p> <p>Suggested measures by IFI: No immediate measures for fish required. If water quality identified as an issue, would recommend concentrating on these as this will assist in improving fish status. There may be hydromorphological issues in the channel also, we surveyed two sites, and these were moderate.</p>	No change in status (2010 – 2015)	No change in status (2010 – 2015)
Protected Areas	N	None	Overlapping / partly within Protected Area	Overlapping / partly within Protected Area
WFD Objectives	Y	Good ecological status by 2021	Good ecological status by 2027	Good ecological status by 2027
EPA biologists notes (if any)	N	An unwelcome decline on the improvement observed in 2013 (Q4) was not maintained at the lowest station (St.21400) (Q3-4) downstream of the Cavan River confluence.	2017: The Cavan River was in poor ecological condition at three of the four sites surveyed in late July 2017.	<p>2017: The Cavan River was in poor ecological condition at three of the four sites surveyed in late July 2017. A welcome improvement was noted, however, at St. 20085.</p> <p>2019: There were minor improvements at two of the three sites sampled on the Cavan River however the ecological condition remained at poor for much of this river with the exception of the upper site (St. 10040) which achieved moderate quality. This</p>

				river appears to be impacted by both nutrients and organic pollution.
Significant issue	Y	<p>There is no updated monitoring data available for the u/s site (St. 21350) on the Annalee_100, however based on the 2015 data nutrients is not an issue.</p> <p>Based on 2018 data: St. 21400 is indicating an upward trend in PO₄, with concentrations also (2018: 0.055 mg/l) exceeding the EQS (0.035 mg/l)</p>	<p>There is no updated monitoring data available for the St. 20400 on the Cavan_020, however, based on the 2015 data NH₃ and PO₄ are both trending downwards while, concentrations are exceeding their respective EQS.</p>	<p>Based on 2018 data: St. 10040 is indicating an upward trend in PO₄, with 2018 concentrations exceeding the EQS</p> <p>There is no updated monitoring data available for the St. 20085 on the Cavan_010, however, based on the 2015 data PO₄ is trending downwards however, concentrations are exceeding their respective EQS.</p> <p>Based on 2018 data: St. 20300 is indicating a downward trend in NH₃, however the concentration is above the EQS, while PO₄, and TON are trending upwards, and the concentration is above the EQS.</p>

*Available in WFD app.

2.1. Annalee_100

2.1.1. Monitoring Station – 0.2 km u/s Cavan River confluence

The monitoring St. 21350 is a PreWfd monitoring station located on the main river channel 0.2 km upstream from Cavan River confluence (Figure 2).

Data summary:

- The 2017 biological data at this monitoring station characterises the river in the Annalee_100 as Good Ecological Status (Q4) (Figure 4).
- Fish status at this station is Moderate. The IFI Fish report 2016 outlines the presence of roach.
- This ecological status has remained at Good Status since 2013 (Figure 4).
- All parameters (NH₃, PO₄ and TON) which were last recorded in 2015 were trending downwards. The baseline concentrations for the parameters last measured in 2015 were also below their retrospective EQS.
- Just to note PO₄ concentrations in 2014 were at the EQS level of 0.035 mg/l (n = 4) but dropped down to 0.025mg/l (n = 3) in 2015 (Table 3).

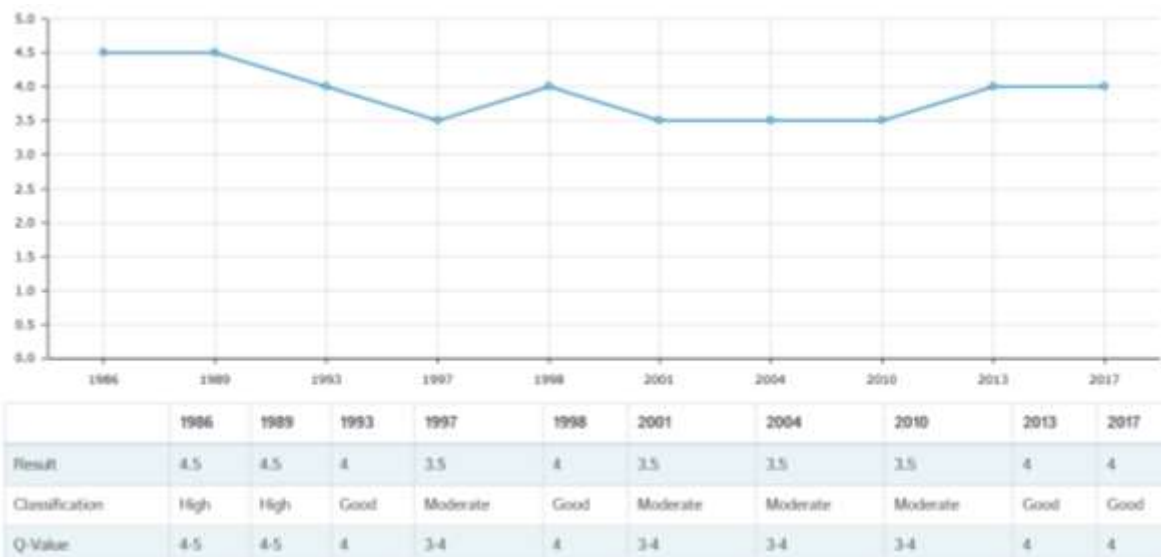


Figure 4 The biological trend and data for monitoring St. 21350 (1986 – 2017).

Table 3 The associated aggregation table for the Ortho-Phosphate (as P mg/l) trend for monitoring St. 21350 (2007 – 2018).

	2007	2008	2009	2010	2011	2012	2013	2014	2015
n	4	4	4	4	4	4	4	4	3
PO₄ mg P L⁻¹	0.053	0.046	0.047	0.025	0.038	0.045	0.030	0.035	0.025

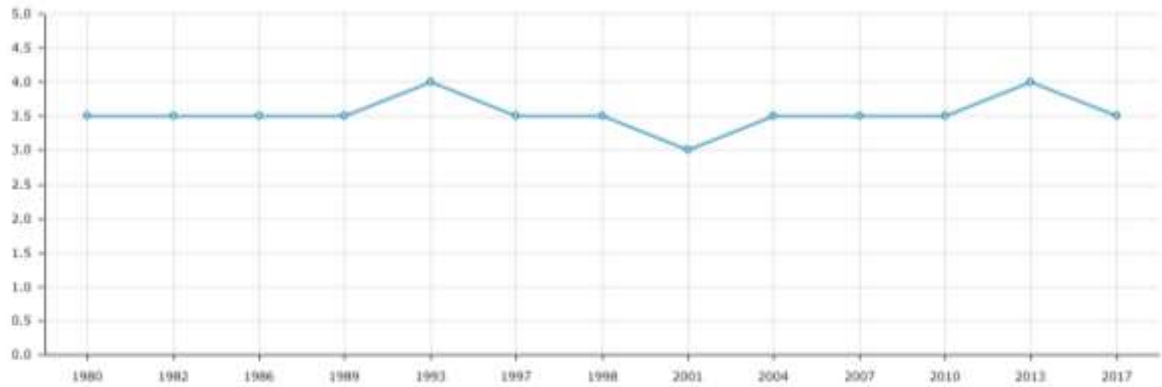
2.1.2. Monitoring Station – 0.2 km d/s of Cavan River confluence

The monitoring St. 21400 is a Surveillance monitoring station located on the main river channel 0.2 km downstream from the Cavan River confluence (Figure 2).

Data summary:

- The 2017 biological data at this monitoring station characterises the river in the Annalee_100 as Moderate Ecological Status (Q3-4) (Figure 5).
- BOD concentration in 2017, 2018 and 2019 consistently fluctuated above the EQS of 1.5mg/l, ranging between 0.5 mg/l on the 07th of March 2017 and 5.1 mg/l on the 21st of September 2017.
- The average NH₃ concentration measured at this station is trending downwards and the baseline concentrations are below their retrospective EQS.
- The average PO₄ concentrations at this station has been above the EQS since 2014 and is currently trending upwards (Table 4, Figure 6). The baseline concentration (2016 – 2018) is 0.063 mg/l.
- The average TON concentrations for this station are currently trending upwards but is below the EQS of 3.5 mg/l (Table 4, Figure 7).

AFA0006_ Annalee PAA



	1980	1982	1986	1989	1993	1997	1998	2001	2004	2007	2010	2013	2017
Result	3.5	3.5	3.5	3.5	4	3.5	3.5	3	3.5	3.5	3.5	4	3.5
Classification	Moderate	Moderate	Moderate	Moderate	Good	Moderate	Moderate	Poor	Moderate	Moderate	Moderate	Good	Moderate
Q-Value	3.4	3.4	3.4	3.4	4	3.4	3.4	3	3.4	3.4	3.4	4	3.4

Figure 5 The biological trend and data for monitoring St. 21400 (1980 – 2017).

Table 4 The associated aggregation table for the Ortho-Phosphate (as P mg/l) trend for monitoring St. 21400 (2007 – 2018).

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
PO ₄	n	14	16	15	16	14	17	15	16	15	12	12	12
	mg P L ⁻¹	0.041	0.036	0.047	0.037	0.047	0.043	0.031	0.051	0.041	0.080	0.054	0.055
TON	n	15	16	15	16	14	17	16	16	15	12	12	12
	mg N L ⁻¹	0.815	0.554	0.586	0.431	0.473	0.346	0.573	0.647	0.463	0.393	0.546	0.734

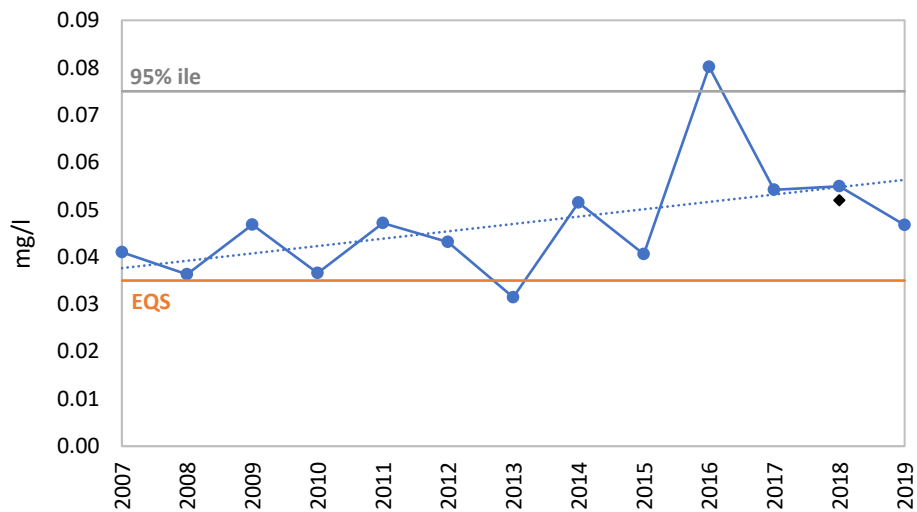


Figure 6 Ortho-Phosphate (as P mg/l) trend chart for monitoring St. 21400 (2007 – 2019).

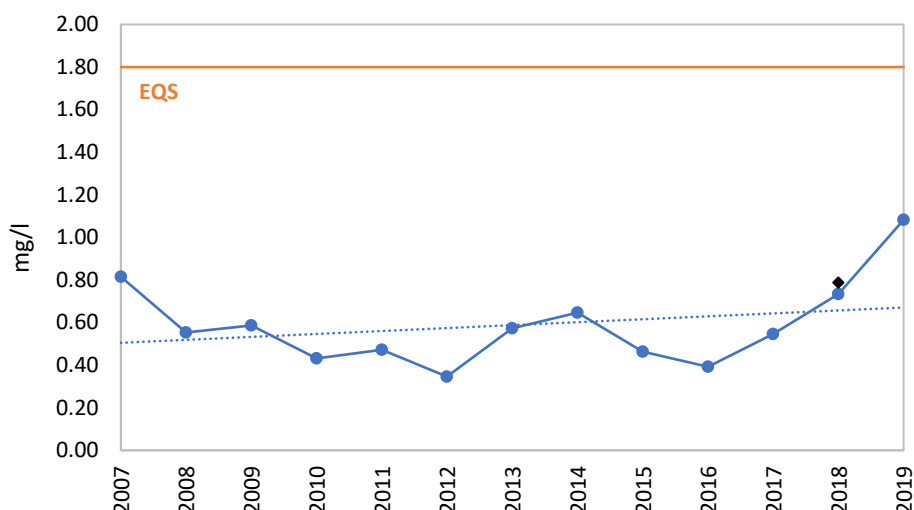


Figure 7 Total Oxidised Nitrogen (as N mg/l) trend chart for monitoring St. 21400 (2007 – 2019).

2.2. Cavan_020

2.2.1. Monitoring Station – 0.2 km u/s of Annalee River confluence (St. 20400)

The monitoring St. 20400 is an Operational monitoring station located on the main river channel 0.2 km upstream of the Annalee River confluence (Figure 3).

Data summary:

- The 2017 biological data at this station characterises the Cavan River as Poor Ecological Status (Q3) (Figure 8).
- Ecological status at this site increased from Q2-3 in 2013 to Q3 in 2017 (Figure 8).
- The average TON concentration measured at this station was trending downwards in 2015 and the baseline concentrations was below the EQS.
- The average NH_3 concentration is trending downwards for this station, however, the annual average concentration is consistently above the EQS with the exception of 2014 when the average concentration was 0.035 mg/l (n = 4) (Table 5, Figure 9). The baseline concentration for NH_3 (2013 – 2015) was 0.090 mg/l.
- Similar to NH_3 , the PO_4 concentration is trending downwards for this station, however, again the annual average concentration is consistently above the EQS ranging between 0.035 mg/l to 0.115 mg/l (Table 5, Figure 10). The baseline concentration for PO_4 (2013 – 2015) was 0.070 mg/l.

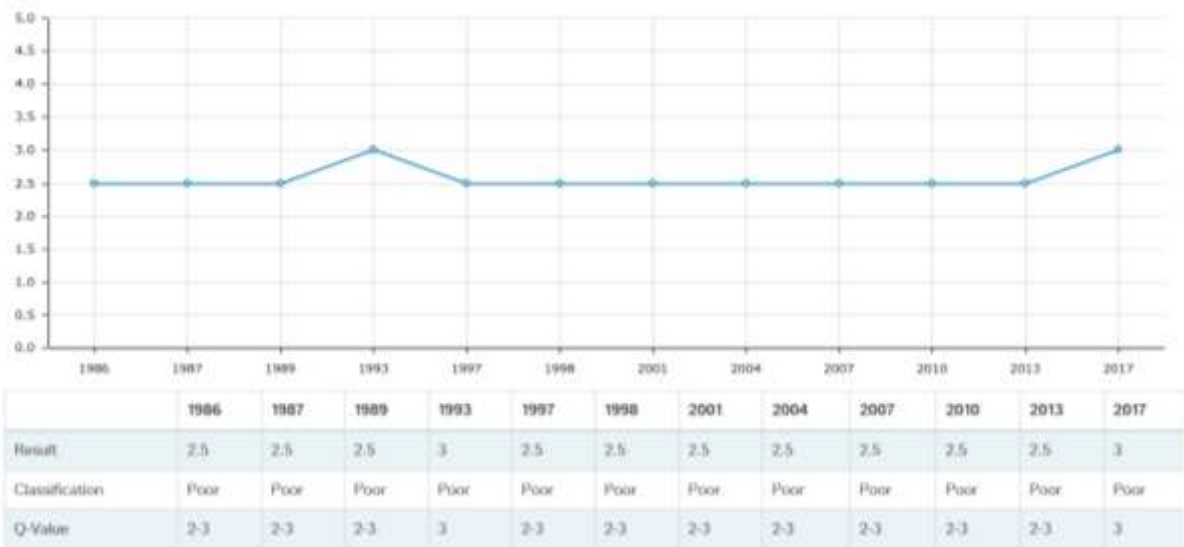


Figure 8 The biological trend and data for monitoring St. 20400 (1986 – 2017).

Table 5 The associated aggregation table for Ammonia (as N mg/l) and Ortho-Phosphate (as P mg/l) trend for monitoring St. 20400 (2007 – 2015).

		2007	2008	2009	2010	2011	2012	2013	2014	2015
NH₃	n	4	4	4	4	4	4	4	4	3
	mg N L⁻¹	0.155	0.122	0.529	0.109	0.084	0.075	0.150	0.035	0.087
PO₄	n	4	4	4	4	4	4	4	4	3
	mg P L⁻¹	0.071	0.067	0.066	0.110	0.115	0.101	0.087	0.088	0.035

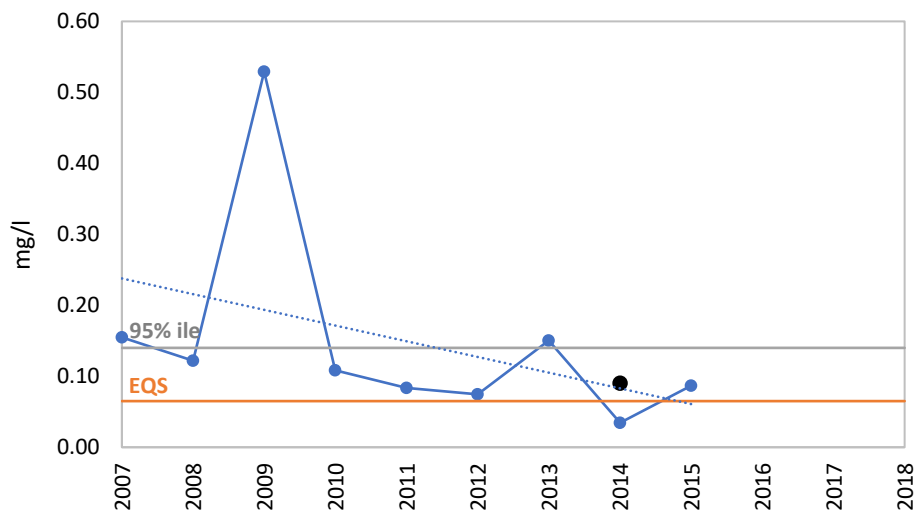


Figure 9 Ammonia (as N mg/l) trend chart for monitoring St. 20400 (2007 – 2015).

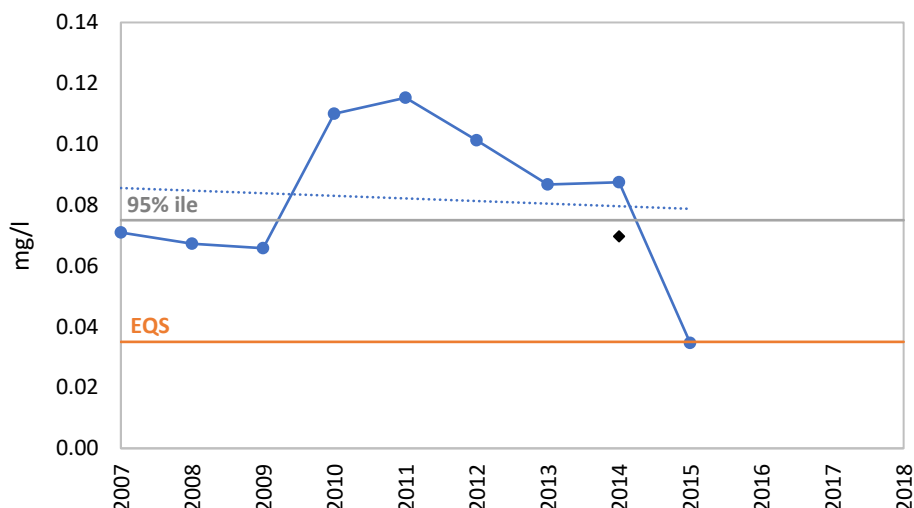


Figure 10 Ortho-Phosphate (as P mg/l) trend chart for monitoring St. 20400 (2007 – 2015).

2.3. Cavan_010

2.3.1. Monitoring Station – Br. SE of Drumkeen house (Br d/s S) (St. 20300)

The monitoring St. 20300 is an Operational monitoring station located on the main Cavan River channel on the border of the Cavan_020 and Cavan_010 waterbodies (Figure 3).

Data summary:

- The 2017 biological data at this station characterises the Cavan River as Poor Ecological Status (Q2-3), which still remained at Poor Ecological Status in 2019, however came up to a Q3 (Figure 10).
- Ammonia at this station is currently trending upwards. Annual average NH_3 concentrations are consistently above the EQS (0.065mg/l) since 2012, with the exception of 2017 (0.046 mg/l, n =15) (Table 6, Figure 11). The baseline concentration for NH_3 is 0.081 mg/l (2016 – 2018).
- Ortho-Phosphate is trending upwards. The annual average PO_4 concentrations at this monitoring station are consistently above the EQS (0.035 mg/l) (Table 6, Figure 12). The baseline concentration for PO_4 is 0.055 mg/l (2016 – 2018).
- Total Oxidised Nitrogen as like PO_4 is trending upwards. Annual average concentrations for TON are gradually increasing since 2016 and are currently measuring 1.8 mg/l (n = 5) (Table 6, Figure 13). The baseline concentration (2016 – 2018) for TON is 1.5 mg/l which is below the EQS of 1.8 for TON.
- BOD concentration fluctuates at this monitoring station but is generally above the EQS of 1.5 mg/l.

AFA0006_ Annalee PAA

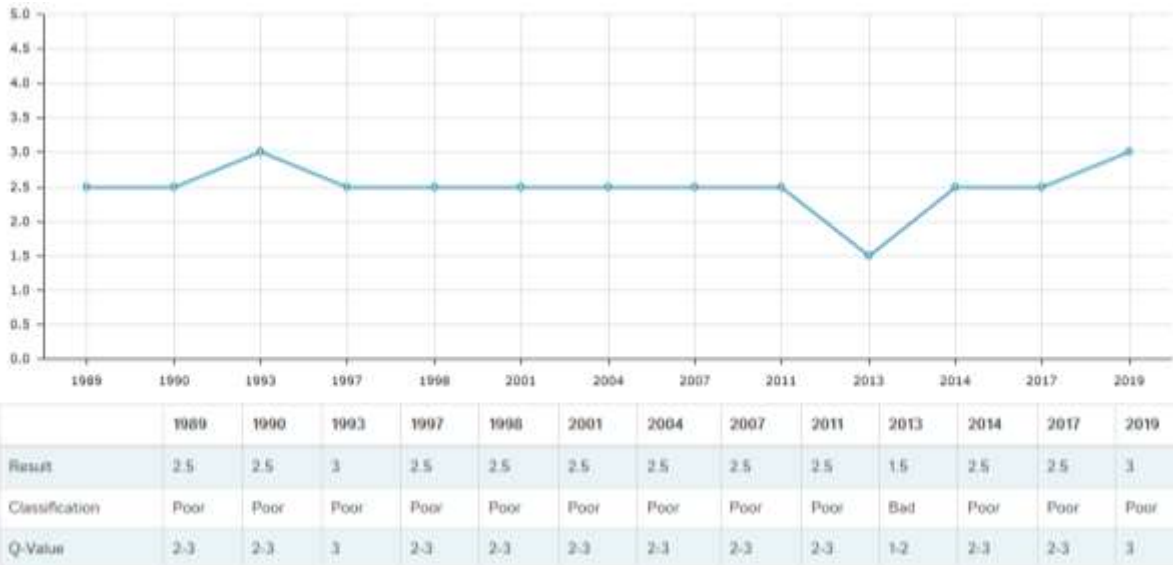


Figure 11 The biological trend and data for monitoring St. 20300 (1989 – 2019).

Table 6 The associated aggregation table for ammonia (as N mg/l), Ortho-Phosphate (as P mg/l) and Total Oxidised Nitrogen trend for monitoring St. 20300 (2007 – 2018).

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
NH ₃	n	4	4	4	4	4	4	4	4	5	5	5	10	
	mg N L ⁻¹	0.982	1.727	0.025	0.074	0.043	0.145	1.930	1.924	0.376	0.092	0.046	0.106	0.247
PO ₄	n	4	4	4	4	4	15	16	15	15	15	17	10	
	mg P L ⁻¹	0.100	0.085	0.048	0.067	0.067	0.123	0.839	0.293	0.068	0.067	0.048	0.051	0.070
TON	n	4	4	4	4	4	4	4	4	5	5	5	10	
	mg N L ⁻¹	2.433	1.543	0.663	0.765	0.945	0.940	1.133	2.238	1.820	1.210	1.394	1.778	5.490

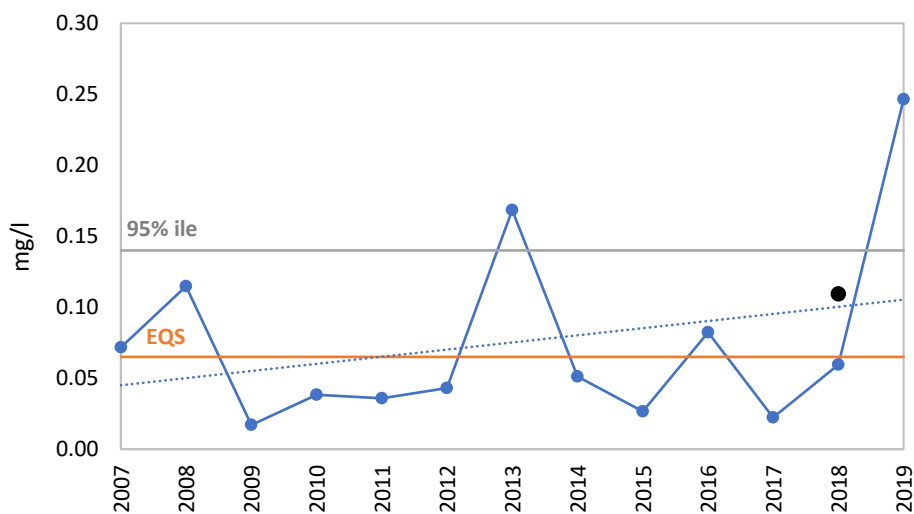


Figure 12 Ammonia (as N mg/l) trend chart for monitoring St. 20300 (2007 – 2019).

AFA0006_ Annalee PAA

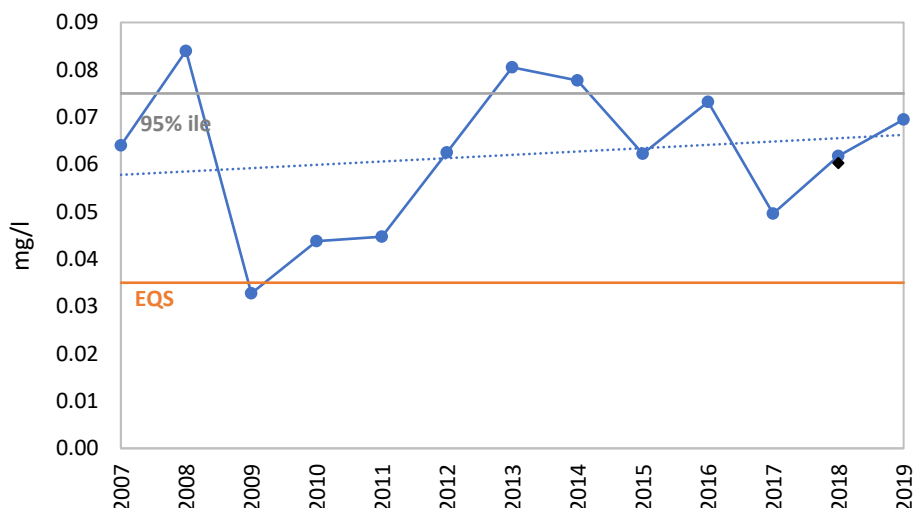


Figure 13 Ortho-Phosphate (as P mg/l) trend chart for monitoring St. 20300 (2007 – 2019).

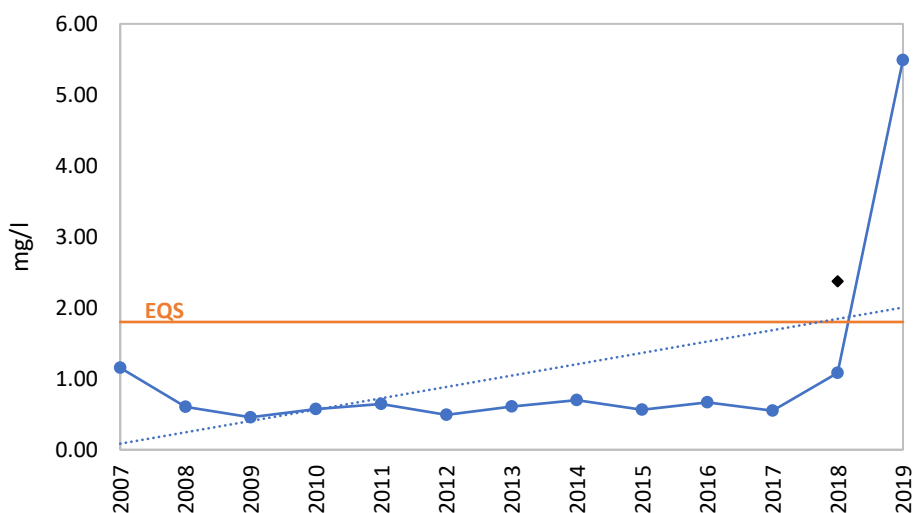


Figure 14 Total Oxidised Nitrogen (as N mg/l) trend chart for monitoring St. 20300 (2007 – 2019).

2.3.2. Monitoring Station – Br. N of Killycannan (St. 20085)

This monitoring St. 20085 is an Operational monitoring station located on the main Cavan River channel in the headwaters of the Cavan_010 waterbodies (Figure 3).

Data summary:

- The 2017 biological data at this station characterises the Cavan River as Poor Ecological Status (Q2-3) (Figure 14).
- The latest results for this station (2015) indicate that the NH₃ and TON concentrations are trending downwards, with annual average concentrations consistently below the EQS.
- The latest PO₄ trend (2015) is progressing downwards, however, the annual average concentration is consistently above the EQS (0.035 mg/l) (Table 7, Figure 15). The baseline concentration for 2013 – 2015 is 0.047 mg/l.
- BOD concentration fluctuates at this monitoring station but is generally above the EQS of 1.5 mg/l.

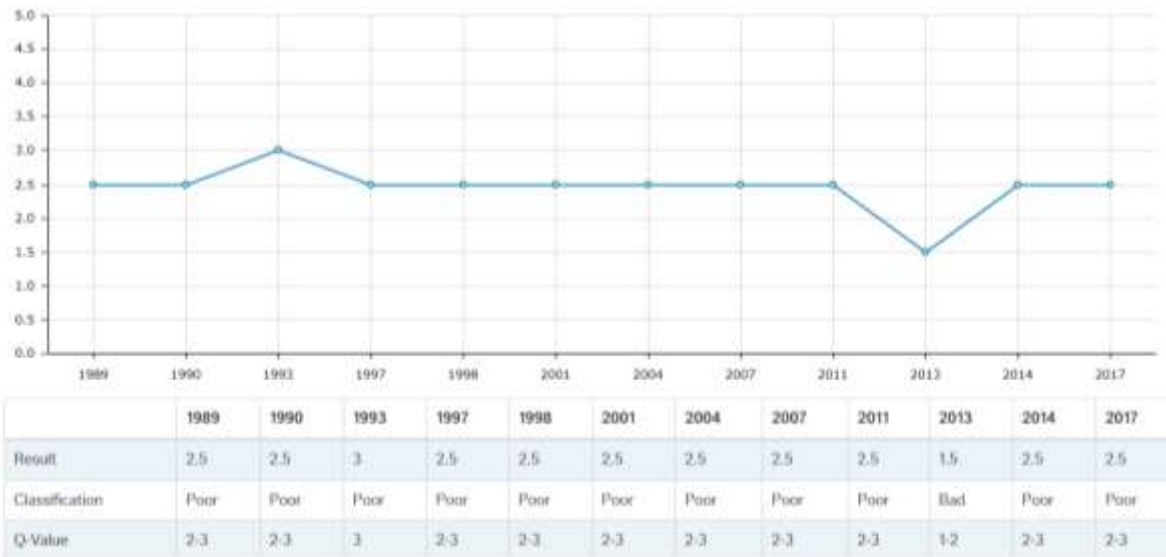


Figure 15 The biological trend and data for monitoring St. 20085 (1989 – 2017).

Table 7 The associated aggregation table for the Ortho-Phosphate (as P mg/l) trend for monitoring St. 20085 (2007 – 2015).

		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
PO ₄	n	4	4	4	4	4	4	4	4	3	0	0	0
	mg P L ⁻¹	0.113	0.084	0.047	0.044	0.047	0.054	0.047	0.042	0.053			

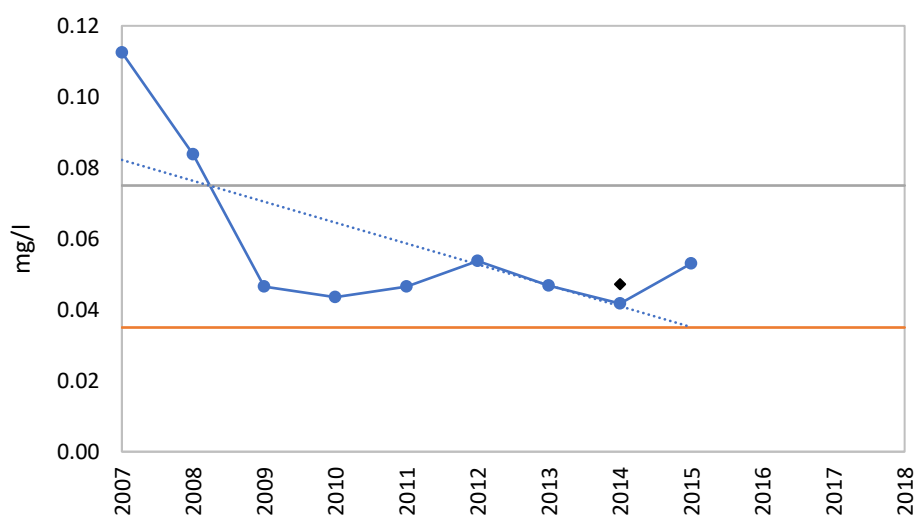


Figure 16 Ortho-Phosphate (as P mg/l) trend chart for monitoring St. 20085 (2007 – 2015).

2.3.3. Monitoring Station – Br. near Breffni Park (St. 10040)

The monitoring St. 10040 is a PreWfd monitoring station located on the main Cavan River channel in the headwaters of the Cavan_010 waterbodies (Figure 3).

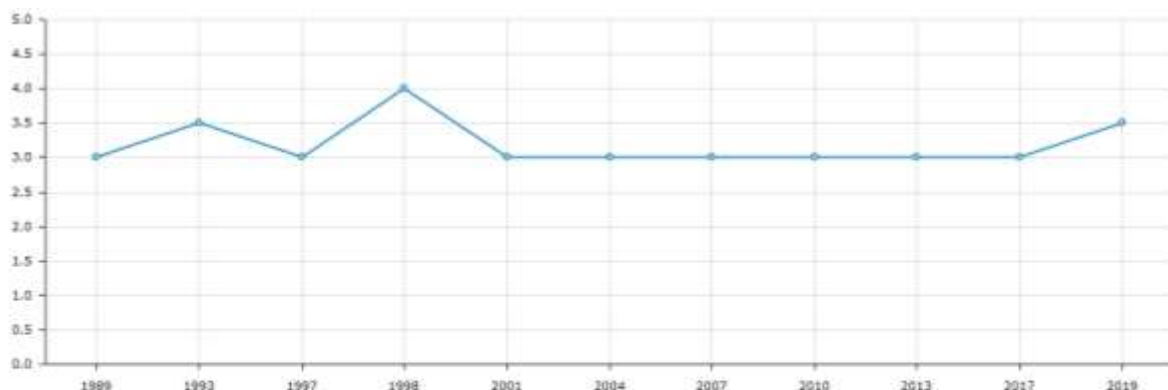
Data summary:

- The 2017 biological data at this station characterises the Cavan River as Poor Ecological Status (Q3) (Figure 16).
- The current NH₃ trend is going downwards. The annual average concentration is below the EQS since 2014 with the exception of 2016 (0.082 mg/l, n = 5), however this did not affect the

AFA0006_ Annalee PAA

baseline concentration (0.055 mg/l, 2016 – 2018) which is still below the EQS. The 2018 average concentration (0.059 mg/l, n = 5) is currently trending close to the EQS.

- Ortho-Phosphate at this station is currently trending upwards with the annual average concentration being above the EQS of 0.035 mg/l since 2010 (Table 8, Figure 17). The baseline concentration (2016 – 2018) is 0.062 mg/l.
- The trend for TON has remained unchanged with the annual averages and baseline concentration (2016 – 2018) (0.76 mg/l) being below the EQS.
- BOD concentration fluctuates around the EQS of 1.5 mg/l at this monitoring station.



	1989	1993	1997	1998	2001	2004	2007	2010	2013	2017	2019
Result	3	3.5	3	4	3	3	3	3	3	3	3.5
Classification	Poor	Moderate	Poor	Good	Poor	Poor	Poor	Poor	Poor	Poor	Moderate
Q-Value	3	3.4	3	4	3	3	3	3	3	3	3.4

Figure 17 The biological trend and data for monitoring St. 10040 (1989 – 2019).

Table 8 The associated aggregation table for the Ortho-Phosphate (as P mg/l) trend for monitoring St. 10040 (2007 – 2018).

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
PO ₄	n	4	4	4	4	4	4	4	4	4	5	5
	mg P L ⁻¹	0.064	0.084	0.033	0.044	0.045	0.063	0.081	0.078	0.062	0.073	0.050

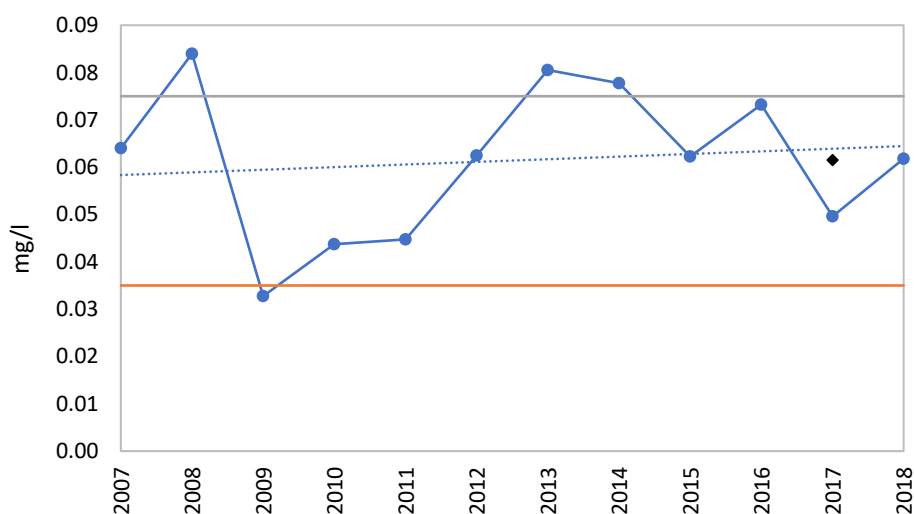


Figure 18 Ortho-Phosphate (as P mg/l) trend chart for monitoring St. 10040 (2007 – 2018).

AFA0006_ Annalee PAA

Table 9 Summary of the 2018 trends for all available chemistry data at each of the monitoring station.

Monitoring Station (Ref No.)	Ammonia (NH ₃) Trend	Ortho-Phosphate (PO ₄) Trend	Total Oxidised Nitrogen (TON) Trend
St 21350 (u/s Cavan R confl.)	Downwards	Downwards	Downwards
St 21400 (d/s Cavan R confl.)	Downwards	Upwards	Downwards
St 20400 (u/s Annalee R confl.)	Downwards	Downwards	Downwards
St. 20300 (Br. SE Drumkeen House)	Downwards	Upwards	Upwards
St. 20085 (Br. N Killycannon)	Downwards	Downwards	Downwards
St. 10040 (Br. near Breffni Park)	Downwards	Upwards	Downwards

AFA0006_ Annalee PAA

Table 10 Summary of chemistry data at each river monitoring station within the Annalee_100, Cavan_020 and Cavan_010 waterbodies.

NH₃

	Monitoring Station		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Annalee 100	St 21350	u/s Cavan R confl.	0.039	0.046	0.049	0.032	0.019	0.030	0.037	0.032	0.010			
Annalee 100	St 21400	d/s Cavan R confl.	0.060	0.049	0.058	0.064	0.048	0.034	0.050	0.032	0.021	0.090	0.033	0.031
Cavan 20	St 20400	u/s Annalee R confl.	0.155	0.122	0.529	0.109	0.084	0.075	0.150	0.035	0.087			
Cavan 10	St 20300	Br. SE Drumkeen House	0.982	1.727	0.025	0.074	0.043	0.145	1.930	1.924	0.376	0.092	0.046	0.106
Cavan 10	St 20085	Br. N Killycannan	0.148	0.038	0.032	0.034	0.032	0.050	0.045	0.021	0.026			
Cavan 10	St 10040	Br. near Breffni Park	0.072	0.115	0.017	0.038	0.036	0.043	0.169	0.051	0.027	0.082	0.022	0.059

PO₄

	Monitoring Station		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Annalee 100	St 21350	u/s Cavan R confl.	0.053	0.046	0.047	0.025	0.038	0.045	0.030	0.035	0.025			
Annalee 100	St 21400	d/s Cavan R confl.	0.041	0.036	0.047	0.037	0.047	0.043	0.031	0.051	0.041	0.080	0.054	0.055
Cavan 20	St 20400	u/s Annalee R confl.	0.071	0.067	0.066	0.110	0.115	0.101	0.087	0.088	0.035			
Cavan 10	St 20300	Br. SE Drumkeen House	0.100	0.085	0.048	0.067	0.067	0.123	0.839	0.293	0.068	0.067	0.048	0.051
Cavan 10	St 20085	Br. N Killycannan	0.113	0.084	0.047	0.044	0.047	0.054	0.047	0.042	0.053			
Cavan 10	St 10040	Br. near Breffni Park	0.064	0.084	0.033	0.044	0.045	0.063	0.081	0.078	0.062	0.073	0.050	0.062

TON

	Monitoring Station		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Annalee 100	St 21350	u/s Cavan R confl.	0.720	0.353	0.578	0.408	0.680	0.303	0.485	0.553	0.407			
Annalee 100	St 21400	d/s Cavan R confl.	0.815	0.554	0.586	0.431	0.473	0.346	0.573	0.647	0.463	0.393	0.546	0.734
Cavan 20	St 20400	u/s Annalee R confl.	1.418	0.918	0.893	0.908	1.063	0.688	0.740	0.843	0.430			
Cavan 10	St 20300	Br. SE Drumkeen House	2.433	1.543	0.663	0.765	0.945	0.940	1.133	2.238	1.820	1.210	1.394	1.778
Cavan 10	St 20085	Br. N Killycannan	2.323	1.908	1.170	1.565	1.390	0.955	1.020	1.008	0.660			
Cavan 10	St 10040	Br. near Breffni Park	1.155	0.605	0.458	0.573	0.645	0.490	0.608	0.698	0.563	0.666	0.548	1.084

3. Significant Pressures

Any further additional information identified on the significant pressures outlined in Table 1 is detailed below. Pressures identified for the Annalee_100 are UWWT plant (Butlersbridge), urban run-off and agriculture, however, agriculture is the only pressure which has been identified as significant for the PAA. This section will further outline significant pressures identified for both the Cavan_020 and Cavan_010. These waterbodies are not part of the PAA, however, they have been identified as potentially contributing to the overall status of the Annalee_100 waterbody, based on the findings of Section 2 Receptor.

Table 11 Summary of waterbodies and pressure information on each waterbody within the Annalee_100 and Cavan River PAA

WB Name	Pressure Category	Pressure Subcat.	Impact	Sig. Pressure	Within AA	IA
Annalee_100	Agriculture	Pasture	Nutrient Pollution	Y	Y	IA7 RWB Pressure: 1) Confirm whether or not the decline in phosphate concentrations in Cavan_020 resulted in a decline in phosphate in Annalee_010. 2) If no decline, complete IA7 on nutrient sources from agriculture. Start at the monitoring station, RS36A021400, walk upstream along the water body and its associated tributaries. Identify point pressures (drains, discharge pipes, farmyards, cattle access) and diffuse pressures (inadequate buffer strips) for sources of nutrients. Collect field parameters (dissolved oxygen, pH, temperature and conductivity). Use results to guide the selection of water quality and small stream risk scores in order to identify critical source areas for nutrients.
	Urban Run-off	Diffuse source run-off		N		
	UWW	Agglomeration <500 PE		N		
Cavan_020	Agriculture	Agriculture	Nutrient and Organic Pollution	Y	N	IA1 RWB Pressure: Watching brief on upstream Cavan town mis-connections IA6. Also see what outcome of IA9 for Farnharn Lough. If this alleviates the problem, then OK. but of not need to follow up with IA7 focusing on agriculture. IA6 RWB Pressure: Diffuse Urban pressure to be investigated.
	Urban Run-off	Diffuse source run-off	Nutrient and Organic Pollution	Y		
Cavan_010	UWW	Agglomeration >10000 PE		N	N	IA6 RWB Pressure: Focus on sources of nutrients and organic pollution from misconnections and unsewered discharges. IA7 RWB Pressure: Focus on sources of nutrients from agriculture upstream of Cavan town, walk along the river and its associated tributaries to see if any impact from agriculture. Identify point (drains, discharge pipes, farmyards, cattle access) and diffuse (inadequate buffer strips) sources of nutrients. Collect field parameters (DO, pH, temperature and conductivity). Use results to guide the selection of water quality and SSRS in order to identify critical source areas for nutrients.
	Urban Run-off	Diffuse source run-off	Nutrient and Organic Pollution	Y		
	Agriculture	Agriculture	Nutrient Pollution	Y		

3.1. Pollution Impact Potential Maps

Agriculture has been identified as a significant pressure for the Annalee_100, Cavan_020 and Cavan_010.

Regarding the Annalee_100 PAA:

- The surface water receptor PO₄ PIP maps indicate that to the north of the Annalee_100 waterbody the PIP ranking is generally 3 or above. However, to the south of the Annalee_100 waterbody there are a small number of areas which are below PIP 4 (Figure 18).
- The surface water receptor NO₃ PIP maps indicate a number of small areas of high PIP in the south of the waterbody (PIP > 4) (Figure 19).
- The groundwater receptor NO₃ PIP maps show that NO₃ isn't an issue in the groundwater (Figure 20).

Additional information for the Cavan_020 and Cavan_010 waterbodies outside the PAA:

- As illustrated in the Annalee_100 PAA the surface water receptor PO₄ PIP maps indicate that PO₄ is an issue for the Cavan_020 and Cavan_010 (PIP > 3). However, there is a small area in the lower section of the Cavan_010 waterbody which has a PIP below 4 (Figure 21).
- The surface water receptor NO₃ map indicates that NO₃ isn't an issue for the Cavan_020. However, in the Cavan_010 there are a number of areas in the south/east section of the waterbody which have a PIP > 4 (Figure 22).
- The groundwater receptor NO₃ PIP maps for the Cavan_020 and Cavan_010 show that NO₃ isn't an issue in the groundwater (Figure 23).

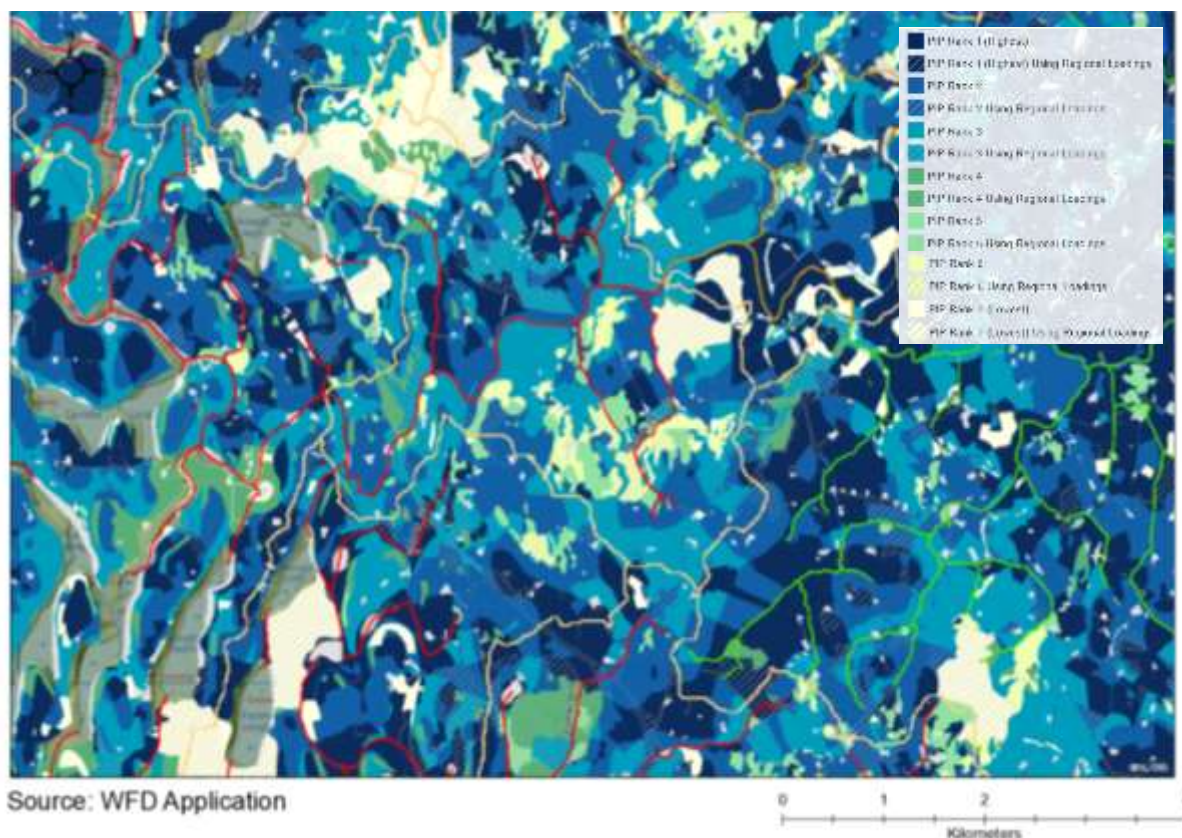


Figure 19 Surface water receptor PO₄ PIP maps for the Annalee_100 waterbody.

AFA0006_ Annalee PAA

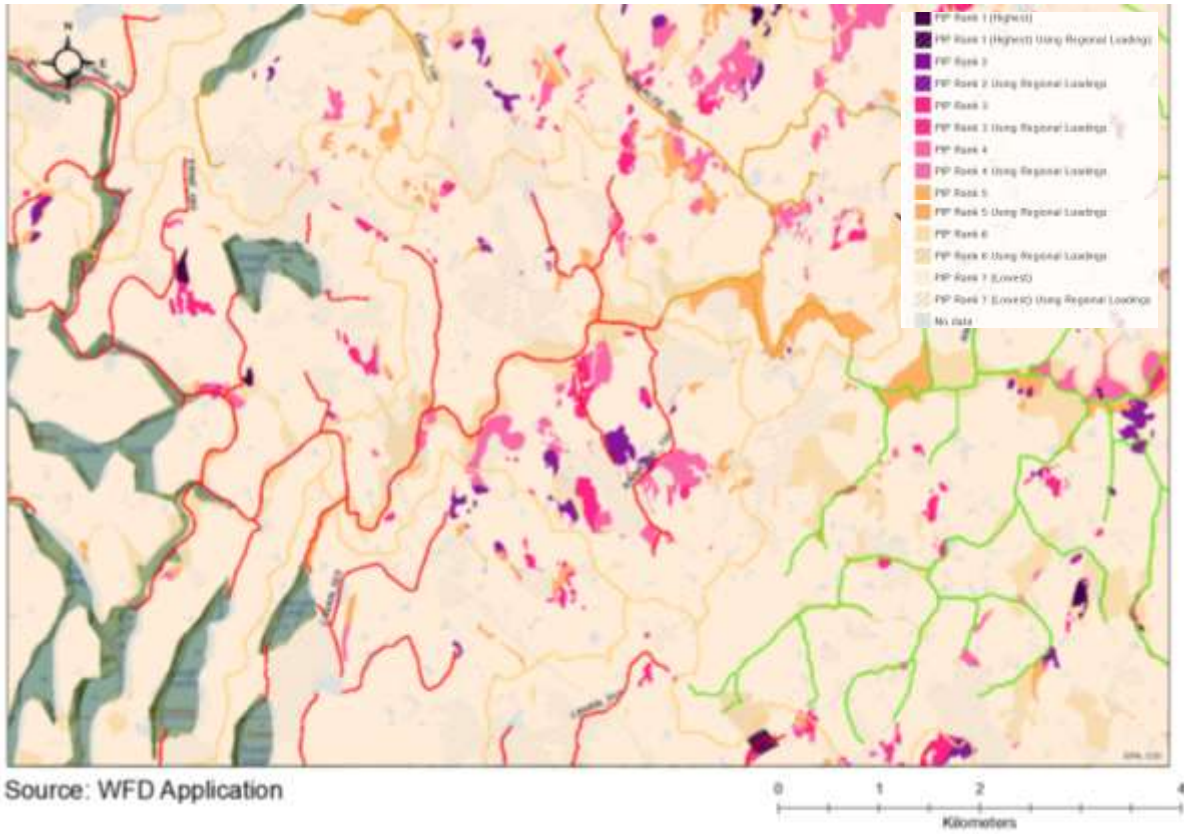


Figure 20 Surface water receptor NO₃ PIP maps for the Annalee_100 waterbody.

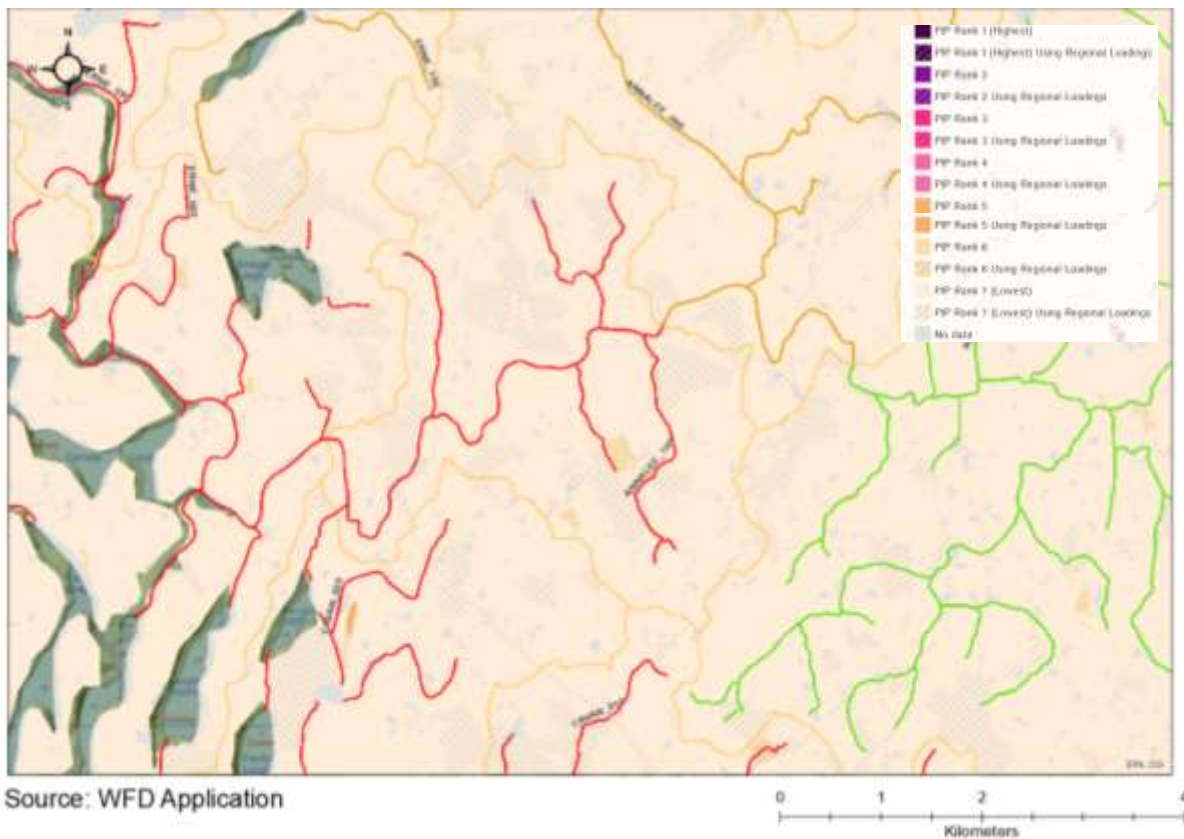


Figure 21 Groundwater receptor NO₃ PIP maps for the Annalee_100 waterbody.

AFA0006_ Annalee PAA

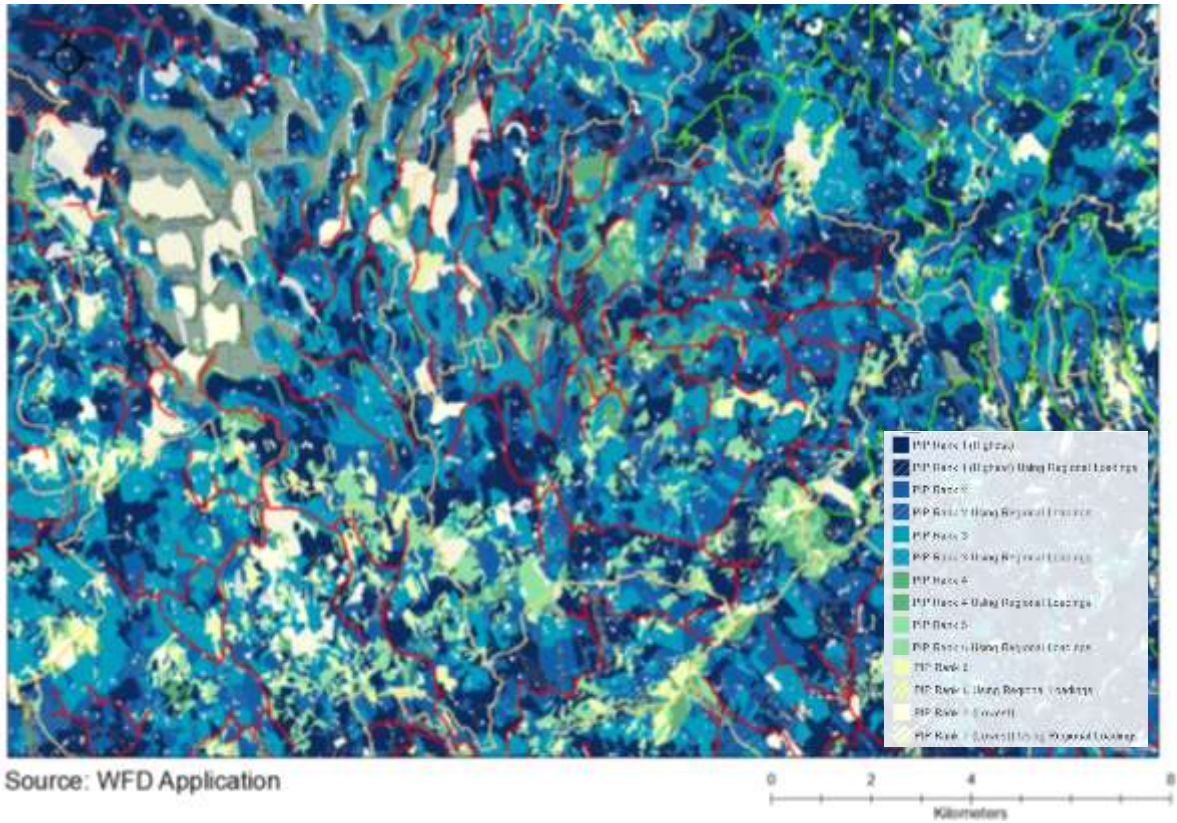


Figure 22 Surface water receptor PO₄ PIP maps for the Cavan_020 and Cavan_010 waterbodies.

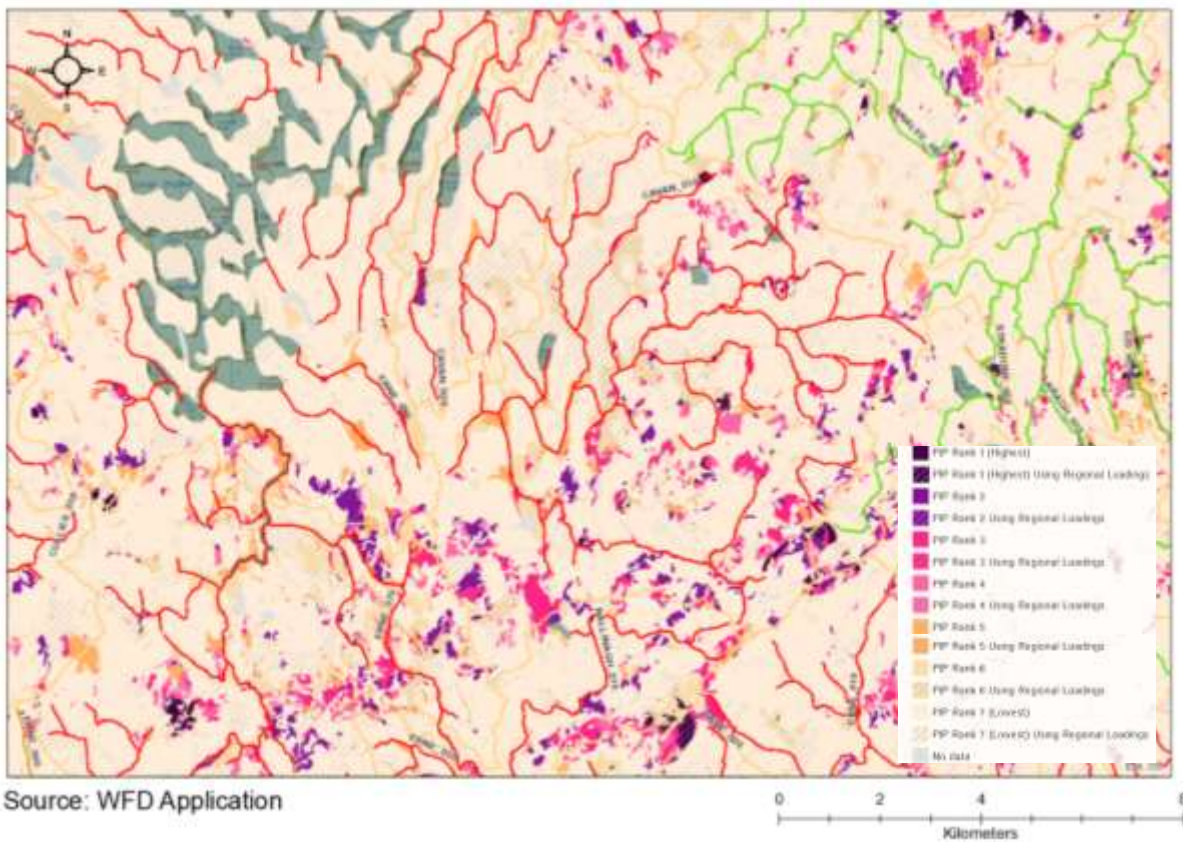


Figure 23 Surface water receptor NO₃ PIP maps for the Cavan_020 and Cavan_010 waterbodies.

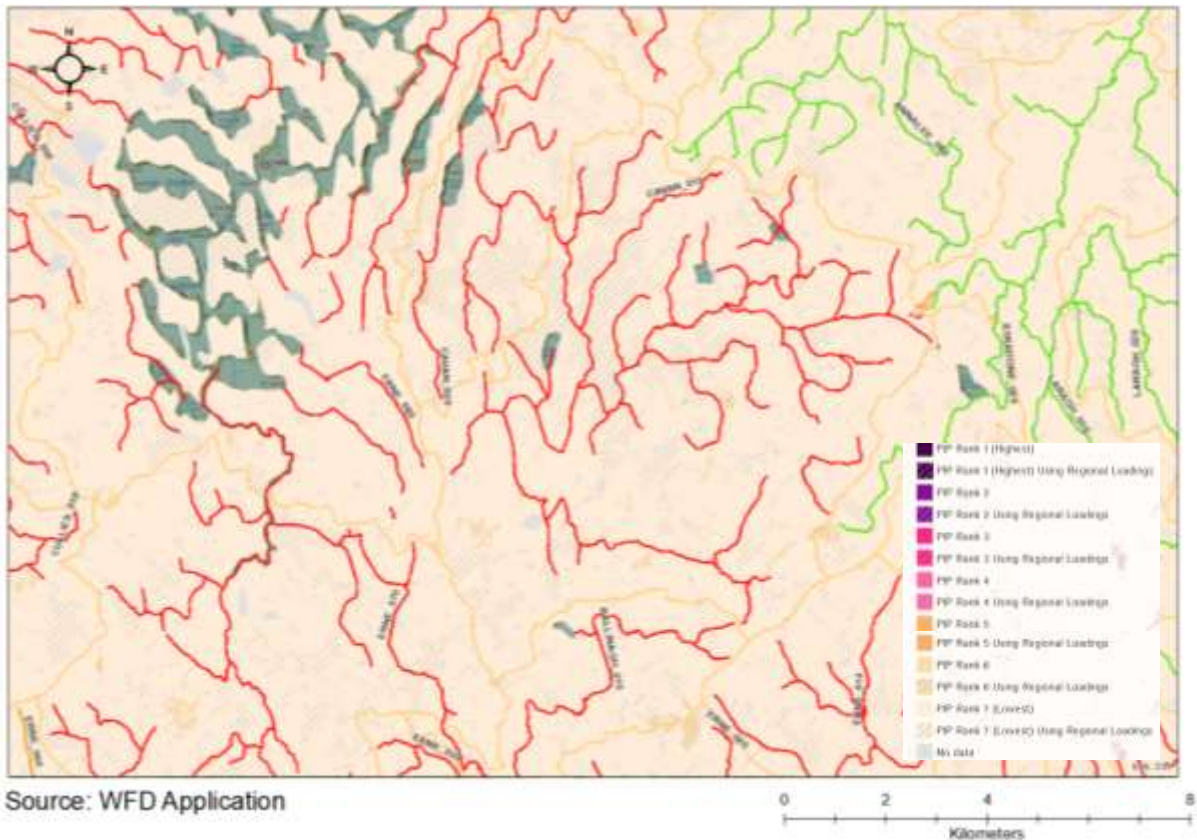


Figure 24 Groundwater receptor NO₃ PIP maps for the Cavan_020 and Cavan_010 waterbodies.

3.2. Urban Run-off

Within the town of Cavan, indicated in brown (Figure 24) misconnections and unsewered discharges have been identified as a significant pressure. It is important to note that Cavan Town is mainly situated in the Cavan_010 however there is a small section to the north/west which is located in the Cavan_020 waterbodies both of which are not in the Annalee PAA.

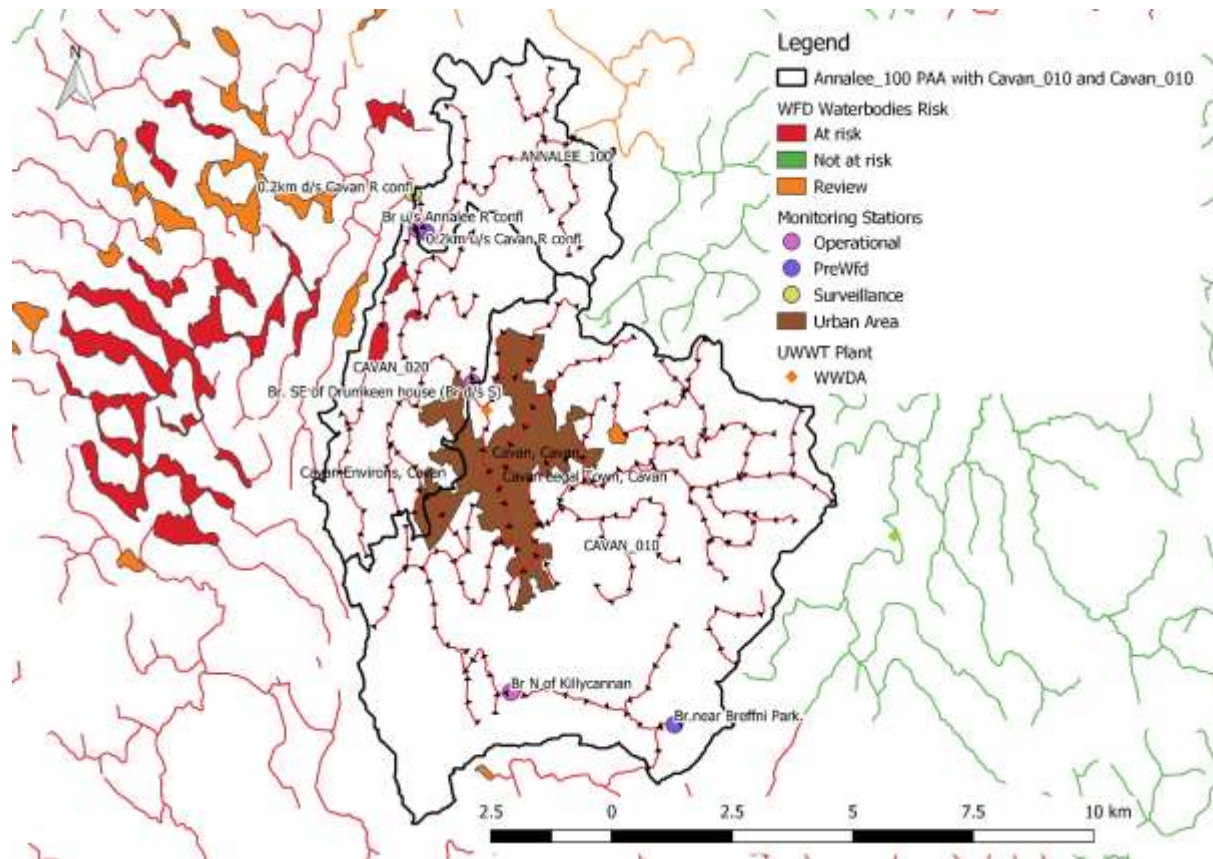


Figure 25 Urban area and UWWT Plant location in the Cavan_020 and Cavan_010 which are outside the PAA boundary.

3.3. Cavan WWTP

The Cavan WWTP hasn't been identified as a significant pressure. However, results from the upstream and downstream sampling location indicate that it may have the potential to increase NH₃ and TON in the Cavan River (Figure 24). It is also important to mention that on the 26th of June 2018 raw sewage was released to the Cavan River resulting in a fish kill. Preliminary findings have suggested this incident was due to a mechanical failure in the plant, however, the investigative report has not been uploaded to the EPA system.

The agglomeration is served by a wastewater treatment plant with a plant capacity PE 30000. The treatment process includes the following:

- Preliminary Treatment (Screening, storm overflow, grease removal, grit removal, landfill leachate pre-treatment and flow measurement)
- Secondary Treatment (Bioreactors (Covered), Vacuum Degassing Treatment, Clarification)
- Nutrient Removal (Chemical Dosing for Phosphate Removal)
- Tertiary Treatment (Cascade Aeration prior to discharge)

Summary for the 2017 AER for the Cavan WWTP:

- 3,978,570kgs sludge as dewatered cake was removed from the WWTP in 2017, which was transferred to a facility in Co. Meath.
- Sludge was dewatered on site by 2 centrifuges.
- No improvements were undertaken at the plant in 2017.
- Planned sewer rehabilitation contract to reduce groundwater infiltration and therefore, CSO spill volume and frequency; expected completion 2018.

AFA0006_ Annalee PAA

- The 2017 AER for the WWTP was compliant with the ELV's set in the wastewater discharge licence.
- The AER for the plant indicates that the Cavan River is Poor Status, has relatively low flow and is subject to various pressures which may impact on water quality.
- The AER also indicates that the downstream monitoring point shows a deterioration in water quality for NH₃ and TON which seems to be linked to the WWTP discharge.
- In 2017 there were two samples found to be above the EQS for NH₃ at the downstream sampling location (Table 12, Figure 25).
- On six occasions samples collected downstream from the WWTP were above the EQS of 1.8 mg/l TON (Table 12, Figure 26).
- Overall samples for both NH₃ and TON downstream (St. 20300) from the WWTP are higher in concentration compared to the upstream (St. 20200) samples collected on the same day (Figure 25, Figure 26).

Table 12 Annual Environmental Report 2017 for the upstream (St. 20200) and downstream (St. 20300) monitoring point at the Cavan WWTP (Licence No. D0020-01).



Appendix 7.2 Ambient Monitoring

Upstream

Date	Ammonia (mg/l)	Ortho P (mg/l)	BOD (mg/l)	Total N (mg/l)	D.O. (% Sat)	D.O. (mg/l)	pH (mg/l)
24/01/2017	0.05	0.05	2.00	1.15	90.00		7.86
14/02/2017	<0.04	0.03	1.50	1.40	91.60		7.84
14/03/2017	0.03	0.03	2.00	1.13	90.80		7.68
18/04/2017	<0.04	0.01	3.00	1.57	113.00		8.00
09/05/2017	0.07	0.05	2.00	1.56	86.40		7.90
20/06/2017	<0.04	0.10	4.00	1.10	80.70		8.00
22/08/2017	<0.04	0.05	2.00	0.81	87.60		7.98
12/09/2017	<0.04	0.07	3.00	0.82	90.20		7.77
03/10/2017	0.03	0.08	<1.5	1.80	82.70		7.46
08/11/2017	0.04	0.04	2.00	0.99	88.20		7.83
Mean	0.04	0.05	2.30	1.23	90.12		7.83
95%ile	0.06	0.09	3.60	1.70	103.37		8.00

Downstream

Date	Ammonia (mg/l)	Ortho P (mg/l)	BOD (mg/l)	Total N (mg/l)	D.O. (% Sat)	D.O. (mg/l)	pH (mg/l)
24/01/2017	0.07	0.05	2.00	4.29	91.40		7.81
14/02/2017	0.05	0.03	2.00	4.25	92.40		7.85
14/03/2017	0.03	0.03	2.00	3.18	89.30		7.77
18/04/2017	<0.04	<0.01	3.00	1.20	129.00		7.95
09/05/2017	0.09	0.04	3.00	6.83	101.70		7.62
20/06/2017	<0.04	0.07	3.00	5.86	90.10		8.00
22/08/2017	<0.04	0.05	2.00	1.94	93.40		7.97
12/09/2017	<0.04	0.05	3.00	1.01	92.50		7.78
03/10/2017	0.04	0.07	<1.5	1.39	86.00		7.57
08/11/2017	0.05	0.04	2.00	1.14	87.70		7.83
Mean	0.05	0.04	2.35	3.11	95.35		7.82
95%ile	0.08	0.07	3.00	6.39	116.72		7.99

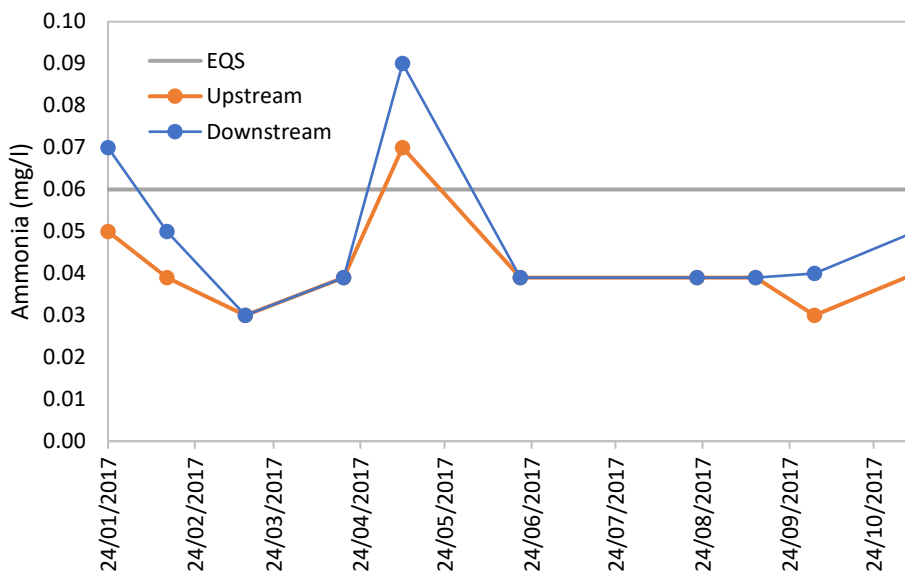


Figure 26 Ammonia concentrations at the upstream (St. 20200) and downstream (St. 20300) monitoring points for Cavan WWTP.

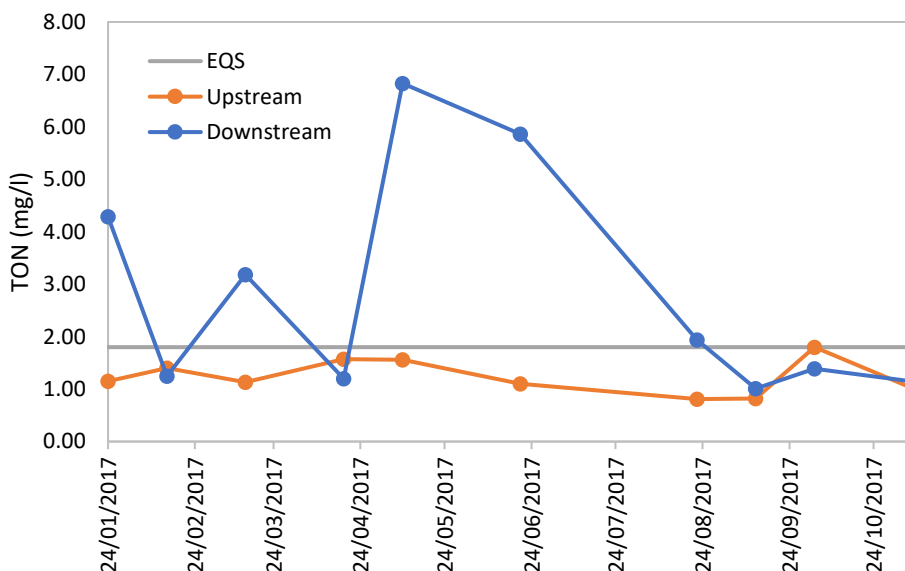


Figure 27 Total Oxidised Nitrogen concentrations at the upstream (St. 20200) and downstream (St. 20300) monitoring points for Cavan WWTP.

3.4. Other Pressures – Butlersbridge WWTP

Butlersbridge WWTP has been identified as a pressure for the Annalee_100 waterbody, however, it has not been identified as a significant pressure. An incident following heavy rainfall causing the water levels in the Annalee River to rise significantly resulting in the WWTP site being flooded was noted on the 16th of March 2019. Due to the level of the river the plant was unable to discharge. In addition, the increased volumes entering the plant due to the heavy rainfall, resulted in the aerator needing to be turned off. The incident was reported to the EPA and a review of the current arrangements at the WWTP and the agglomeration with regard to the potential for washout of the plant under storm conditions and the identification of measures needed to eliminate washout events is to be carried out.

4. Pathway Information and Analysis

4.1. Overview of Pathways in the PAA

The drivers for this section are the significant issues(s), as these dictate the pathways that are relevant. The regional pathway framework is provided by the aquifers in the PAA (Figure 27). One compartment is identified:

1. Poor aquifer bedrock which is generally unproductive except for local zones (PI).

Using the well/poorly drained soils map the one compartment is further sub-divided into 3 sub-compartments (Figure 28, Table 13).

Note the pathways information for the Cavan_020 and Cavan_010 have outlined in the Appendix A.

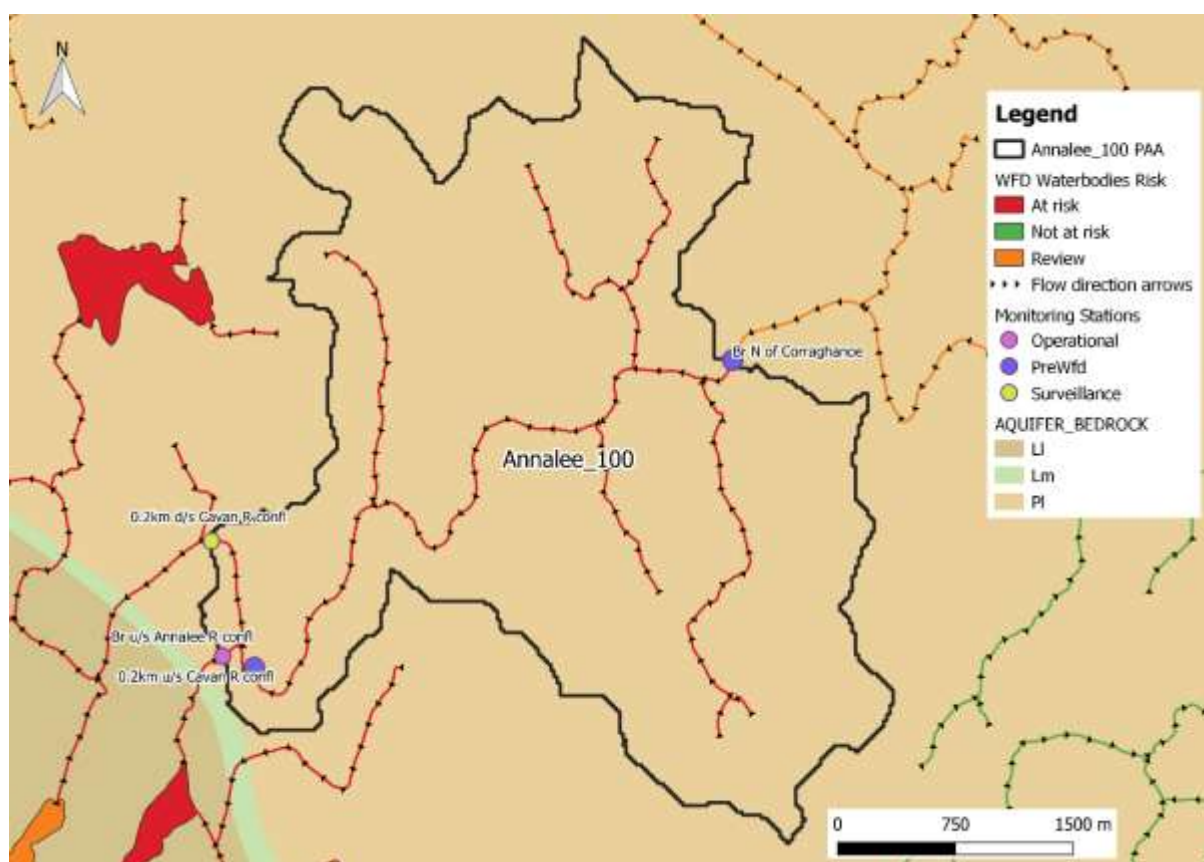


Figure 28 The aquifer bedrock for the Annalee_100 waterbody.

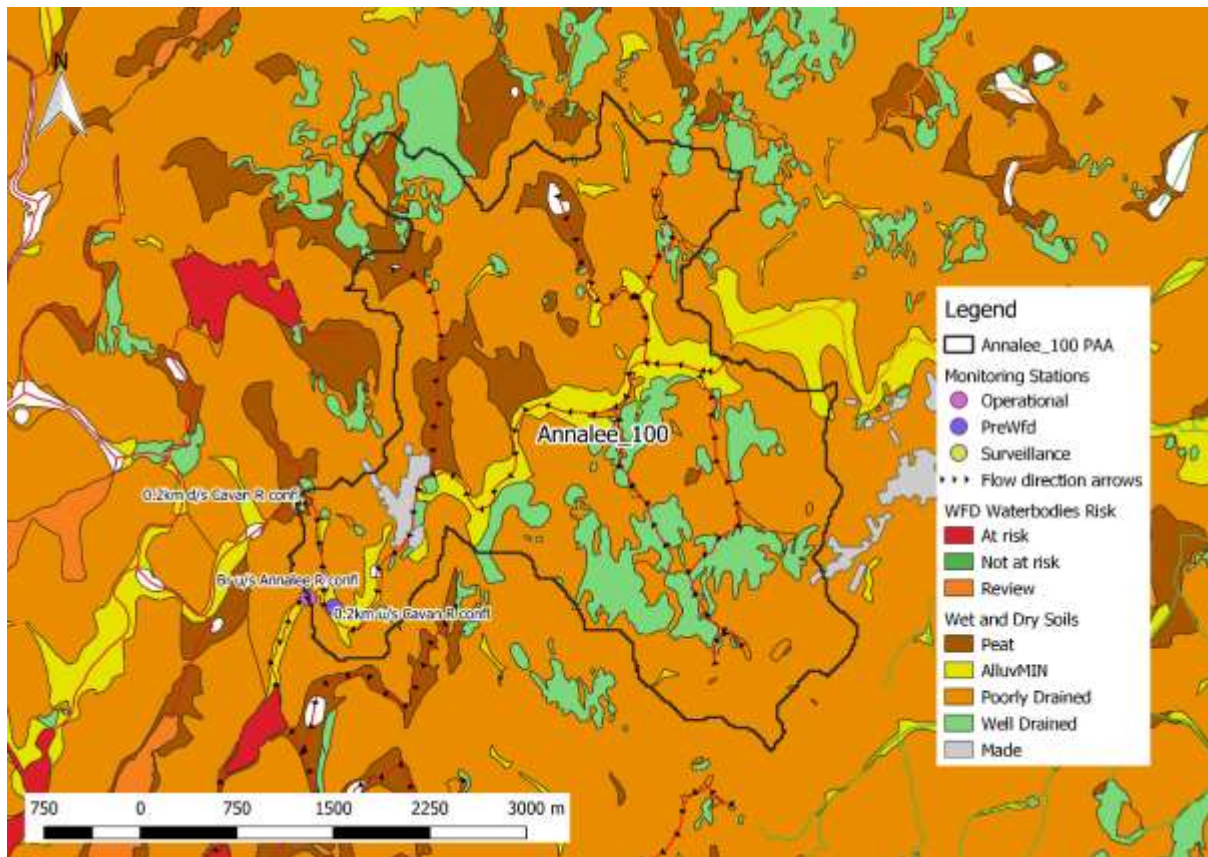


Figure 29 The wet and dry soils for the Annalee_100 waterbody.

Table 13 Conceptual model information for the pathways in the Annalee_100 PAA.

Compartment 1			
Direct ¹	Drains		
Aquifer (Fig. 27)	PI		
Rock Units	Ordovician Metasediments		
Sub-Comp. 1A		Sub-Comp. 1B	Sub-Comp. 1C
Soil type (Fig. 28)	Poorly drained	Well drained	Peat
Subsoil	Till derived chiefly from lower Palaeozoic rock	Rock covered by shallow soil	Cut Peat
Subsoil K	Low	N/A	Low
Groundwater Vulnerability (Fig. 29)	L, M, H, E _x	E _x	E
PO ₄ Susceptibility (Fig. 30)	Moderate	Low	Moderate
NO ₃ Susceptibility (Fig. 31)	Low	High to Very High	Low
PO ₄ PIP (Fig. 18)	Moderate to High	Moderate to High	Very High
NO ₃ PIP (Fig. 19, Fig. 20)	Low	Moderate to High	Low
Main Flow Paths	Overland and land drains	Overland, Near surface flow, Groundwater flow and land drains	Overland and land drains

¹ Point discharges to the water body

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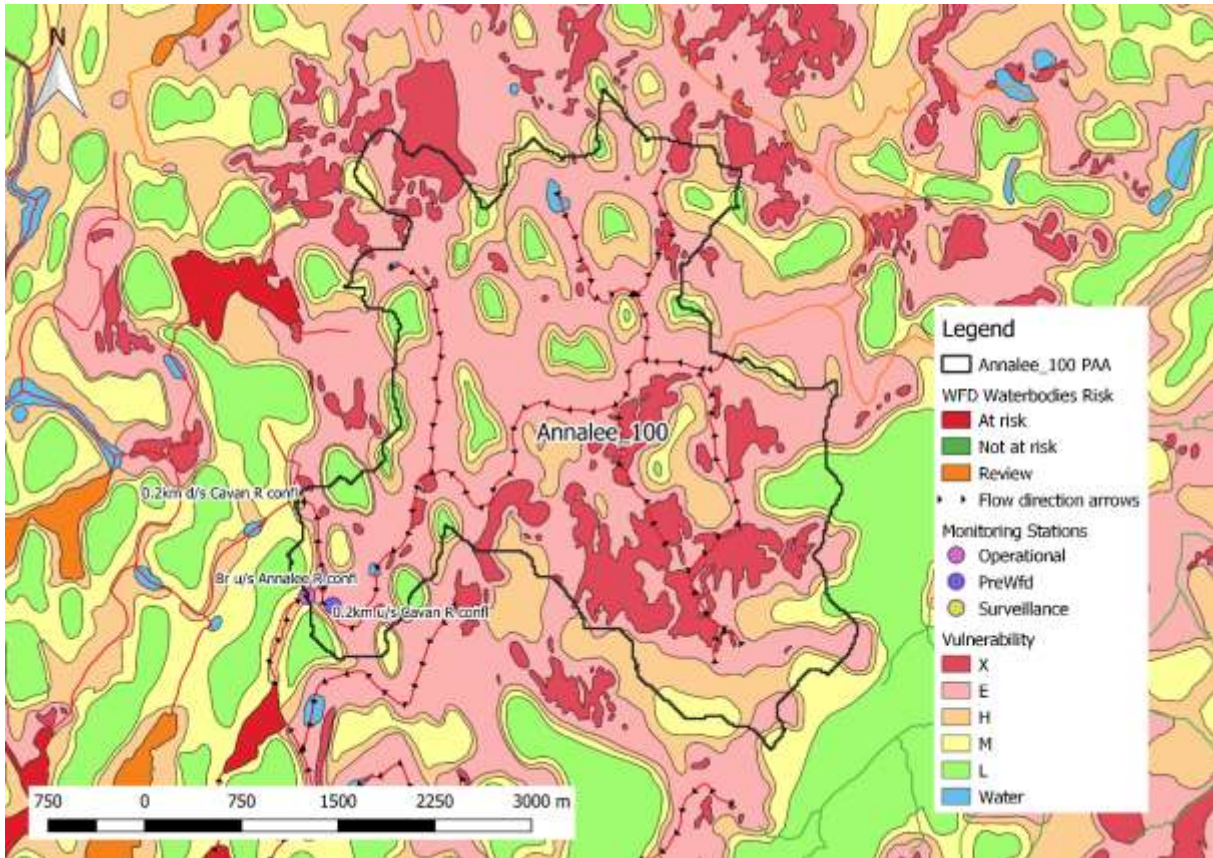


Figure 30 The groundwater vulnerability map for the Annalee_100 waterbody.

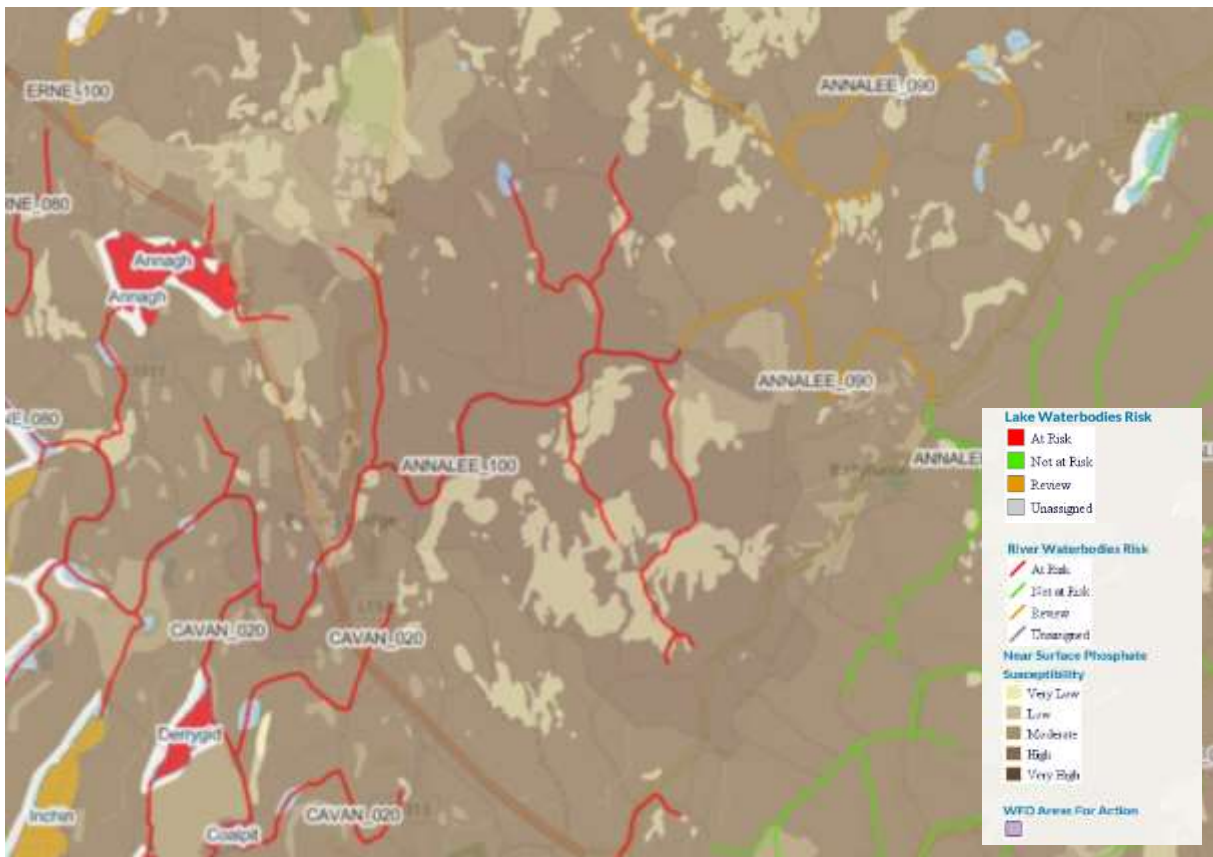


Figure 31 The near surface PO₄ susceptibility map for the Annalee_100 waterbody.

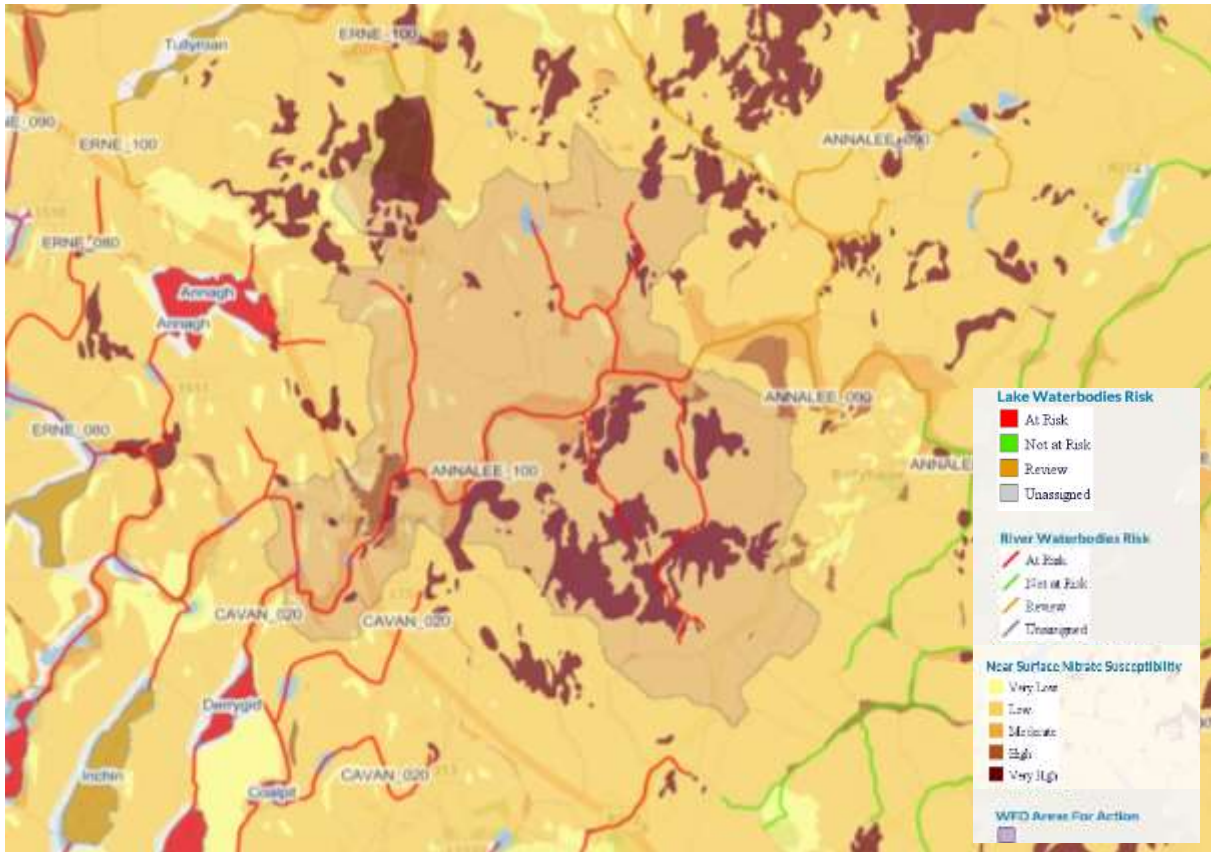


Figure 32 The near surface NO₃ susceptibility map for the Annalee_100 waterbody.

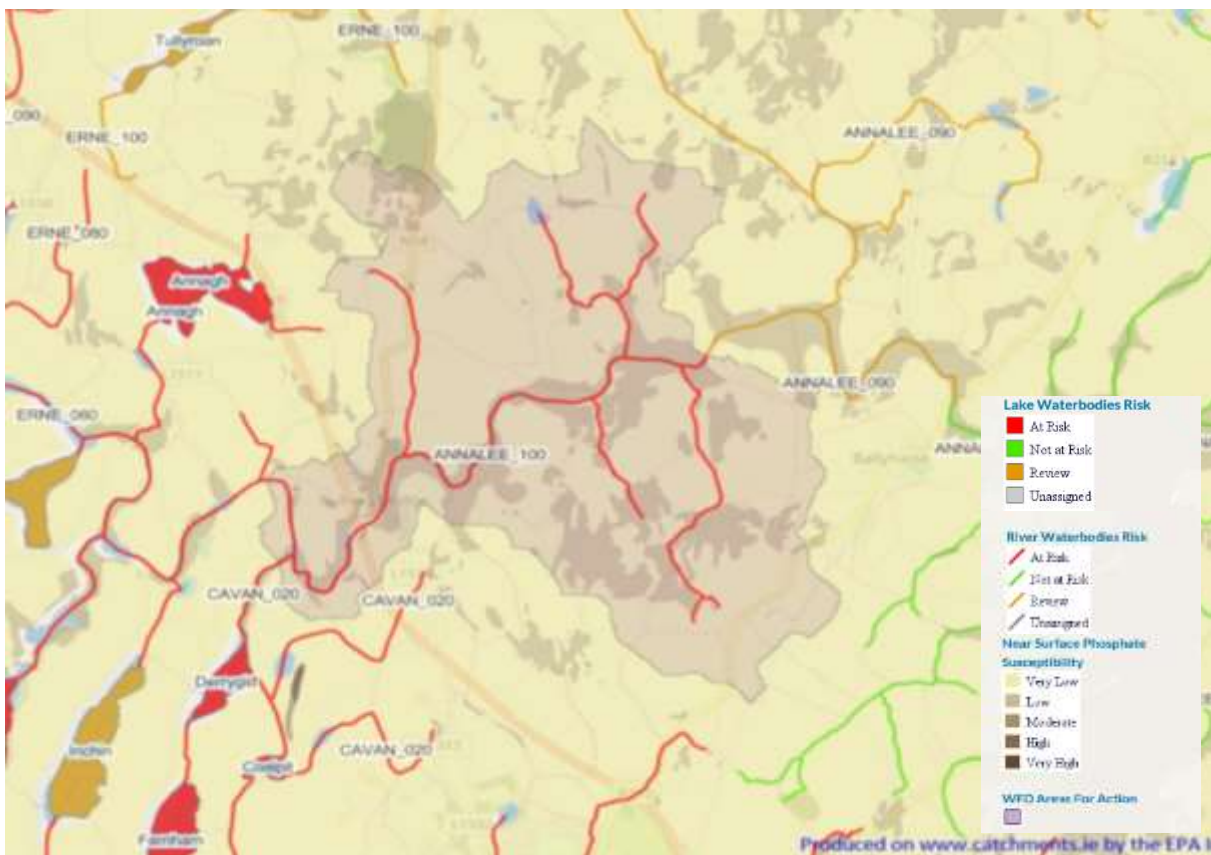


Figure 33 The sub-surface NO₃ susceptibility map for the Annalee_100 waterbody.

5. Interim 'Story' of the Priority Area for Action

The desktop study for the Annalee_100 has identified agriculture to be a significant pressure to the Moderate Ecological Status of the waterbody. However, the desk study has also highlighted that pressures (Agriculture, Urban Runoff and WWTP) from the Cavan_020 and Cavan_010 may also be contributing significantly to the status of the Annalee_100. This would require further field investigation in order to confirm this. Overland flow dominates the pathway throughout the waterbody particularly in the poorly drained and peaty soils. However, there is an area of well-drained soil in the south of the waterbody which preferential flow path include near surface and groundwater flow. This desk study has indicated that PO₄ is the significant issue at the outflow monitoring station for the Annalee_100 waterbody. Note even though the Cavan_010 and Cavan_020 is not included within the Annalee_100 PAA the desk study has highlighted that PO₄ is also a significant issue for the Cavan River along with NH₃ and TON. This will need further investigation through the local catchment assessment (LCA).

5.1. Annalee_100 waterbody

Risk category: *At Risk*

Status: Moderate. The Q-value at the u/s station recorded Q 4 in 2017.

Hydrochemistry summary: St. 21350 (2015): NH₃ 0.010 mg/l, PO₄ 0.025 mg/l, TON 0.407 mg/l
 St. 21400 (2018): NH₃ 0.031 mg/l, **PO₄ 0.055 mg/l**, TON 0.734 mg/l

Baseline Concentration: St. 21350: NH₃ 0.026 mg/l, PO₄ 0.030 mg/l, TON 0.481 mg/l
 St. 21400: NH₃ 0.051 mg/l, **PO₄ 0.063 mg/l**, TON 0.558 mg/l

Significant issue: St. 21350: No issues identified

St. 21400: **PO₄** is currently trending upwards and exceeding its EQS

Significant pressure: Agriculture has been identified as the significant pressure, however, based on the 2015 data from the monitoring St. 21350 u/s of the Cavan River confluence, NH₃, PO₄ and TON are not identified as significant issues. Regarding the d/s monitoring station (St. 21400) of the Cavan River confluence, PO₄ has been identified as the significant issue.

Relevant pathways: Overland and near surface flow throughout the waterbody with a number of small areas of groundwater flow to the south. Due to the poorly draining soil dominating the waterbody land drains also need to be considered as a pathway for pollutants.

5.2. Cavan_020 waterbody

Risk category: *At Risk*

Status: Poor

Hydrochemistry summary: St. 20400 (2015): **NH₃ 0.087 mg/l**, PO₄ 0.035 mg/l, TON 0.430 mg/l

Baseline Concentration: St. 20400: **NH₃ 0.090 mg/l**, **PO₄ 0.070 mg/l**, TON 0.671 mg/l

Significant issue: NH₃ concentrations are trending downwards, however latest 2018 data is exceeding the EQS. PO₄ concentrations are also trending downwards, however, that baseline concentration (2013 -2015) exceeded the EQS.

Significant pressure: Agriculture and Urban Run-off

Relevant pathways: Overland, near surface flow and land drains.

5.3. Cavan_010 waterbody

Risk category: *At Risk*

Status: Poor

Hydrochemistry summary: St. 10040 (2018): NH₃ 0.059 mg/l, **PO₄ 0.062 mg/l**, TON 1.084 mg/l

St. 20085 (2015): NH₃ 0.026 mg/l, **PO₄ 0.053 mg/l**, TON 0.660 mg/l

St. 20300 (2018): **NH₃ 0.106 mg/l**, **PO₄ 0.051 mg/l**, TON 1.778 mg/l

Baseline Concentration: St. 10040: NH₃ 0.050 mg/l, **PO₄ 0.062 mg/l**, TON 0.766 mg/l

AFA0006_ Annalee PAA

St. 20085: NH₃ 0.031 mg/l, **PO₄ 0.047 mg/l**, TON 0.896 mg/l

St. 20300: **NH₃ 0.081 mg/l**, **PO₄ 0.055 mg/l**, TON 1.461 mg/l

Significant issue: St. 10040: **PO₄** trending upwards and exceeding EQS.

St. 20085: **PO₄** trending downwards and exceeding EQS

St. 20300: **NH₃** trending downwards and exceeding EQS. **PO₄** and **TON** trending upwards and exceeding EQS.

The PIP and P susceptibility maps indicate PO₄ as the main issue in the Cavan_010 waterbody, while the N susceptibility maps indicate NO₃, to be an issue mainly around Cavan Town and a few small areas in the southern part of the waterbody where soil depth is shallow.

Significant pressure: Agriculture and Urban Run-off

Relevant pathways: Overland, near surface flow and land drains throughout the waterbody, with groundwater flow predominantly an issue in the southern part of the waterbody where the soil depth is shallow.

The environmental objective date for all the waterbodies in the Annalee sub-catchment is Good Status by 2021.

6. Communications Plan

A community information meeting will be held in Butlersbridge Community Centre, Butlersbridge, Co. Cavan, H12 XV44 on Thursday the 7th of March 2019 from 7:30 – 8:30 pm.

Review the finding of the desktop with Cavan County Council and any other interested organisations for their input and knowledge of the sub-catchment. Discuss with Cavan County Council on whether they have any additional information for the Cavan River, particularly in relation to the lower monitoring station (St. 20400) on the Cavan_020.

Due to the fish status driving the ecological status in the Annalee_100 waterbody, findings of the desk study should be reviewed with IFI for their input and knowledge of the sub-catchment.

7. Work plan

7.1. Further Characterisation Action Assigned:

Annalee_100:

- *“Confirm whether or not the decline in phosphate concentrations in Cavan_020 resulted in a decline in phosphate in Annalee_100.”*
- *“If no decline, complete IA7 on nutrient sources from agriculture. Start at the monitoring station, RS36A021400, walk upstream along the water body and its associated tributaries. Identify point pressures (drains, discharge pipes, farmyards, cattle access) and diffuse pressures (inadequate buffer strips) for sources of nutrients. Collect field parameters (dissolved oxygen, pH, temperature and conductivity). Use results to guide the selection of water quality and small stream risk scores in order to identify critical source areas for nutrients.”*

7.2. Further Information Required

- The 2018 Annual Environmental Reports for both Cavan WWTP and Butlersbridge WWTP have been requested from the EPA.

7.3. Local Catchment Assessment

7.3.1. Annalee_100

The latest data available (2015) for the u/s monitoring station (St. 21350) on the Annalee River is indicating that issues being observed at the d/s station (St. 21400) is not stemming from the Annalee_100 waterbody. This would need further verification through carrying out SSIS/RA and collecting samples for water chemistry at the u/s monitoring station. If the information from the field work verifies the findings from this desk study, it can potentially rule out agriculture from the Annalee_100 waterbody as being the single significant pressure driving the status. If, however, this is not the case stream walks of the Annalee_100 would be required, looking particularly at identifying diffuse agricultural pressures, which would be required to be referred on to the ASSAP advisor for the region.

Additionally, if results for the u/s (St. 21350) monitoring station potentially rule out agriculture above this station as being the significant issue for Annalee_100 PAA, it would be worth walking the stretch of river between the u/s (St. 21350) and d/s (St. 21400) monitoring stations to rule out any other pressures other than the pressure of the inflowing Cavan River.

The EPA have outlined their planned monitoring for the Annalee_100 for the next three years on the EDEN App which is summarised in Table 14

Table 14 Planned EPA monitoring for the Annalee_100 (2019 – 2021)

	U/S of the Cavan R. conf. (St. 21350)			D/S of the Cavan R conf. (St. 21400)		
	2019	2020	2021	2019	2020	2021
Chemical Surface Water Status	0	0	0	12	0	0
Fish Status or Potential	0	0	0	1	0	0
General Conditions	0	0	0	12	12	12
Hydromorphological Conditions	0	0	0	1	0	0
Invertebrate Status or Potential (AWIC)	0	0	0	0	0	0
Invertebrate Status or Potential (Q-Value)	1	0	0	1	0	0
Macrophyte Status or Potential	0	0	0	1	0	0
Phytobenthos Status or Potential	0	0	0	1	1	1
Specific Pollutant Conditions	0	0	0	12	0	0

8. Review of Mitigation Options

- Overland mitigation options need to be considered when looking at pathway interception options for the Annalee_100 waterbody in poorly draining areas.
- Planned sewer rehabilitation contract to reduce groundwater infiltration and therefore, CSO spill volume and frequency; expected to be completed in 2018. The improvement programme will be reviewed by Irish Water to assess works required to comply with the licence condition on prioritised basis

Date of Completion of Desk Study: 25/11/2019

Work Plan Summary:

1. Identify if there is any further up to-date data and information for the two monitoring stations (St. 21350 and St. 21400) on the Annalee River and the lower monitoring station (St. 20400) on the Cavan River.
2. Carry out an SSIS/RA at St. 21350, St. 21400 and St. 20400 to determine the current status.
3. As the St. 21350 is not on the operational monitoring programme for 2019, take chemistry samples.
4. Depending on the findings of the SSIS/RA at St. 21350
 - 4.1. If the status is indicating no change do a stream walk from the u/s (St. 21350) monitoring station down to the d/s (St. 21400) monitoring station to identify any further potential pressures other than the inflowing Cavan River which could be contributing to status.
 - 4.2. If the status is indicating a change need to (1) eliminate the inflowing tributaries by carrying out SSIS/RA (2) carry out a stream walk, SSIS/RA and portable measurements (conductivity, pH, DO and temperature) u/s of St. 21350 along the main river channel looking particularly at agricultural pressures (land drains and diffuse sources). In this instance any further findings from the stream walk would need to be referred to the ASSAP advisor for the region.

Appendix A

Additional information for the Cavan_020 and Cavan_010 is outlined in the Appendix.

The initial characterisation sub-catchment assessment recommended that the following actions be undertaken for the Cavan_020 and Cavan_010:

Cavan_020:

- *“Watching brief on upstream Cavan town mis-connections IA6. Also see what outcome of IA9 for Farnharn Lough. If this alleviates the problem, then OK. but of not need to follow up with IA7 focusing on agriculture.”*
- *“Diffuse Urban pressure to be investigated.”*

Cavan_010:

- *“Focus on sources of nutrients and organic pollution from misconnections and unsewered discharges.”*
- *“Focus on sources of nutrients from agriculture upstream of Cavan town, walk along the river and its associated tributaries to see if any impact from agriculture. Identify point (drains, discharge pipes, farmyards, cattle access) and diffuse (inadequate buffer strips) sources of nutrients. Collect field parameters (DO, pH, temperature and conductivity). Use results to guide the selection of water quality and SSRS in order to identify critical source areas for nutrients.”*

Table 15 Conceptual model information for the pathways in the Cavan_020 and Cavan_010 waterbodies

Compartment 1			
Direct ¹	Cavan WWTP, Drains		
Aquifer (Fig. 33)	PI, LI		
Rock Units	Ordovician Metasediment, Dinantian (early) Sandstones, Shales and Limestones, Slurian Metasediments and Volcanics		
	Sub-Compartment 1A	Sub-Compartment 1B	Sub-Compartment 1C
Soil type (Fig. 34)	Poorly drained	Well drained	Peat
Subsoil	Till derived chiefly from lower Palaeozoic rock	Rock covered by shallow soil	Cut Peat
Subsoil K	Low	N/A	Low
Groundwater Vulnerability (Fig. 29)	L, M, H, Ex	Ex	E
PO ₄ Susceptibility (Fig. 30)	Moderate	Low	Moderate
NO ₃ Susceptibility (Fig. 31)	Low	High to Very High	Low
PO ₄ PIP (Fig. 18)	Moderate to High	Moderate to High	Very High
NO ₃ PIP (Fig. 19, Fig. 20)	Low	Moderate to High	Low
Main Flow Paths	Overland and land drains	Overland, Near surface flow, Groundwater flow and land drains	Overland and land drains

¹ Point discharges to the water body

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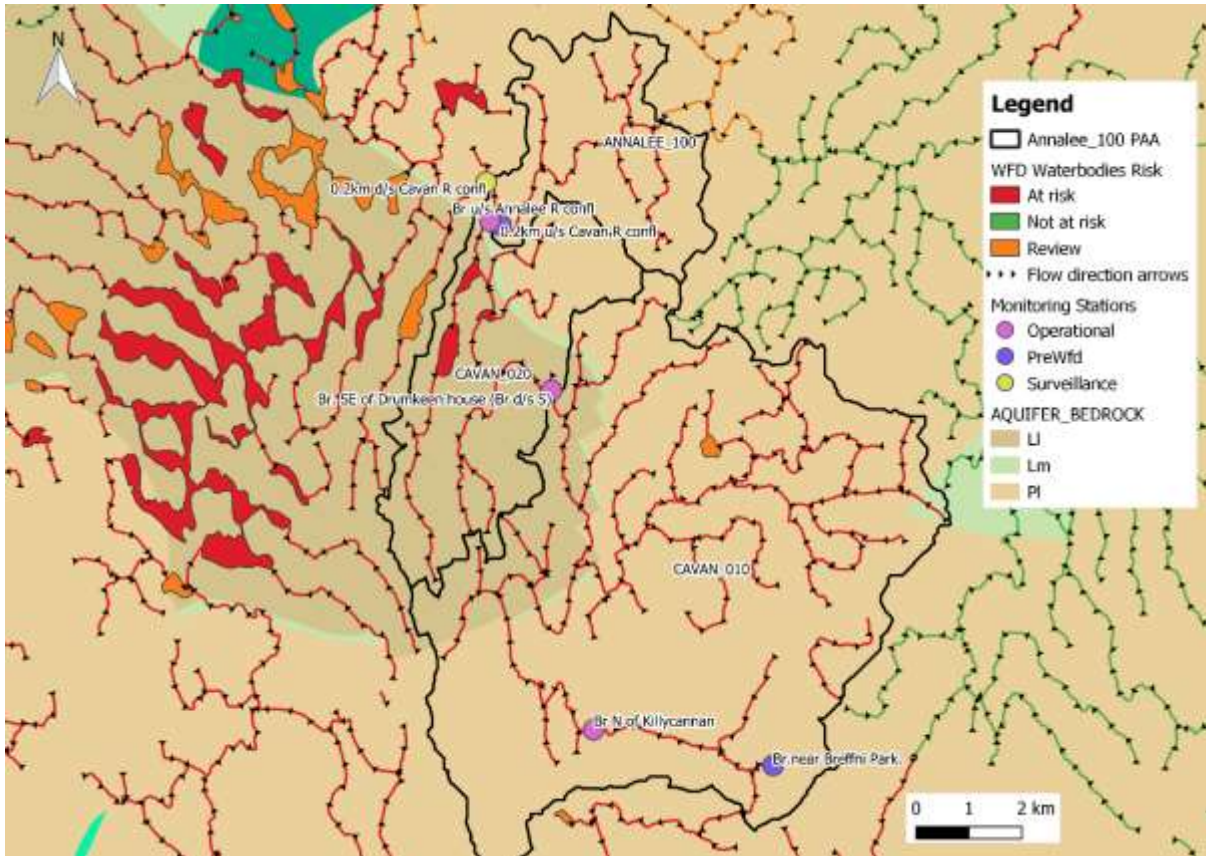


Figure 34 The aquifer bedrock for the Annalee_100, Cavan_020 and Cavan_010 waterbodies.

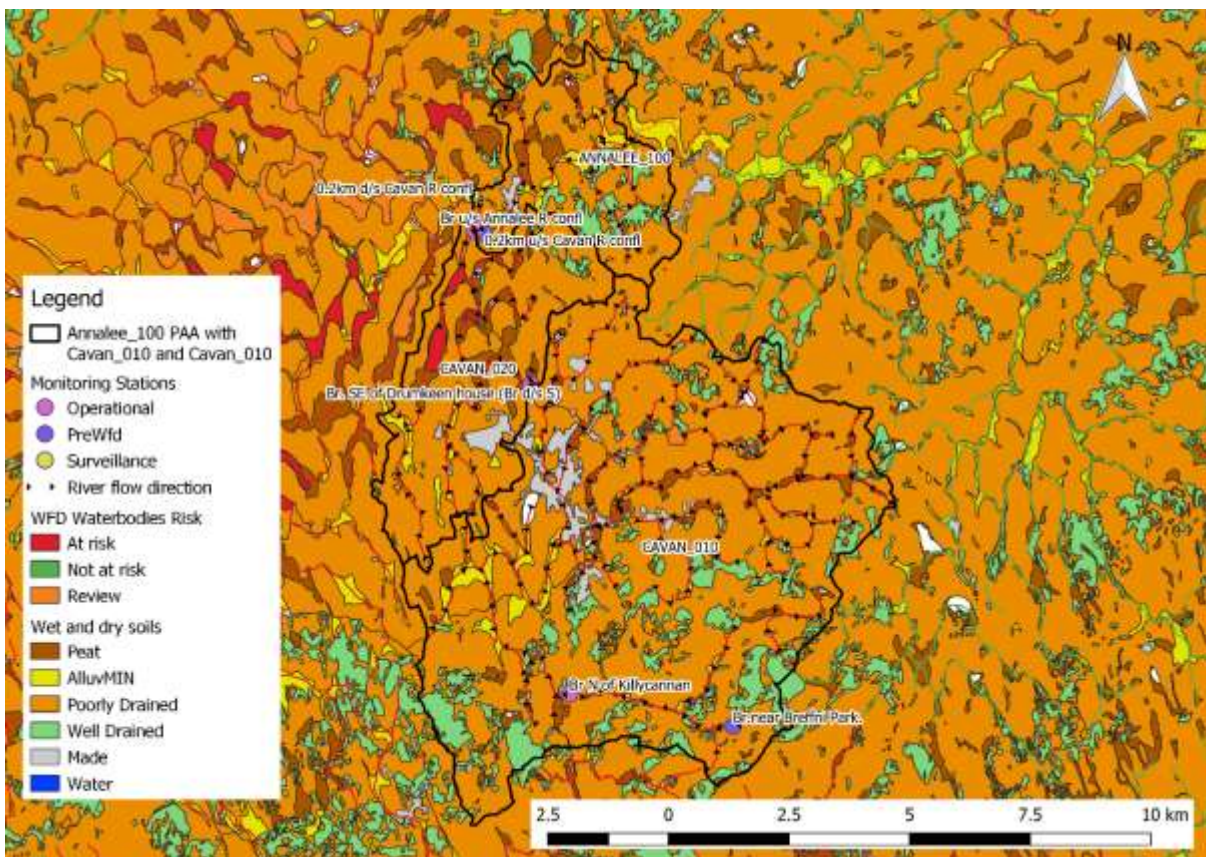


Figure 35 The wet and dry soils for the Annalee_100, Cavan_020 and Cavan_010 waterbodies.

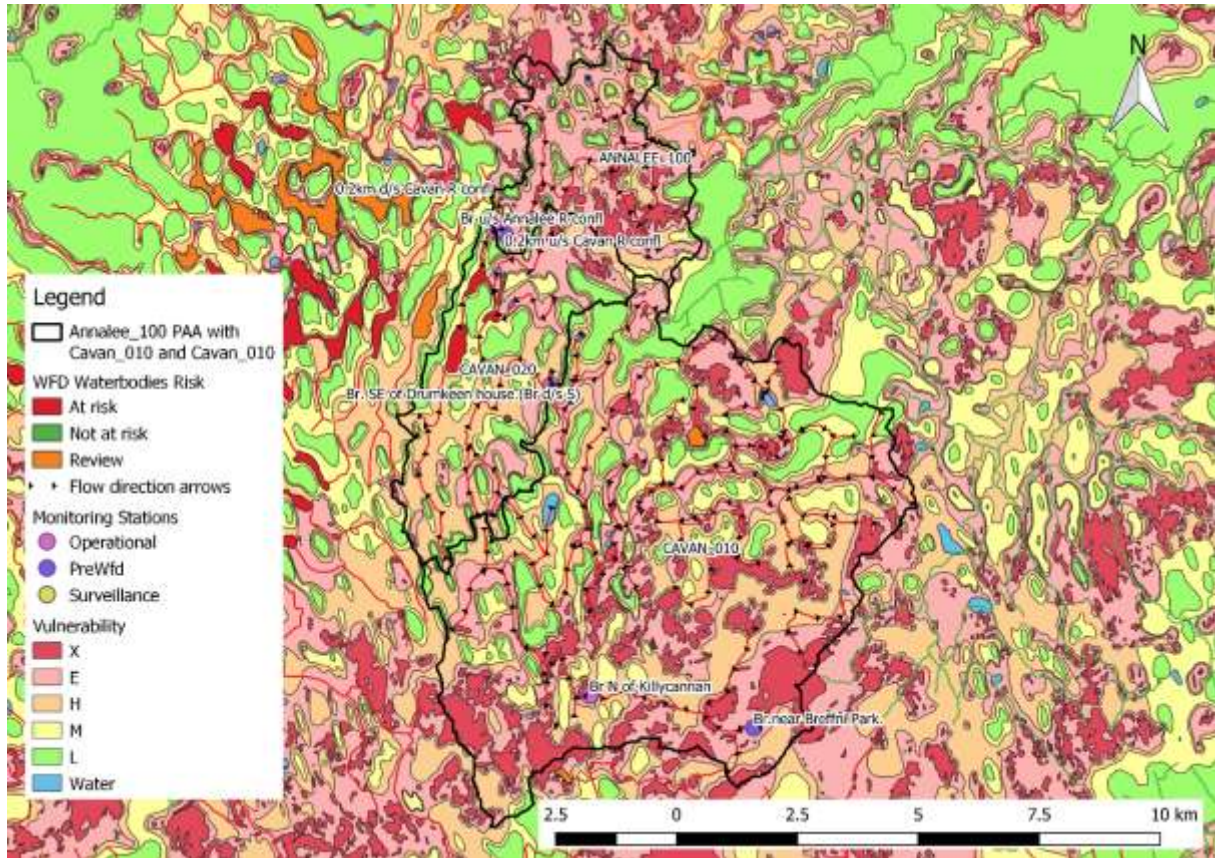


Figure 36 The groundwater vulnerability for the Annalee_100, Cavan_020 and Cavan_010 waterbodies.

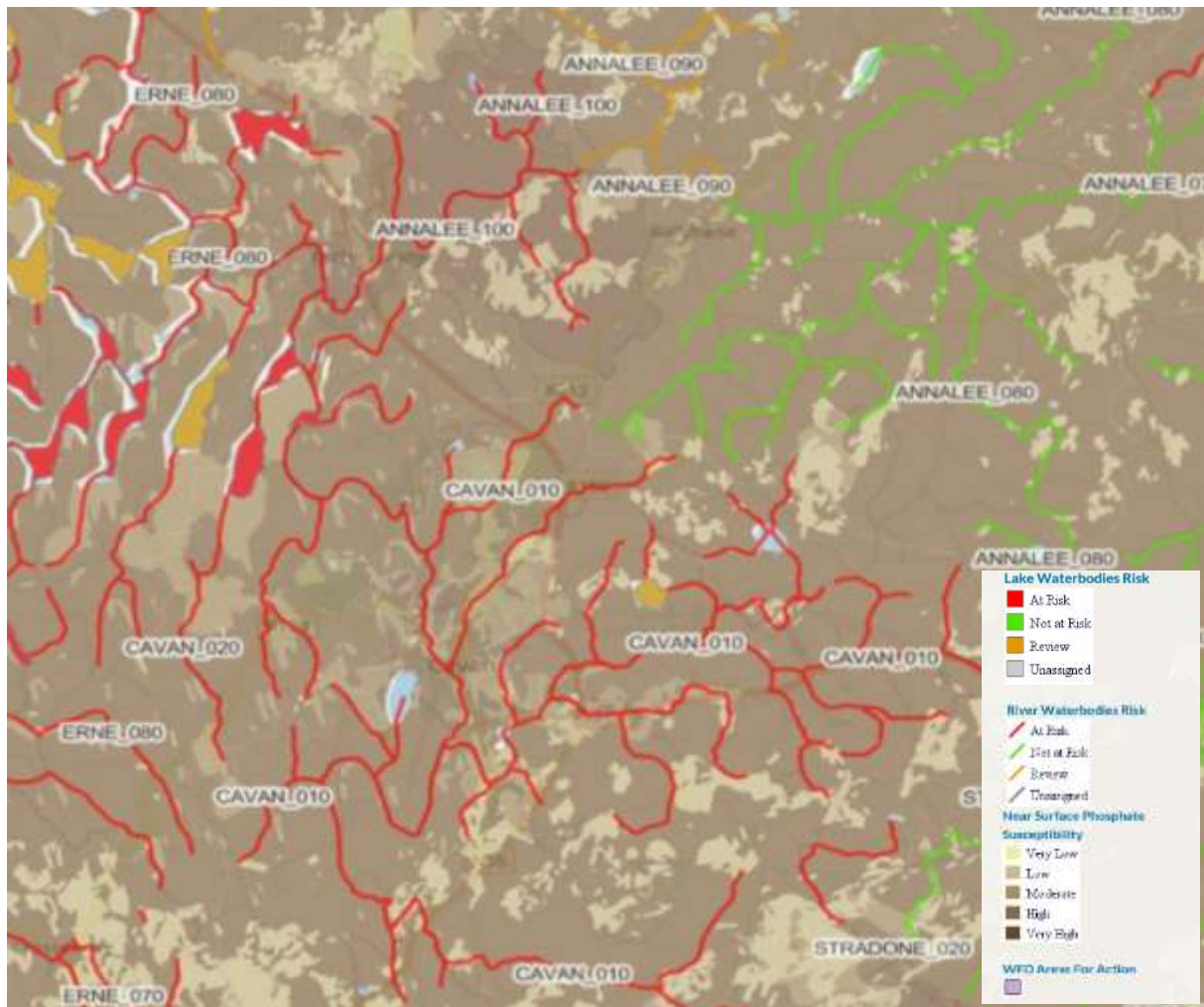


Figure 37 The near surface PO₄ susceptibility map for the Annalee_100, Cavan_020 and Cavan_010 waterbodies.

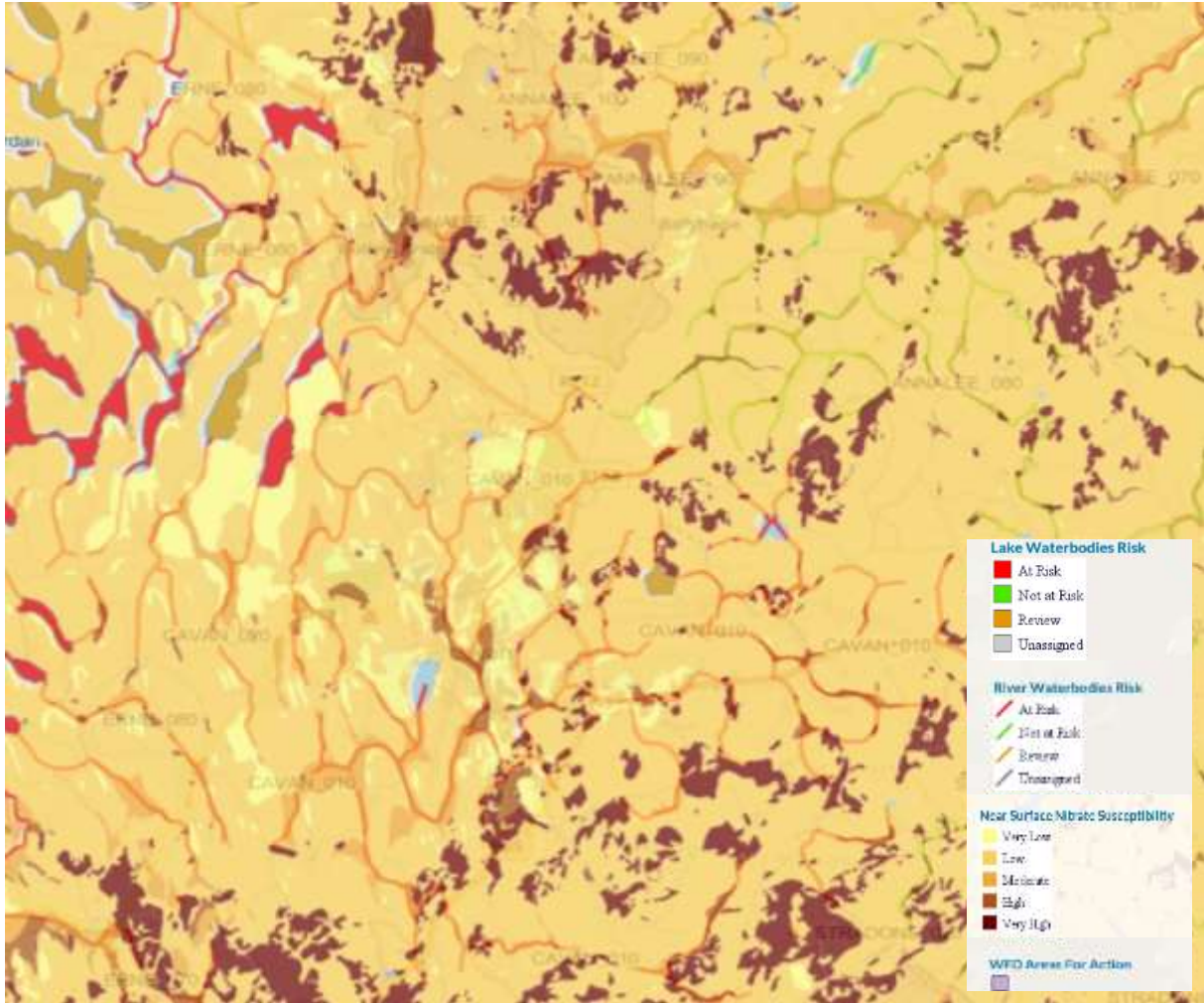


Figure 38 The near surface NO₃ susceptibility map for the Annalee_100, Cavan_020 and Cavan_010 waterbodies.

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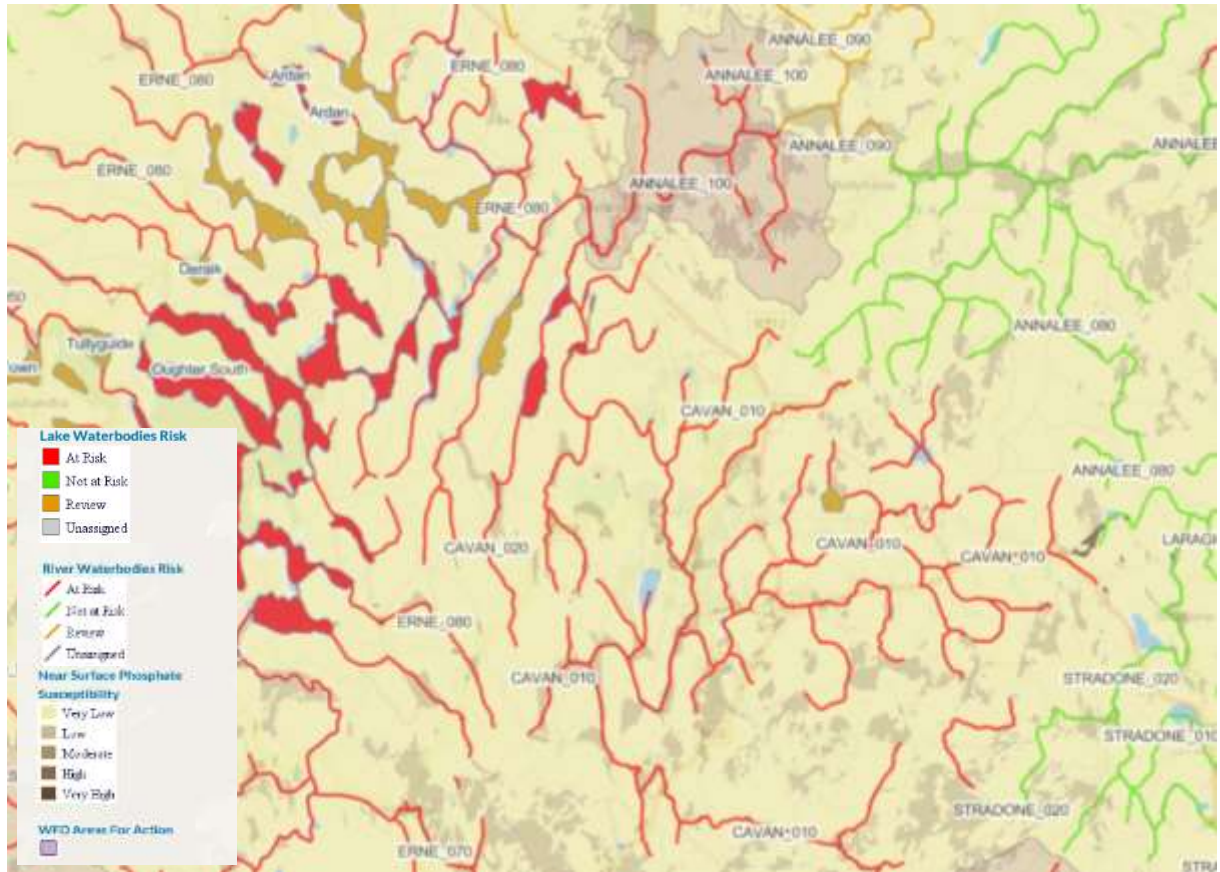


Figure 39 The sub-surface NO₃ susceptibility map for the Annalee_100, Cavan_020 and Cavan_010 waterbodies

Appendix B



WFD Waterbody Code IE_NW_36A021400	WFD Waterbody Name ANNALEE_100	Station Name 0.2km d/s Cavan R conf		
River code and year: 36A021400 sampled in 2017	River: ANNALEE	Easting: 240059	Northing: 310842	Sample date: 18/08/17 03:00 PM
Access and H&S rating:	Left Hand Side	Upstream and Downstream Low Hazard site		

Filamentous algae, macrophytes & shading		Station type, sediment, livestock access & erosion	
Cladophora		Station Type	Typical riffle-glide
Vaucherla		Substrate Features	Normal
Filamentous algae - Total	1 - 2.5%	Substrate Siltation	Slight to Moderate
Total Macrophytes	20%	Livestock Access	Cattle
		Livestock Access Impact	Mild
Shading	Light to Moderate	Bank Erosion	U/S Left Bank
		Bank Erosion Extant	Mild
		Recent Flood	No
		Flow/Discharge	Normal to Low

Overview of macroinvertebrate data

The site 36A021400 on the ANNALEE river was sampled in 2017. A total of 20 invertebrate taxa were recorded. There were 2 sensitive mayfly and 0 sensitive stonefly found at the site. Sensitive taxa were found in good numbers. The results of an examination of key tolerant taxa found: Simuliidae (Few), Gammarus (Numerous) and Baetis rhodani (Numerous). When high numbers of tolerant taxa are found like this, especially when combined with a low density or absence of sensitive taxa, it is usually indicative of moderate or lower status. The Q value assigned to this site was 3-4, indicative of moderate conditions. Trend data and river summary assessments are available at <http://www.epa.ie/QValue/webusers/>. Text is autogenerated; represents a simplification and adjustments for specific typologies/habitat/atypical conditions are not represented (e.g. acidified sites / non-riffle-glide habitats).

River code and year
 36A021400 sampled in 2017

Group	Taxon	Sensitivity	Abundance	
Mayfly	Ecdyonurus	Sensitive	Common	██████████
Mayfly	Heptagenia	Sensitive	Few	██████
Bugs	Aghelecheridae	Less sensitive	Numerous	██████████
Caddisfly	Limnephilidae	Less sensitive	Few	██████
Caddisfly	Lepidostomatidae	Less sensitive	Few	██████
Beetle	Limnius volckmani	Tolerant taxa	Few	██████
Blackfly larvae	Simuliidae	Tolerant taxa	Few	██████
Caseless Caddis	Hydropsyche	Tolerant taxa	Few	██████
Caseless Caddis	Rhyacophila	Tolerant taxa	Few	██████
Caseless Caddis	Polycentropus	Tolerant taxa	Few	██████
Chironomids	Chironomidae	Tolerant taxa	Few	██████
Mayfly	Serratella ignita	Tolerant taxa	Few	██████
Mayfly	Baetis rhodani	Tolerant taxa	Numerous	██████████
Shrimp	Gammarus	Tolerant taxa	Numerous	██████████
Snails	Bithynia	Tolerant taxa	Few	██████
Sponges	Porifera	Tolerant taxa	Few	██████
Leeches	Glossiphonia	Very tolerant taxa	Common	██████████
Leeches	Helobdella	Very tolerant taxa	Few	██████
Clam	Sphaerium	Very tolerant taxa	Dominant	██████████
Worms	Tubificidae	Most tolerant taxa	Few	██████

Figure 40 The 2017 EPA biologist report for the Annalee_100.

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Appendix C

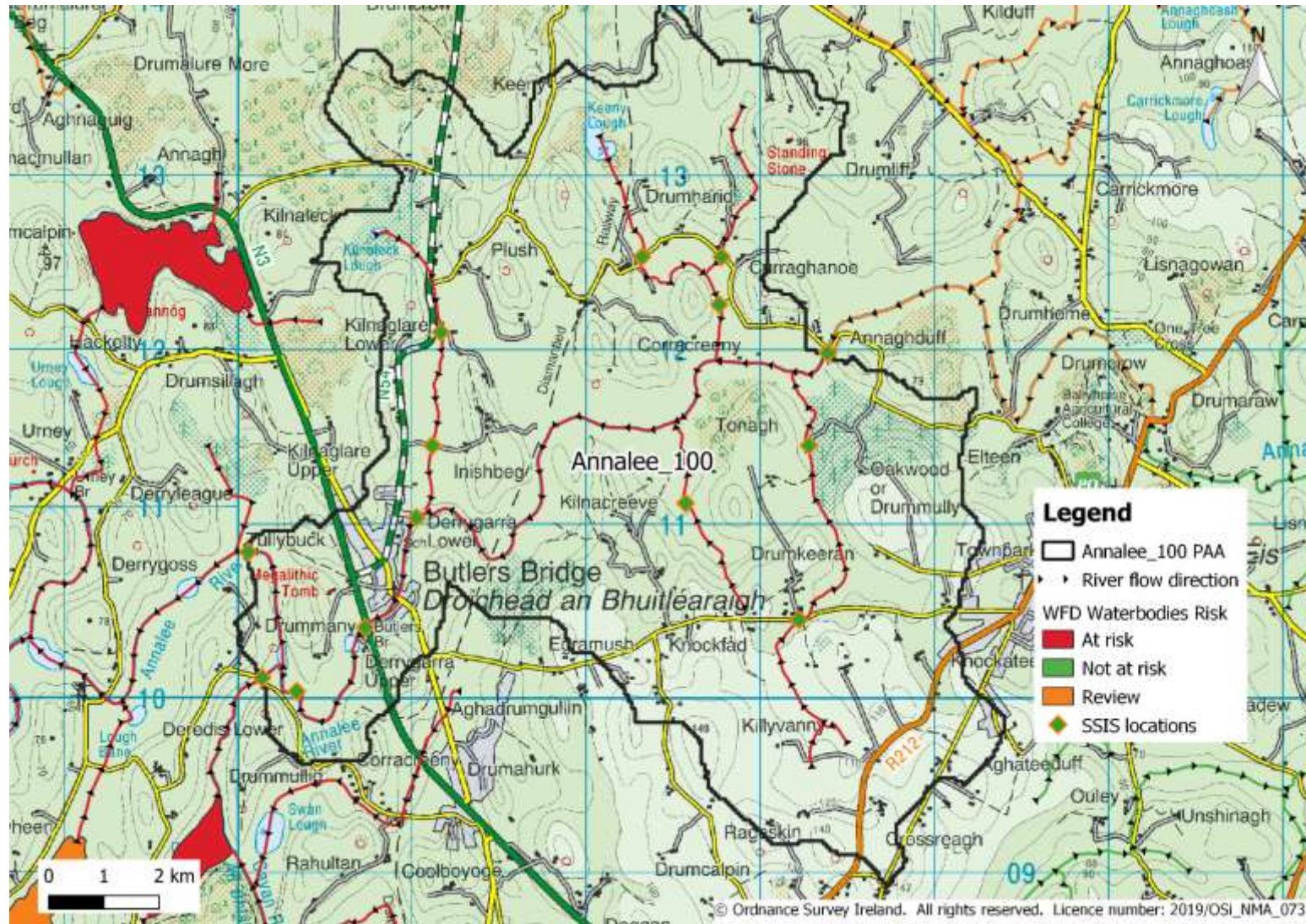


Figure 41 Initial sampling locations for SSIS/RA analysis.