Nitrates Directive
2016 Derogation Report for Northern Ireland
in accordance with Article 10 of
Commission Decision 2015/346/EC

August 2017

CONTENTS

CONTENTS **Page No**

This report has been prepared by the Northern Ireland Nitrates Directive Scientific Working Group (SWG) and Nitrates Implementation and Communication Group (NICG). The groups are comprised of scientific, regulatory, advisory and policy staff from the:-

Department of Agriculture, Environment and Rural Affairs (DAERA) www.daera-ni.gov.uk)

Northern Ireland Environment Agency (NIEA) (an agency within DAERA) www.daera-ni.gov.uk/northern-ireland-environment-agency

Agri-Food and Biosciences Institute (AFBI) (a Non-Departmental Public Body sponsored by DAERA; www.afbini.gov.uk

College of Agriculture, Food and Rural Enterprise (CAFRE) (a division within DAERA,); www.cafre.ac.uk/

For further information please contact:-
Environmental Farming Branch
Department of Agriculture, Environment and Rural Affairs
R652 Dundonald House
Upper Newtownards Rd
Ballymiscaw
Belfast
BT4 3SB

Email: Siobhan.Bowers@daera-ni.gov.uk

1. INTRODUCTION

The Nitrates Directive (91/676/EEC) (the Directive) is currently implemented in Northern Ireland through the 2015-2018 Nitrates Action Programme (NAP) contained in the Nitrates Action Programme Regulations (Northern Ireland) 2014 (the 2014 NAP Regulations) and subsequent amending regulations[1]. From 2011-2014 it was implemented through the NAP contained in the 2010 NAP Regulations and subsequent amending regulations[2]. The Regulations limit the amount of nitrogen (N) from livestock manure that can be applied to land to 170 kg N/ha/year on all non-derogated farms and are the responsibility of the Department of Agriculture, Environment and Rural Affairs (DAERA).

Most of the measures contained in the 2010 NAP Regulations were carried forward into the 2014 NAP Regulations. However, controls on some measures were revised and additional guidance[3] on the NAP was produced for farm businesses.

In 2007, the United Kingdom (UK), with regard to Northern Ireland, was granted derogation (until 31 December 2010) by Commission Decision 2007/863/EC (the 2007 Decision) to permit an increase in the amount of grazing livestock manure that may be applied to land from 170 kg N/ha/year up to a limit of 250 kg N/ha/year on grassland farms which meet certain criteria. After application and discussion with the Commission, derogation was renewed (until 31 December 2014) by Commission Decision 2011/128/EU (the 2011 Decision). Measures relating to the Decision were included in the 2010 NAP Regulations.

Following a further application and discussion with the Commission and a positive Member State vote at the EC Nitrates Committee in November 2014, derogation was renewed (until 31 December 2018) (Commission Decision 2015/346/EU – the 2015 Decision). Measures relating to the new Decision have been included in the 2014 NAP Regulations.

In accordance with the 2015 Decision, Northern Ireland must update and send to the Commission maps every year, showing the percentage of grassland farms, percentage of livestock and percentage of agricultural land covered by an individual derogation in each district of Northern Ireland, as well as maps of local land use.

Article 10 of the 2015 Decision requires that the results of monitoring be transmitted to the Commission annually, with a concise report on water quality and evaluation practice. The report shall also provide information on how the evaluation of the implementation of the derogation conditions is carried out through controls at farm level and include

[1] The Nitrates Action Programme (Amendment) Regulations (Northern Ireland) 2015
[2] The Nitrates Action Programme (Amendment) Regulations (Northern Ireland) 2012
[3]Nitrates Action Programme 2015-2018 and Phosphorus Regulations Guidance Booklet https://www.daera-ni.gov.uk/sites/default/files/publications/dard/nap-2015-2018-and-phosphorus-regulations-guidance-booklet-final-may-2016.pdf

information on non-compliant farms based on results of administrative and field inspections.

A first report for Northern Ireland (for 2007 and 2008) was submitted to the Commission in 2009 and since then a report has been submitted annually for the preceding year (with maps for the current year). Therefore, this report provides the annual report on implementation of the derogation in 2016 and maps for 2017.

2. MAPS

In 2016, 298 farm businesses out of approximately 25,600 direct aid claimants (i.e. 1.2%) operated under an approved derogation in Northern Ireland, compared to 225 (i.e. 0.77%) in 2015.

Table 1 on page 10, shows the predicted grassland area and livestock manure loadings of farm businesses which applied to operate under the terms of the derogation in years 2010 to 2017.

Under the Water Framework Directive (2000/60/EC) (WFD), Northern Ireland shares three International River Basin Districts (IRBDs) with the Republic of Ireland and there is one River Basin District (RBD) entirely within Northern Ireland. In the 'UK Article 3 Report on the WFD' Northern Ireland was further subdivided into 31 sub-catchments which form the basis of the maps presented below.

2.1 Percentage of grassland farms covered by an individual derogation in 2017

The map in Figure 1 shows the percentage of grassland farm businesses by area who applied for an individual derogation in 2017, broken down by location of the land within the 31 sub-catchments. Across Northern Ireland this equates to 2.88% of grassland. The highest percentage in any sub-catchment is 26.28%.

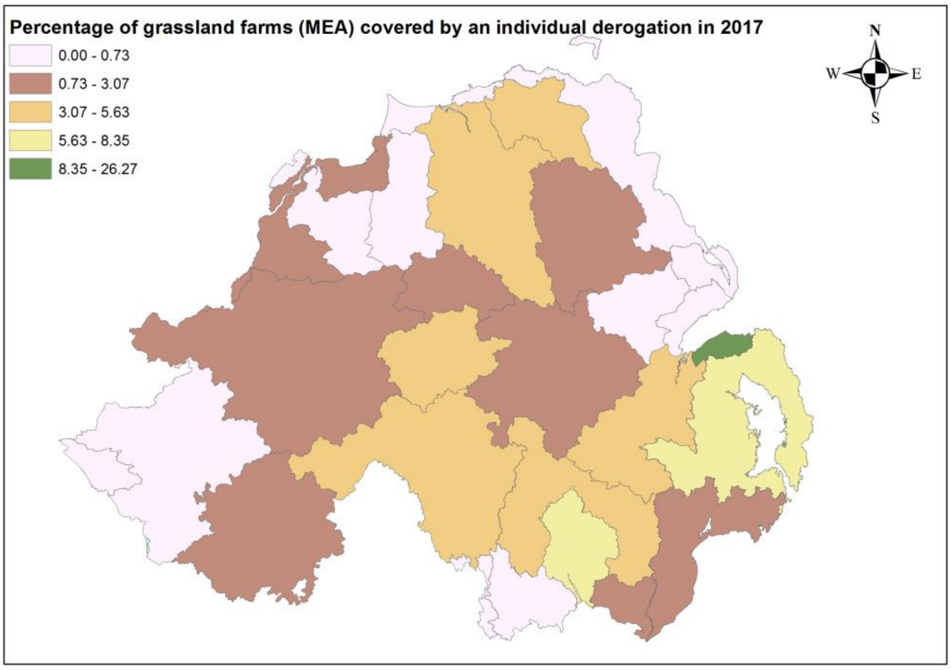


Figure 1: Percentage of grassland farms covered by an individual derogation 2017

2.2 Percentage of cattle livestock covered by an individual derogation in 2017

The map in Figure 2 shows the percentage of cattle livestock covered by an individual derogation in 2017. This has been calculated on the basis of nitrogen (N) produced and is broken down by location of the farm business address within the 31 sub-catchments. Across Northern Ireland this equates to 6.53% of cattle livestock N produced. The highest percentage in any sub-catchment is 37.75%.

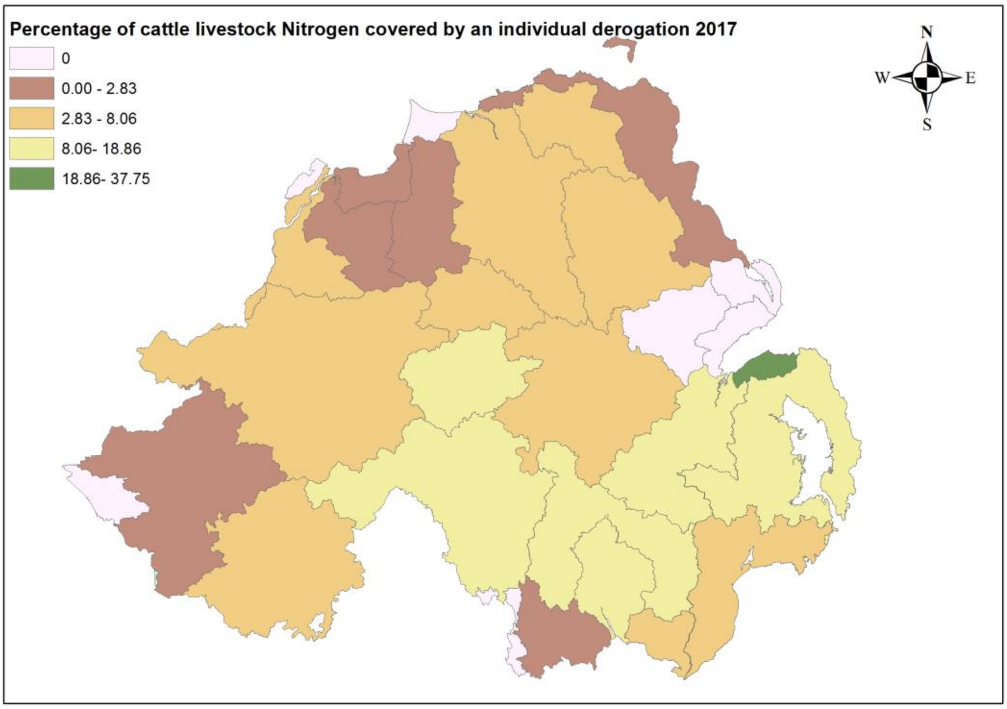


Figure 2: Percentage of cattle livestock covered by an individual derogation 2017

2.3 Percentage of agricultural land covered by an individual derogation in 2017

The map in Figure 3 shows the percentage of agricultural land covered by farm businesses who applied for an individual derogation in 2017, broken down by location of the farm business address within the 31 sub-catchments. Across Northern Ireland this equates to 2.81% of agricultural land. The highest percentage in any sub-catchment is 20.07%

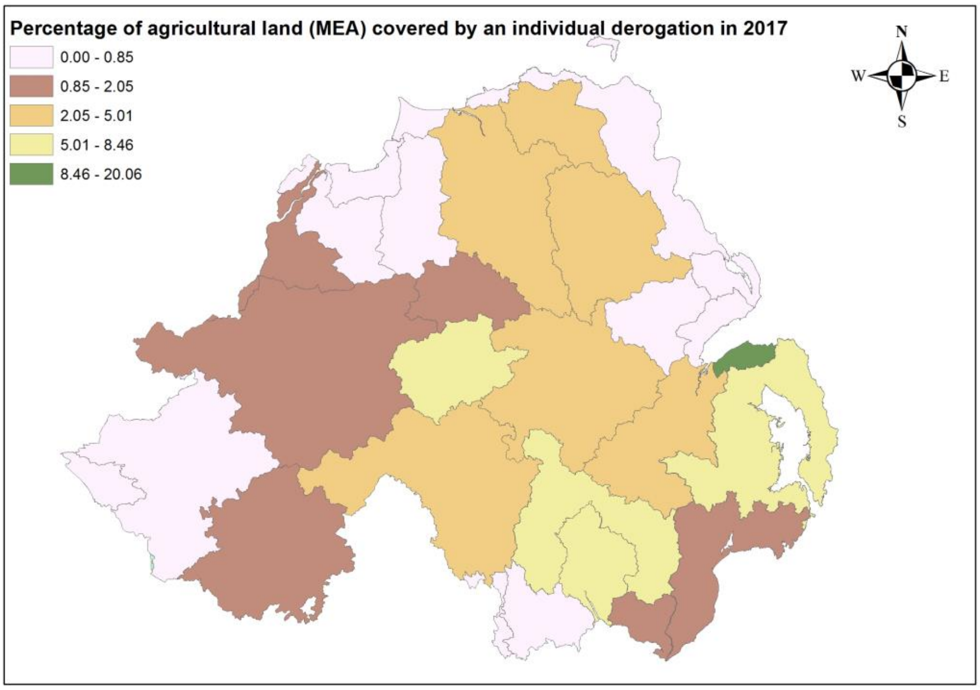


Figure 3: Percentage of agricultural land covered by an individual derogation 2017

2.4 Map of local land use for 2017

Agricultural land use in Northern Ireland is dominated by grassland farming systems. According to the Northern Ireland Agricultural Census (June 2016) (www.daera-ni.gov.uk/publications/agricultural-census-northern-ireland-2016), managed grassland accounted for approximately 79% of a total agricultural area of 1,013,200 ha. Arable and other crops accounted for 5% of the total and rough grazing for 14%. The map in Figure 4 shows the declared land-uses across Northern Ireland from the 2017 SAF application.

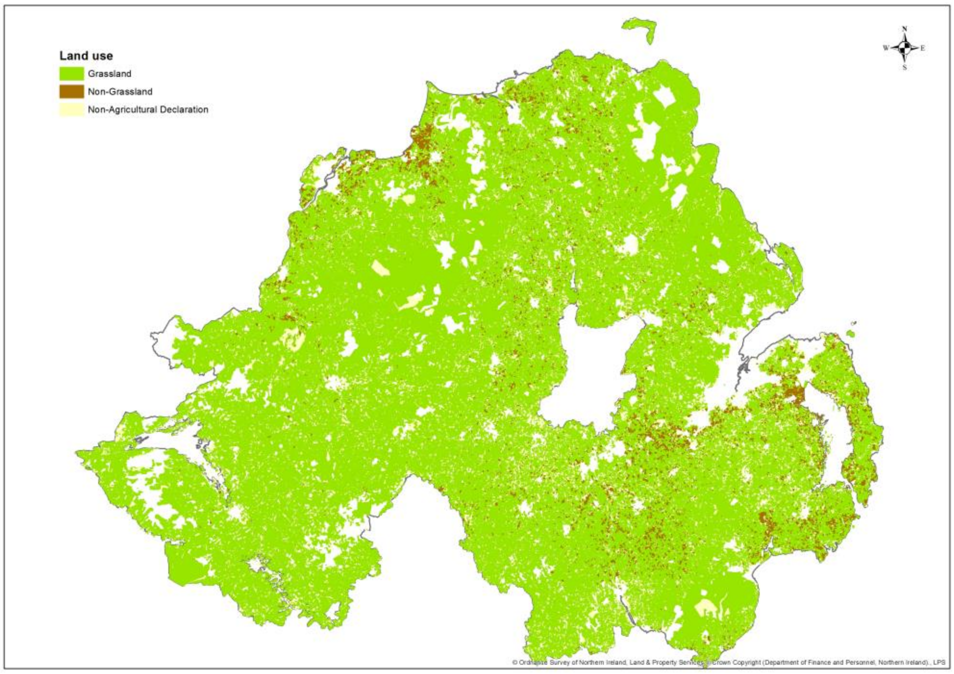


Figure 4: Map of local land use for 2017

Table 1: Predicted average (and minimum-maximum) grassland areas and livestock manure loadings of farm businesses which applied for derogation in years 2010 to 2017

Parameter	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Grassland area (%)	97 (81-100)	98 (81-100)	97 (81-100)	98 (82–100)	98 (82–100)	98 (83–100)	98 (82–100)	98 (81–100)
Farm size (ha)	86 (11-263)	84 (11–261)	83 (14–260)	85 (14–280)	88 (14–272)	86 (10–370)	88 (7-334)	90 (16-348)
Total livestock manure nitrogen loading (kg N/ha/year)	201 (11-247)	206 (155–250)	204 (119–249)	205 (36–249)	205 (122–246)	205 (12–250)	213 (23-250)	215 (22-250)
Grazing livestock manure nitrogen loading (kg N/ha/year)	203 (11-247)	206 (195–250)	204 (119–249)	205 (36–249)	205 (122–246)	206 (12–250)	213 (23-250)	215 (22-250)

3. WATER QUALITY

In accordance with Article 10 of the 2015 Decision, the results of monitoring and a concise report on water quality are transmitted to the Commission annually in this Derogation report.

The following section provides information on the measured nitrate and phosphorus levels and evolution of water quality in rivers, streams, lakes and groundwater over the period 2012 to 2016. Results are assessed both for Northern Ireland as a whole, and for the sub-catchments (Crawfordsburn and Clanrye) where the concentration of derogated farms was highest in 2016 (high derogation catchments) and in previous reporting periods (Strangford and Ballinderry catchments).

Groundwater monitoring data are not available for the Crawfordsburn catchment which is not considered representative of Northern Ireland, because of its urban nature. The percentage of farm land in comparison to total catchment area in the Crawfordsburn catchment (23 %) is low in comparison to the other catchments: Clanrye (56 %), Strangford (51 %) and Ballinderry (71 %). There are currently no groundwater monitoring stations within the Clanrye catchment, as lead-in times for new stations exceed one year. The list of catchments with the highest percentage of derogated farms is updated annually and 2016 was the first time that the Clanrye catchment was considered a high derogation catchment.

In this report, comparisons of the mean annual average data for the period 2012-2015 (as reported in the Northern Ireland 2016 Nitrates Article 10 Report[4]) and the most recent annual average data for the current reporting year (2016) are presented. In each period, surface water data were only included where sufficient numbers of samples over the four years (2012-2015) and one year (2016) were available[5]. In the four-year (2002-2015) period all groundwater data were included. For the current reporting year 2016, all available groundwater data were included; consisting on average of two samples per monitoring site.

Presentation of the four-year data set (2012-2015) as reported in the Northern Ireland 2016 Nitrates Article 10 Report, provides continuity with other Nitrates Directive 91/676/EEC (ND) reporting requirements and it provides a clear indication of how the water quality is evolving since the Article 10 Report for the period 2012-2015.

[4] Member States must report every four years to the Commission on the status of water quality in accordance with Article 10 of the Nitrates Directive (91/676/EEC). The ‘Nitrates Directive Development Guidance Notes for Member States’ issued in 2011, indicate that for the purposes of reporting, data may be averaged over more than one year. The UK 2016 Nitrates Article 10 Report was completed in July 2016 and data was summarised and presented for 2012-2015.

[5] Sufficient numbers of samples, for annual average, in the four-year period 2012-2015 were considered to be ≥20 samples and ≥10 for the current reporting year (2016).

The results of a single year analysis must be treated with caution; due to the relatively low numbers of samples involved and possible variability due to climatic influences (for the purposes of this report, adjustments have not been made for weather or other varying annual effects). When considering the following results it should, therefore, be remembered that variations in annual precipitation or in seasonal patterns of rainfall can increase nutrient run-off and thereby potential nutrient input to surface waters. Average monthly precipitation for Northern Ireland for 2012-2015 was 84.1 mm and for 2016 was lower at 78.7 mm (source: Met Office).

In 2009, a revision of the surface freshwater monitoring network was carried out to broaden the coverage in Northern Ireland for Water Framework Directive (2000/60/EC) (WFD) monitoring for the six-year period 2009-2014. The revision also reduced the numbers of monitored sites from 579 to 528 whilst continuing to fulfil monitoring obligations under WFD, Freshwater Fish Directive (2006/44/EC) (FFD) and ND. Further financial constraints led to another revision of the network in 2010. The new approach incorporated monthly sampling at a reduced number of core sites (258) with the remainder of sites (270) monitored for two years within the six-year River Basin Plan cycle on a rolling programme basis (2009-2014).

This meant that the average number of monthly samples analysed for nutrients was reduced from 579 to an average of 348 in each year. Changes to the monitoring programme were implemented in 2015 for the second cycle of the River Basin Management Plans (RBMP) through better targeting and by adopting a risk based approach to monitoring. Although WFD surveillance monitoring stations continue to be sampled monthly, the remainder of the stations are sampled on a quarterly basis, i.e. four samples per year. In 2016, the average number of monthly samples analysed for nutrients is 169, with a further 356 stations monitored quarterly.

Groundwater quality in Northern Ireland is assessed in accordance with NIEA's groundwater monitoring programme through the collection of water samples from boreholes and springs that are mostly owned and operated by third parties. The public water supply provider in Northern Ireland (NI Water Ltd) does not currently utilise groundwater with the exception of Rathlin Island, a small island off the north coast of Northern Ireland. Hence, NIEA rely mostly on third party owned boreholes and the co-operation of land/property owners to continue sampling from their groundwater sources for the chemical/nutrient monitoring.

This means that the composition of the ground water monitoring network can change due to businesses closing or changing their groundwater usage and in addition, datasets for trend assessments are often small. The monitoring network consists mainly of industrial boreholes where groundwater is utilised for manufacturing or food/drinks production. A small number of springs or boreholes purpose-installed by NIEA, which are purged prior to sampling, are also monitored. The selection of groundwater monitoring sites to date has been based on a pressure-pathway assessment of the groundwater bodies and the availability of potential monitoring points.

3.1 Nitrate concentrations in surface freshwater

In the period 2012-2015, NIEA monitored nitrate concentrations at 337 surface freshwater monitoring stations across Northern Ireland. The annual average nitrate concentration at these stations was 5.2 mg NO_3/l. In 2016, nitrate concentrations were monitored at 162 surface freshwater stations giving an annual average nitrate concentration of 3.8 mg NO_3/l.

Table 2: Annual average nitrate concentrations (based on number and % of monitoring stations) of surface freshwater across Northern Ireland, 2012-2015 and 2016

Average nitrate concentration (mg NO_3/l)	Northern Ireland	
	2012-2015 (337 stations)	**2016 (162 stations)**
0–9.99	89.34% (301)	95.7% (155)
10–24.99	10.7% (36)	4.3% (7)
25–39.99	0	0
>40	0	0

Table 3: Annual average nitrate concentrations (based on number of monitoring stations) of surface freshwater in the high derogation catchments, 2012-2015 and 2016

Average nitrate (mg NO_3/l)	Ballinderry Catchment		Strangford Catchment		Clanrye Catchment		Crawfordsburn Catchment	
	2012-15 (23 sites)	**2016** (22 sites)	**2012-15** (19 sites)	**2016** (14 sites)	**2012-15** (9 sites)	**2016** (2 sites)	**2012-15** (1 site)	**2016** (1 site)
0–9.99	82.6% (19)	100% (22)	63.2% (12)	71.4% (10)	44.4% (4)	100% (2)	100% (1)	100% (1)
10–24.99	17.4% (4)	0	36.8% (7)	28.6% (4)	55.6% (5)	0	0	0
25–39.99	0	0	0	0	0	0	0	0
>40	0	0	0	0	0	0	0	0

In 2012-2015, 52 of the monitored surface freshwater stations were located in the four catchments with the highest proportion of derogated farms and an annual average nitrate concentration of 8.5 mg NO_3/l was recorded. In 2016, 39 stations were monitored in these catchments with an annual average concentration of 6.99 mg NO_3/l.

Table 2 shows annual average nitrate concentrations in surface freshwater across Northern Ireland in 2012-2015 and 2016 based on the number and percentage of stations monitored.

Table 3 shows the average nitrate concentrations in surface freshwater in the four high derogation catchments in 2012-2015 and 2016 based on the number and percentage of stations monitored.

Figure 5 shows the distribution of nitrate in surface freshwater across Northern Ireland and the high derogation catchments in 2016. Average nitrate concentrations in 2016 were generally low across Northern Ireland, with 100% of surface water stations below 25 mg NO_3/l.

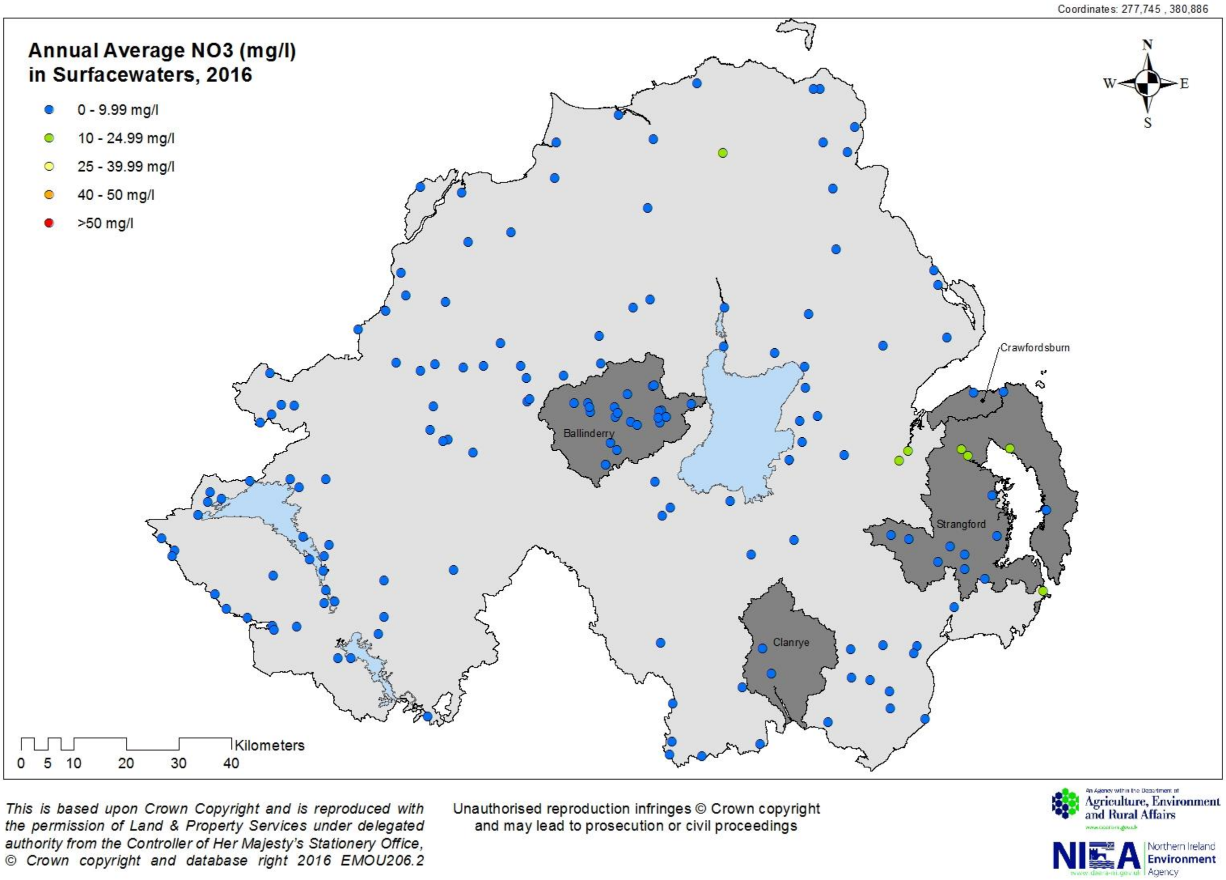


Figure 5: Distribution of annual average nitrate concentrations at surface freshwater stations in 2016

Nitrate concentration trends in Table 4 and Figure 6 indicate that the annual average nitrate concentrations in common surface freshwater stations across Northern Ireland were stable or decreasing at 100% of surface freshwater sites (including the high derogation catchments) between the two reporting periods, 2012-2015 and 2016.

Further long term trend analysis of nitrate data based on 321 common sampling points over the period 2008–2015 was recently undertaken for reporting under Article 10 of the Nitrates Directive. The majority (98.1%) of surface freshwater sites experienced a decrease or stabilisation in nitrate between the previous Article 10 reporting period (2008-2011) and the current reporting period (2012-2015). 1.9% of sites (six river sites) exhibited a weak increase in nitrate between the two reporting periods. Longer term temporal trends of 302 sites[6] showed that average monthly nitrate concentrations at surface freshwater sites over a ten year period indicated a significant decrease.

However, when comparing the last six years, no significant trend was indicated. Stations across Northern Ireland showing increasing trends in nitrate will be subject to targeted action. Further investigations and actions in these catchments will be implemented as part of targeted catchment projects under WFD in the RBDs. This will include engagement with the sewerage undertaker, home owners and farmers in the local areas, to follow up actions arising from reported pollution incidents and improve water protection.

Table 4: Change in average nitrate concentrations (based on % and number of common monitoring stations) of surface freshwater across Northern Ireland and in the high derogation catchments, between 2012-2015 and 2016

Difference in average nitrate concentration (mg NO_3/l) 2012-2015 – 2016	**% and number of common monitoring stations**		
	Decrease[1]	**Stable[2]**	**Increase[3]**
Northern Ireland (152 Stations)	26.3% (40)	73.7% (112)	0
Ballinderry Catchment (21 Stations)	85.7% (18)	14.3% (3)	0
Strangford Catchment (14 Stations)	35.7% (5)	64.3% (9)	0
Clanrye Catchment (2 Stations)	50% (1)	50% (1)	0
Crawfordsburn Catchment (1 Stations)	100% (1)	0	0

Difference is assessed by change in concentration – [1]Decrease ≤ -1 mg/l, [2]Stable -1 to +1 mg/l, [3]Increase ≥ +1 mg/l

[6] The non parametric Seasonal Mann Kendall Tau (SMK) test was used along with Theil- Sen test to determine trends and provided a measure of the overall trend of each of the 302sites. 622 sites (minimum 6 years data as recommended by UKTAG) were analysed and of these, 302sites passed secondary quality screening.

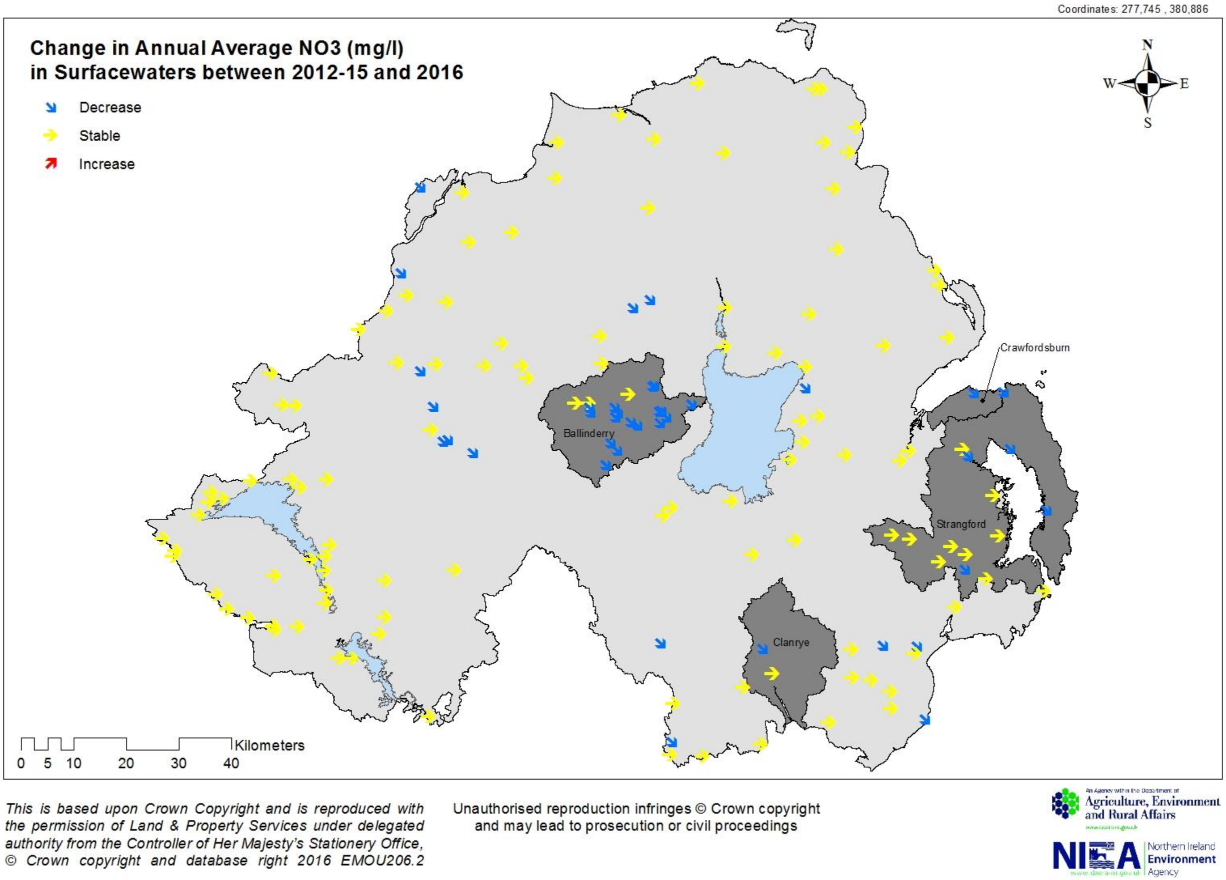


Figure 6: Change in annual average nitrate concentrations at surface freshwater stations between 2012-2015 and 2016

3.2 Nitrate concentrations in groundwaters

In the period 2012 to 2015, NIEA monitored nitrate concentrations at 56 groundwater monitoring sites across Northern Ireland at which average nitrate concentrations were determined. The average nitrate concentration at the 56 sites in 2012-2015 was 6.26 mg NO_3/l. In 2016, nitrate concentrations were monitored at 52 groundwater sites across Northern Ireland giving an average concentration of 4.13mg NO_3/l.

In 2012-15, 11 of the monitored groundwater sites were located in the two high derogation catchments (Ballinderry and Strangford) and an average concentration of 12.09 mg NO_3/l was recorded. In 2016, 11 of the monitored groundwater sites were located in the high derogation catchments and an average concentration of 9.67mg NO_3/l was recorded.

This higher average value for the high derogation catchments is due mainly to two monitoring sites in the Strangford catchment (one monitoring site in the Ards groundwater body, the other monitoring site in the Belfast East groundwater body), as discussed below.

Table 5 shows the average nitrate concentrations in groundwater across Northern Ireland and in the high derogation catchments for 2012–2015 and 2016. Figure 7 shows the distribution of nitrate in groundwater across Northern Ireland and in the two catchments in 2016.

Table 5: Average nitrate concentrations (based on number of monitoring sites) of groundwater across Northern Ireland and in the high derogation catchments with the highest proportion of derogated farms, 2010-2012 and 2016

catchment	groundwater body	Average nitrate concentration (mg NO_3/l)	0-24.99	25–39.99	40–50	>50
Northern Ireland		2012-2015 56 Sites	55	0	0	1
		2016 52 Sites	51	0	1	0
Ballinderry	Cookstown	2012-2015 4 Sites	4	0	0	0
		2016 4 Sites	4	0	0	0
	Moneymore	2012-2015 1 Site	1	0	0	0
		2016 1 site	1	0	0	0
Strangford	Ards Peninsula	2012-2015 1 Site	0	1	0	0
		2016 1 Site	1	0	0	0
	East Belfast	2012-2015 5 Site	4	0	0	1
		2016 5 Sites	4	0	1	0

Average nitrate concentrations in groundwater across Northern Ireland were generally low, with 55 of the 56 sampling points at less than 25 mg NO_3/l in 2012-2015 compared with 51 out of 52 sampling points at less than 25 mg NO_3/l in 2016. Average nitrate concentrations in the Ballinderry catchment in 2016 were generally low with all of the monitoring sites below 25 mg NO_3/l. In 2016 five of the six monitoring sites in the Strangford catchment were also below 25 mg NO_3/l, but one monitoring site (East Belfast groundwater body) had an average concentration between 40 and 50 mg/l. The site is the East Belfast groundwater body with a concentration between 40 and 50 mg NO_3/l and had previously an average concentration above 50 mg NO_3/l. In 2016 is was only possible to sample this site once due to access problems, as NIEA relies on third parties for access to land and boreholes. Therefore, the apparent downward trend has a low confidence level and future monitoring results need to be considered.

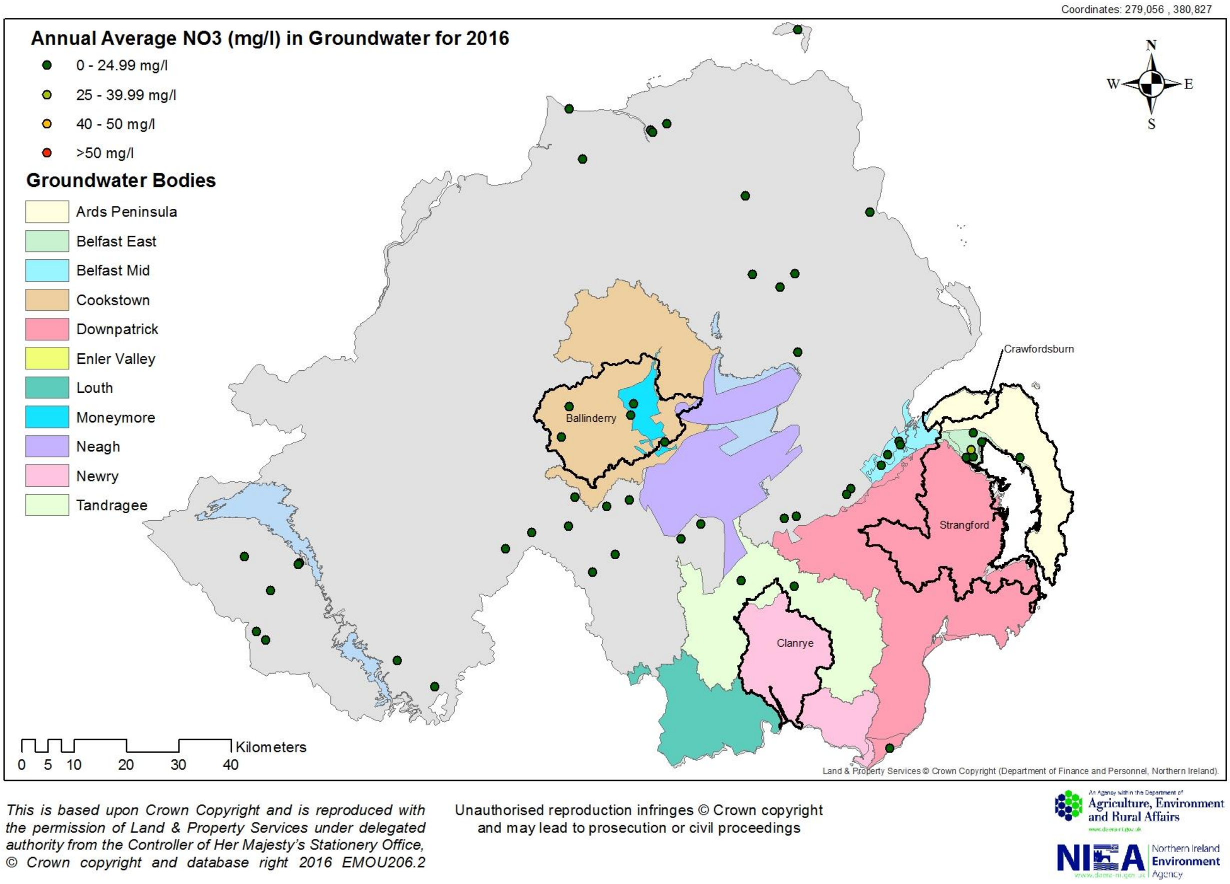


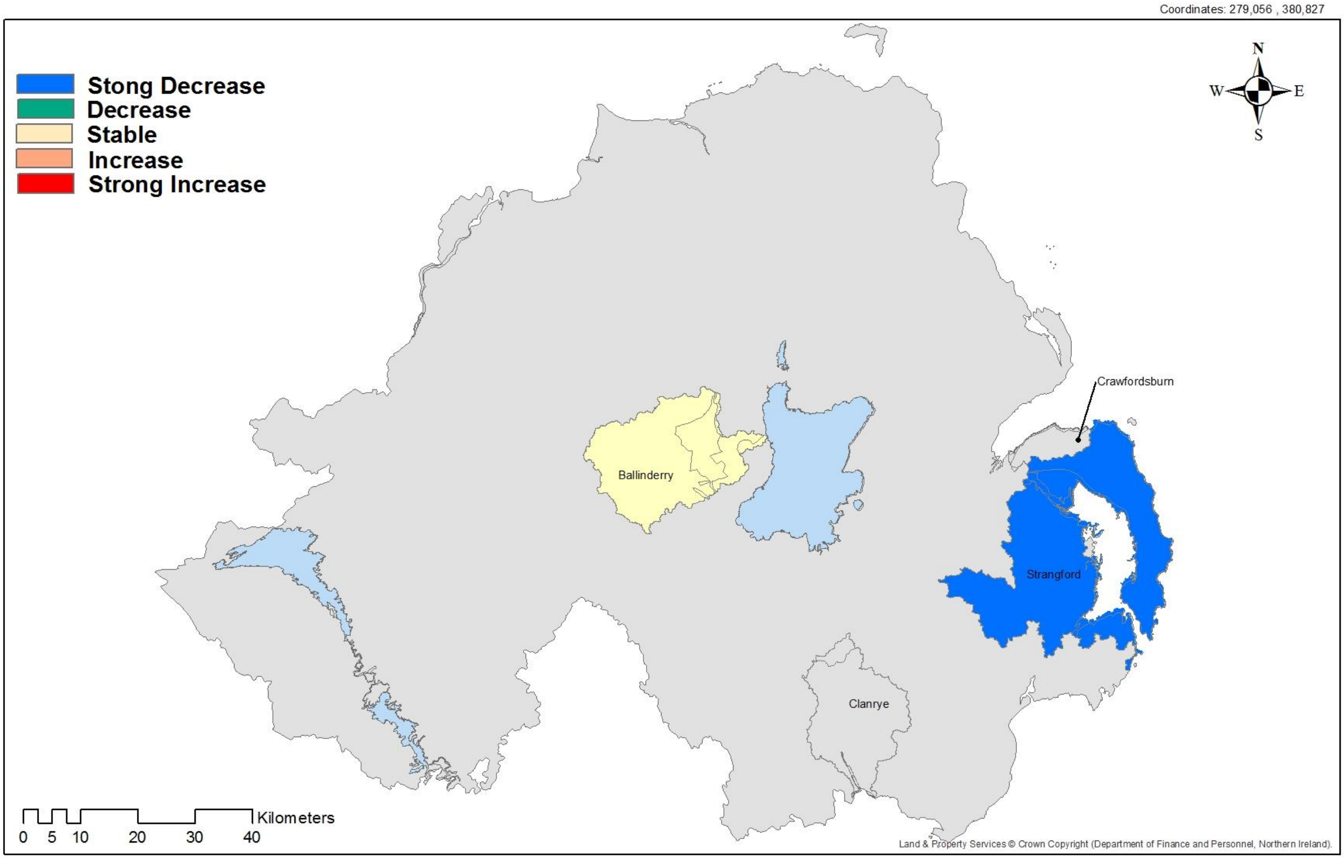
Figure 7: Distribution of annual average nitrate concentrations at groundwater stations in 2016. High Derogation Catchments are labelled and outlined with black line. Sampled groundwater bodies within these catchments are coloured according to legend

Nitrate concentration trends in groundwater across Northern Ireland, in Table 6, indicate a decrease or stabilisation in Ballinderry and Strangford high derogation catchments in 2016 compared to 2012-2015. Although the percentage of derogated farm land to overall farm land in the Crawfordsburn catchment is quite high (22 %), its overall percentage of farm land within the catchment is low (23 %) due to the urban nature of the catchment. For comparison the percentage of farm land within the catchment is 51 % and 71 % for the Strangford and Balllinderry catchments, respectively. Therefore, the Crawfordsburn catchment is not considered representative of the overall situation in Northern Ireland. There are currently no groundwater monitoring stations within the Clanrye catchment, as lead-in times for new stations exceed 1 year. The list of catchments with the highest percentage of derogated farms is updated annually and 2016 was the first time that the Clanrye catchment was considered a high derogation catchment.

For the trend assessments averages of the groundwater body parts within each catchment are compared from the 2012-2015 and 2016 time periods.

Table 6: Change in average nitrate concentrations (based on averages per groundwater body part in each catchment) across Northern Ireland and in the high derogation catchments, between 2011-2015 and 2016

Catchment	groundwater body	Difference in average nitrate concentration (mg NO_3/l)	> -5	-1 to -5	-1 to +1	+1 to +5	> +5
Northern Ireland				•			
Ballinderry	Cookstown				•		
	Moneymore				•		
Strangford	Ards Peninsula		•				
	East Belfast		•				



Agriculture, Environment and Rural Affairs

NIEA Northern Ireland Environment Agency

Figure 8: Changes in nitrate concentration averages per groundwater body part in each catchment between the periods of 2008-2011 and 2015

3.3 Eutrophic indicators - phosphorus concentrations in rivers and streams

Since the adoption of the WFD, methodologies for assessment of eutrophication in rivers and lakes have changed. Historically, waters were assessed for trophic status using guidance issued by the UK authorities in 2002. Under the current WFD methodology, transposed in Northern Ireland as The Water Environment (Water Framework Directive)

Regulations (Northern Ireland) 2017[7], freshwater bodies are assessed for trophic status using WFD standards for both phosphorus (SRP) and biological indicators.

For the purposes of this report SRP is considered on its own and without the supporting biological parameters normally required to classify status. To be consistent in the approach and for temporal comparative purposes Northern Ireland has assessed data from 2012-2016 using the SRP standards calculator as set out in the regulations noted above, to obtain a site specific WFD SRP Classification for each site. They have been derived using a new approach to setting phosphorus standards that produces site specific estimates of natural phosphorus concentrations, taking account of a site's alkalinity and altitude (UKTAG, 2015).

The revised standards represent a major step forward in matching nutrient concentration to ecological change. The standards are more precautionary than previous SRP standards used in the first cycle of River basin Management Plans as UKTAG found these to be insufficiently stringent, with High or Good status phosphorus classifications being produced for water bodies where there are clear ecological impacts of nutrient enrichment.

In the period 2012-2015, NIEA monitored annual soluble reactive phosphorus (SRP) concentrations at 391 surface freshwater river stations across Northern Ireland. The annual average SRP concentration at these sites was 64.8 µg SRP/l. In 2016, SRP concentrations were monitored at a reduced number of sites - 140 surface freshwater river stations, giving an annual average SRP concentration of 73.8 µg SRP/l.

In 2012-2015, 38 of the monitored surface freshwater monitoring stations were located in the four catchments with the highest proportion of derogated farms and an average phosphorus concentration of 107.2 µg SRP/l was recorded. In 2016, the same 38 stations were also monitored in these catchments with an annual average concentration of 132.5 µg SRP/l. Table 7 shows the WFD SRP status in rivers and streams across Northern Ireland for 2012-2015 and 2016.

Table 7: WFD SRP status (based on % and number of monitoring stations) of surface freshwater in rivers and streams across Northern Ireland, 2012–2015 and 2016

WFD SRP Class	**Northern Ireland**	
	2012-2015 (391 Stations)	**2016 (140 Stations)**
High	127 (32.5 %)	34 (24.3 %)
Good	132 (33.8 %)	50 (35.7 %)
Moderate	110 (28.1 %)	44 (31.4 %)
Poor	22 (5.6 %)	12 (8.6 %)
Bad	0	0

[7] http://www.legislation.gov.uk/nisr/2017/81/pdfs/nisr_20170081_en.pdf

Results in Table 7 show that in the 2012-15 reporting period, 66.3% of river sites were classified as High or Good for SRP status. The remaining 33.7% of river sites had a WFD SRP classification of less than Good status and are considered to be at risk from eutrophication or eutrophic. Of these sites, 5.6% were classed as Poor status for SRP.

In 2016, 60% of river sites were classified as High or Good for SRP status. 40% of river sites had a WFD SRP classification of less than Good status. Of these, 8.6% were classified as Poor status for SRP, indicative of nutrient enrichment. No sites were classed as Bad status in either reporting period. Compared with the previous reporting period (2012-15), there was a decrease in the number of sites that were classed as High or Good.

Table 8 shows the WFD SRP status of surface freshwater monitoring stations in rivers and streams in the high derogation catchments in 2012-2015 and 2016. Figure 9 shows the distribution of WFD SRP status across Northern Ireland and the four derogation catchments in 2016.

Average SRP concentrations in the Ballinderry catchment , ranged from 19.3 to 119 µg SRP/l in 2012-2015 and 30.8 to 121.7 µg SRP/l in 2016, with 32% of sites classed as High or Good status and 68% classed as Moderate status. No sites were classed as Poor or Bad status.

Average concentrations in the Strangford catchment ranged from 27.3 to 488 µg SRP/l in 2012-2015 and 33.3 to 675.8 µg SRP/l in 2016, with no change in the number of sites classified as less than Good status between reporting periods.

Average SRP concentrations in the Clanrye catchment ranged from 99.4 to 143 µg SRP/l in 2012-2015 and 116.4 to 150.8 µg SRP/l in 2016, with both sites classed as Moderate status in both reporting periods. The average concentration at the single site in the Crawfordsburn catchment was103 µg SRP/l in 2012-2015 and 139 µg SRP/l in 2016, with no change in Moderate status between reporting periods (Table 8 and Figure 9).

Table 8: WFD SRP status (based on number of common stations) of surface freshwater in rivers and streams in the high derogation catchments, 2012-2015 and 2016

WFD SRP Class	Ballinderry Catchment (22 sites)		Strangford Catchment (13 sites)		Clanrye Catchment (2 sites)		Crawfordsburn Catchment (1 sites)	
	2012-2015	2016	2012-2015	2016	20012-2015	2016	2012-2015	2016
High	4.5% (1)	4.5% (1)	7.7% (1)	7.7% (1)	0	0	0	0
Good	59.1% (13)	27.3% (6)	0	0	0	0	0	0
Moderate	36.4% (8)	68.2% (15)	38.5% (5)	30.8% (4)	100% (2)	100% (2)	100% (1)	100% (1)
Poor	0	0	53.8% (7)	61.5% (8)	0	0	0	0
Bad	0	0	0	0	0	0	0	0

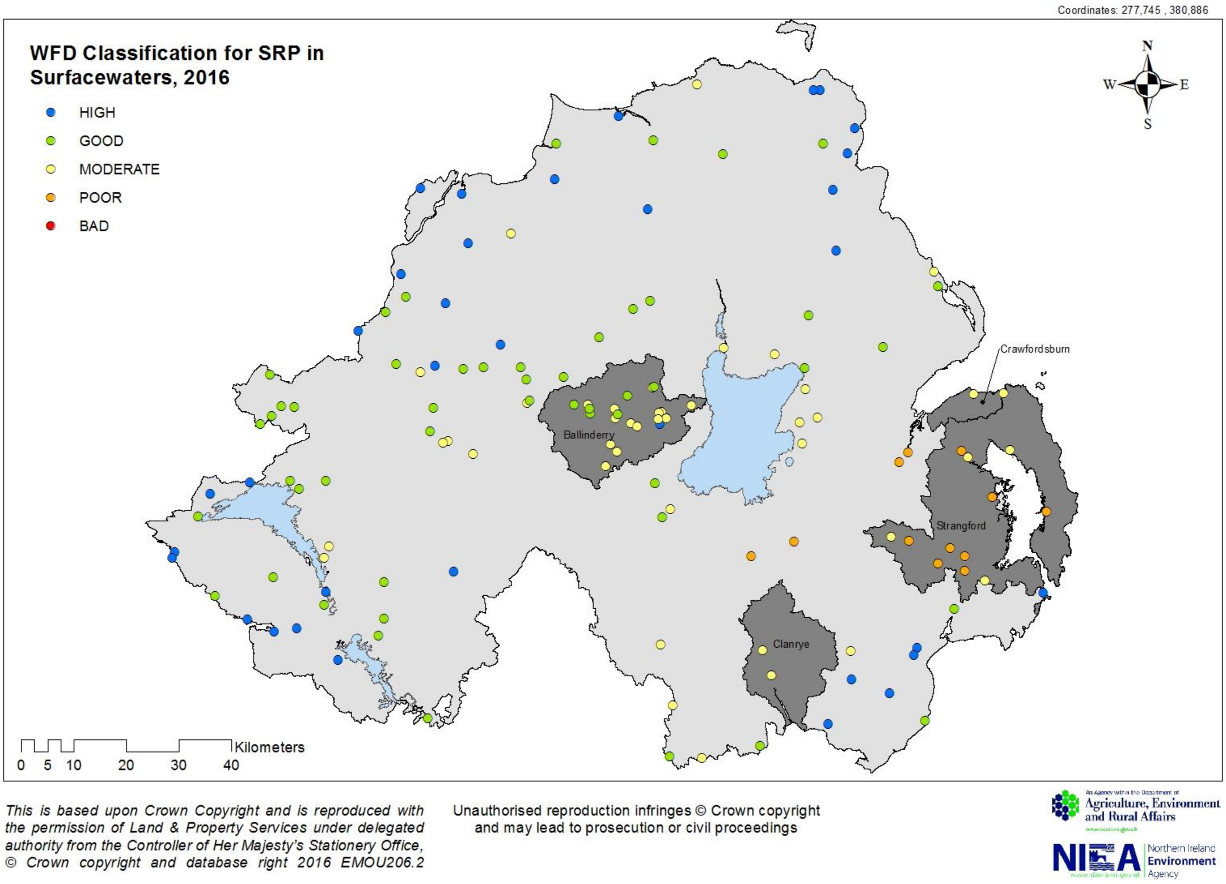


Figure 9: Distribution of WFD SRP status at surface freshwater stations in rivers and streams in 2016

The change in annual average SRP concentrations were historically reported in previous Derogation Reports according to Nitrates Directive guidance circulated in 2011. This identifies if a change is significant at ±50 µg/l, but this is a relatively coarse assessment. By also reporting the change in WFD SRP status using site specific standards, these will be more responsive to changes occurring and highlight any deterioration. This may be due to natural conditions as relatively small changes in SRP concentration can result in a change in class.

Trends in annual average SRP concentration shown in Table 9 and Figure 10 indicate a decline or stabilisation in SRP levels at 96.3% of common surface freshwater monitoring stations in rivers and streams between 2012-2015 and 2016 across Northern Ireland when assessed according to Nitrates Directive guidance. Some changes in concentrations did occur which led to changes in WFD status at individual sites (Table 10 and Figure 11). 20.6% (28 sites) deteriorated by one class for WFD SRP status. 77.2% (105 sites) remained stable in WFD SRP status and 2.2% (3 sites) exhibited an improvement in class between the two reporting periods for the high derogation catchments.

The two sites in the Clanrye and the one site in the Crawfordsburn catchment remained stable with Moderate WFD SRP status between the two reporting periods. 92.3% (12 sites) remained stable in the Strangford catchment whilst 7.7% (1 site) deteriorated by one class for WFD SRP status. 68.2% (15 sites) remained stable in the Ballinderry catchment whilst 31.8% (7 sites) deteriorated by one class for WFD SRP status. As previously highlighted, these results should be treated with a degree of caution as natural variation in nutrient concentration is expected year to year due to seasonal and climatic changes.

All monitoring stations showing higher concentrations of SRP or decline in WFD status for SRP will be subject to further investigations and actions as part of the relevant targeted catchment projects under WFD for each of the RBDs. This will include engagement with the sewerage undertaker, home owners and farmers in the local areas, to follow up actions arising from reported pollution incidents and improve water protection.

Further long term trend analysis of SRP data based on 374 common sampling points over the period 2008–2015 was recently undertaken for reporting under Article 10 of the Nitrates Directive. The majority (87.1%) of river sites experienced a decrease or stabilisation in SRP between the previous Article 10 reporting period (2008-2011) and the current reporting period (2012-2015). 12.8% of sites exhibited a weak increase in SRP between the two reporting periods. Longer term temporal trends of 165 sites[8] showed that average monthly SRP concentrations at river sites over a ten year period indicated a significant decrease. However, when comparing the last six years, no significant trend was indicated.

Table 9: Change in average soluble reactive phosphorus concentrations (based on % and number of common monitoring stations) of surface freshwater in rivers and streams across Northern Ireland and in the high derogation catchments, between 2012-2015 and 2016

[8] The non parametric Seasonal Mann Kendall Tau (SMK) test was used along with Theil- Sen test to determine trends and provided a measure of the overall trend of each of the 165 sites. 622 sites (minimum 6 years data as recommended by UKTAG) were analysed and of these, 165 sites passed secondary quality screening.

Difference in average Soluble Reactive Phosphorus concentration (µg NO_3/l) 2012-2015 – 2016	% and number of common monitoring stations		
	Decrease[1]	**Stable[2]**	**Increase[3]**
Northern Ireland (136 Stations)	0	96.3% (131)	3.7% (5)
Ballinderry Catchment (22 Stations)	0	100% (22)	0
Strangford Catchment (13 Stations)	0	69.2% (9)	30.8% (4)
Clanrye Catchment (2Stations)	0	100% (2)	0
Crawfordsburn Catchment (1 Stations)	0	100% (1)	0

Difference is assessed by change in concentration – [1]Decrease ≤ -50 µg/l, [2]Stable -50 to +50 µg/l, [3]Increase ≥ +50 µg/l

Table 10: Change in WFD SRP classification (based on % and number of common monitoring stations) of surface freshwater in rivers and streams across Northern Ireland and in the high derogation catchments, between 2012-2015 and 2016

WFD SRP Classification (n=136)	% and number of common monitoring stations				
	Strong Decrease[1]	**Weak Decrease[2]**	**Stable[3]**	**Weak Increase[4]**	**Strong Increase[5]**
Northern Ireland (136 Stations)	0	2.2% (3)	77.2% (105)	20.6% (28)	0
Ballinderry Catchment (22 Stations)	0	0	68.2% (15)	31.8% (7)	0
Strangford Catchment (13 Stations)	0	0	92.3% (12)	7.7% (1)	0
Clanrye Catchment (2 Stations)	0	0	100% (2)	0	0
Crawfordsburn Catchment (1 Station)	0	0	100% (1)	0	0

[1] Strong Decrease = ≥2 improvements in class
[2] Weak Decrease = 1 improvement in class
[3] Stable = No change in class
[4] Weak Increase = 1 deterioration in class
[5] Strong Increase = ≥2 deteriorations in class

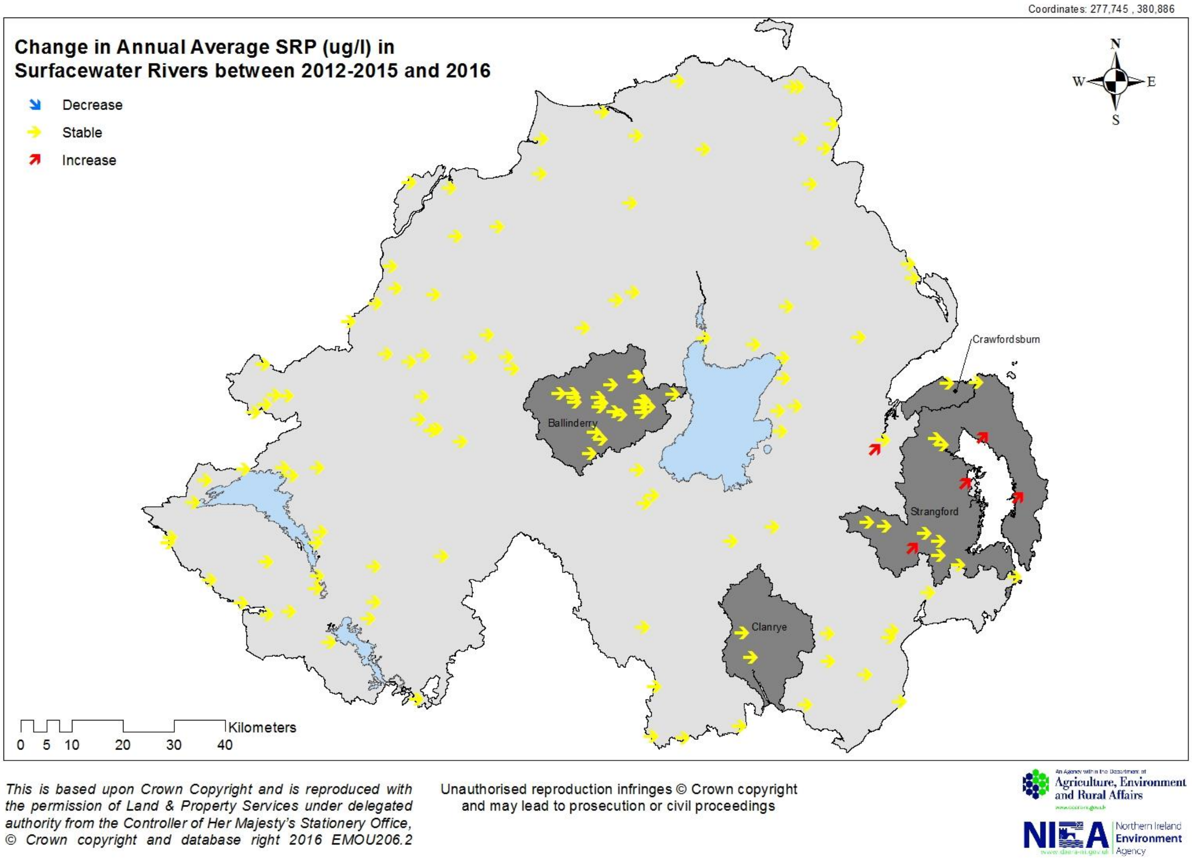


Figure 10: Change in SRP concentrations in surface water between 2012-2015 and 2016 when assessed according to Nitrates Directive guidance.

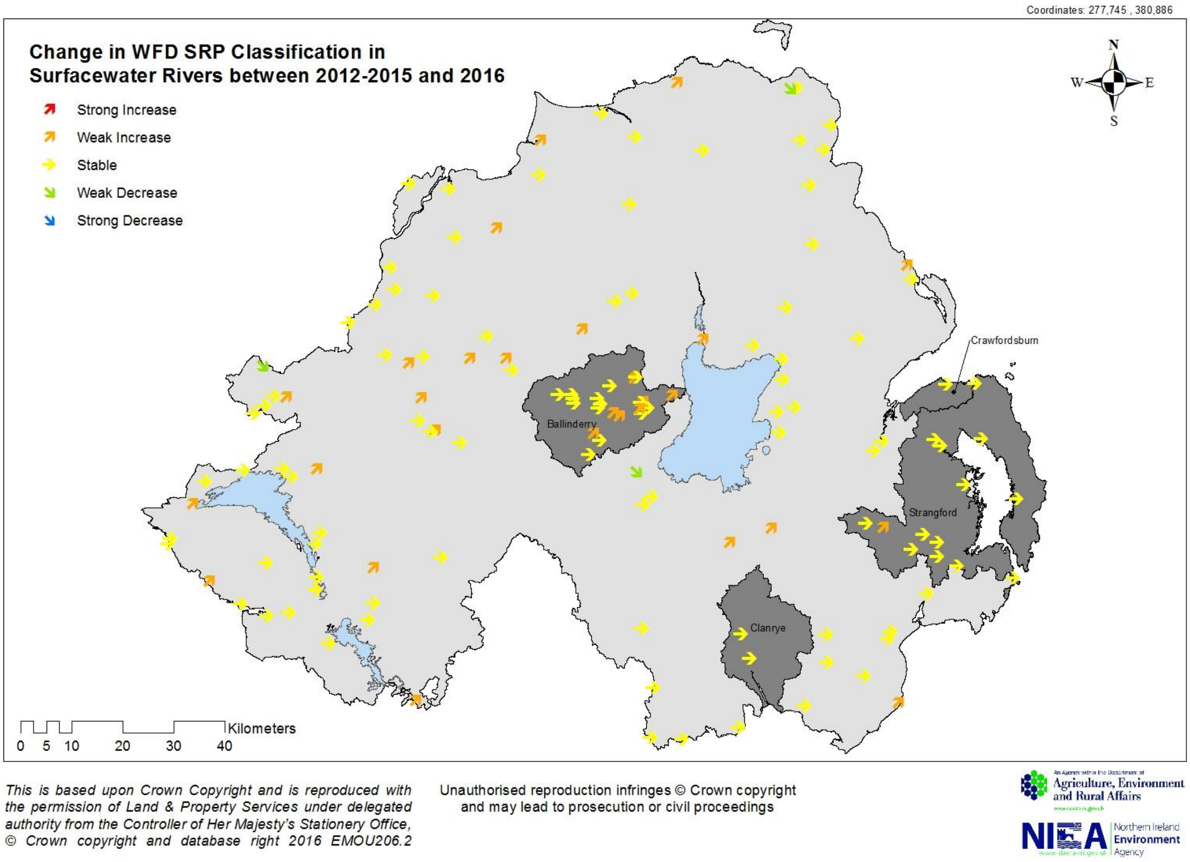


Figure 11: Change in WFD SRP classification in river monitoring sites between 2012-2015 and 2016

In this report, both the assessments using Nitrates Directive and WFD criteria show deterioration as indicated by the percentage of sites that are exhibiting increasing SRP levels. This is a cause for concern therefore, DAERA has included an SRP indicator for Water Quality in the proposed Programme for Government (PfG). The SRP indicator used is the annual average SRP (µg/L) for 93 surveillance river sites and is not a WFD status assessment. For PfG it is required that a threshold for change is set and an appropriate level for the threshold is currently under discussion.

3.4 Eutrophic indicators - phosphorus concentrations in lakes

For the purposes of this report total phosphorus (TP) is considered on its own as a eutrophication indicator and without the supporting data on chlorophyll-α and biology normally required to classify under the WFD.

In the WFD classification period 2012-2014, NIEA monitored annual TP concentrations at 21 WFD lake and reservoir monitoring stations (Lower Lough Erne is divided into two water bodies) across Northern Ireland, with a surface area greater than 50 ha (known as surveillance lakes). In 2016, the same 21 lake and reservoir monitoring stations were monitored. The annual average TP concentration for the 21 common surveillance stations was 65 µg TP/l for the period 2012-2014 and 76 µg TP/l for 2016.

Table 11 and Figure 12 show that in 2016, seven lakes and reservoirs were classed as High or Good WFD status whilst fourteen were classed as Moderate, Poor or Bad WFD status, indicative of nutrient enrichment. Although no lakes showed any improvement in class between the two reporting periods (2012-14 and 2016), seventeen lakes remained stable for WFD TP status. Two lakes (Lough Neagh and Portmore Lough) were classed as Bad WFD TP status in both reporting periods.

Four lakes exhibited deterioration by one class in TP status between the two reporting periods. Castlehume Lough deteriorated from High to Good, Lough Melvin deteriorated from Good to Moderate, Lower Lough Erne at Kesh deteriorated from Good to Moderate and Lower Lough Erne at Devenish deteriorated from Moderate to Poor TP status. Clea Lakes (Poor status in both reporting periods) is the only lake in a derogated catchment (Strangford). All lakes exhibiting eutrophic conditions will be subject to further investigations and actions as part of the relevant RBD programme of targeted catchment projects under WFD.

Table 11: WFD status based on average total phosphorus (TP) concentrations (based on number of common monitoring stations) of WFD surveillance lakes and reservoirs across Northern Ireland, 2012-2014 and 2016

WFD TP Class	Northern Ireland	
	2012-2014 (21 stations)	2016 (21 stations)
High	5	4
Good	4	3
Moderate	3	4
Poor	7	8
Bad	2	2

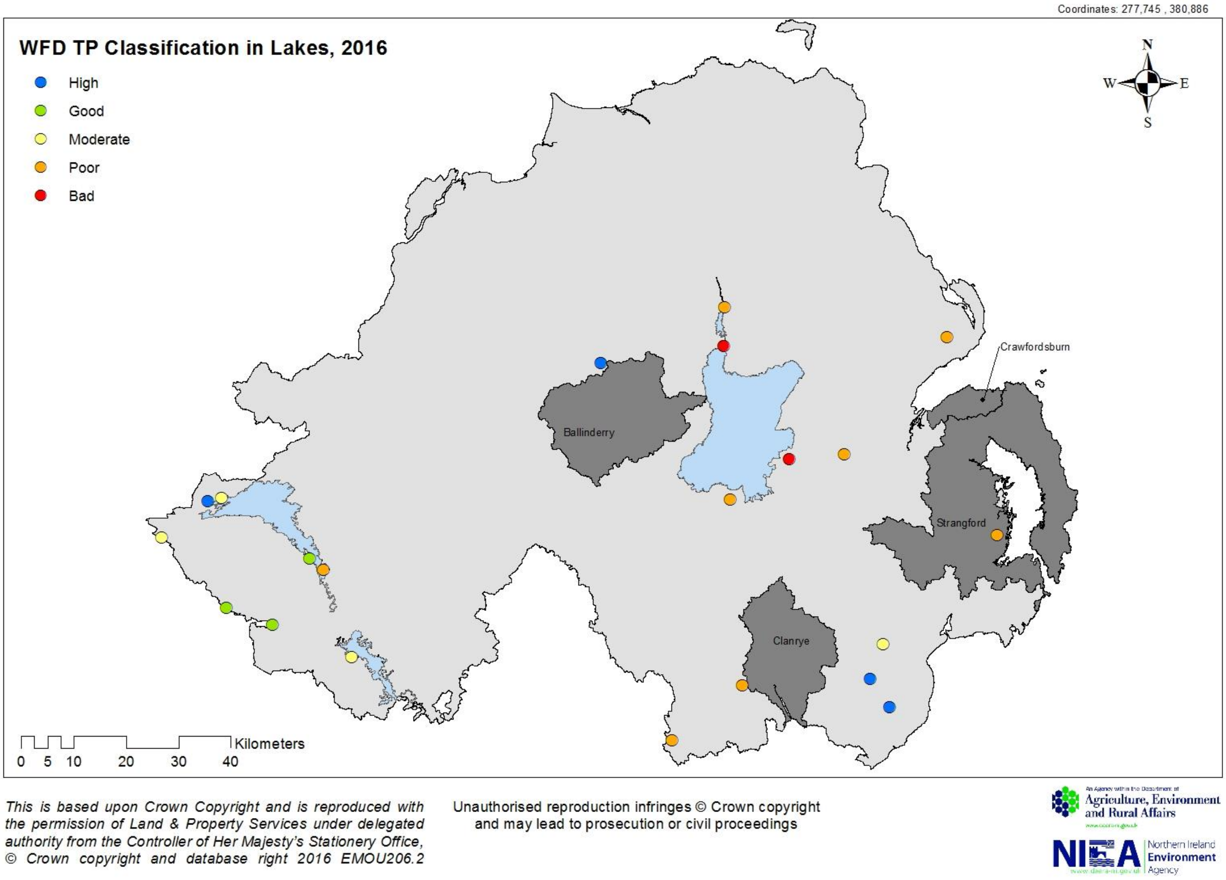


Figure 12: Distribution of WFD TP status in surveillance lakes and reservoirs in 2016

4. SOIL MONITORING

To meet the requirements of Article 8(2) of the 2015 Derogation Decision, a detailed monitoring program has been established. It will provide relevant soil P data for modelling P losses from derogated and non-derogated farms on the main soil types of Northern Ireland and information on farming practices etc on derogated and non-derogated farms. A pair of sub-catchments has been identified in the Upper Bann River Catchment (Figure 13). One sub-catchment has a significant proportion of derogated farmland (120 out of 329 fields are on derogated farms) and the other has no derogated farmland (Figure 14). In accordance with Article 8(2) of the 2015 Derogation Decision, the most important soil profile types in Northern Ireland, i.e. Gleys (57%), and also the most important Hydrology of Soil Types (HOST) classes (17-24) particularly 24, i.e. soils developed on slowly permeable material (54%), are well represented within this pair of sub-catchments. The requirement to monitor soils on farms with *“levels of intensity and fertilisation practices”* typical for Northern Ireland has also been fulfilled by having two contrasting small sub-catchments with either some or no derogated farmland.

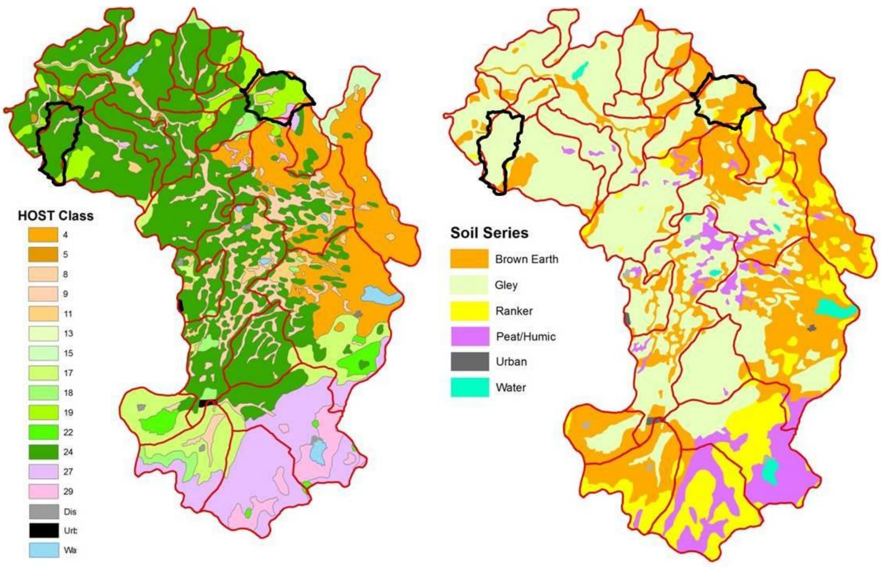


Figure 13 Maps of the Upper Bann River Catchment indicating soil types and Hydrology of Soil Types (HOST) classifications present in selected pairs of derogated and non-derogated sub-catchments.

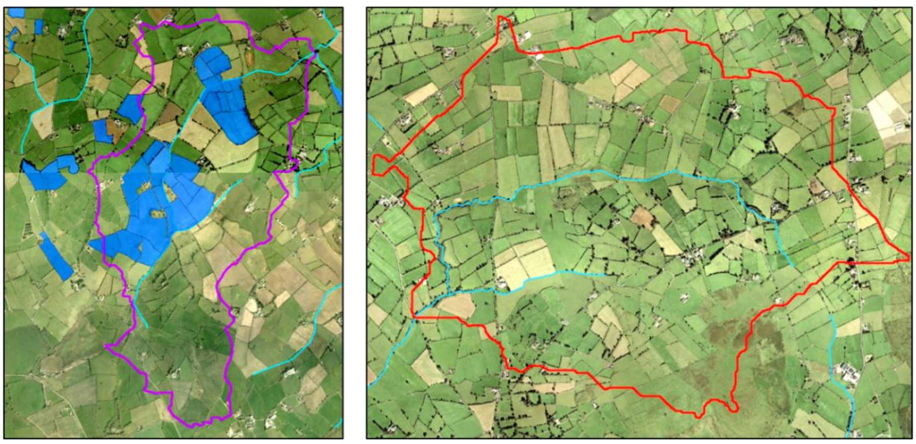


Figure 14 ‘Derogated’ (UB03) and Non-derogated (UB15) sub-catchments in the Upper Bann (UB) catchment with derogated farmland coloured blue.

Soil sampling in both catchments commenced in November 2016. In total 945 fields were identified for sampling (including land outside the catchment boundary) of which 884 were sampled up to February 2017. Remaining farms will be approached again in autumn 2017 with a view to achieving 100% coverage for reporting in June 2018, covering the 2017-2018 derogation period.

4.1 Nitrogen and Phosphorus concentrations in soil water under derogated and non-derogated conditions

Article 8(2) of the 2015 Derogation Decision requires assessments to be made of N and P concentrations in soil water, to facilitate model-based estimates of nitrate and P losses from farms benefiting from derogation. However, these assessments are not considered to be appropriate in grassland situations in Northern Ireland for the following reasons.

The procedures for measuring N (*nitrate and ammonium*) and P (*SRP and total P*) concentrations in soil water (*solution*) are both difficult and problematic necessitating either vacuum plate extraction of soil solutions from individual intact soil cores, or the installation of ceramic suction cups in soil profiles to collect soil water/solution samples in situ. In commercial farming situations the ceramic cup apparatus can easily be damaged by farm machinery or livestock.

Furthermore, obtaining representative samples of soil solution is difficult because of preferential flow pathways which form along root channels or crevices allowing some downward flowing water to bypass the samplers (Ryan *et al*., 2006). An additional difficulty is the fact that the soil water samples collected by either technique are point-specific, since they are taken from single points within a field. Consequently, to allow for the high degree of spatial heterogeneity in N and P concentrations across grassland fields (Cuttle *et al*., 2001; McCormick *et al*, 2009), scores of points would have to be sampled, and this would simply not be cost-effective or practicable.

Temporal heterogeneity is also a problem, as nutrient levels in soil solution are subject to appreciable short-term fluctuations, owing to rainfall dilution etc (Magid & Neilsen, 1992). Assessments of N and P concentrations in soil water therefore, do not provide a basis for predicting mean annual N and P losses to water at field and farm scales on grassland farms in Northern Ireland.

The factor most responsible for ‘poor’ water quality in Northern Ireland is P mobilisation from farmland into freshwater ecosystems and the resultant upsurge in algal growth in this P-limited rather than N-limited environment (Parr & Smith, 1976; Gibson & Stevens, 1979).

Consequently, to assess the impact of derogation on water quality, primary emphasis will be placed on quantifying the risk of P loss, rather than N loss, from farmland. In this regard, researchers in New Zealand have demonstrated that soil Olsen-P, in fields receiving nutrient inputs, is significantly correlated with both dissolved reactive phosphorus

(DRP) and total P concentrations in overland flow from grassland sites on a broad range of soil types (McDowell *et al*., 2003).

Importantly, this soil parameter (*Olsen-P*) can be measured on bulked subsamples of soil (*0-75 mm depth*) easily collected from multiple locations across whole fields, as opposed to the single point locations associated with measurements of soil water P concentrations, thus minimising problems owing to spatial heterogeneity in soil P, as noted above. Moreover, Olsen-P assessments appear to be temporally quite stable (Shi *et al*., 2002).

In addition, the bulked soil samples could also be analysed for $CaCl_2$- P, which can provide a proxy estimate of DRP concentration in soil sub-surface flow (McDowell *et al*., 2003). These complementary soil P assessments, together with information and data on soil hydrology and connectivity, and on farm nutrient management practices, will then be used to model and compare P losses from derogated and non-derogated farms.

N is rarely limiting to algal growth in freshwater bodies in Northern Ireland (Parr & Smith, 1976; Gibson & Stevens, 1979) Mean nitrate concentrations in surface and ground waters are generally low and in almost all cases are well below the EU maximum admissible limit for drinking water (Northern Ireland NAP Review Report 2014). Modelling N losses from derogated farmland is still important to ensure that derogation measures are effective in preventing any deterioration in water quality attributable to N losses linked to farming.

As outlined above, soil N assessments are both problematic and poorly related to N loss by leaching or runoff from grassland. Therefore, information and data on soil type, soil hydrology and connectivity, and details of farming practices will be used to model and compare N losses from derogated and non-derogated farms.

In summary, soil Olsen-P and $CaCl_2$-P concentrations are being monitored in soils instead of P concentrations in soil water. In the absence of suitable soil N metrics, model estimates of nitrate loss from farms will be based primarily on soil typology and hydrology plus local climatic and farm management information.

Results from the first phase of soil sampling in the catchments have been used to map soil chemistry within both sub-catchments (Figure 15). Although 884 fields in total were sampled, the total numbers of sampled fields within the catchment boundaries are 169 in the derogated and 324 in the non-derogated catchments, and it is these (n=493) which are the focus of this analysis.

Field characteristics differ between catchments with larger field sizes in the derogated catchment (41 % > 2 ha in area) compared to the non-derogated catchment (9 % > 2 ha in area). This may reflect more intensive agriculture which has, over time, led to enlargement and merging of smaller fields in the derogated catchment, but also the difference in elevation and topography between catchments (Derogated Elevation Range: 80 - 170m; Non-Derogated Elevation Range: 125 – 310 m).

The distribution of soil P between catchments differs considerably (Figure 16). The majority of fields, 79%, in the derogated catchment are at index 3 or above, compared to 43% of fields in the non-derogated catchment. The number of fields with excessively high soil P is greater in the non-derogated catchment with 4.9% of fields (n=16) in excess of Index 4, compared to 1.2% of fields (n=2) in the derogated catchment. A full assessment will require the farm nutrient budgets to be completed (autumn 2017). The differences may indicate better nutrient management practices and soil testing on some farms in the derogated catchment, where better control of nutrient applications to crop requirements may be preventing over enrichment of particular fields.

The higher numbers of highly P-enriched fields (Index 5, 6 &7) in the non-derogated catchment (c.f. the derogated catchment), especially in proximity to farmyards, may indicate that ease of manure transport to particular fields is a stronger determinant of nutrient loading. The more extensive nature of agriculture in the non-derogated catchment is reflected however, by the proportion of fields lower than Index 3 (45.9%) compared to the equivalent proportion in the derogated catchment (18.9%).

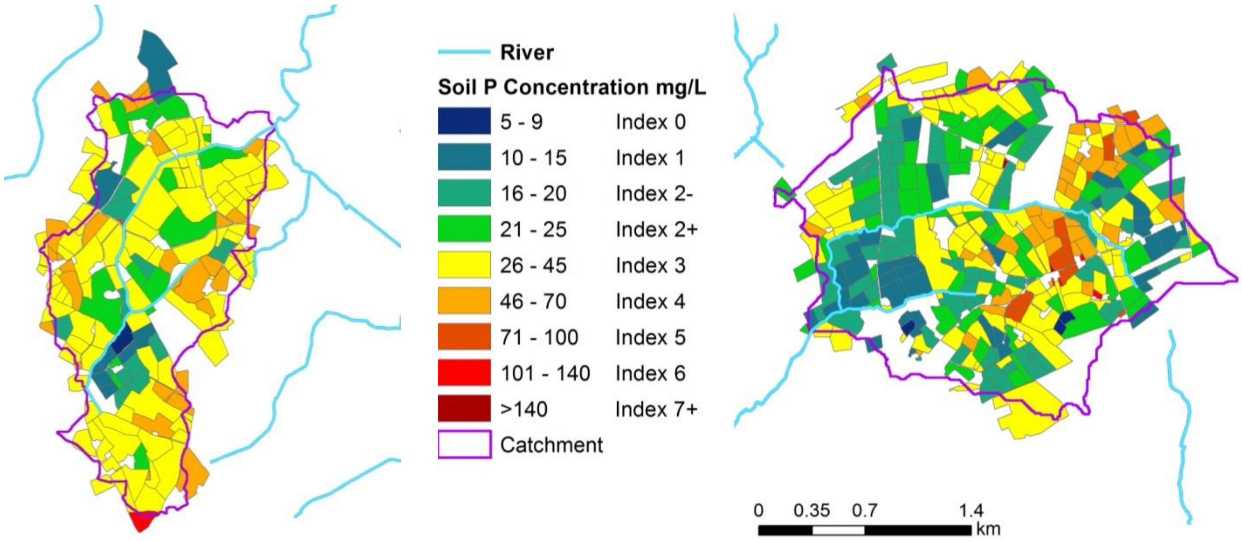


Figure 15 Soil P concentrations for the ‘Derogated’ (left) and ‘Non-derogated’ (right) sub-catchments in the Upper Bann catchment. Blank areas within the catchment boundaries were not included in the 2016/17 sampling programme.

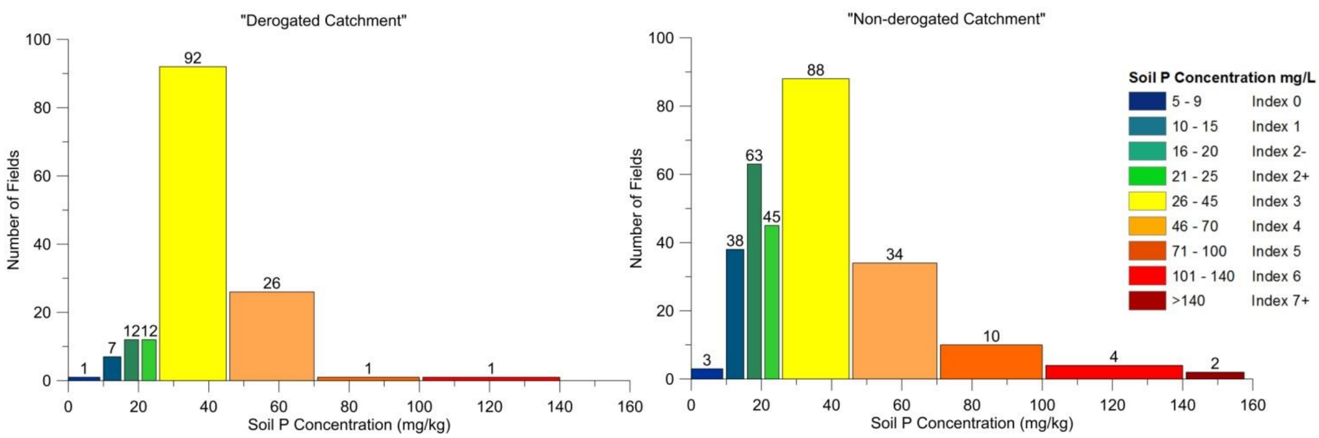


Figure 16 Histograms of P Index category for the ‘Derogated’ (n=169 fields) and ‘Non-derogated’ (n=324 fields) sub-catchments in the Upper Bann (UB) catchment.

References

Cuttle, S.P., Scurlock, R.V. & Davies, B.M.S. (2001). Comparison of fertilizer strategies for reducing nitrate leaching from grazed grassland, with particular reference to the contribution from urine patches. *Journal of Agricultural Science*, **136**: 221-230.

Gibson, C.E. & Stevens, R.J. (1979). Changes in Phytoplankton Physiology and Morphology in response to dissolved nutrients in Lough Neagh, Northern Ireland. *Freshwater Biology*, **9**: 105-109.

Magid, J. & Nielsen, N.E. (1992). Seasonal variation in organic and inorganic phosphorus fractions of temperate-climate sandy soils. *Plant and Soil*, **144**: 155-165.

McCormick, S., Jordan, C. & Bailey, J.S. (2009). Within and between-field spatial variability in soil phosphorus levels within a permanent grassland area. *Precision Agriculture*, **10**: 262-276.

McDowell, R.W., Monaghan, R.M. & Morton, J. (2003). Soil phosphorus concentrations to minimise potential P loss to surface waters in Southland. *New Zealand Journal of Agricultural Research*, **46**: 239-253.

NAP Review Report (2014). Review of 2011-2014 Action Programme for the Nitrates Directive in Northern Ireland and associated regulations. Accessed at: www.daera-ni.gov.uk/sites/default/files/publications/daera/ni-nap-review-report-2014.PDF

Parr, M.P. & Smith, R.V. (1976). The identification of phosphorus as a growth limiting nutrient in Lough Neagh using bioassays. *Water Research*, **10**: 1151-1154.

Ryan, M., Brophy, C.,Connolly, J., McNamara, K. & Carton, O.T. (2006). Monitoring of nitrogen leaching on a dairy farm during four drainage seasons. *Irish Journal of Agricultural and Food Research*, **45**: 115-134.

Shi, Z., Wang, K., Bailey, J.S., Jordan, C. & Higgins, A.J. (2002). Temporal Changes in the Spatial Distribution of some Soil Properties on a Temperate Grassland Site. *Soil Use and Management*, **18**:353-362.

4.2 Mineral nitrogen (N) in soil profile under derogated and non-derogated conditions

As indicated above, soil sampling and analysis commenced in the autumn of 2016, as part of the sampling programme. However, measurements of mineral N are not being made, but rather estimates of nitrate loss from farms will be modelled based on soil typology and hydrology plus local climatic and farm management information. Due to difficulties in the initial recruitment of farmers to the project there has been a delay in acquiring all the necessary data for modelling. This information is expected to be collected by autumn 2017 to allow modelling to proceed. It is anticipated that full results from modelling of potential for nitrate loss from derogated land will be available to report in June 2018.

Assessments of mineral N in soil profiles, which involve the collection of deep soil cores (*up to 900 mm depth*), each of which is separately analysed for mineral N, and the periodic soil N assessments to be made on derogated farms as specified in Article 5(6) of the 2015 Derogation Decision, are not appropriate for predicting N losses to water from grassland in Northern Ireland for the following reasons:-

a) They provide only a snap-shot in time of the amounts of mineral N present in soil, and it is known that mineral N pools fluctuate appreciably over time owing to a number of competing loss processes, and not just nitrate leaching/runoff. Lysimeter studies in Northern Ireland at the Hillsborough farm research site show that when chemical N inputs to grassland exceed 300 kg N ha^{-1} yr^{-1}, losses of nitrate from soil significantly exceed the amounts released into ground or drainage waters almost certainly because of gaseous (denitrification) N losses (Mills, 1997), which can be substantial (*i.e. > 70 kg N* ha^{-1}) on NI grassland (Jordan, 1989). It is also worth noting that researchers in Ireland failed to find any relationship between mineral N concentrations in grassland soils and nitrate concentrations in ground waters (Humphrey's *et al*., 2008).

b) Because soil cores (*0-900 mm*) taken to assess mineral N in soil profiles are collected at single points within fields, the N values obtained are point-specific. Consequently, large numbers of cores would need to be collected and analysed to accommodate the high degree of spatial heterogeneity in soil mineral N supply and formation (Murphy *et al*., 2013) across fields, particularly in grazing situations (Cuttle *et al*., 2001; Hutchings *et al*., 2007), but also under cutting management (Bailey *et al*., 2001) This would not be cost-effective or practicable.

Therefore, model estimates of nitrate loss from farms will be made based on soil typology and hydrology plus local climatic and farm management information instead of mineral N assessments in soil profiles.

References

Bailey, J.S., Wang, K., Jordan, C. & Higgins, A.J. (2001). Use of Precision Agriculture Technology to Investigate Spatial Variability in Nitrogen Yields in Cut Grassland. *Chemosphere*, **42**:131-140.

Cuttle, S.P., Scurlock, R.V. & Davies, B.M.S. (2001). Comparison of fertilizer strategies for reducing nitrate leaching from grazed grassland, with particular reference to the contribution from urine patches. *Journal of Agricultural Science*, **136**: 221-230.

Hutchings, N.J., Olesen, J.E., Petersen, B.M. & Berntsen, J. (2007). Modelling spatial heterogeneity in grazed grassland and its effects on nitrogen cycling and greenhouse gas emissions. *Agriculture, Ecosystems & Environment*, **121**: 153-163.

Humphreys, J., Casey, I.A., Darmody, P., O'Connell, K.O., Fenton, O. & Watson, C.J. (2008). Quantities of mineral N in soil and concentrations of nitrate-N in groundwater in four grassland-based systems of dairy production on a clay-loam soil in a moist temperate climate. *Grass and Forage Science*, **63**: 481-494.

Jordan, C., 1989. The effect of fertiliser type and application rate on denitrification losses from cut grassland in Northern Ireland. *Fertiliser Research*, **19**: 45–55.

Mills, C.L. (1997). *The Nutrient Economy of Grazed Grassland*. PhD thesis, Faculty of Agriculture and Food Science, The Queens University of Belfast.

Murphy, P.C.N., O'Connell, K., Watson, S., Watson, C.J. & Humphreys, J. (2013). Seasonality of nitrogen uptake, apparent recovery of fertiliser nitrogen and background supply in two Irish grassland soils. *Irish Journal of Agricultural & Food Research*, **52**, 17-38.

5. REINFORCED WATER MONITORING

5.1 Summary of results from reinforced water monitoring in agricultural catchments in proximity to most vulnerable water bodies

Renewed monitoring was re-established in August 2016 for the Colebrooke and Upper Bann catchments following a gap from 2014. Preliminary results for the period August 2016 – May 2017 are available for reporting. However, this period does not cover a hydrological year. From October 2017 onward, the results for each complete hydrological year will be reported annually.

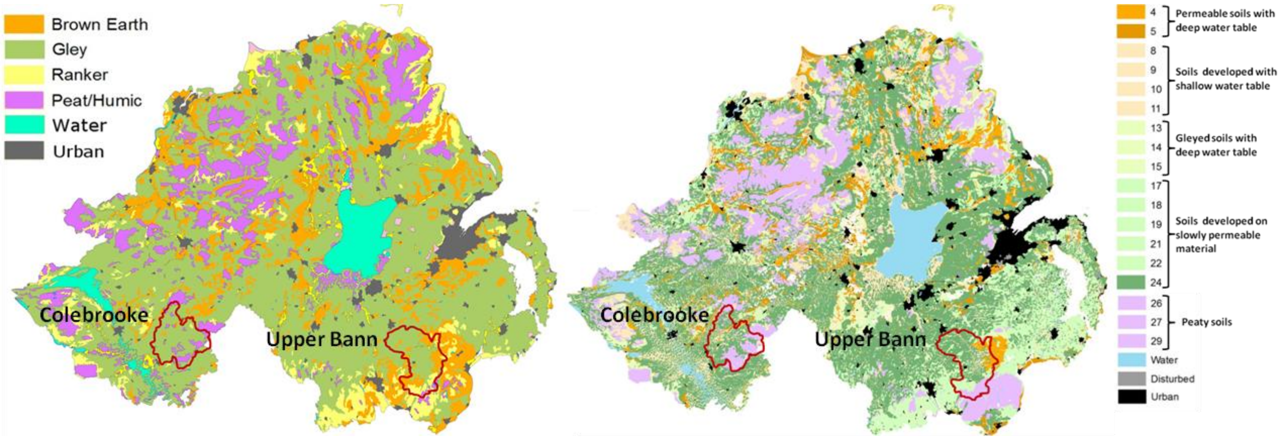


Figure 17 (a) General soil profile types in NI, and **(b)** General Hydrology of Soil Types (HOST) classes in NI

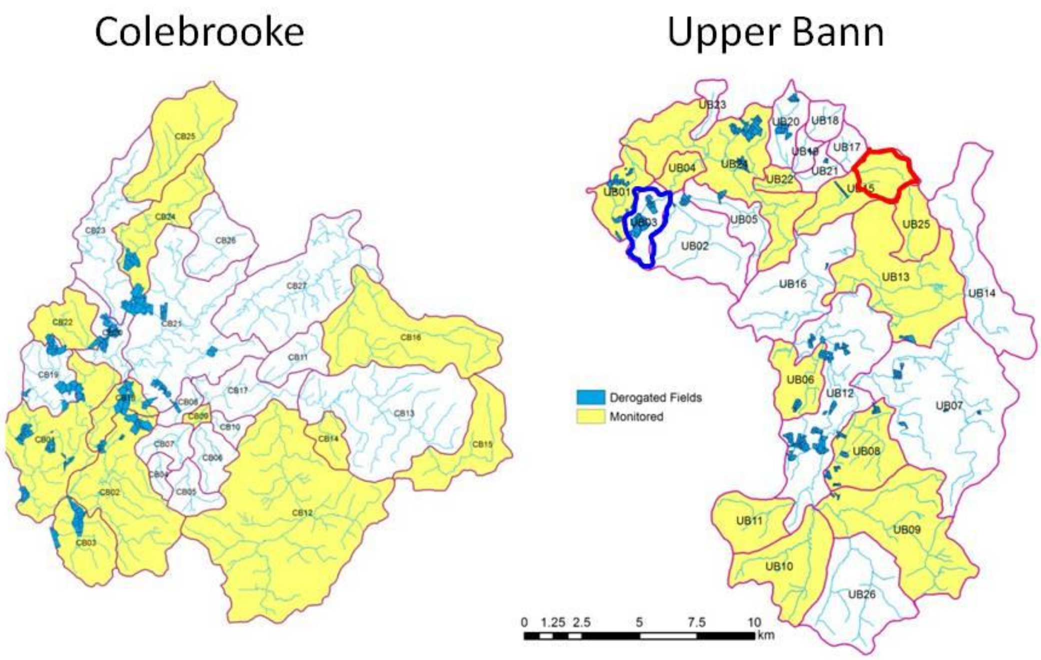


Figure 18 Colebrooke and Upper-Bann Catchments showing locations of sub-catchments (in yellow) for renewed water chemistry monitoring, locations of derogated fields (in blue), and also the locations of 'small' 'derogated' (blue outline) and non-derogated sub-catchments (red outline) for comprehensive monitoring of surface waters, ground waters, soils and nutrient inputs-outputs.

The new amplified program of nutrient monitoring commenced in August 2016 in 24 previously monitored sub-catchments in the Upper Bann and Colebrooke; 12 sub-catchments in each catchment (Figure 18). To this bi-monthly monitoring round an additional 2 catchments were included in the Upper Bann; one (UB03) representing a derogated catchment and the other (UB15a) a non-derogated catchment. Water quality data from these 26 sites will provide evidence for current and subsequent annual derogation reports under Article 8(3) and Article 10(4) of the 2015 Derogation Decision.

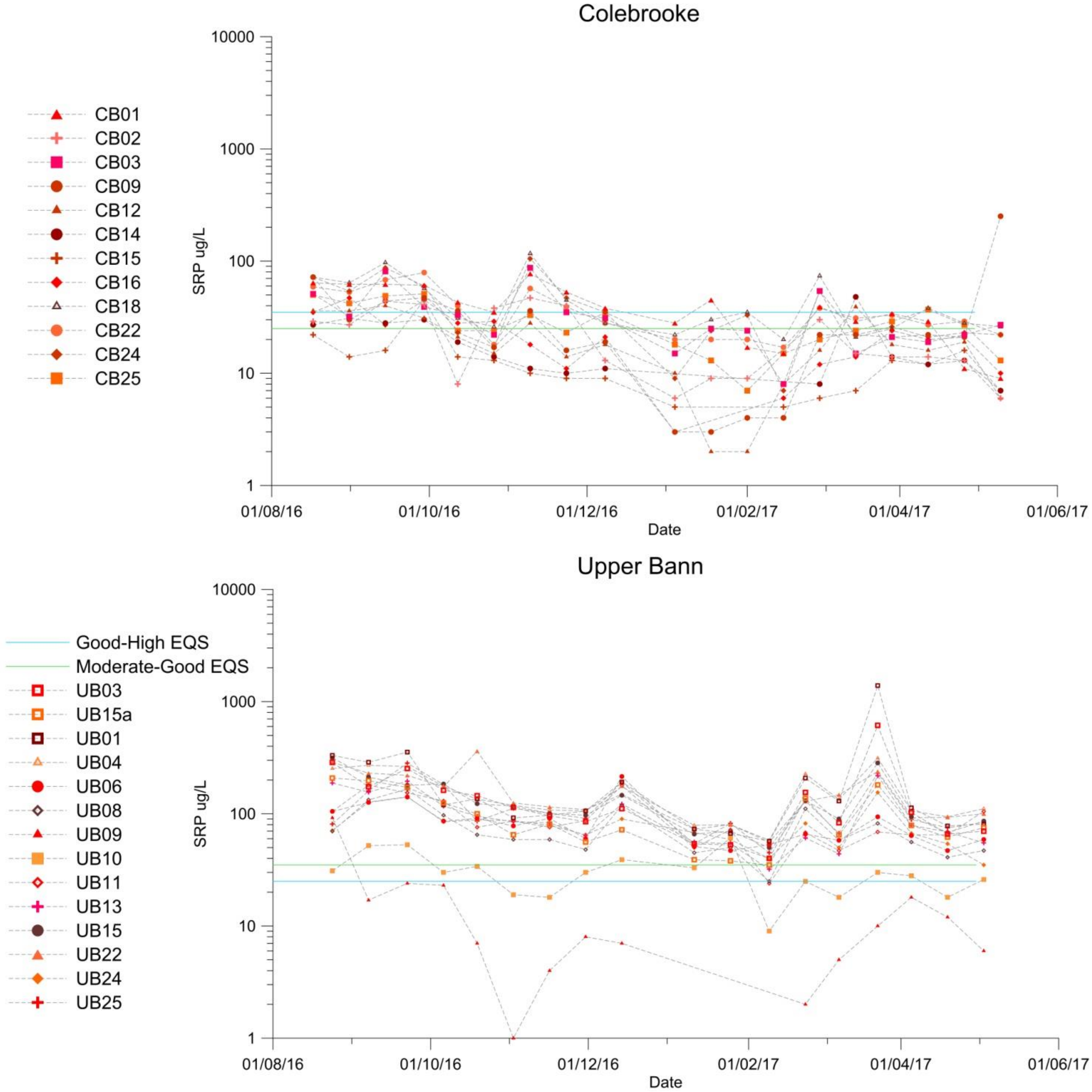


Figure 19: Concentration time series for bi-monthly sampling of SRP in the Colebrooke (top) and Upper Bann (bottom) catchments. Environmental Quality Standards for high and good status waterbodies are indicated.

Although not covering a full hydrological year, results to date are indicative of the difference in land use and nutrient pressures between the Colebrooke and Upper Bann catchments as a whole (Figure 19). Of the 14 sub-catchments monitored in Upper Bann on a bi-monthly basis, only 2 catchments (in the Mourne headwaters) have median SRP concentrations lower than the Good-Moderate Environmental Quality Standard (G-M EQS) (0.035 mg/L) for freshwaters. Of the remaining 12 catchments, including the derogated and non-derogated study catchments, 8 exceeded the G-M EQS on all sampling occasions and 4 had lower concentrations on only one sampling instance over the August – May monitoring period.

By contrast, in the Colebrooke catchment median concentrations are below the G-M EQS for all but one catchment and concentration time series vary more among sub-catchments than in the Upper Bann. Further examination of land use and farming intensity in these catchments will be needed to disentangle these relationships further.

The revised program aims to address limitations with respect to resolution and precision evident in the 2009-2014 sampling program. The bi-monthly sampling in this period failed to produce consistent evidence of increases or decreases in N and P concentrations in rivers either annually or seasonally thus limiting our ability to assess the efficacy of derogation measures.

In assessing changes in P loss from headwater catchments Bieroza *et al*. (2014) and Burt *et al*. (2011) argued that discrete sampling programmes (*fortnightly to monthly resolution*) would be able to detect long term trends (>10 years). Identification of significant shorter term changes would require high frequency monitoring of stream P concentrations (*sub-hourly continuous/hydrological event sampling resolution*).

Declines in N and P concentrations in streams in the Colebrooke and Upper Bann catchments between 1990 and 2009, largely as a result of controls on agricultural point source pollution, were sufficiently pronounced that statistically significant trends were evident. In contrast, between 2009 and 2014 the rates of decline in N and P concentrations were much smaller and hence more difficult to detect at fortnightly sampling intervals.

Therefore, in the new program, bi-monthly sampling will be supplemented with targeted storm flow event sampling, commencing in autumn 2017. Event sampling will capture periods when diffuse losses are dominant and counter the bias of routine grab sampling towards low flows in which point source signatures are more prevalent, particularly in the ‘flashy’ hydrological regimes in Irish rivers.

In the additional contrasting derogated and non-derogated sub-catchments (*UB3 and UB15a)* in the Upper Bann, both routine grab sampling and storm flow event sampling will be conducted once installation of fixed monitoring infrastructure is completed in both. This installation, due to be completed in July 2017, will allow continuous discharge and basic water quality monitoring (pH, conductivity, temperature, DO and turbidity) at both sites which will be supplemented by more intensive sampling.

In one site a near-continuous phosphate analyser will also be trialled with the possibility of extending to other catchments if proven successful. This will be initiated in July 2017. This high resolution data will ‘fill the gap’ in existing monitoring and allow the differences in load and nutrient export at differing resolutions to be assessed. To date, the monitoring programme includes both catchments in the bi-monthly scheme and these preliminary results are available for comparison, though with caveats based on the low frequency of sampling.

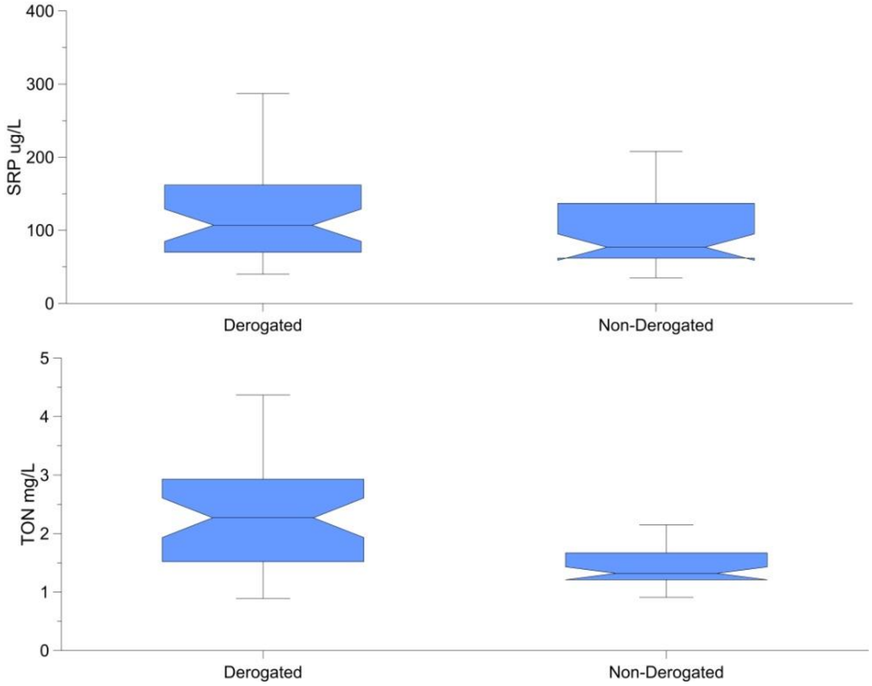


Figure 20: Notched box-whisker plots of SRP and TON for the derogated and non-derogated catchment, showing the medians, 25th and 75th percentiles and interquartile range.

A preliminary comparison of SRP between the derogated and non-derogated catchment (Figure 20) shows no significant difference in terms of concentration (where an overlap of the notches indicates that the medians are not significantly different). For TON there is a difference, with higher concentrations in the derogated catchment. An additional t-test supported this with no significant difference for SRP ($t=2.07$, $P=0.053$, $df=17$) and a significant difference for TON ($t=4.52$, $P=0.0002$, $df=17$).

Until a full hydrological year of data has been acquired and higher resolution sampling has been initiated to capture diffuse transfers during storm events, a definitive assessment of nutrient loads cannot be made. Furthermore, links between water quality and soil nutrient status will require the farm nutrient budgets to be completed and additional data collection.

Groundwater monitoring is a key requirement under Article 8 of the 2015 Derogation Decision for Northern Ireland, and is currently carried out by NIEA. Currently, NIEA are monitoring one borehole in the Colebrooke catchment and one in the Upper Bann catchment. To increase spatial resolution and focus on potential agricultural impacts on groundwater status, a baseline survey was undertaken in the autumn of 2016-spring 2017 to identify wells and springs suitable for sampling. As the survey found only 2 sources within the non-derogated catchment and 5 in the derogated catchment, the survey was extended to include another 6 sites just outside the catchment boundaries belonging to farmers who have land in the catchments.

Of the 13 boreholes/wells recorded (Figure 21) 9 are in current use while the rest are no longer used. Of the wells in use one provides a supply for domestic use; the rest are used for livestock drinking water, yard washing and milk cooling. Three wells had previously been tested for quality by the farmers.

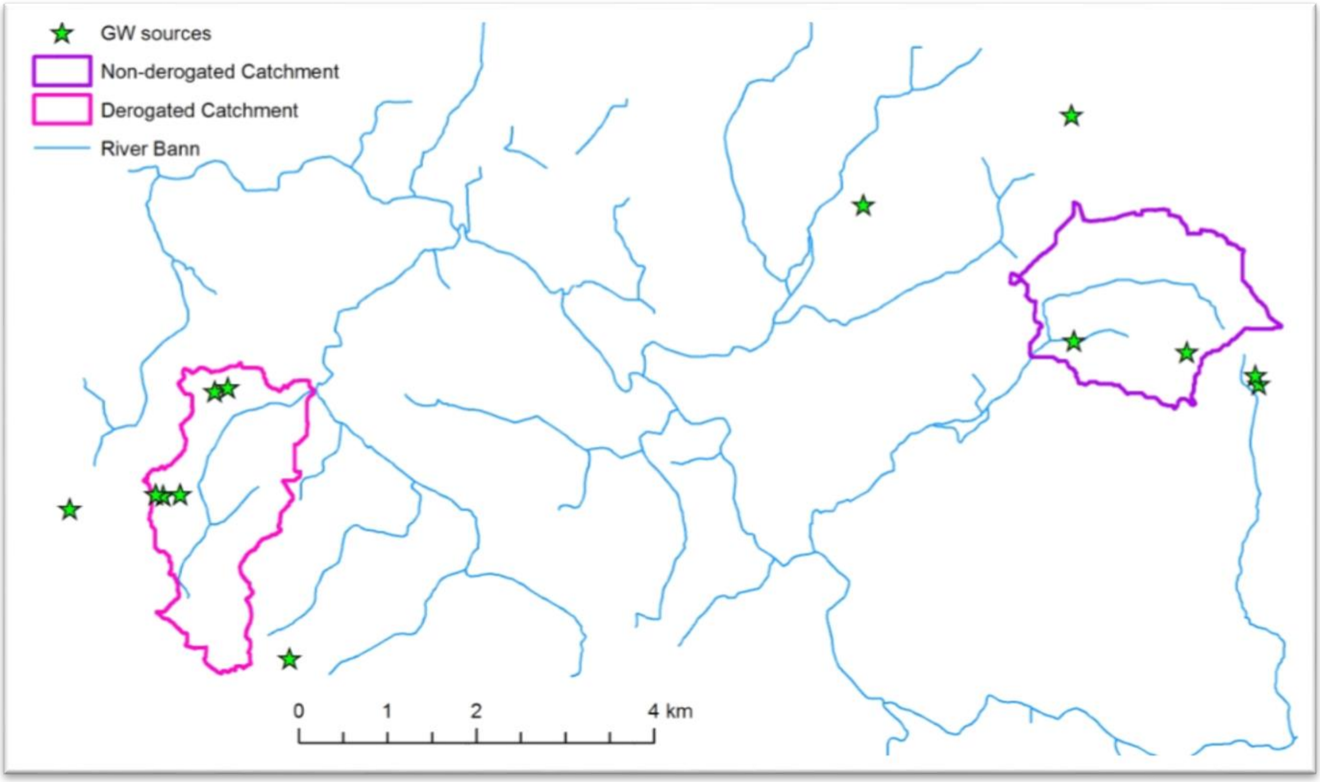


Figure 21: Locations of the initial groundwater sampling wells, springs and boreholes

Table 12: Summary results from the initial groundwater monitoring round of the Upper Bann derogated and non-derogated catchments. Some chemical parameters are still under analysis.

	All Samples (n=13)			Derogated Samples (n=7)			Non-Derogated Samples (n=6)		
	Median	Min	Max	Median	Min	Max	Median	Min	Max
Temperature	12.1	10.3	13.9	12.5	10.9	13.9	12.0	10.3	12.5
pH	7.60	6.40	8.50	7.70	6.60	8.00	6.90	6.40	8.50
EC (ppm)	263	121	1153	342	244	446	234	121	1153
Sulphate (mg/L)	15.62	7.29	31.35	17.15	8.32	31.35	13.78	7.29	30.49
Suspended Solids Dry (mg/L)	1.0	0.0	3.0	1.0	0.0	3.0	0.5	0	3.0
Total P (ug/L)	31.0	10.0	102.0	37.0	10.0	67.0	14.5	10.0	102.0
TSP (ug/L)	17.0	7.0	96.0	29.0	9.0	65.0	13.5	7.0	96.0
SRP (ug/L)	17.0	4.0	91.0	18.0	4.0	56.0	12.5	6.0	91.0
TON (mg/L)	1.57	0.00	3.50	0.23	0.00	3.50	1.69	0.18	2.91
Ammonium (ug/L)	13	6	235	13	6	235	13	7	95
NO2 (ug/L)	1.0	0.0	18.0	1.0	0.0	18.0	0.5	0.0	6.0

Thirteen sources were sampled between the 18th and 25th May 2017, during a prolonged dry period (1 well was not accessible during sampling). Summary results are presented in Table 12. Overall, TON (nitrate + nitrite) levels were below the average recorded for NI (5.1 mg NO_3/l - Section 3.1). SRP concentrations ranged between 4-91ug/L across all sites sampled.

Four sites exceeded the Good-Moderate EQS of 35 ug/L; 2 in the derogated catchment area and 2 in the non-derogated catchment area. One well in current use had notably high levels of chloride (389 mg/L) and a low pH (6.4) and this is being investigated further. Further analysis of the results will relate the chemistry to land use, soil and geology and an additional monitoring round will be added in autumn 2017 to continue at least annually thereafter.

References

Bieroza, M.Z., Heathwaite, A.L., Mullinger, N.J. & Keenan. P.O. (2014). Understanding nutrient biogeochemistry in agricultural catchments: the challenge of appropriate monitoring frequencies. *Environmental. Science: Processes Impacts*, **16**: 1676–1691.

Burt, T.P., N.J.K. Howden, F. Worrall, and J.J. McDonnell. 2011. On the value of long-term, low-frequency water quality sampling: avoiding throwing the baby out with the bathwater. *Hydrol. Processes*, 25: 828–830.

6. LAND USE AND AGRICULTURAL PRACTICE ON DEROGATED FARMS

6.1 Land use, cropping and agricultural practice on derogated farms

Agricultural holdings account for approximately 75% of Northern Ireland's land area, with 93% of the agricultural area being grassland. 90% of farms are classified as being mainly grazing livestock using EU farm classification typology.

Farm businesses operating under approved derogation in 2016 followed this pattern. Farming activity, livestock and crops are detailed in Tables 13 and 14.

Table 13: Farming activity on farm businesses operating under derogation in 2016

Farm Type	Number of farm businesses 2016	Percentage of derogated farms 2016
Dairy cattle	269	90.3
Cattle and sheep	15	5
Cattle and poultry	3	1
Mixed	11	3.7
Total:	**298**	**100**

Notes: 1. Farm type - determined from DAERA Agricultural Census
2. Mixed farms – farms that have no dominant enterprise and do not fit into other categories
3. Data covers all farm businesses that applied for a derogation in 2016.

All farms operating under derogation have at least 80% grassland area. 62 derogated farms grew crops, of which 44 grew a single crop and the remaining 18 grew multiple crop varieties. Wheat and Barley are the predominant crops, covering 74% of the total cropped area on all derogated farms. Land areas of crops on individual farms ranged from 0.72 to 21.46 ha. Crops are summarised in Table 14.

Table 14: Crops on farm businesses operating under derogation in 2016

Crop	Number of farm businesses 2016	Land area (ha)
Spring wheat	14	124.46
Winter wheat	20	170.87
Maize	5	52.88
Spring barley	14	104.44
Winter barley	8	72.21
Potatoes	1	2.21
Spring oats	4	29.01
Winter Triticale	1	6.1
Other	14	73.29
	Total land area:	**635.47**

7. MODELLING

7.1 Results of model-based calculations of nitrate and phosphorus losses from derogated farms

As indicated above, data collection to support model-based calculation of nitrate and P losses from derogated farms commenced in Spring 2017, due to delays in recruiting farmers to the programme. As such, there are no results to report for the 2016-2017 reporting period. It is anticipated that by autumn 2017, the modelling approaches will have been tested and validated under Northern Ireland conditions. Results of model-based calculations of nitrate and P losses from derogated farmland should be available to report in June 2018.

Once relevant soil and farm nutrient management data have been collected from farms in the derogated and non-derogated pair of sub-catchments in the Upper Bann Catchment (Figure 18) along with early results of water quality monitoring, an advanced export coefficient modelling approach will be used at farm-scale on selected derogated and non-derogated farms in each sub-catchment.

It is expected that the FARM Scale Optimisation of Pollutant Emission Reductions (FARMSCOPER) decision support tool (Gooday *et al*., 2014), or an equivalent type of model, will be used to estimate diffuse losses of P, N and sediment from individual farms and to identify the potential impacts of mitigation measures.

FARMSCOPER was specifically developed and tested for use within England and Wales, and hence some modifications may be required for its application within Northern Ireland, specifically in relation to soil typologies and climatic zones contained in the model.

In England and Wales three soil types were selected to cover the main pathways for pollutant transfer: (1) free-draining permeable soils, (2) impermeable soils artificially drained for arable cultivation; and (3) impermeable soils drained for either arable/grassland cultivation. These may require modification for a Northern Ireland context with implementation of the *Phosphorus and Sediment Yield Characterisation in Catchments (PSYCHIC*), *National Environment Agricultural Pollution (*NEAP-N) and *MANure Nitrogen Evaluation Routine (*MANNER) models to generate area-weighted pollutant losses for each soil typology and climatic zone.

FARMSCOPER allows farms to be specified individually and the pollutant losses and potential efficacy of a range of 70 mitigation approaches to be assessed (Newell Price *et al*., 2011), with economic costs calculated as an option if desired. The most recent development (FARMSCOPER 3) allows for up-scaling through use of multiple farm-scale simulations to produce results at catchment or sub-catchment scales. The outputs of the model will provide estimates of nutrient exports from farms as well as identifying the most effective measures for mitigating these losses (Gooday *et al*., 2014).

To target measures cost-effectively within farms, identification of potential hotspots of nutrient loss, i.e. critical source areas (CSAs), is required. This can be achieved by modelling the hydrological connectivity of the farms following the source-pathway-receptor approach (Haygarth *et al*., 2005) and employing a methodology such as SCIMAP (Reaney *et al*., 2011), which when combined with soil P data for each field, should be able to identify fields on farms that pose the greatest risk to water quality and where mitigation measures should be focused.

Catchment scale modelling of land use practice impacts will also be attempted utilising Soil and Water Assessment Tool (SWAT) (Arnold *et al*., 2012) or the Source Apportionment Geographic Information System (SAGIS) modelling framework (Comber *et al*., 2013) to model N and P contributions from multiple sources within the Colebrooke catchment (*and also in the Upper Bann Catchment – budget permitting*).

Having derogated and non-derogated farms within both main river catchments, and high frequency storm flow event sampling in the contrasting three small sub-catchments, will facilitate up-scaling of the modelling of nutrient losses from farm to catchment scale. Results of soil P analyses (Olsen-P) from derogated farms, under Article 5(6) of the 2015 Derogation Decision, will be used to assess the overall impact of derogation on P losses from farmland across Northern Ireland.

References

Arnold, J.G., D. N. Moriasi, P. W. Gassman, K. C. Abbaspour, M. J. White,R. Srinivasan, C. Santhi, R. D. Harmel, A. van Griensven, M. W. Van Liew, N. Kannan, M. K. Jha. (2012) SWAT: Model Use, Calibration, and Validation. *Transactions of the ASABE*. **55**: 1491-1508.

Comber, S. D., Smith, R., Daldorph, P., Gardner, M. J., Constantino, C., & Ellor, B. (2013). Development of a chemical source apportionment decision support framework for catchment management. *Environmental science & technology*, **47**: 9824-9832

Gooday, R. D., Anthony, S. G., Chadwick, D. R., Newell-Price, P., Harris, D., Duethmann, D & Winter, M. (2014). Modelling the cost-effectiveness of mitigation methods for multiple pollutants at farm scale. *Science of the Total Environment*, **468**: 1198-1209

Haygarth, P. M., Condron, L. M., Heathwaite, A. L., Turner, B. L., & Harris, G. P. (2005) The phosphorus transfer continuum: Linking source to impact with an interdisciplinary and multi-scaled approach. *Science of the Total Environment*, **344**: 5-14.

Newell Price, J. P., Harris, D., Taylor, M., Williams, J. R., Anthony, S. G., Duethmann, D., & Misselbrook, T. H. (2011). An inventory of mitigation methods and guide to their effects on diffuse water pollution, greenhouse gas emissions and ammonia emissions from agriculture. *Report prepared as part of Defra Project WQ0106, ADAS and Rothamsted Research North Wyke.*

Reaney, S. M., Lane, S. N., Heathwaite, A. L., & Dugdale, L. J. (2011). Risk-based modelling of diffuse land use impacts from rural landscapes upon salmonid fry abundance. *Ecological Modelling*, **222**: 1016-1029.

8. COMPLIANCE WITH THE DEROGATION CONTROLS FOR 2016 AND 2017

8.1 Derogation controls in Northern Ireland

NIEA, on behalf of DAERA, is the competent authority for enforcement of the NAP legislation in Northern Ireland. In accordance with Article 4 of the 2015 Decision, the 2014 NAP Regulations require farmers in Northern Ireland who wish to benefit from derogation to submit an annual application to the NIEA by 1 March for that calendar year. NIEA have 28 days from receipt to make a decision on whether to grant or refuse the application.

The Regulations also require farmers in Northern Ireland to prepare and keep a fertilisation plan for the calendar year in accordance with Article 5 of the 2015 Decision. This must be available on derogated farms no later than 1 March of that calendar year.

Additionally, in accordance with Article 5 of the 2015 Decision, the Regulations require farmers in Northern Ireland to submit fertilisation accounts to NIEA for the previous calendar year by 1 March of the following year. Therefore, applications for derogation must be accompanied by the fertilisation account for the previous year, where relevant.

8.2 Compliance with the derogation controls

Compliance with the Decisions is assessed in three key ways:-

1. administrative checks of derogation applications for the current calendar year;
2. on-farm inspections of records from previous years, current fertilisation plans, farm facilities and fields; and
3. administrative checks of fertilisation accounts for the previous calendar year.

8.2.1 Administrative checks of 2017 derogation applications

In 2017, there were 310 approved derogation applications and three refused applications. These were refused as the application was received after 1 March 2017 deadline.

8.2.2 2016 On-farm inspections

In accordance with the 2015 Decision, at least 5% of derogated farms are selected for on-farm inspections. In 2016, a total of 298 farmers had received approval for derogation from NIEA. Two farms provided evidence to NIEA that they could comply with 170 kg N/ha/yr limit and were withdrawn. Sixteen of these farms (5%) were selected for on-farm inspections. During inspection derogated farms are assessed against all of the NAP and Derogation requirements.

Tables 15 and 16 indicate the findings of on-farm inspections of farms operating under an approved derogation in 2016. There was one non-compliance detected on each of three farms (out of 16 inspected). These were due to the entry or risk of entry of fertiliser entering a waterway.

Table 15: Breach type and frequency from derogation inspections, 2016

Breach Description	Number of breaches
Entry / Risk of entry of fertiliser into a waterway	3
TOTAL	**3**

Table 16: Breach severity from derogation inspections, 2016

Breach Description	Number of breaches
LOW	3
TOTAL	**3**

8.2.3 Administrative checks of fertilisation accounts for 2016

In 2016, a total of 298 farmers had approved derogations. Two of these farm businesses withdrew in year. One farm was removed from the calculations due to a high non-grazing livestock manure total which resulted in an excessively high nitrogen loading for the grazing livestock manure. This farm is being breached for the nitrogen loading. One farm was removed for having insufficient grassland.

In addition twenty-one farmers provided evidence to NIEA that they had operated below the 170 kg N/ha/year limit. Of these 21 farms, four failed to submit fertilisation accounts by 1 March 2017. Of the remaining 273 farms, 98.3% of fertilisation accounts for the calendar year 2016 were received by NIEA on or before 1 March 2017.

Table 17 shows the finalised results of administrative checks on the 273 fertilisation accounts submitted in 2017 for the calendar year 2016. Compliance with the rules has decreased very slightly compared to 2015. Targeted training and amended guidance for 2015–2018 relating to the Nitrates Action Programme 2014 Regulations should assist compliance levels particularly with newly derogated farms.

A total of 12 non-compliances were detected in the accounts of 11 farm businesses. Non-compliance was mostly aligned to the P balance, record keeping and late submission of fertilisation accounts. NIEA continues to engage with colleagues in the Department and stakeholder representatives regarding these non-compliances.

Table 17: Compliance of fertilisation accounts for 2016

Measure Description	Average (min-max)	Number of Breaches
80 % grassland	98 (80–100)	0/173
Total grazing livestock N (up to 250 kg N/ha/year)	217 (168-265)	1/173
Total livestock manure N loading (170 kg N/ha/year non-grazing + 250 kg N/ha/year grazing)	217 (171-265)	See above
Total chemical N fertiliser usage on grassland (not to exceed 272 or 222 kg N/ha/year for dairy or other farms respectively)	174 (0–372)	1/173
Total chemical N fertiliser usage on land other than grassland (not to exceed crop requirement)	134 (0–220)	0/55*
Phosphorus balance up to 10 kg P/ha/year	5 (-36.9-15)	5/173
No, partial or late records	N/A	5/173

**Statistics based on 55 farms which had land other than grassland and which used chemical N fertiliser.*

Table 18: Predicted and observed statistical values (verified for land area) for farm businesses which operated under derogation in 2016

Average (min-max)	Predicted from applications 2016	Fertilisation accounts 2016
Grassland area (%)	98 (82–100)	98 (80–100)
Farm size (ha)	88 (7-334)	90 (13–348)
Total livestock manure N loading (kg N/ha/year)	213 (23–250)	217 (171–-265)
Grazing livestock manure N loading (kg N/ha/year)	213 (23–250)	217 (168–265)
Chemical N fertiliser usage (kg N/ha/year)	N/A	174 (0–372)
Phosphorus (P) balance (kg P/ha/year)	N/A	5(-36.9-15)

Table 18 shows statistics for observed values for the 273 farm businesses that submitted fertilisation accounts for the calendar year 2016. The values are calculated (using land areas verified through cross-checks with other data sources) from information supplied in the fertilisation accounts. Observed values are compared, where possible, to predicted values from the initial 298 approved derogations. Fertilisation accounts which have produced outlying values are likely to be examined further and the farm business may be more likely to be subject to an on-farm inspection (due to a higher environmental risk rating).

9. GUIDANCE AND TRAINING TO SUPPORT THE DEROGATION

9.1 Nitrates derogation guidance

In 2015 DARD and DOE, (now DAERA) jointly produced updated guidance for the revised 2015-2018 NAP to support implementation of the nitrates derogation. In June 2016 the Nitrates Derogation Guidance, Fertilisation Plan and Fertilisation Account (including the Phosphorus Balance worksheet) were printed and issued to all farm businesses operating under a derogation. In January 2017, these farm businesses received an application form for 2017 and a letter reminding them to submit their Fertilisation Account for 2016 by 1 March 2017 and also to submit their application form for 2017 by the same date if they wished to continue to have a derogation.

9.2 Nitrates derogation training

In 2016 the College of Agriculture, Food and Rural Enterprise (CAFRE) within DAERA continued to provide a wide range of support on the Nitrates Derogation for farmers in Northern Ireland. Farmers operating under derogation in 2016 were supported by CAFRE Dairy Development Advisers on a one to one basis as and when requested.

9.3 Other training and support associated with Nitrates Action Programme

Other training related to the NAP that took place in 2016-2017 was reduced from previous years as the CAFRE delivery team was under strength over the 2016/17 winter period. A total of 7 nitrates courses were delivered to 72 farmers by the Agr- Environment Team. However, this was complemented by the CAFRE Development Advisers delivering nitrates and nutrient management to almost 3000 farmers who belonged to recently set up Business Development Groups.

In addition, CAFRE Advisers and the Agri-Environment Team took and successfully dealt with numerous calls from farmers on nitrates related issues including the closed period, manure exports and the derogation.

9.4 CAFRE Nutrient Calculators

As described in the previous report, CAFRE has lead responsibility for the development and maintenance of a suite of five on-line calculators designed to help farmers to manage their farms to comply with various aspects of the NAP Regulations. The calculators are available on the DAERA web-site at: www.daera-ni.gov.uk. The calculators continue to be well used and Table 19 shows the number of unique users for each of these on-line calculators at March 2017. The number of users increased by 38% in 2016/17 following an update and refresh of their design and operation.

Table 19: User numbers for on-line calculators

Calculator	Number of users at March 2017
Livestock Manure Nitrogen Loading	3432
N Max for Grassland	726
Crop Nutrient Recommendation	919
Phosphorus Balance	479
Livestock Manure Storage	1382

9.5 Other communication methods

In 2016-2017 DAERA issued technical information in the form of a number of press articles and management notes through various channels including the agricultural press, Departmental e-newsletter and the Farm Advisory System Newsletter to update farmers on water quality and nutrient issues, promote the nitrates derogation and nutrient management planning. These articles are also published on DAERA's website along with frequently asked questions, NAP Regulations, derogation information booklets, and booklets for derogation fertilisation plans, accounts and worksheets.

DAERA continues to highlight the NAP Regulations, including nitrates derogation, at a variety of agricultural shows, events and meetings. For example, in meetings held by the CAFRE Dairy Development Advisers in January and February 2017, they reminded farmers about the need to meet the 1 March 2017 deadline for submission of their Fertilisation account and next year's derogation application.

10. RESEARCH PROJECTS

In order to underpin the implementation of the Directive and the action programme measures in Northern Ireland, DARD (now DAERA) commissioned AFBI to carry out a range of research projects during the period 2008-2012. Some of the research was undertaken in accordance with Articles 8.2-8.6 of the 2007 Derogation Decision for NI, granting derogation for intensive grassland systems, and is still on-going. Further research in support of the 2015-2018 derogation and NAP has also been commissioned by DAERA. A summary of key findings from on-going research, and details of new research projects, are provided in this section.

10.1 Project 0618 - Monitoring the effectiveness of the nitrates action programme for Northern Ireland (On-going research)

Under Article 8.6 of the 2007 Derogation Decision, and as part of monitoring the effectiveness of the NAP for Northern Ireland, a representative soil sampling scheme (RSSS) has been operated by AFBI since 2004, to identify the impact of the NAP on soil fertility in Northern Ireland, especially on soil Olsen-P. In the RSSS, 500 grassland fields across Northern Ireland are sampled, 100 per year, on a five-year rolling basis. The fields selected were located on intensively stocked, but non-derogated farms operating at near to the 170 kg N/ha manure loading limit.

Comparing the mean Olsen-P concentrations (in the 0-75 mm soil layer and the complete A horizon) across all sites in the first five-year period (2004-2008) with those in the second five-year period (2009-2013), revealed small but significant ($P \leq 0.02$) increases in soil Olsen P with time, in both the 0-75 mm soil layer (41.69 mg Olsen-P l^{-1} for 2009-2013 compared to 40.19 mg Olsen-P l^{-1} for 2004-2008) and the A horizon (39.19 mg Olsen-P l^{-1} for 2009-2013 compared to 35.06 mg Olsen-P l^{-1} for 2004-2008).

Although statistically significant, the increases are small in real terms and likely to be of minimal environmental significance. Analysis of the latest paired RSSS samples (100 sites, sampled in 2014-2015, compared with the same sites sampled in 2009-2010), indicate no significant change in soil Olsen-P status.

AFBI also operate a 5 km grid survey to monitor soil quality across Northern Ireland. The sample points are located at 5 km Ordnance Survey grid intersections, and identify over 600 sites which include all major land cover types and agricultural land uses within Northern Ireland. The sites were originally sampled in 2004-2005 with a view to a 10-year resample cycle, which was carried out in 2014-2015.

Analysis of change between 2004-2005 and 2014-2015 with reference to average Olsen-P concentrations in each Index P range (based on the initial index P values in 2004/2005), indicates specific contrasting trends. Mean Olsen-P concentrations for soils initially identified within soil Olsen-P Index ranges 0 and 1, increased between 2004-2005 and 2014-2015. In contrast, it was found that soils initially within the soil P Index 4+ bracket decreased significantly, with mean values falling from 65.1 mg Olsen-P l^{-1} to 55.1 mg Olsen-P l^{-1} in the 0-75 mm soil layer and from 67.6 mg Olsen-P l^{-1} to 62.9 mg Olsen-P l^{-1} in the A horizon. It would appear, therefore, that over the past 10 years, less P has been applied to land already over-supplied with this nutrient.

Subject to securing of funding, continuation of the sampling programme will allow further monitoring of soil P concentrations so any emerging trends can be identified and mitigation action taken if necessary.

10.2 Project 9420 – UK Environmental Change Network: Freshwater (On-going research)

Project 9420 monitors water quality in Lough Erne and Lough Neagh, the two largest lakes in Northern Ireland. The overall aim of the project is to provide long term and standardised data on Lough Neagh and Lough Erne with respect to nutrients and eutrophication.

Lough Neagh

The long-term dataset (<40 years) for Lough Neagh was examined for changes in chlorophyll-a, nutrient concentrations over a period of generally increasing water temperatures. The time series spanned a period of nutrient enrichment, toxic algal blooms and a recent reduction in chlorophyll-a.

A generally decreasing trend was evident for chlorophyll-α in the Lough between 1993 and 2011. The observed recent decrease in chlorophyll-a concentration did not correspond to decreases in SRP or TP concentration; both increased over the same period.

Results

Our results show that TP loading from the catchment over the time period has been variable, whereas there has been a significant decrease in the TON coming from the catchment (8,236 to 5,396 tonnes of N, 1984 and 2011 respectively). Figure 22 a shows the mass of TP from the Lough Neagh catchment. Figure 22 b shows the mass of nitrate flowing from the catchment to the lake; a decreasing trend was observed in recent years.

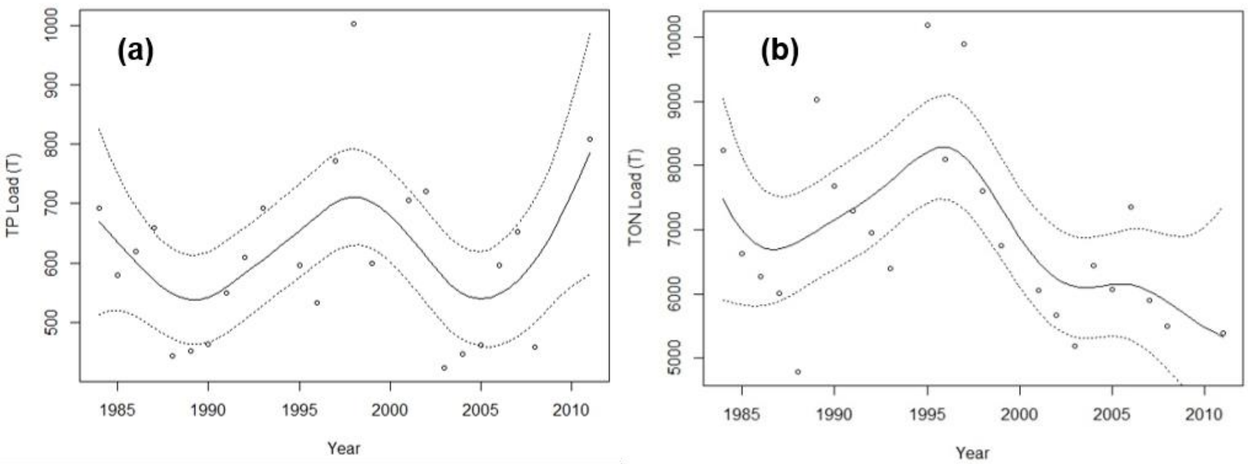


Figure 22: (a) Mass (tonnes) of total phosphorus (TP) flowing from the catchment to Lough Neagh, 1984 to 2011, **(b)** mass (tonnes) of total oxidised nitrogen, (TON – mostly nitrate in lough Neagh) flowing from the catchment to Lough Neagh, 1984 to 2011.

Nutrient loading from the catchment appeared uncoupled to lake nutrient concentration in recent years. This must be taken into account when setting nutrient management targets in the catchment as lake nutrients appear to be uncoupled from catchment loadings in recent years.

Lough Erne

In Lough Erne we analysed the annual input of TP and total oxidised Nitrogen (TON) to Lower Lough Erne from Upper Lough Erne, along with the annual mean concentrations at sample site LE1 in Lower Lough Erne. The input of TP did vary considerably from year to year as a result of higher discharges in wet years (e.g. 1983, 1993-1995). Overall, there was an approximately 25% increase in input from 160 to 200 tonnes a year over the 1975 to 2010 period. Although the TP results for the lake water cover a shorter period, the concentration did increase over the 1991-2010 period, from approximately 50 to 65 µg l^{-1} (Figure 23 a).

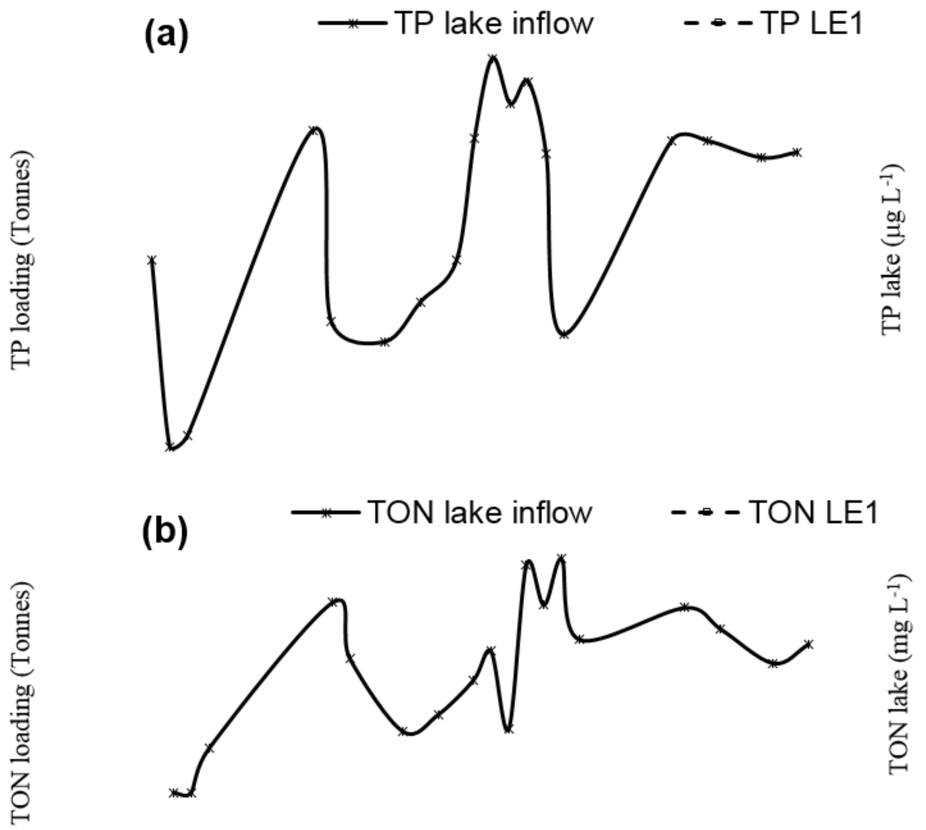


Figure 23: Variation of annual nutrient input from Upper Lough Erne to Lower Lough Erne over the 1975 to 2010 period, along with the annual mean concentration at site LE1 on Lower Lough Erne for **(a)** total phosphorus (TP lake) and **(b)** total oxidized nitrogen (TON lake).

The TON annual input also varies from year to year according to discharge and there was a general increase of approximately 40% from 3,000 to 4,200 tonnes per year over the period, a larger increase than was found for TP. The TON concentration in the lake was variable, particularly from 1991 to 1996, but it then decreased over the 1997 to 2010 period, by approximately 50% from 1.0 to 0.5 mg N L-1 (Figure 23 b).

These results show that there was a difference in the response of TP and TON in Lower Lough Erne to the increasing inputs; while the lake water TP concentration increased, as would be expected from increasing input, the TON concentration decreased, at least over the period for which there are results, 1991 to 2010 (Figure 23).

As the TP concentration in the lake increased from 50 to 65 µg L-1, biological productivity is very likely to have also increased, resulting in the assimilation of TON (mainly nitrate) to support the additional production and so a reduction in the lake water TON concentration.

The increased productivity, as implied by the reduced TON concentration may have been even greater as the reduction in TON took place even though the TON load to the lower lake increased by approximately 40%. Commonly, an increase in the lake water chlorophyll-α concentration is the usual biological response to higher nutrient concentrations and there is some support for this up to 1997. After this date the response is confounded in Lough Erne by the impact of the introduction of the invasive alien zebra mussel (Figure 24).

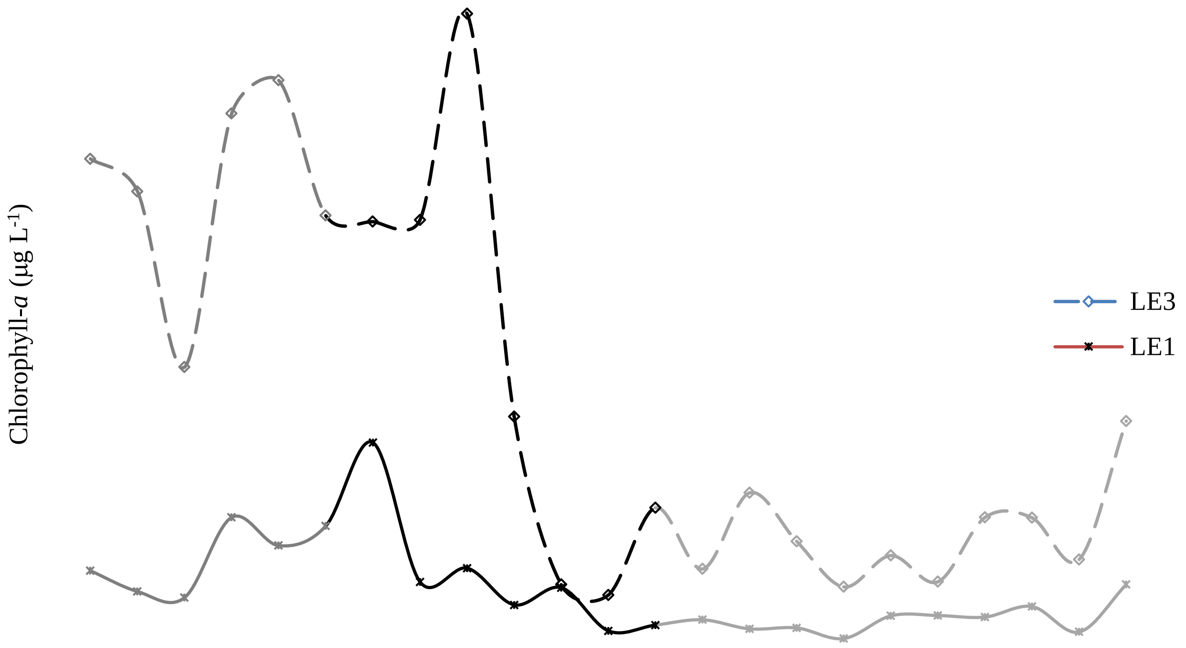


Figure 24: Variation of the mean annual chlorophyll-α concentration from 1991 to 2013 at sites LE1 and LE3 in Lower Lough Erne. Three time periods are shown that indicate the impact of the roach (1991 to 1996), impact of the zebra mussel Dreissena polymorpha (1997 to 2003) and selective recovery of impacted zooplankton (2004 to 2013).

10.3 Project 16/4/03 – Monitoring, modelling and mitigation of N and P losses from land to water under derogated and non-derogated conditions in the Colebrooke and Upper Bann Catchments (New Research)

The Overall Objectives of the monitoring/modelling programme are to provide scientific evidence to:-

1. Meet the additional/amplified monitoring and reporting requirements of Articles 8 and 10 of the 2015 Derogation Decision.
2. Identify and validate strategies which minimise N and P losses to water, optimise farm productivity and reduce variable costs on ruminant livestock farms.

These Objectives are being addressed in four Work Packages (**WPs**):-

WP 1 – Surface Water Sampling

In compliance with Article 8(3) of the 2015 Derogation Decision, monitoring of chemical water quality (nutrients) in streams in 12 sub-catchments in each of the Upper Bann (UB) and Colebrooke (CB) catchments, which ceased in 2014, will be reinstated at bi-monthly frequencies, This will be supplemented with targeted storm flow event sampling to improve resolution and precision of sampling - c.f. the 2009-2014 monitoring program.

Bi-monthly and seasonal hydrological event sampling for nutrients will also be conducted in two contrasting sub-catchments (*one containing* a significant proportion of derogated *farmland and the other containing only non-derogated farmland*) within the UB catchment. Samples will also be analysed for a range of tracers to help determine the contributions of rural septic tank outflows to P loads.

WP 2 – Groundwater Sampling

Groundwater monitoring is a requirement under Article 8 of the 2015 Derogation Decision. A baseline survey within the pair of UB sub-catchments (*but if necessary extended to include other sub-catchments*) will be undertaken to identify, in consultation with landowners, wells and springs suitable for sampling. Potential threats to water quality in each well/spring will be noted during sampling. After an initial monitoring round, a sub-set of wells/springs will be identified and monitored annually.

WP 3 – Soil Sampling, Farm Data Collection & Nutrient Management Advice

To provide relevant soil P data for modelling P losses from derogated and non-derogated farms on the main soil types of Northern Ireland in accordance with Article 8(2) 2015 Derogation Decision, and information on farming practices etc on derogated and non-derogated farms in accordance with Article 8(4) of the 2015 Derogation Decision, a sampling/data collection scheme will be conducted.

In the pair of UB sub-catchments (*one sub-catchment with a significant proportion of derogated farmland and the other with no derogated farmland*), all fields (*713 in total*) will be soil tested for Olsen-P and Calcium Chloride extractable P ($CaCl_2$-P). A 1 m resolution Light Detection And Ranging (LiDAR) digital terrain model (DTM) will be applied to help identify potential Critical Source Areas (CSAs) for P loss within sub-catchments.

For whole farms in each sub-catchment (*33 in total – 10 dairy and 23 Beef & Sheep*), information and data on nutrient imports and exports will be collected to calculate annual farm N and P surpluses, and concentrate feeds, silages and manures analysed.

For the 10 dairy farms, in addition to this, records of fertiliser and manure application to fields will be maintained annually, and twice yearly, samples of manures and concentrate feeds will be collected and analysed for N and P to help quantify nutrient cycling and flows within these farming systems.

For the first two years, the 10 dairy farmers will not be given any nutrient management advice but simply allowed to continue with their normal nutrient management practices, to allow assessments of baseline conditions to be made for each sub-catchment in terms of farm P balances, mean soil Olsen-P concentrations, breakdowns of farmland in different soil P index ranges and water chemistry and biology.

In year three, farmers will be offered nutrient management and nutrient budgeting advice including recommendations for Nitrogen Phosphorus Potassium (NPKs) fertiliser on fields, for manure usage and avoidance of potential CSAs, and for the amounts and P contents of concentrates fed to help evaluate the impact of these measures on water quality in succeeding years (>10 years).

WP 4 – Modelling of Nutrient Losses from Farmland

In compliance with Article 10 of 2015 Derogation Decision, nitrate and P losses from derogated farmland will be modelled using soil-P and farm-gate N and P balance information together with the results of chemical water quality monitoring in the sub-catchments using a ‘source-pathway-receptor’ approach.

An export coefficient modelling approach will be applied to estimate diffuse losses of P and N from individual farms. Soil P distribution data for farms of different intensities will then be used together with known breakdowns of farming intensities within catchments to scale-up model estimates of P loss to catchment scale.

Catchment scale modelling will be attempted to model N and P contributions from multiple sources and to assess the overall impact of derogation on nutrient losses from farmland across Northern Ireland.

Results

The results to date for WP1 and WP2 are reported in Section 5 of this report, those for WP3 are reported in Section 4, and currently there are no results to report for WP4.

10.4 Project 16/4/01 – Management of manure nutrients for sustainable grass-based dairy production in Northern Ireland (New Research)

The Overall Objective of the project is to:-

> Evaluate the potential for restrictions on concentrate-P inputs and manure processing plus export, to facilitate application of dairy manures or manure/digestate liquid fractions to grassland soils whilst simultaneously reducing risk of P loss to water (*by lowering soil Olsen-P and reducing ‘run-off-vulnerable’-P*) plus maintaining farm productivity.

To help achieve the Overall Objective there will be four Specific Objectives:-

1. Determine how soluble and insoluble P fractions in dairy cow slurries relate to farm P balances and contribute to Olsen-P accumulation in soil.
2. Assess the efficiency of screw-press mechanical separation for partitioning P (N, Potassium (K) and Sulphate (S)) in dairy slurries (*of differing initial Dry Matter (DM) contents*) and anaerobic digestates, with or without Magnesium Chloride ($MgCl_2$) pre-treatment to precipitate struvite ($NH_4MgPO_4 \cdot 6H_2O$).
3. Assess the plant availability of P, K and S in liquid fractions of separated dairy slurries, anaerobic digestates and dairy slurries with a wide range of P concentrations.
4. Seek to identify cost-effective strategies with the potential to optimise soil P status on farms with different levels of P surplus, without completely halting manure application to high P soils or compromising grass or milk production.

The above objectives will be pursued in four complementary work packages (**WPs**)

WP1 – Relationship of manure P fractions to farm P surplus and contributions of manures to 'crop-available'- and 'run-off-vulnerable'-P in soil

Samples of dairy manures will be collected from 10 dairy farms in the sister DAERA Evidence and Innovation (E&I) project (***Research Supporting the NAP and Derogation***) and from a range of benchmarked dairy farms (>50) with different concentrate usages, levels of milk production per cow, and farm P surpluses, to potentially provide manures with total P concentrations ranging from 2.5 g P/kg Dry Matter (DM) to 9.5 g P/kg DM, and from farms with P surpluses ranging from -5 kg P/ha/yr to +35 kg P/ha/yr.

These samples (*plus the solid and liquid fractions of separated dairy slurries and digestates, with or without Magnesium Chloride ($MgCl_2$) pre-treatment, from **WP2***) will be analysed for total P (N, K and S) contents and then subjected to a modified Hedley extraction procedure to fractionate P into water-soluble plus bicarbonate, hydroxide- and acid-soluble fractions.

Samples of silage and concentrates will be collected from farms and analysed for P etc and information on feed usage and milk yields obtained to enable calculation of P concentrations in dairy cow whole diets during confinement, and also whole year and winter period farm P balances. Multivariate regression analysis will be used to determine relationships between whole year and winter farm P surpluses (*and winter dietary P levels*) and manure P fractions of differing solubility and hence differing run-off potentials.

Samples of each manure (*and also the liquid fractions of separate dairy slurries and digestate, with and without $MgCl_2$ pre-treatment, from **WP2***) will be mixed with soils of low (Index 1), optimum (Index 2) and high P (Index 3) status (*but of similar type, hydrology and parent material*), to supply equal rates of total P; a mono-ammonium phosphate treatment will also be included to permit a comparison with inorganic fertiliser P.

The soils will be incubated at 12°C (to replicate spring soil temp conditions) for 12 weeks. Samples will be taken after 6 and 12 weeks and analysed for Olsen-P as an indicator of crop-available P, and for water and $CaCl_2$-P as indicators of P run-off potential. The results will be used to assess the relative contributions of inorganic fertiliser P and manures (*from farms with differing P surpluses*) to ‘crop-available’- and ‘run-off-vulnerable’-P in soil.

WP2 – Efficiency of screw-press partitioning of P in dairy manures and digestate

Dairy cattle slurries with a range of DM contents will be separated by screw press to determine the effect of slurry DM content on nutrient partitioning. Separator efficiencies (*plus energy costs etc*) for partitioning of DM, N, P, K and S will be calculated for solid and liquid fractions.

The effects of screw press screen size and feedstock flow rate on partitioning of DM, N, P, K and S contents will then be examined for dairy cattle slurry of known DM content, and for anaerobic digestate derived from dairy cow slurry co-digested with grass silage from the AFBI Anaerobic Digester plant.

The effects of $MgCl_2$ pre-treatment of dairy cattle slurry and anaerobic digestate feedstock to precipitate struvite prior to screw-press separation will be examined to assess the effectiveness (*and costs*) of this strategy in increasing P partitioning to solid fractions in the different feedstock.

WP3 – Plant availability of P, K and S in separated dairy manures and digestate

A pot experiment will be established to evaluate the plant availabilities of P, K and S in slurry samples from representative benchmark dairy farms and in liquid fractions of screw-press separated slurries and digestate (*with and without struvite precipitation*), relative to P, K and S supplied as inorganic fertiliser.

The trial will be conducted using a sandy loam (*Index 1 for P and K and low in S*), and with perennial ryegrass as the indicator crop. Plants will be established for six weeks and cut, and then liquid manures and fertilisers applied to the surface of pots for two subsequent harvests.

DM yields and nutrient off-takes will be evaluated at each harvest and results for manure treatments compared with those for the fertiliser control (*response curves*) to assess relative availabilities of P, K and S in the different manures and manure liquid fractions and digestate.

WP4 – Strategies to optimise soil P status without detriment to productivity

Results from work packages **WP1**, **WP2** and **WP3**, will be interrogated to determine if specific combinations of concentrate P restriction and slurry/digestate processing can be identified for farms with different P surpluses and concentrate usage that would permit recycling of manures or manure liquid fractions to grassland of high P status, whilst simultaneously reducing concentrations of 'run-off-vulnerable'-P in soil without compromising grass production (*i.e. by maintaining adequate inputs of P and some manure K and S to help meet crop requirements, and reducing the need for expensive inorganic K additions*). Case study cost-benefit analyses will be conducted to determine the most appropriate strategies for different intensities of dairy enterprise.

Results

Work was initially delayed by about 3 months due to issues over the confidentiality of CAFRE Farm Bench mark data. As Work package 1 (WP1) was dependent on gaining access to CAFRE benchmark dairy farms with a wide range of P balances to collect samples of slurry, concentrate feeds and silage and to collect farm data needed to quantify accurately the farm P balances, letters of explanation (drafted by AFBI) were sent out by CAFRE to reassure farmers. As a result 110 benchmark dairy farmers indicated a willingness to be involved, 48 of whom were selected, and farm sampling commencing at the beginning of February 2017.

Questionnaires pertinent to farm P surplus for FY 16/17 were issued to all participating farmers. Samples of slurry, concentrates and silage samples were collected from all participating farmers. Questionnaire collation is underway with an approximate 50% return rate to date. All silage samples have been analysed at AFBI Hillsborough for commercial silage analysis, and results returned to farmers, while concentrate analysis is on-going.

Slurry samples have been characterised by the Soils Lab in AFBI Newforge and results of total P in slurry (corrected to 6% DM) will be used to inform the incubation which is part of WP1. Corrected total P concentrations in slurry ranged from 0.36 to 0.62 mg P/kg slurry at 6% DM, i.e. a twofold difference in total P concentration between lowest and highest, and the range in water soluble P concentrations may be even greater.

Farm P surplus will be accurately calculated based on information from questionnaires on concentrate and fertiliser use and farm produce export, and from measured concentrations of P in feed concentrates, and the relationship with slurry total P quantified. Figure 25 shows CAFRE calculated farm P surplus/ha compared to measured slurry total P concentration (mg/kg at 6% DM) from 36 of the participating farms. The relatively poor relationship is partly due to the fact that CAFRE farm P balances take no account of P applied in fertiliser, nor do they allow for significant differences in the P contents of concentrate feeds.

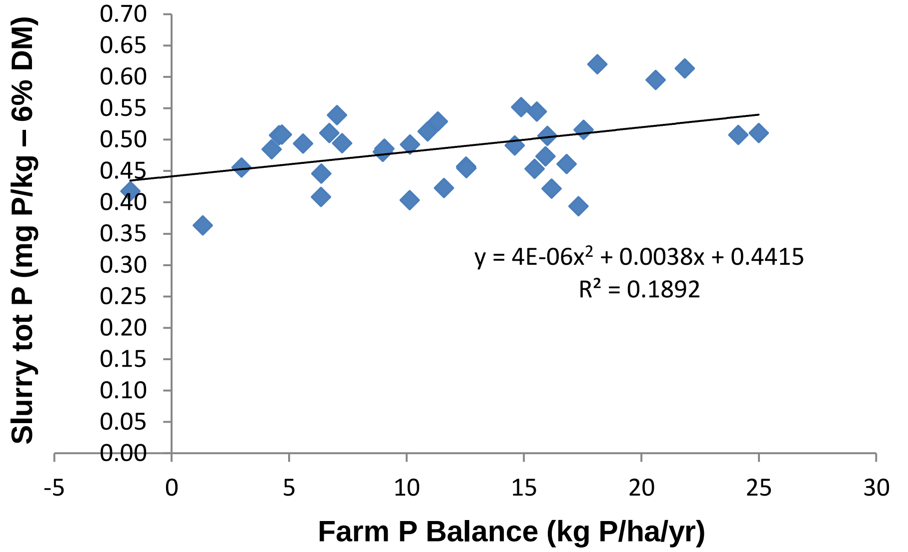


Figure 25. Relationship between CAFRE estimate farm P surplus/ha and slurry TP (mg/kg slurry at 6% DM) from 36 Benchmark dairy farms in NI

To date, soil of the same parent material of optimum (index 2) and high (index 4) P index from AFBI Hillsborough has been collected by AFBI and prepared for incubation (air dried to 40% soil moisture content). Slurry from a selection of the 48 farms along with samples of anaerobic digestate and separated slurry from Hillsborough will be added to these soils and incubated for 6 and 12 weeks respectively. Currently, AFBI is carrying out method testing in order to derive the best method to quantify soil P fractions in the slurry collected (MRP, organic P, inorganic P etc) using a modified Hedley fractionation procedure. It is estimated that the incubation will commence by end of July 2017 after these important method tests are completed and the appropriate SOPs created.

10.5 Project 16/4/02 – Quantification of phosphorus release from sediments in Lough Neagh and factors affecting the recovery of water quality (New Research)

The objective of this project is to determine the extent to which historically accumulated internal nutrients drive the current chemical and ecological status of Lough Neagh, and provide timescales for recovery. We will also characterise P input from the catchment.

The focus of the work will be on nutrients (N and P), the internal loading of P from the lake sediments and the delay in chemical recovery that results from internal loading. A number of sediment cores will be taken from the Lough. Sediment chemistry, in particular the different P fractions present in the core, will be analysed in AFBI. The chemistry results obtained will be used to develop the Lough Neagh model.

Currently water quality management is through nutrient reduction measures in the catchment. However, reduction of P/N loading may not lead to an immediate improvement in lake water quality due to internal loading. While P release from anoxic sediments is well studied and can be predicted accurately, P release from oxygenated sediments is less well understood, especially in Lough Neagh.

Many parameters potentially influence P release from oxygenated sediments such as temperature, pH, oxygen levels and the presence of N. Nitrate in lake water helps maintain iron in an oxidised state, which increases the sediment binding capacity of P. Since nitrate entering the lake has decreased, it is possible that this has influenced sediment P release. An objective of this project will be to assess the impact of nitrate reductions from the catchment on the lake. We will estimate the time scale of meeting nutrient and biological targets. This will help us to identify potential future nutrient management requirements.

Results

There are no results to report as yet, as the project has been delayed by more than 8 months as the Project Leader was on maternity leave.

11. CONCLUSION

In 2017, 310 farm businesses out of approximately 25,200 direct aid claimants (1.2 %) in Northern Ireland are operating under an approved derogation, compared to 298 (1.2 %) in 2016.

11.1 WATER QUALITY

Nitrate concentrations in Northern Ireland surface freshwaters remain relatively low, with the average nitrate concentration for all monitoring stations below 25 mg NO_3/l in 2016. Surface freshwater nitrate concentration trends indicated a decrease or stability at 100% of sites across Northern Ireland between 2012-2015 and 2016.

Groundwater nitrate concentrations across Northern Ireland are also generally low with 51 of the 52 stations below 25 mg NO_3/l in 2016. Average nitrate concentrations in one of the two high derogation catchments (Ballinderry) were generally low with all of the monitoring sites below 25 mg NO_3/l in 2015. Five of the six groundwater sites in the Strangford catchment were also below 25 mg NO_3/l, but one site (East Belfast groundwater body) had an average concentration between 25 and 40 mg/l. Nitrate concentration trends in groundwater across Northern Ireland indicate a decrease or stabilisation in all of the two high derogation catchments in 2016 compared to 2012-2015.

Phosphorus concentrations were assessed using current WFD standards for rivers and lakes. For SRP in rivers, 60% of sites were classed as either High or Good status. In the middle and eastern parts of Northern Ireland the majority of catchments were classed as Moderate or Poor status. A comparison of phosphorus classes in the four high derogation catchments showed higher P concentrations in the Strangford catchment compared with the Ballinderry, Clanrye and Crawfordsburn catchments. The general trend was stability (96.3%) in overall SRP levels across Northern Ireland between 2012-2015 and 2016. This trend was similar in the high derogation catchments.

In this report, both the assessments using Nitrates Directive and WFD criteria show deterioration as indicated by the percentage of sites that are exhibiting increasing SRP levels. This is a cause for concern and therefore, DAERA has included an SRP Water Quality indicator in the proposed Programme for Government (PfG). The SRP indicator used is the annual average SRP (µg/L) for 93 surveillance river sites and is not a WFD status assessment. For PfG it is required that a threshold for change is set and an appropriate level for the threshold is currently under discussion.

Lakes continue to exhibit poorer classification based on TP concentrations with 14 of the 21 classed as Moderate or worse status in 2016. The overall trend between 2012-2014 and 2016 in lakes was largely stable.

11.2 ADVISORY SUPPORT

As in previous years, DARD (now DAERA) delivered a number of training and advisory events for farmers across Northern Ireland and provided information and guidance to farm businesses using a wide range of media, including one to one advice for derogated farms, where requested. Updated guidance documents on the NAP 2015-2018 and derogation workbooks were published and distributed. The CAFRE Nutrient Calculators were updated and refreshed and uptake increased by 38% from March 2016. These on-line calculators are designed to help farmers comply with various aspects of the NAP Regulations.

11.3 COMPLIANCE

Compliance observed during on farm inspections of selected derogated farms in 2016 was similar to 2015, with one non-compliance found on each of three farms, (out of 16 inspected). Administrative checks on the fertilisation accounts for the calendar year 2016 indicated a very slightly lower rate of compliance compared to 2015, with most non-compliances being attributable to the P balance. DAERA continues to review training delivery and provide information for farmers to help address these non-compliances.

11.4 RESEARCH AND MONITORING

To underpin the implementation of the Directive and the action programme measures in Northern Ireland, alongside on-going research commissioned by DARD (now DAERA), AFBI has been commissioned to carry out a range of new research projects. A summary of key findings from the on-going research, plus details of new research projects are given at section 10.

This includes a new amplified monitoring programme which is being set up to meet the additional monitoring requirements of the 2015 Derogation Decision. The data collected from this monitoring programme will provide evidence for future annual derogation reports. The range of research projects demonstrates our continued commitment to making progress on water quality issues.