Council Directive of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (91/676/EEC)

Article 10 Report for Ireland for the Period 2016-2019

Prepared by the

Environmental Protection Agency

December 2020

EXECUTIVE SUMMARY

Purpose

This report is prepared in response to Article 10 of the Nitrates Directive (91/676/EEC). The report covers the seventh reporting period from 2016 to 2019. The report is submitted by the Environmental Protection Agency (EPA) and has been produced with assistance from the Department of Agriculture, Food and the Marine (DAFM), Teagasc (the agriculture and food development authority in Ireland) and the Department of Housing, Local Government and Heritage (DHLGH).

The information is presented according to the four sections in Annex V of the Nitrates Directive and comprises:

- A description, with maps, of the evolution of water quality in groundwater and surface waters;
- A statement on the adoption of a Whole Territory Approach with respect to the designation of nitrate vulnerable zones;
- A summary of agricultural activities and an account of the implementation of the agricultural Code of Good Practice;
- A summary of the principal measures and an evaluation of the National Action Programme for limiting nitrate inputs from agricultural sources.

Water Quality Monitoring in Ireland

Ireland uses data from the WFD surveillance monitoring programme to satisfy the reporting requirements of Article 10 of the Nitrates Directive. Adopting a common group of monitoring stations has allowed robust water quality comparisons to be made with the previous Nitrates Directive reporting periods. The surveillance monitoring programme is a sub-set of the overall WFD monitoring programme, and it's the wider WFD monitoring programme that is used when reporting on water quality in relation to the European Commission Implementing Decision (C/2018/0624) for Ireland to operate a derogation from the limits of the Nitrates Directive.

Nitrate Concentrations in Groundwater and Surface Water

The European Commission's Article 11 report summarising Member States Article 10 reports for the sixth Nitrates Directive reporting period (2012-2015) indicates that nitrate concentrations in Irish waters are amongst the lowest in the EU (EU Commission, 2018). However, based on 4-year average results, this report indicates that groundwater, riverine and transitional water nitrate concentrations have increased since the sixth reporting period.

Groundwater

- Average nitrate concentrations were greater than 25 mg/l NO_3 at 18.5% of monitoring stations. Three stations had average concentrations greater than 50 mg/l NO_3, whereas none were greater than 50 mg/l NO_3 in the 2012-2015 reporting period.
- There has been a 5.5% increase in the number of stations with average nitrate concentrations greater than 25 mg/l NO_3 since the 2012-2015 reporting period. Most of the

groundwater monitoring stations with average nitrate concentrations greater than 25 mg/l NO_3 are in the south east.

- 7.5% of stations had a strong increase in average nitrate concentration, with a further 30% of stations showing a weak increase in average nitrate concentration. Most of these increases have been observed in the south east and south west.

Rivers

- 24.4% of river stations had average concentrations greater than 10 mg/l NO_3. Two river stations recorded concentrations greater than 25 mg/l NO_3.
- Since 2012-2015 there has been a 5% increase in the percentage of river stations recording average winter concentrations greater than 10 mg/l NO_3 and a 10% increase in river stations recording maximum concentrations greater than 25 mg/l NO_3.
- Since 2012-2015 there has been a weak increase in average annual nitrate concentrations in 13% of rivers, with a strong average annual concentration increase in 1% of rivers. Most of these increases have been observed in the south east.
- The winter average concentration has also increased in rivers, with 8% of rivers showing a weak increase and 1% showing a strong increase since 2012-2015.
- 81% of all river stations were recorded as non-eutrophic in 2016-2019, with 87% of rivers not changing trophic state since 2012-2015. The south east is where the greatest trophic change has occurred, with some rivers becoming more eutrophic.

Lakes

- Over 90% of lakes had average and winter average concentrations less than 2 mg/l NO_3. No lakes were found to have annual average or winter average nitrate concentrations above 10 mg/l NO_3.
- Annual average and winter average lake nitrate concentrations are generally stable with very little change in the past decade.
- 66% of all lakes were recorded as non-eutrophic in 2016-2019, with 82% of lakes not changing trophic state since 2012-2015.

Transitional and Coastal Waters

- In 2016-2019, all transitional and coastal waters recorded winter and annual averages below 25 mg/l NO_3.
- Nitrate concentrations have been relatively stable in most transitional waters since 2012-2015. Where increases in nitrate concentration in transitional waters have been observed, they are predominantly occurring in the south east.
- Nitrate concentrations in coastal waters have mostly been stable.
- Four of the 18 transitional waters were eutrophic in 2016-2019, a net increase of one water body since 2012-2016. Where change in trophic state is occurring, it is occurring in the transitional waters of the south east.
- None of the seven coastal water bodies are eutrophic in 2016-2019 but a second water body was designated "could become eutrophic".
- Nearly all transitional and coastal water bodies have not changed trophic state since 2012-2015.

Agricultural Action Programme and Code of Practice

In 2018, the fourth Nitrates Action Programme (NAP) was informed by the findings of the EPA Water Quality in Ireland Report 2010-2015 (EPA, 2017), which indicated that the national picture was relatively stable, although some water bodies had improved while others have deteriorated. The fourth NAP introduced several significant new measures on a phased basis to allow farmers time to make the necessary changes on holdings.

In parallel, the WFD River Basin Management Plan (RBMP) 2018-21 prioritised targeted catchment assessments by the public authorities, with the aim of assessing and identifying measures to restore or prevent water quality deterioration.

In 2019, following the EPA Water Quality in Ireland Report 2013-2018 (EPA, 2019), the multi-agency Nitrates Expert Group was reconvened, and a voluntary mid-programme review of the NAP was undertaken in response to the reported decline in water quality. This group proposed new measures and advisory notices for consideration and most of these measures were introduced in 2020.

The first public consultation on the next NAP commenced in December 2020; this is open until 15th January 2021. The timing of this consultation period should inform the WFD RBMP for the 3rd planning cycle, allowing for better alignment of the overlapping objectives. A broad range of potential new NAP measures will be considered for the planned implementation of the NAP from 1st January 2022.

Forecast of Future Evolution of Water Body Quality

In Ireland, the agri-food sector has performed strongly in recent years with the value of food and drink exports growing by over 60% since 2010. In 2019, the agri-food sector accounted for 7.1% of total employment with primary agriculture, forestry and fishing accounting for 61% of this employment.

Agriculture covers over 65% of the land area of Ireland and is the most prevalent pressure affecting 53% of water bodies. The main water quality problems from farming are loss of excess nutrients and sediment to water. These losses arise from point sources such as farmyards, or from diffuse sources such as spreading of fertilisers and manures. Excess phosphorus and sediment typically cause problems in rivers and lakes, and too much nitrogen is the main issue for estuaries and coastal waters.

Overall, to achieve the WFD objectives, mitigation measures need to be targeted to the water quality issues and physical settings where they occur, i.e. the critical source areas. Within a catchment, the critical source areas for phosphorus and nitrate are likely to occur in different locations: poorly draining soils are the riskiest for diffuse phosphorus losses, while freely draining soils are more important for losses of diffuse nitrate. Therefore, any mitigation measures introduced should be tailored and targeted to the critical source area that is relevant to the pollutant of concern. The outcomes of WFD characterisation assessments undertaken for the 2022-2027 RBMP will refine our understanding of the nutrient critical source areas within each catchment.

There is a good relationship between farming intensity and nitrate concentrations in waters, but there is water quality variability within and between sub-catchments. Detailed research work in the Agricultural Catchments Programme has highlighted that soils, weather and farming practices also have a significant influence on nitrate concentrations at the local scale. This has important implications for selecting the right measures in the right place, at the right times.

An integrated approach to address water quality issues is being undertaken in Ireland. This includes collaboration between the different environmental and agricultural policy makers, researchers and public authorities, with the aim of informing policy so that the right measure can be undertaken in the right place.

Progress has been made in understanding better the complexity of the factors affecting nutrient loss to water in the diverse agricultural landscape. An encouraging result is water quality improvement in 152 of 726 water bodies that were prioritised areas for action in the WFD River Basin Management Plan (RBMP) 2018-21 was observed by the end of 2019 (EPA, 2020). This reflects the positive efforts of local authorities, other public bodies, local communities and land owners.

The development of the next CAP is an opportunity to incorporate measures based on research output that are known to benefit water quality. A key learning point to date has been that the right measure in the right place is particularly relevant for the Irish situation. Knowledge transfer mechanisms will be developed to link research and findings to the advisory and farming communities.

CONTENTS

LIST OF MAPS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

ACP	Agricultural Catchments Programme
AECM	Agri-Environment and Climate Measures
AEOS	Agri-Environment Options Scheme
AIM	Animal Identification System
AKIS	Agricultural Knowledge and Innovation Systems
ASSAP	Agricultural Sustainability and Advice Programme
CSO	Central Statistics Office
DAFM	Department of Agriculture, Food and the Marine
DHLGH	Department of Housing, Local Government and Heritage
e-PRTR	European Pollutant Release and Transfer Register
FAS	Farm Advisory System
GAEC	Good Agricultural and Environmental Conditions
GAP	Good Agricultural Practice
GHG	Green House Gases
GLAS	Green Low-Carbon Agri-Environment Scheme
ICM	Integrated Catchment Management
LESS	Low Emission Slurry Spreading
NAP	National Action Programme
OECD	Organisation for Economic Co-operation and Development
OSI	Ordinance Survey Ireland
OFS	Organic Farming Scheme
RBD	River Basin District
RDP	Rural Development Programme
REPS	Rural Environment Protection Scheme
RBAPS	Results Based Agri-environmental Pilot Scheme
RBMP	River Basin Management Plan
S.I.	Statutory Instrument
TAMS	Targeted Agricultural Modernisation Scheme
TSAS	Trophic Status Assessment Scheme
WISE	Water Information System for Europe
WFD	Water Framework Directive

1 INTRODUCTION

1.1 Purpose

This report is prepared in response to Article 10 of the Nitrates Directive (91/676/EEC). The report covers the seventh reporting period from 2016 to 2019. The Report contains information, as outlined in Annex V of the Directive, regarding the monitoring of waters against pollution from agricultural sources and the details of, and results from, action programmes drawn up by the State to combat pollution in vulnerable areas.

1.2 Background to the Report

1.2.1 The Nitrates Directive

The objective of the Nitrates Directive, which was adopted in 1991, is the reduction of water pollution caused or induced by nitrates from agricultural sources and the prevention of further such pollution, with the primary emphasis being on the management of livestock manures and other fertilisers.

The Nitrates Directive requires Member States to:

- Monitor waters and identify those that are polluted or are liable to pollution by nitrates from agriculture;
- Establish a code of good agricultural practice to protect waters from such pollution;
- Promote the application by farmers of the code of good agricultural practice;
- Identify the area or areas to which an action programme should be applied to protect waters from pollution by nitrates from agricultural sources;
- Develop and implement action programmes to reduce and prevent such pollution in the identified area: action programmes are to be implemented and updated on a four-year cycle;
- Monitor the effectiveness of the action programmes; and
- Report to the EU Commission on progress.

The Nitrates Directive defines those waters 'polluted or liable to pollution' as:

- Surface freshwaters, such as those used for the abstraction of drinking water, which contain, or could contain, if preventative action is not taken, nitrate concentrations greater than 50 mg/l NO_3;
- Groundwaters which contain, or could contain, if preventative action is not taken, nitrate concentrations greater than 50 mg/l NO_3; and
- Natural freshwater lakes, or other freshwater bodies, estuaries, coastal waters and marine waters which are found to be eutrophic or soon may become eutrophic if preventative action is not taken.

The Directive requires that each Member State should submit a report on the implementation of the Nitrates Directive at the end of each four-year programme. This seventh report covers the years 2016-2019. This Directive specifies that the report should include information on water quality monitoring, the action programmes and an evaluation of measures associated with these action programmes.

1.2.2 Previous Reporting Period 2012-2015

Since 2005, the responsibility for reporting under the Nitrates Directive has been assigned to the Environmental Protection Agency (EPA), under the European Communities (Good Agricultural Practice for Protection of Waters) Regulations (S.I. No. 788 of 2005), which implement the requirements of the Nitrates Directive.

The Article 10 Report for Ireland at the end of the sixth reporting period (2012-2015) was submitted in June 2016 by the Environmental Protection Agency and comprised information on the Action Programmes and information compiled by the Environmental Protection Agency on the evaluation of water quality. The sixth report and associated data are available at http://cdr.eionet.europa.eu/ie/eu/nid/.

This report and associated data are the seventh report for Ireland, covering the period 2016-2019.

1.3 Water Monitoring in Ireland

Under Article 10 of Ireland's National Regulations implementing the Water Framework Directive - European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003; as amended in 2014 by S.I. No. 350 of 2014) – the EPA was given authority for preparing the monitoring programme and for specifying the public authorities responsible for carrying out the monitoring.

The Irish WFD monitoring programme was published in 2006 (EPA, 2006), with monitoring starting in 2007. The programme encompasses the three categories of Surveillance, Operational and Investigative Monitoring specified in the WFD. Data from the Surveillance Monitoring Programme for surface water and the Surveillance and Operational Monitoring Programme for groundwater, which are representative of water quality in Irish waters generally, are used for Article 10 Nitrates Directive and European State of the Environment reporting via the European Environment Agency (EEA) Waterbase system.

1.4 Report Structure and Content

1.4.1 Report Structure

This Report has been produced in accordance with the European Commission's Nitrates Directive Article 10 Development Guide for Member States', published in 2020. The Report is split into sections as specified in the guidelines, which contain the following information:

- A description, with associated maps, of evolution of quality of freshwaters (surface and groundwater), transitional and marine waters since previous monitoring with respect to nitrates – Chapter 2.
- Description and justification of the designated vulnerable zones (including map), and of the extensions or additions carried out or envisaged – Chapter 3.
- An account of the development, promotion and implementation of the Good Agricultural

Practice Regulations, including a summary of national agricultural statistics for the national territory – Chapter 4.

- An account of the principal measures contained in the Action Programme, and a description of the precise way limits are being applied for the annual land application of organic nitrogen compounds – Chapter 5.

- The results of the evaluation of the action programmes – Chapter 6.

- A forecast of the future evolution of water body quality – Chapter 7.

Data reporting sheets and the maps that accompany this report and have been uploaded to the Central Data Repository at http://cdr.eionet.europa.eu/.

The structure and formats of the spatial and non-spatial data tables comply with the specification provided in the EU Reportnet Data Dictionary.

1.4.2 Note on Reporting Period Trend Analysis

The reporting guidelines require an analysis comparing water quality results from the current period with those reported under the previous period(s). Data for the previous reporting periods (2008-2011 and 2012-15) have been included in this report to enable the trend analysis to be undertaken.

1.5 General Context

The general physical features, water catchments and Article 10 monitoring locations for Ireland are shown on Maps 1-1 to 1-4. The Water Framework Directive River Basin Management Plan (2018-21) for Ireland has included two River Basin Districts (RBDs) to cater for the management of water nationally and internationally (with Northern Ireland). Water quality is assessed at an individual water body scale and this is aggregated to a sub-catchment and catchment scale to facilitate and prioritise water management.

2 EVALUATION OF WATER QUALITY

2.1 Groundwater

2.1.1 Groundwater Monitoring Network

A total of 200 groundwater stations are included in this report, spanning the 2016-2019 reporting period, which are a subset of the overall WFD Groundwater Monitoring Programme.

Table 2-1 indicates the number of groundwater monitoring stations, and the type of groundwater sampled during each reporting period.

Table 2-1: Number of Groundwater Monitoring Stations in each Reporting Period

	Reporting Period (2008-2011)	Reporting Period (2012-2015)	Reporting Period (2016-2019)	Common sampling points between last three reporting periods
Phreatic groundwater (0-5m)	26	25	25	25
Phreatic groundwater (5-15m)	90	88	87	87
Phreatic groundwater deep (15-30m)				
Phreatic groundwater (>30m)				
Captive groundwater	-	-	-	-
Karstic groundwater	95	92	88	88
Total	**211**	**205**	**200**	**200**
Notes: Section 2.1.2 provides an explanation of sampling depth.				

Table 2-2 indicates five stations that were included during the 2012-2015 reporting period were not included in the monitoring network for the current reporting period. These stations were removed from the monitoring network due to the closure of abstractions, primarily as part of national water supply rationalisation programmes.

In accordance with the guidance documents, no replacement/alternative stations have been added to the groundwater monitoring programme in 2016-2019 because all the dropped stations had average concentrations less than 25 mg/l NO_3.

Table 2-2: Stations removed from groundwater monitoring programme since 2012-2015

Removed Stations				Annual Average Concentration (mg/l NO_3)				Concentration less than 25 mg/l NO_3?	Reason for Removal
National Station Code	National Station Name	Longitude	Latitude	2012	2013	2014	2015		
IE_WE_G_0001_0300_0001	Ballyvaughan	-9.16526622	53.1018555	2.91	4.15	3.34	2.75	Yes	No longer in use as a drinking water supply, unable to sample from it.
IE_SH_G_0044_1300_0008	Kerry Spring Water	-10.3918768	52.1676364	8.62	8.50	10.04	11.74	Yes	Business closed, unable to get access to site.
IE_SE_G_0160_1400_0001	Athy UDWS (Townparks BH)	-6.9887215	52.9973213	15.76	18.16	No samples	No samples	Yes	Boreholes no longer in operation as supply was changed to surface water.
IE_NB_G_0016_2400_0007	Spring Lake	-6.69012179	53.9757554	9.88	8.16	7.31	No samples	Yes	Borehole decommissioned by local authority.
IE_SH_G_0105_2600_0009	Keadew	-8.1445764	54.0559903	5.13	4.66	6.50	5.98	Yes	Borehole decommissioned by local authority.

2.1.2 Note on Sampling Depth

The following two paragraphs are quoted from the WFD Programme Report (EPA, 2006) to explain why sampling depth reported is an estimate:

"Generally, sampling depth is not considered to be a critical factor when monitoring groundwater in the Republic of Ireland because most of the bedrock aquifers are unconfined and have fissure permeability only. The only aquifers in the Republic of Ireland with an intergranular permeability are the sand and gravels. Consequently, groundwater velocities in most Irish bedrock aquifers are relatively fast (a few metres/day) and mixing of groundwater in the top ~60m readily occurs. The proposed monitoring network uses points with relatively large groundwater abstractions, and these

are considered to give representative samples because they are not usually affected by local point source pollution.

In the case of springs, the sampling depth is at the ground surface. In boreholes, pumps are usually located towards the bottom of the boreholes; therefore, the sampling depths are determined by borehole depth. In some instances, screens are installed at the main water entry zones. In the remaining monitoring points, the boreholes are 'open hole', i.e. a liner or screen is not needed. Water can usually be drawn from all bedrock fractures in the borehole, i.e. from the total bedrock length. Therefore, the water sample is generally a composite of water from all fractures and/or conduits throughout the total length of bedrock in the borehole".

2.1.3 Nitrate Concentrations in Groundwater

The distribution of average nitrate concentrations for the period 2016-2019 are shown on Map 2-1 and the results are summarised in Table 2-3.

The results for 2016-2019 show that three of the 200 stations had average nitrate concentrations greater than 50 mg/l NO_3 and that 37 (18.5%) had concentrations greater than 25 mg/l NO_3.

- There has been a 5.5% increase in the number of stations with concentrations greater than 25 mg/l NO_3 since the 2012-2015 reporting period.
- Three stations (1.5%) had average concentrations greater than 50 mg/l NO_3, whereas none were greater than 50 mg/l NO_3 in the 2012-2015 reporting period.
- Most of the groundwater monitoring stations with average nitrate concentrations greater than 25 mg/l NO_3 are in the south east.

Table 2-3: Quality Classes for Average Nitrate Concentrations (mg/l NO_3) in Groundwater - number (and percentage) of sampling points

<table>
<tr><th rowspan="2"></th><th colspan="4">Number of sampling points mg/l NO3*</th></tr>
<tr><th><25</th><th>25-39.99</th><th>40-50</th><th>>50</th></tr>
<tr><td>Phreatic groundwater (0-5m)</td><td>20 (10%)</td><td>4 (2%)</td><td>0</td><td>1 (0.5%)[1]</td></tr>
<tr><td>Phreatic groundwater (5-15 m)</td><td rowspan="3">74 (37%)</td><td rowspan="3">12 (6%)</td><td rowspan="3">1 (0.5%)</td><td rowspan="3">0</td></tr>
<tr><td>Phreatic groundwater deep (15-30m)</td></tr>
<tr><td>Phreatic groundwater (>30m)</td></tr>
<tr><td>Captive groundwater</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Karstic groundwater</td><td>69 (34.5%)</td><td>16 (8%)</td><td>1 (0.5%)</td><td>2 (1%)[2]</td></tr>
<tr><td>Total (n=200)</td><td>163 (81.5%)</td><td>32 (16%)</td><td>2 (1%)</td><td>3 (1.5%)</td></tr>
<tr><td>2012-2015 period</td><td>178 (87%)</td><td>25 (12%)</td><td>2 (1%)</td><td>0</td></tr>
<tr><td>2008-2011 period</td><td>183 (87%)</td><td>23 (11%)</td><td>5 (2%)</td><td>0</td></tr>
<tr><td colspan="5">Notes:
*Rounding to 0.1%

1. Station code: IE_SE_G_0156_1600_0004
2. Station codes: IE_SW_G_0082_0500_0017; IE_SE_G_0156_1600_0005</td></tr>
</table>

The distribution of maximum nitrate concentrations for the period 2016-2019 are shown in Map 2-2 and the results summarised in Table 2-4.

The maximum nitrate values show that most (69%) stations had maximum concentrations lower than 25 mg/l NO_3 and a further 21.5% had maximum concentrations lower than 40 mg/l NO_3. Seven stations had maximum concentrations greater than 50 mg/l NO_3.

Table 2-4: Quality Classes for Maximum Nitrate Concentrations (mg/l NO_3) in Groundwater - number (and percentage) of sampling points

	Number of sampling points mg/l NO_3*			
	<25	**25-39.99**	**40-50**	**>50**
Phreatic groundwater (0-5m)	15 (7.5%)	6 (3%)	3 (1.5%)	1 (0.5%)[1]
Phreatic groundwater (5-15 m) Phreatic groundwater deep (15-30m) Phreatic groundwater (>30m)	59 (29.5%)	22 (11%)	4 (2%)	2 (1%)[2]
Captive groundwater	-	-	-	-
Karstic groundwater	64 (32%)	15 (7.5%)	5 (2.5%)	4 (2%)[3]
Total (n=200)	**138 (69%)**	**43 (21.5%)**	**12 (6%)**	**7 (3.5%)**
2012-2015 period	*149 (73%)*	*41 (20%)*	*9 (4%)*	*6 (3%)*
2008-2011 period	*134 (64%)*	*46 (22%)*	*15 (7%)*	*16 (8%)*

Notes:
*Rounding to 0.1%

1. Station code: IE_SE_G_0156_1600_0004
2. Station codes: IE_EA_G_0036_3400_0004; IE_SE_G_0131_3700_0004
3. Station codes: IE_SW_G_0082_0500_0017; IE_SE_G_0156_1600_0005; IE_SE_G_0156_1600_0006; IE_SE_G_0040_3700_0004

The trend since the last reporting period (2012-2015) is a 4% increase in the proportion of stations with maximum concentrations greater than 25 mg/l NO_3 (from 27% to 31%) and a slight increase (1 station) in stations with maximum concentrations greater than 50 mg/l NO_3 class (from 3% to 3.5%). Further analysis of the trend in concentration values is given in Section 2.1.4.

2.1.4 Nitrate Trend Analysis in Groundwater

The trend analysis compares average and maximum nitrate concentrations for the current reporting period (2016-2019) against values at corresponding stations from the previous reporting period (2012-2015).

Average and maximum nitrate concentration trends at the 200 stations are summarised in Table 2-5 and Table 2-6 respectively. Maps 2-3 and 2-4 show the respective trends in average and maximum nitrate concentrations since 2012-2015.

Table 2-5 shows that 7.5% of stations (15 stations) had a strong increase in average nitrate concentration with a further 30% of stations (60 stations) showing a weak increase in average nitrate concentration. Most of these increases have been observed in the south east and south west. There was a decrease in average nitrate concentration at 17% of stations, with concentrations stable at 45.5% of stations. The 15 stations showing a strong increase in average nitrate concentration are listed in Table 2-7.

In the 2012-2015 report, there were six stations identified as showing strongly increasing trends in average nitrate concentrations since 2008-2011. Of these six stations, only one (IE_SH_G_0027_1300_0012: Gale Bridge) has subsequently shown a decrease in average nitrate concentration. Of the remaining five stations, one has shown a weak increase in average nitrate concentration (IE_SE_G_0163_1500_0003: Ballyragget PWS), with the remainder showing a strong increase in average concentration since the 2012-2015 period.

Table 2-5: Trends in Average Groundwater Nitrate Concentrations - number (and percentage) of sampling points

Water bodies	Number of sampling points mg/l NO_3*				
	< -5	-5 to -1	-1 to +1	+1 to +5	> +5
Phreatic groundwater (0-5m)	0	7 (3.5%)	9 (4.5%)	8 (4%)	1 (0.5%)
Phreatic groundwater (5-15 m) Phreatic groundwater deep (15-30m) Phreatic groundwater (>30m)	2 (1%)	16 (8%)	45 (22.5%)	19 (9.5%)	5 (2.5%)
Captive groundwater	-	-	-	-	-
Karstic groundwater	2 (1%)	7 (3.5%)	37 (18.5%)	33 (16.5%)	9 (4.5%)
Total (n=200)	**4 (2%)**	**30 (15%)**	**91 (45.5%)**	**60 (30%)**	**15 (7.5%)**

Notes:
*Rounding to 0.1%

Trend classes between current and previous reporting period:
Strong increase: > +5 mg/l NO_3
Weak increase: +1 to +5 mg/l NO_3
Stable: -1 to +1 mg/l NO_3
Weak decrease: -1 to -5 mg/l NO_3
Strong decrease: < -5 mg/l NO_3

Table 2-6: Trends in Maximum Groundwater Nitrate Concentrations - number (and percentage) of sampling points

Water bodies	Number of sampling points mg/l NO_3*				
	< -5	-5 to -1	-1 to +1	+1 to +5	> +5
Phreatic groundwater (0-5m)	3 (1.5%)	7 (3.5%)	6 (3%)	6 (3%)	3 (1.5%)
Phreatic groundwater (5-15 m) Phreatic groundwater deep (15-30m) Phreatic groundwater (>30m)	7 (3.5%)	19 (9.5%)	27 (13.5%)	21 (10.5%)	13 (6.5%)
Captive groundwater	-	-	-	-	-
Karstic groundwater	8 (4%)	11 (5.5%)	24 (12%)	26 (13%)	19 (9.5%)
Total (n=200)	**18 (9%)**	**37 (18.5%)**	**57 (28.5%)**	**53 (26.5%)**	**35 (17.5%)**

Notes:
*Rounding to 0.1%

Trend classes between current and previous reporting period:
Strong increase: > +5 mg/l NO_3
Weak increase: +1 to +5 mg/l NO_3
Stable: -1 to +1 mg/l NO_3
Weak decrease: -1 to -5 mg/l NO_3
Strong decrease: < -5 mg/l NO_3

Table 2-6 shows that the maximum nitrate concentration has increased at approximately 44% of stations, with a weak increase and strong increase in maximum nitrate concentration recorded at 53 and 35 stations, respectively. The maximum nitrate concentration was stable at 57 stations (28.5%), with a decrease in the maximum nitrate concentration at the remaining 55 stations (27.5%).

Overall, since the 2012-2015 report, strong increases in the average or maximum nitrate groundwater concentration have been seen in 7.5% and 17.5% of stations respectively.

Table 2-7: Stations Showing a Strong Increase in Average Nitrate Concentrations in Groundwater since 2012-2015

National Station Name	National Station Code	Average Nitrate Concentration (mg/l NO_3)		Maximum Nitrate Concentration (mg/l NO_3)		Average Concentration (mg/l NO_3) at Stations with a Strong Concentration Increase	Was a Strong Concentration Increase Identified in the 2012-2015 Report?
		2012-2015	2016-2019	2012-2015	2016-2019		
IE_SE_G_0160_0100_0001	Baganelstown PWS (BH-C)	34.73	42.00	48.71	48.71	7.27	No
IE_NW_G_0011_0600_0004	Pettigo	3.18	8.55	8.41	41.19	5.37	No
IE_SE_G_0128_1500_0004	Bennettsbridge RWS (BH2)	18.86	25.91	24.33	38.97	7.05	No
IE_SE_G_0128_1500_0019	Thomastown WS (BH 9, GAA Grounds)	23.18	32.14	32.11	35.43	8.96	Yes
IE_SE_G_0156_1600_0004	Cullohill GWS (Toberboe Spring)	36.95	57.68	48.71	84.14	20.73	No
IE_SE_G_0156_1600_0005	Durrow PWS (Fermoyle WS)	45.25	56.28	70.86	97.43	11.03	Yes
IE_SE_G_0156_1600_0006	Durrow PWS (Presentation Convent Well)	30.15	38.57	42.96	57.57	8.42	No
IE_SH_G_0251_2500_0009	Moneygall (Busherstown Well)	19.53	25.21	28.34	48.71	5.67	No
IE_SE_G_0131_3700_0002	Bouladuff / Borrisoleigh PWS (BH1)	9.51	15.35	17.27	33.66	5.84	No
IE_SE_G_0131_3700_0004	Kilmakill	19.57	27.11	27.90	53.14	7.54	No
IE_SE_G_0158_3700_0009	Thurles WS (Tobernaloo)	21.72	27.01	27.90	43.84	5.30	Yes
IE_SE_G_0040_3700_0004	Fethard RWS (Laffansbridge)	31.45	38.16	55.61	70.86	6.71	No
IE_SE_G_0119_3700_0006	Inchirourke	22.15	30.19	29.67	34.10	8.03	Yes
IE_SE_G_0131_3700_0012	Toberadorah Springs	24.69	30.59	28.79	48.71	5.91	No
IE_EA_G_0036_3400_0004	Bulford Farm	21.12	27.72	23.91	84.14	6.60	No

2.2 Surface Water Monitoring – Lakes and Rivers

2.2.1 Rivers and Lakes Monitoring

The WFD surface water monitoring programme started in 2007. The surveillance monitoring network serves as the core representative network for the WFD, Nitrates Directive and State of the Environment reporting via the EEA WISE network.

The surveillance monitoring network has remained relatively stable with a few minor amendments to stations based on safety grounds and to make it more representative of Irish rivers and lakes. Data are presented in this report for 180 surveillance monitoring river stations and 74 surveillance monitoring lakes from the WFD National Monitoring Programme. The previous report also presented results for these 180 river stations and 74 lakes (Table 2-8).

Table 2-8: Surface Water Monitoring Network (Rivers and Lakes)

Water bodies	Reporting Period			Common sampling points between last three reporting periods
	2008-2011	2012-2015	2016-2019	
Rivers	178	180	180	178
Lakes	74	74	74	74

No river or lake stations were removed since the 2012-2015 reporting period and therefore no further information is required on replacement / alternative stations.

2.2.2 Nitrate Concentrations in Lakes and Rivers

Annual average, winter average and maximum nitrate concentrations for the current and previous reporting periods are summarised for rivers and lakes in Table 2-9. Annual average, winter average and maximum nitrate concentrations for 2016-2019 in rivers and lakes are shown on Maps 2-5 to 2-10.

Nitrate concentrations in Irish rivers stations are lower than the European average, with 24.4% of river stations showing average concentrations greater than 10 mg/l NO_3.

- Two river stations recorded concentrations greater than 25 mg/l NO_3.
- The highest annual average was 32.11 mg/l NO_3 and the highest winter average was 33.88 mg/l NO_3 (recorded in the same river).
- The highest maximum concentration recorded was 52.8 mg/l NO_3, and that was the only location with a maximum concentration greater than 50 mg/l NO_3.
- The highest riverine nitrate concentrations are observed in the south east.

There has been little change in the proportion of rivers in each annual average concentration quality class since 2012-2015. The winter average concentration has seen a ~5% increase in the percentage of river stations recording winter concentrations greater than 10 mg/l NO_3. The maximum concentration data suggest an ~10% increase in river stations recording concentrations greater than 25 mg/l NO_3 when compared to 2012-2015 data.

Most lakes had concentrations less than 2 mg/l NO_3 range for both the annual average (94.6%) and winter average (91.9%). No lakes were found to have annual average or winter average nitrate concentrations above 10 mg/l NO_3. Maximum nitrate concentrations exceeded 10 mg/l NO_3 in six lakes, with 12.85 mg/l NO_3 being the maximum lake concentration recorded.

Table 2-9: Quality classes for Nitrate Concentrations in Rivers and Lakes: 2008-2011; 2012-2015; and 2016-2019 – Number of sampling points (and percentage)

Water bodies	Quality classes (mg/l NO_3)*					
	0-1.99	2-9.99	10-24.99	25-39.99	40-50	>50
Rivers annual average						
2016-2019	59 (32.8%)	77 (42.8%)	42 (23.3%)	2 (1.1%)	0	0
2012-2015	59 (32.6%)	81 (44.8%)	39 (21.6%)	2 (1.1%)	0	0
2008-2011	52 (29.2%)	84 (47.2%)	40 (22.5%)	2 (1.1%)	0	0
Rivers winter average[1]						
2016-2019	51 (28.3%)	75 (41.7%)	52 (28.9%)	2 (1.1%)	0	0
2012-2015	51 (28.2%)	85 (47.0%)	43 (23.8%)	2 (1.1%)	0	0
2008-2011	51 (28.7%)	84 (47.2%)	40 (22.5%)	3 (1.7%)	0	0
Rivers maximum						
2016-2019	10 (5.6%)	82 (45.6%)	61 (33.9%)	24 (13.3%)	2 (1.1%)	1 (0.6%)
2012-2015	19 (10.5%)	79 (43.7%)	75 (41.4%)	8 (4.4%)	1 (0.6%)	0
2008-2011	19 (10.7%)	66 (37.1%)	69 (38.8%)	22 (12.3%)	2 (1.1%)	0
Lakes annual average						
2016-2019	70 (94.6%)	4 (5.4%)	0	0	0	0
2012-2015	71 (96%)	3 (4%)	0	0	0	0
2008-2011	70 (95%)	4 (5%)	0	0	0	0
Lakes winter average						
2016-2019	68 (91.9%)	6 (8.1%)	0	0	0	0
2012-2015	67 (91%)	5 (7%)	0	0	0	0
2008-2011	69 (93%)	7 (9%)	0	0	0	0
Lakes maximum						
2016-2019	22 (29.7%)	46 (62.2%)	6 (8.1%)	0	0	0
2012-2015	23 (31%)	47 (64%)	4 (5%)	0	0	0
2008-2011	34 (46%)	39 (53%)	1 (1%)	0	0	0
Notes: *Rounding to 0.1%						

2.2.3 Nitrate Trend Analysis in Lakes and Rivers

Table 2-10 shows the trends in annual average, winter average and maximum nitrate concentrations in rivers and lakes since the previous reporting cycles. Maps 2-11 to 2-16 show the results of the annual average, winter average and maximum nitrate concentrations trend analysis for rivers and lakes since 2012-2015.

Significant increases in the average annual nitrate concentrations have been observed since the 2012-2015 report, with ~13% of rivers showing a weak increase and 1% showing a strong increase in average annual nitrate concentrations. This is replicated in the winter average concentration in rivers, with ~8% of rivers showing a weak increase and 1% showing a strong increase in the winter average concentration. Most of these increases have been observed in the south east.

The maximum nitrate concentration in rivers has seen significant increases, with approximately 50% of rivers showing either a weak or strong increase in maximum nitrate concentration, compared to 23% of rivers in 2012-2015.

In contrast to the rivers, nitrate concentrations in lakes are stable with very little change across all three reporting periods for annual average and winter average lake nitrate concentrations. While there is greater variability in the maximum lake nitrate concentrations in 2016-2019 than in previous reports, there is no obvious trend apparent, although 2016-2019 seems to represent a slight improvement in maximum nitrate concentration when compared to 2012-2015.

Table 2-10: Change in River and Lake Nitrate Concentrations since the previous reporting period – Number of sampling points (and percentage)

Water bodies	Number of sampling points (% of points)*				
	< -5	-5 to -1	-1 to +1	+1 to +5	> +5
Rivers annual average 2016-2019 2012-2015 2008-2011	 0 0 9 (6.1%)	 6 (3.3%) 21 (11.9%) 64 (43.2%)	 139 (77.2%) 127 (83.0%) 72 (48.7%)	 33 (18.3%) 9 (5.1%) 3 (2.0%)	 2 (1.1%) 0 0
Rivers winter average 2016-2019 2012-2015 2008-2011	 0 0 20 (13.5%)	 4 (2.2%) 15 (8.5%) 72 (48.6%)	 126 (70.0%) 143 (81.3%) 53 (35.8%)	 48 (18.3%) 18 (10.2%) 3 (2.0%)	 2 (1.1%) 0 0
Rivers maximum 2016-2019 2012-2015 2008-2011	 13 (7.2%) 22 (12.4%) 26 (17.6%)	 29 (16.1%) 68 (38.4%) 36 (24.3%)	 47 (26.1%) 46 (26.0%) 46 (31.1%)	 53 (29.4%) 28 (15.8%) 30 (20.3%)	 38 (21.1%) 13 (7.3%) 10 (6.8%)
Lakes annual average 2016-2019 2012-2015 2008-2011[a]	 0 0 0	 0 0 4 (7%)	 74 (100%) 74 (100%) 57 (93%)	 0 0 0	 0 0 0
Lakes winter average 2016-2019 2012-2015 2008-2011[a]	 0 0 0	 1 (1.4%) 0 7 (14%)	 72 (97.3%) 73 (99%) 42 (86%)	 1 (1.4%) 1 (1%) 0	 0 0 0
Lakes maximum 2016-2019 2012-2015 2008-2011[a]	 4 (5.4%) 0 6 (10%)	 20 (27.0%) 8 (11%) 9 (15%)	 21 (28.4%) 31 (42%) 35 (57%)	 22 (29.7%) 29 (39%) 11 (18%)	 7 (9.5%) 6 (8%) 0

Notes:
*Rounding to 0.1%
[a] Not all 74 lakes monitored in 2008-2011 were previously monitored in 2004-2007. Monitoring began at some lakes in 2007 in response to WFD monitoring requirements.

Trend classes between current and previous reporting period:
Strong increase: > +5 mg/l
Weak increase: +1 to +5 mg/l
Stable: -1 to +1 mg/l
Weak decrease: -1 to -5 mg/l
Strong decrease: < -5 mg/l

2.2.4 Eutrophication in Lakes and Rivers

The assessment of trophic condition in Irish rivers is based on biological assessments using a biotic index scheme using aquatic macroinvertebrate communities. The EPA Quality Rating System (Q-Value) enables an assessment of the biological response to eutrophication and organic pollution in a predictable manner. The method has been inter-calibrated for the pressure 'organic enrichment' at an EU level under the WFD.

As it is not strictly a trophic status system it must be used with some caveats, as not all pollution of Irish rivers is due to eutrophication. It is used in this report because it enables trend analysis of the data that has been gathered in Ireland since the first Nitrates Directive Article 10 report. The scheme is WFD-compliant and incorporates the WFD's normative definitions for ecological status. The biotic index contains five levels of ecological status, as defined by specific assemblages of macro invertebrates.

In accordance with the Nitrates Directive Article 10 assessment and reporting guidelines, the five classes historically used to indicate trophic condition have been modified to the three classes; "Non-eutrophic"; "Could become eutrophic"; and "Eutrophic". Table 2-11 relates the Q-Values to WFD ecological status, trophic condition and trophic state.

As indicated in the reporting guidelines, mesotrophic water bodies are at the interface between non-eutrophic and eutrophic water designations. In order to differentiate eutrophication levels in these mesotrophic waters, river phosphorus data has been considered, with phosphorus concentrations lower than the Irish Good Status EQS (0.035 mg/l P) reverting to a non-eutrophic designation and concentrations above 0.05 mg/l P being assigned a eutrophic designation. The remaining mesotrophic waters have been assigned the category "Could become eutrophic".

Table 2-11: Biotic Index for Indication of Water Quality

WFD Ecological Status	Q-Values	Trophic Condition	Phosphorus Concentration (mg/l P)	Article 10 Trophic State
High	5, 4-5	Ultra-oligotrophic	-	Non-eutrophic
Good	4	Oligotrophic	-	Non-eutrophic
Moderate	3-4	Mesotrophic	<0.035	Non-eutrophic
			0.035-0.05	Could become eutrophic
			>0.05	Eutrophic
Poor	3, 2-3	Eutrophic	-	Eutrophic
Bad	2, 1-2, 1	Hypertrophic	-	Eutrophic

In the previous 2012-2015 report, lake water quality in Ireland was assessed using a modified version of the OECD scheme based on the annual maximum chlorophyll concentration. In accordance with the updated Nitrates Directive Article 10 assessment and reporting guidelines, the six classes historically used to indicate trophic condition have been modified to the three classes; "Non-eutrophic"; "Could become eutrophic"; and "Eutrophic".

The overall trophic state of Irish lakes is therefore based on the assessment of WFD nutrient standards and WFD biological quality elements that are known to be sensitive to nutrient enrichment. The component parts are total phosphorus, macrophytes, phytobenthos and phytoplankton. All biological assessment methods have been intercalibrated for the pressure 'enrichment' at an EU level under the WFD. The scheme is WFD-compliant and incorporates the WFD's normative definitions for ecological status.

In accordance with the European guidance on eutrophication (EC, 2009), where the combination of nutrient enrichment indicators indicates nutrient enrichment i.e. poor or bad status, these have been categorised as being eutrophic. Where the combination of nutrient enrichment indicators indicates slight nutrient enrichment i.e. moderate status, then this equates to the definition of mesotrophic, and are categorised as "Could become eutrophic". All other lakes are categorised as being non-eutrophic.

In relation to these lake assessments, the influence of other non-nutrient related WFD biological quality elements, primarily presence/absence of fish, has also been considered in this assessment. If a lake has not reached Good Status due to non-nutrient pressures and the nutrients or biological quality elements indicators do not indicate eutrophication, then they are not assigned an Article 10 category of eutrophic.

2.2.5 Trophic Condition of River and Lakes

Biological sampling is undertaken on a three-yearly rolling basis, so every river and lake is sampled at least one year in three. Therefore, rivers and lakes may have been visited more than once in the 2016-2019 reporting period. When this happens, data from the most recent biological sampling is used to determine the biological condition.

Biological condition was assessed at 178 of the 180 rivers included in the Article 10 assessment during the 2016-2019 reporting period. The total number and proportion of stations in each trophic status class are presented in Table 2-12 for the 2008-2011, 2012-2015 and 2016-2019 periods. The trophic state results for rivers from 2016-2019 are shown on Map 2-17.

Table 2-12: Trophic State of Rivers

Sampling Period	Stations Sampled	Trophic State – Number and Percentage of Sampling Stations		
		Non-Eutrophic	Could Become Eutrophic	Eutrophic
2016 - 2019	178	144 (81%)	5 (3%)	29 (16%)
2012 - 2015	180	142 (79%)	6 (3%)	32 (18%)
2008 - 2011	178	139 (78%)	7 (4%)	32 (18%)

Table 2-12 indicates that 81% of all river stations were recorded as non-eutrophic in 2016-2019, with a net improvement of four rivers becoming less eutrophication since the previous reporting period(s).

Table 2-13: Trend in Trophic State for Rivers from 2012-2015 to 2016-2019 - Number of sampling points (and Percentage)

	Change in Trophic State – No. of stations (and percentage)				
	Strong decrease	Weak decrease	Stable	Weak increase	Strong increase
Rivers (n=178)	11 (6%)	1 (1%)	154 (87%)	4 (2%)	8 (4%)

Explanation of change classes:

Strong increase: Non-eutrophic to Eutrophic
Weak increase: Could become eutrophic to Eutrophic or Non-eutrophic to Could become eutrophic
Stable: No change in class
Weak decrease: Eutrophic to Could become eutrophic or Could become eutrophic to Non-eutrophic
Strong decrease: Eutrophic to Non-eutrophic

There are 178 river monitoring stations that are common to the 2012-2015 and 2016-2019 reporting periods. The trend in trophic status is shown in Table 2-13 and Map 2-18. Overall, Table 2-13 indicates that the riverine eutrophic state has been stable since 2012-2015, with 87% of rivers not changing trophic state. However, the south east is where rivers have started to show the greatest signs of change to more a more eutrophic state.

The biological condition was assessed at all 74 of the lakes included in the Article 10 assessment during the 2016-2019 reporting period. The total number and proportion of stations in each trophic status class are presented in Table 2-14 for the 2008-2011, 2012-2015 and 2016-2019 periods. The trophic state results for lakes from 2016-2019 are shown on Map 2-19.

Table 2-14: Trophic State of Lakes

Sampling Period	Lakes Sampled	Trophic Status – Number of Lakes (and percentage)		
		Non-Eutrophic	Could Become Eutrophic	Eutrophic
2016 - 2019	74	49 (66%)	19 (26%)	6 (8%)
2012 - 2015	74	48 (65%)	18 (24%)	8 (11%)
2008 - 2011	74	47 (64%)	21 (28%)	6 (8%)
Notes: Monitoring data presented in each reporting period took place in 2017-2019; 2013-2015; and 2010-2012 respectively.				

Table 2-14 indicates that 66% of all lakes were recorded as non-eutrophic in 2016-2019, compared with 65% in 2012-2015 and 64% in 2008-2011. Overall this represents a slight net water quality improvement, with fewer lakes exhibiting signs of eutrophication.

There are 74 lakes that are common to the 2012-2015 and 2016-2019 reporting periods. The trend in trophic status is shown in Table 2-15 and Map 2.20. Table 2-15 indicates that most lakes (82%) have not changed trophic state since the last reporting period. Overall, there was a slight improvement in lake trophic state, with 11% of lakes improving, compared to 7% showing decline.

Table 2-15: Trend in Trophic State for Lakes from 2012-2015 to 2016-2019 - Number of sampling points (and Percentage)

	Change in Trophic State – No. of stations (and %)				
	Strong decrease	Weak decrease	Stable	Weak increase	Strong increase
Lakes (n=74)	0	8 (11%)	61 (82%)	5 (7%)	0
Explanation of change classes: Strong increase: Non-eutrophic to Eutrophic Weak increase: Could become eutrophic to Eutrophic or Non-eutrophic to Could become eutrophic Stable: No change in class Weak decrease: Eutrophic to Could become eutrophic or Could become eutrophic to Non-eutrophic Strong decrease: Eutrophic to Non-eutrophic					

2.3 Surface Water Monitoring – Transitional, Coastal and Marine Waters

2.3.1 Monitoring Network for Transitional, Coastal and Marine Waters

Monitoring data for the current reporting period were obtained for 122 WFD surveillance monitoring stations for transitional and coastal stations from the WFD National Monitoring Programme. The data have been summarised for the current period 2016-2019 and compared to the previous reporting periods (2008-2011 and 2012-2015). A breakdown of the numbers and types of monitoring stations is given in Table 2-16.

Table 2-16: Number of transitional and coastal stations with Nitrate monitoring

Water bodies	Reporting Period			Common sampling points between last three reporting periods
	2008-2011	2012-2015	2016-2019	
Transitional	99	108	95	69
Coastal	24	32	27	20
Total	123	140	122	89

Most transitional and coastal water bodies have several monitoring stations and the monitoring data are collectively considered to determine the nutrient and biological condition. A total of 21 previously monitoring stations were not monitored in 2016-2019. Three of these 21 stations are only assessed for biological condition (relevant to trophic state) and 18 are stations are only assessed for nitrate concentrations.

Trophic state assessments were last made at SW_230_0100 (transitional water body) in 2008-2011 and therefore, this station is not referenced in Table 2-17. Table 2-17 indicates two stations were dropped/changed since 2012-2015 with trophic state assessments made at NW_120_0000 (transitional water body) and WE_460_0000 (coastal water body) in 2012-2015. NW_120_0000 has subsequently been identified as a coastal water body in this report i.e. it was incorrectly reported as a transitional water body in previous reports.

Table 2-17: Stations removed/changed from transitional and coastal waters trophic state monitoring programme since 2012-2015

Removed Stations					Trophic State		Concentration less than 25 mg/l NO_3?	Reason for Removal
National Station Code	National Station Name	Water Type	Longitude	Latitude	2008-2011	2012-2015		
NW_120_0000	Gweebarra Bay	Transitional	-8.43709	54.87507	Non-eutrophic (unpolluted)	Non-eutrophic (unpolluted)	Yes	Still being monitored and reported on, but now as a coastal water body with the same National Station Code
WE_460_0000	Ballysadare Bay	Coastal	-8.61056	54.24526	Non-eutrophic (unpolluted)	Non-eutrophic (unpolluted)	Yes	Sampling issues; adjacent transitional water body (WE_460_0300) is sampled and reported on.

Of these 18 stations where nitrate concentrations are monitored, nine were still being monitored in 2012-2015 and nine were last monitored in 2008-2011. Table 2-18 identifies the nine stations that were dropped since 2012-2015.

The eight stations dropped in 2008-2011 were AV000; ER005; SR000; CC110; CC120; MS000; SN400 (all transitional water bodies) and KK030; KK050 (both coastal water bodies).

Table 2-18 Stations removed from transitional and coastal waters nitrates monitoring programme since 2012-2015

Removed Stations					Annual Average Concentration (mg/l NO_3)				Concentration less than 25 mg/l NO_3?	Reason for Removal
National Station Code	National Station Name	Water Type	Longitude	Latitude	2012	2013	2014	2015		
SR100	R. Nore at Brownsbarn Br.	Transitional	-7.0913815	52.5006981	13.52	No samples	No samples	No samples	Yes	Sampling issues; several other sampling locations in the Nore Estuary (SE_100_0400)
KK010	Kilbrickan Pier	Coastal	-9.6308832	53.3605423	0.12	No samples	No samples	No samples	Yes	Sampling issues; several other sampling locations in Kilkieran Bay WE_200_0000)
KK020	Flannery Bridge	Coastal	-9.702466	53.3564301	0.17	No samples	No samples	No samples	Yes	Sampling issues; several other sampling locations in Kilkieran Bay (WE_200_0000)
KK040	Oilean na dTrachta	Coastal	-9.635272	53.3032646	0.16	No samples	No samples	No samples	Yes	Sampling issues; several other sampling locations in Kilkieran Bay (WE_200_0000)
GW020	Opposite Derryhenny	Transitional	-8.2421417	54.8816071	0.31	No samples	No samples	No samples	Yes	Sampling issues; several other sampling locations in Gweebarra Estuary (NW_120_0100)
SB150	R Ballisodare at Ballisodare Bridge	Transitional	-8.509553	54.2097588	1.17	No samples	No samples	No samples	Yes	Sampling issues; several other sampling locations in Ballysadare Estuary (WE_460_0300)
MS030	Kinvarra Bridge	Transitional	-9.5618267	53.3357925	0.12	No samples	No samples	No samples	Yes	Sampling issues; several other sampling locations in Camus Bay (WE_200_0200)
MS040	An Silear pier	Transitional	-9.5943546	53.3373756	0.14	No samples	No samples	No samples	Yes	Sampling issues; several other sampling locations in Camus Bay (WE_200_0200)
MS060	Loch an aibhinn, Camus Bay	Transitional	-9.5714655	53.3147621	0.23	0.17	No samples	No samples	Yes	Sampling issues; several other sampling locations in Loch an aibhinn, Camus Bay (WE_200_0700)

The stations removed from the monitoring network after 2012-2015 were excluded due to operational and sampling reasons, and there are already several stations being monitored in the associated transitional or coastal water bodies.

No replacement/alternative stations have been added to the transitional and coastal monitoring programme in 2016-2019 because all the dropped stations had average concentrations less than 25 mg/l NO_3 and there are already several other stations being monitored in these water bodies.

2.3.2 Nitrate Concentrations in Transitional, Coastal and Marine Waters

The average annual, winter average and maximum nitrate concentrations for the transitional and coastal monitoring stations are shown on Maps 2-21 to 2-23 and summarised in Table 2-19. Nitrate is measured as dissolved inorganic nitrogen, which has been converted to nitrate assuming that all measured nitrogen is present as nitrate. Direct nitrate measurements are not taken at these stations.

Table 2-19: Quality classes for Nitrate Concentrations in Transitional and Coastal Waters: 2008-2011; 2012-2015; and 2016-2019 – Number of sampling points (and percentage)

Water bodies	Quality classes (mg/l NO_3)*					
	0-1.99	2-9.99	10-24.99	25-39.99	40-50	>50
Transitional annual average						
2016-2019	55 (57.9%)	31 (32.6%)	9 (9.5%)	0	0	0
2012-2015	54 (32.6%)	27 (44.8%)	8 (21.6%)	0	0	0
2008-2011	53 (29.2%)	37 (47.2%)	9 (22.5%)	0	0	0
Transitional winter average[1]						
2016-2019	39 (41%)	42 (44.2%)	14 (14.8%)	0	0	0
2012-2015	36 (40.9%)	41 (46.6%)	11 (12.5%)	0	0	0
2008-2011	33 (34.7%)	44 (46.3%)	18 (19%)	0	0	0
Transitional maximum						
2016-2019	31 (32.6%)	42 (44.2%)	20 (21.1%)	2 (2.1%)	0	0
2012-2015	31 (34.4%)	42 (46.7%)	16 (17.8%)	0	1 (1.1%)	0
2008-2011	23 (23.2%)	49 (49.5%)	18 (18.2%)	8 (8.1%)	0	1 (1%)
Coastal annual average						
2016-2019	26 (96.3%)	1 (3.7%)	0	0	0	0
2012-2015	27 (96.4%)	1 (3.6%)	0	0	0	0
2008-2011	25 (100%)	0	0	0	0	0
Coastal winter average[1]						
2016-2019	26 (96.3%)	1 (3.7%)	0	0	0	0
2012-2015	25 (83.3%)	5 (16.7%)	0	0	0	0
2008-2011	19 (82.6%)	4 (17.4%)	0	0	0	0
Coastal maximum						
2016-2019	17 (63%)	9 (33.3%)	0	0	0	1 (3.7%)
2012-2015	20 (71.4%)	8 (28.6%)	0	0	0	0
2008-2011	17 (68%)	7 (28%)	1 (4%)	0	0	0
Notes: *Rounding to 0.1% 1. Not all locations are sampled in winter						

In 2016-2019, all transitional and coastal waters recorded winter and annual averages below 25 mg/l NO_3. This was the case during the previous reporting periods and nationally there have been lower concentrations recorded in transitional and coastal waters than in previous reporting periods.

Maximum concentrations can be variable due to the influence of a single sampling event. In 2016-2019, one coastal location was influenced by such a single sampling event, with low concentrations measured in other samples at this location. Otherwise the concentrations in coastal waters remain stable when compared to previous reporting. Greater variability is observed in the maximum concentrations in transitional waters, but again nationally, there appears to be stability when compared with previous reporting.

It must be noted that these concentrations are face-value and not related to the salinity of the sample. Similar assessments for trophic status and WFD assessments are calculated on a water body basis with salinity-corrected assessment criteria.

2.3.3 Nitrate Trend Analysis in Transitional and Coastal Waters

Annual average, winter average and maximum nitrate concentrations were compared at the 89 transitional and coastal monitoring stations common to the 2016-2019, 2012-2015 and 2008-2011 periods. The trend analysis results are summarised in Table 2-20 and the trend comparisons for annual average, winter average and maximum nitrate concentrations between 2012-2015 and 2016-2019 are shown on Maps 2-24 to 2-26.

The average nitrate concentrations have been stable in 91.6% of transitional water bodies since 2012-2015, but concentration reductions reported in the 2012-2015 and 2008-2011 reports are no longer evident. Where increases in nitrate concentration in transitional waters have been observed, they are predominantly occurring in the south east. There is greater variability in the winter average concentrations with a greater number of transitional waters having increases nitrate concentration in 2016-2019 than occurred in previous reporting periods. Maximum nitrate concentrations also have increased more than in previous reporting periods.

Stable average and winter average nitrate concentrations are evident in over 90% of coastal waters. The maximum concentrations show a greater degree of variability, with an increased number of waters showing a weak increase in maximum nitrate concentration than in the previous reporting periods.

This simple trend analysis does not consider the salinity of the samples, the diluting capacity of seawater or the variable dynamics of the marine environment. Overall the trends in transitional and coastal water show that the annual, winter and maximum nitrate concentrations have generally remained stable.

Table 2-20: Change in Transitional and Coastal Waters Nitrate Concentrations since the previous reporting period – Number of sampling points (and percentage)

Water bodies	Number of sampling points (% of points)*				
	< -5	-5 to -1	-1 to +1	+1 to +5	> +5
Transitional annual average					
2016-2019	0	3 (3.6%)	76 (91.6%)	4 (4.8%)	0
2012-2015	0	12 (14.5%)	67 (80.7%)	4 (4.8%)	0
2008-2011	8 (8.1%)	27 (27.3%)	63 (63.6%)	1 (1%)	0
Transitional winter average					
2016-2019	0	6 (9.2%)	44 (67.7%)	12 (18.5%)	3 (4.6%)
2012-2015	1 (1.3%)	28 (36.8%)	38 (50%)	8 (10.6%)	1 (1.3%)
2008-2011	2 (2.5%)	25 (31.3%)	46 (57.5%)	7 (8.7%)	0
Transitional maximum					
2016-2019	0	13 (16.9%)	44 (57.1%)	18 (23.4%)	2 (2.6%)
2012-2015	13 (20.7%)	16 (25.4%)	29 (46%)	4 (6.3%)	1 (1.6%)
2008-2011	18 (18.1%)	17 (17.2%)	36 (36.4%)	13 (13.1%)	15 (15.2%)
Coastal annual average					
2016-2019	0	0	21 (95.5%)	1 (4.5%)	0
2012-2015	0	0	22 (95.7%)	1 (4.3%)	0
2008-2011	0	0	24 (100%)	0	0
Coastal winter average					
2016-2019	0	1 (4%)	23 (92%)	1 (4%)	0
2012-2015	0	2 (9.5%)	19 (90.5%)	0	0
2008-2011	0	4 (26.7%)	11 (73.3%)	0	0
Coastal maximum					
2016-2019	0	1 (2.2%)	18 (40%)	25 (55.6%)	1 (2.2%)
2012-2015	0	10 (55.6%)	8 (44.4%)	0	0
2008-2011	0	4 (23.5%)	11 (64.7%)	1 (5.9%)	1 (5.9%)

Notes:
*Rounding to 0.1%

Trend classes between current and previous reporting period:
Strong increase: > +5 mg/l
Weak increase: +1 to +5 mg/l
Stable: -1 to +1 mg/l
Weak decrease: -1 to -5 mg/l
Strong decrease: < -5 mg/l

2.3.4 Eutrophication in Transitional, Coastal and Marine Waters

Since 2001, the Trophic Status Assessment Scheme (TSAS) has been adopted to measure sensitivity to eutrophication in transitional, coastal and marine stations. The system is based on evaluating water quality parameters against a set of criteria which are grouped into the following three categories related to the median salinity of the sample:

- criteria for nutrient enrichment;
- criteria for accelerated growth of phytoplankton and macroalgae, and
- criteria for “undesirable disturbance” (EPA, 2010).

A detailed description of the system is given in the EPA Water Quality in Ireland Report 2007-2009 (EPA, 2010). Historically, water bodies are classified and reported as being Eutrophic; Potentially Eutrophic; Intermediate; and Unpolluted.

In accordance with the Nitrates Directive Article 10 assessment and reporting guidelines, the four classes historically used to indicate trophic condition have been modified to the three classes; "Non-eutrophic"; "Could become eutrophic"; and "Eutrophic".

In relation to transitional and coastal waters; where the TSAS assessment indicates that the water is unpolluted then they are designated as being non-eutrophic; where they are potentially eutrophic and intermediate they are designated as being "could become eutrophic"; and previously designated eutrophic waters remain at a eutrophic designation.

2.3.5 Trophic Condition of Transitional, Coastal and Marine Waters

Trophic Status is assessed at the water body level. The TSAS assessment covers 25 water bodies from the WFD monitoring programme. Trophic status is assigned on a whole-water body basis using the most recent combined three-year assessment. These waters were also assessed for trophic condition in 2012-2015 and 2008-2011.

Map 2-27 shows the trophic status classes in these waters in 2016-2019 and the results for this period and the previous two reporting periods are summarised in Table 2-21.

Table 2-21: Trophic State of Transitional and Coastal Waters in 2016-2019

Sampling Period	Water Bodies	Trophic State – Number of water bodies (and percentage)		
		Non-Eutrophic	Could Become Eutrophic	Eutrophic
Transitional Waters				
2016 - 2019	18	12 (67%)	2 (11%)	4 (22%)
2012 - 2015	18	10 (56%)	5 (28%)	3 (16%)
2008 - 2011	18	10 (56%)	7 (39%)	1 (5%)
Coastal Waters				
2016 - 2019	7	5 (71%)	2 (29%)	0
2012 - 2015	7	6 (86%)	1 (14%)	0
2008 - 2011	7	6 (86%)	1 (14%)	0

Table 2-21 indicates that 12 of the 18 transitional waters were recorded as non-eutrophic in 2016-2019, compared with ten in both 2012-2015 and 2008-2011. Overall, one water body has become more eutrophic and two water bodies have become less eutrophic when compared to 2012-2015. Where there have been increases in eutrophication, it has occurred along the south eastern seaboard. Overall, five of the seven coastal waters are non-eutrophic in 2016-2019, although one coastal water body has shown signs of increased eutrophication and has been designated "could become eutrophic".

There are 25 transitional and coastal water bodies that are common to the 2012-2015 and 2016-2019 reporting periods. The trend in trophic status is shown in Table 2-22 and Map 2-28. Table 2-22 indicates that 11 of the 18 transitional water bodies and six of the seven coastal water bodies have not changed trophic state since the last reporting period.

Table 2-22: Trend in Trophic State for Transitional and Coastal Waters from 2012-2015 to 2016-2019 - Number of sampling points (and Percentage)

	Change in Trophic State – No. of stations (and %)				
	Strong decrease	Weak decrease	Stable	Weak increase	Strong increase
Transitional (n=18)	0	4 (22%)	11 (61%)	3 (17%)	0
Coastal (n=7)	0	0	6 (86%)	1 (14%)	0

Explanation of change classes:

Strong increase: Non-eutrophic to Eutrophic
Weak increase: Could become eutrophic to Eutrophic or Non-eutrophic to Could become eutrophic
Stable: No change in class
Weak decrease: Eutrophic to Could become eutrophic or Could become eutrophic to Non-eutrophic
Strong decrease: Eutrophic to Non-eutrophic

3 NITRATE VULNERABLE ZONES

Ireland has adopted a whole territory approach in implementing the Nitrates Directive. This decision was given legal effect in 2003 by the European Communities (Protection of Waters against Pollution from Agricultural Sources) Regulations, 2003 (S.I. No. 213 of 2003). There has been no revision to this decision and the Action Programme is being applied across the whole national territory.

The Nitrates Directive is one of the key directives which form the basic measures that Member States are required to fully implement under the Water Framework Directive. Therefore, the adoption of a whole territory approach to implementation of the Nitrates Directive and the establishment of legally binding limits for the application of nitrogen and phosphorus to agricultural land in Ireland ensures that all Irish farmers are considered in relation to environmental objectives of the Water Framework Directive.

4 DEVELOPMENT, PROMOTION AND IMPLEMENTATION OF CODE OF GOOD PRACTICE

4.1 Nitrogen Discharges to the Environment

Figures for the annual nitrogen losses to water from agricultural sources and nitrogen discharges to water from industrial and wastewater sources are summarised in Table 1.

Table 4-1: Total Nitrogen Losses and Discharges to the Environment

	2012-2015 Reporting Period		2016-2019 Reporting Period	
Period Total (thousand tonnes)	3,286		2,709[4]	
Agricultural N (Organic N + Mineral N)[1] (thousand tonnes)	2012	777.7	2016	853.0
	2013	841.9	2017	896.8
	2014	822.9	2018	935.5
	2015	825.4	2019	N/A[4]
Industrial N (not connected with urban)[2] (thousand tonnes)	2012	0.077	2016	0.072
	2013	0[3]	2017	0.057
	2014	0.061	2018	0[3]
	2015	0.051	2019	0[3]
Urban wastewater[2] (thousand tonnes)	2012	4.057	2016	5.987
	2013	4.002	2017	5.220
	2014	4.548	2018	5.779
	2015	5.270	2019	6.487

Notes:
1. Total application of organic and mineral N to agricultural land (these figures are not losses to the environment) – estimate from Central Statistics Office (CSO), Ireland and Department of Agriculture, Food and the Marine figures.
2. Total nitrogen discharge from industrial and urban wastewater treatment plants, based on e-PRTR submissions to the EPA. The figures only relate to those facilities with emissions greater than the e-PRTR thresholds i.e. industrial facilities with emissions above 0.05 (thousand tonnes) and urban wastewater treatment plans with population equivalents of >100,000.
3. No facilities discharging greater than the e-PRTR threshold.
4. Total not available, pending national inventory submissions for Green House Gases (GHG) and air pollution in Q1 2021

Industrial data reported in Table 4.1 are based on annual returns to the EPA from licenced facilities under the e-PRTR reporting mechanism. The mass loadings reported and the numbers of wastewater treatment plants for which data was available are indicated in the yearly totals.

Agricultural N represents total application to land of organic and mineral N and does not represent actual losses. These data were obtained from the Department of Agriculture, Food and the Marine (DAFM) and collated by Central Statistics Office (CSO). The Eurostat Nutrient Budget Methodology (Eurostat, 2013) has been applied to the data for reporting on Agricultural N.

4.2 Code of Good Practice

The Nitrates Directive has been implemented in Ireland since 1991 by way of extensive monitoring of nitrate levels in waters, the assessment of the trophic status of waters, the development and dissemination in 1996 of a *Code of Good Agricultural Practice to Protect Waters from Pollution by Nitrates* and a range of other measures which operate to protect water quality from pollution by agricultural sources.

Ireland adopted a whole territory approach in 2003 for the purposes of further implementation of the Nitrates Directive. A National Action Programme (NAP) was finalised in 2005. Elements of this first NAP were given statutory effect by the European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2006. The NAP is required to be reviewed and, where necessary, revised, at least every four years. There have been three NAPs implemented in Ireland since 2006, the second and third came into effect in 2010 and 2014 respectively. Following a scientific review, public consultation and discussion with the Commission, Ireland's fourth NAP was developed and published in 2018.

4.3 Data Concerning the National Territory of Ireland

Ireland operates a whole of territory approach to the implementation of the Nitrates Directive. Therefore, all farming activity in the country must be according to the Code of Good Agricultural Practice. A summary of agricultural activity in Ireland during the period 2016-2019 is presented in Table 4-2 together with figures for the previous reporting period, where available.

Table 4-2: Agricultural Statistics for Ireland

	2012 - 2015 Reporting Period		2016 – 2019 Reporting Period	
Total land area (km^2)[1]	68,900		70,273	
Agricultural land (km^2)[1]	2012	45,327	2016	44,612
	2013	44,778	2017	44,895
	2014	44,658	2018	45,163
	2015	44,295	2019	45,244
Agricultural land available for application of manure (km^2)[1,2]	2012	40,515	2016	39,288
	2013	40,043	2017	39,693
	2014	39,715	2018	39,922
	2015	39,260	2019	40,029
Grassland area (km^2)[1]	2012	41,507	2016	40,954
	2013	40,996	2017	41,239
	2014	40,981	2018	41,492
	2015	40,698	2019	41,677
Perennial crops (km^2)[1]	**Fruit crops**		**Fruit crops**	
	2012	9	2016	8
	2013	9	2017	8
	2014	9	2018	8

	2015 9	2019 8
Annual use of organic N from livestock manure (thousand tonnes)[3]	2012 481.2	2016 513.9
	2013 488.9	2017 527.7
	2014 491.2	2018 527.0
	2015 495.4	2019 N.A.
Annual use of organic N other than livestock manure (thousand tonnes)	n.a.	n.a.
Annual use of mineral N (thousand tonnes N)[1]	2012 296.5	2016 339.1
	2013 353.0	2017 369.1
	2014 331.8	2018 408.5
	2015 329.9	2019 367.4
Number of farmers[1,4]	2013 139,600 (72,800 full time)	2016 137,500 (50,500 full time)
Number of farmers with livestock[1]	Total number of farms (000s) with:	Total number of farms (000s) with:
	Year - 2013	Year - 2016
	Specialist beef 78.8	Specialist beef 78.3
	Specialist dairy 15.3	Specialist dairy 16.1
	Specialist sheep 15.0	Specialist sheep 15.1
	Specialist tillage 5.3	Specialist tillage 4.7
	Mixed grazing livestock 13.1	Mixed grazing livestock 11.6
	Mixed crops and livestock 2.6	Mixed crops and livestock 2.1
	Mixed field crops 7.9	Mixed field crops 8.2
	Other 1.3	Other 1.3
Livestock numbers (million heads, in June)[1]		
Cattle	2012 6.8	2016 7.2
	2013 6.9	2017 7.4
	2014 6.9	2018 7.3
	2015 7.0	2019 7.2
Sheep	2012 5.2	2016 5.2
	2013 5.0	2017 5.2
	2014 5.1	2018 5.1
	2015 5.1	2019 5.1
Pigs	2012 1.6	2016 1.6
	2013 1.6	2017 1.6
	2014 1.6	2018 1.6
	2015 1.5	2019 1.6

Poultry	2012 n.a.	2016 n.a.
	2013 n.a.	2017 n.a.
	2014 n.a.	2018 n.a.
	2015 n.a.	2019 n.a.
Other: **Horses, ponies, mules, jennets, asses, goats, farmed deer**	2012 0.1	2016 0.1
	2013 0.1	2017 0.1
	2014 0.1	2018 0.1
	2015 0.1	2019 0.1

Notes:

[1] Central Statistics Office (CSO), Ireland

[2] Estimated from the area allocation to grassland and crop production, but excludes rough grazing

[3] According to Eurostat Nutrient Budget Methodology

[4] Based on Farm Structure Survey 2013 and 2016. Farmer=Farm holder

N.A. = not available, pending national inventory submissions for GHG and air pollution in Q1 2021

n.a. = not available

5 PRINCIPAL MEASURES UNDER NATIONAL ACTION PROGRAMME

5.1 Agricultural Activities, Development and Nitrogen Assessment

Statistics summarising agricultural activity in Ireland during the current and previous reporting periods are presented in Table 5.1.

Table 5-1: Summary of Agricultural Activities

	Previous Reporting period 2012 - 2015		Current Reporting period 2016 - 2019	
Total land area (km^2)[1]	68,900		70,273	
Agricultural area (km^2)[1]	2012	45,327	2016	44,612
	2013	44,778	2017	44,895
	2014	44,658	2018	45,163
	2015	44,295	2019	45,244
Agricultural area available for application of manure (km^2)[1,2]	2012	40,515	2016	39,288
	2013	40,043	2017	39,693
	2014	39,715	2018	39,922
	2015	39,260	2019	40,029
Evolution in farming practices				
Grassland area (km^2)[1]	2012	41,507	2016	40,954
	2013	40,996	2017	41,239
	2014	40,981	2018	41,492
	2015	40,698	2019	41,677
Perennial crops (km^2)[1]	Fruit crops		Fruit crops	
	2012	9	2016	8
	2013	9	2017	8
	2014	9	2018	8
	2015	9	2019	8
Manure N excretion per animal category[3] (000 tonnes/year)				
Cattle	2012	420.8	2016	454.3
	2013	429.7	2017	465.9
	2014	431.9	2018	465.9
	2015	436.5	2019	N.A.
Sheep and goats	2012	32.5	2016	31.6
	2013	32.3	2017	33.7
	2014	31.8	2018	32.9
	2015	31.5	2019	N.A.
Pigs	2012	12.9	2016	12.9
	2013	12.6	2017	13.2

	2014 13.0	2018 13.1
	2015 12.5	2019 N.A.
Poultry	2012 8.4	2016 9.4
	2013 8.2	2017 9.5
	2014 8.8	2018 9.7
	2015 9.2	2019 N.A.
Other**:** *Horses, ponies, mules, jennets, asses, farmed deer*	2012 6.6	2016 5.7
	2013 6.1	2017 5.4
	2014 5.2	2018 5.3
	2015 5.7	2019 N.A.
Notes: [1] Central Statistics Office (CSO), Ireland. [2] Estimated from the area allocated to grassland and crop production but excludes rough grazing. [3] According to Eurostat Nutrient Budget Methodology N.A. = not available, pending national inventory submissions for GHG and air pollution in Q1 2021		

5.1.1 Principal Evolution Observed in Crops

Changes Favourable to Limit Nitrogen Losses

- Total grassland area increased to an average of 4,134,050 ha in the current period compared to 4,104,550 ha in the 2012-2015 period[1].
- Mild winters and cool summers with rainfall relatively evenly distributed throughout the year and moist soils ensure grass growth, and nitrogen uptake, almost right throughout the year in Ireland.
- The land area used for potato cultivation continued to reduce from an average of 9,420 ha in the 2012-2015 period to average of 8,780 ha in the current period 2016-2019.
- The total area devoted to cereal crops has decreased from an average of 305,575 ha in the 2012-2015 period to average of 270,700 ha in the current period 2016-2019.
- The slight decreasing trend continued in the area devoted to tillage crops, fruit and horticulture from 368,425 in the 2012-2015 period to an average of 361,275 ha in the current period 2016-2019.
- The NAP requires green cover be put in place where a total herbicide is used, or arable land is ploughed after 1st July each year.

Changes Unfavourable to Limit Nitrogen Losses

- The area devoted to maize silage increased from 13,750 in the 2012-2015 period to average of 14,300 ha in the current period 2016-2019.
- The late harvest of crops reduces the quality and effectiveness of green cover being established (by sowing a winter crop or via natural regeneration) before the onset of winter.
- Average annual sales of mineral N have increased from 327,827 tonnes in the 2012-2015 period to average of 371,015 tonnes in the current period 2016-2019.

[1] Central Statistics Office (CSO), Ireland. This includes pasture, Hay, Grass silage and rough grazing in use, Central Statistics Office, Ireland

- There was both extremely wet and extremely dry weather during the current period 2016-2019.

5.2 Action Programme

In Ireland, the European Communities (Good Agricultural Practice for Protection of Waters) Regulations and amendments are given legal effect by Statutory Instruments. The Nitrates Action Programme (NAP) is required to be reviewed and, where necessary, revised, at least every four years. The dates of publication and revisions to Ireland's NAP's are listed in Table 5-2. Details of Commission Decisions and approval periods allowing Ireland to operate a derogation from the limits of the Nitrates Directive to an annual maximum of 250 kg organic N per hectare are also provided in Table 5-2.

The current Article 10 reporting period 2016-2019 spans the third and fourth NAPs. Statutory Instrument S.I. 31 of 2014 and amendments giving effect to the third NAP was revoked and replaced by S.I. 605 of 2017 on 1 January 2018 which gives legal effect to Ireland's fourth NAP. This Regulation and associated amendments expire on 31 December 2021.

On 3 March 2018, the amending S.I. 65 of 2018 gave legal effect to the Commission Implementing Decision approving Ireland to operate a derogation from the limits of the Nitrates Directive, thereby replacing the revoked S.I. No. 134 of 2014. This approval also expires on 31st December 2021.

Table 5-2 provides details on amendments to the current NAP that have taken place in 2020 i.e. after the 2016-2019 Article 10 reporting period. In 2019, a public consultation with stakeholders was initiated voluntarily for the purpose on strengthening water protection in relation to derogated farms. Based on the outcome of the consultation the Nitrates Expert Committee recommended additional measures for farmers availing of derogation, which was given legal effect by S.I. 40 of 2020. More recently S.I. 225 of 2020 extended several of these measures to include all farms stocked at or above 170 kg organic N per hectare.

Table 5-2: Revisions Nitrates Action Programme

Nitrates Action Programme	Date of effect	National Statutory Instrument *	Purpose and effect
NAP 1	01/02/2006	S.I. No. 788 of 2005	Primary Legislation
	01/08/2006	S.I. No. 378 of 2006	Primary Legislation
	19/07/2007	S.I. No. 526 of 2007	Amendment for clarification
	31/03/2009	S.I. No. 101 of 2009	Amendment approving derogation
NAP 2	28/12/2010	S.I. No. 610 of 210	Primary Legislation including derogation
	29/03/2011	S.I. No. 125 of 2011	Amendment clarification
NAP 3	31/01/2014	S.I. No. 31 of 2014	Primary Legislation
	18/03/2014	S.I. No. 134 of 2014	Amendment approving derogation
	17/10/2014	S.I. No. 463 of 2014	Amendment clarification
NAP 4	02/01/2018	S.I. No. 605 of 2017	Primary Legislation
	13/03/2018	S.I. No. 65 of 2018	Amendment approving derogation
	14/02/2020	S.I. No. 40 of 2020	Amendment to derogation
	26/06/2020	S.I. No. 225 of 2020	Amendment data sharing
	20/11/2020	S.I. No. 259 of 2020	Amendment additional measures

Derogation approval	Date of effect	Implementing Decision	Expiration date
NAP 1	22/10/2007	C(2007)5095	17 July 2010
NAP 2	24/02/2011	C(2011)1032	31 Dec 2013
NAP 3	27/02/2014	C(2014) 1194	31/12/2017
NAP 4	08/02/2018	C(2018) 626	31/12/ 2021

*Irish Statute Book Available at: www.irishstatutebook.ie

5.2.1 Introduced or Modified Elements of Action Programme

The fourth NAP was developed following a scientific review, public consultation and discussion with the Commission. The measures included in the third NAP, as reported in the 2012-2015 report, that have been continued are listed below under NAP 3 and 4 for each measure, with introduced or modified elements adopted in the fourth NAP identified under NAP 4. Several measures introduced in the fourth NAP are to be implemented on a phased basis to allow time to make necessary changes on the holdings. Consequently, they fall outside of the 2016-2019 reporting period but are included for reference and consideration.

1. Periods of Prohibition of Application

NAP 3 and 4

The country is divided into three zones for the purposes of the Regulations. These zones are related to the length of the growing season, weather, soil types etc. in each zone (see **Error! Reference source not found.**).

- Chemical fertiliser may not be applied between the 15th September and 12th/15th/31st January (the end of the prohibited period varies depending on Zone) – see Table 5-3.
- Organic fertilisers (other than farmyard manure) may not be applied between the 15th October and the 12th/15th/31st January.
- Farmyard manure may not be applied between 1st November and the 12th/15th/31st January.
- Soiled water or chemical fertilisers to meet the crop requirements of autumn-planted cabbage or of crops grown under permanent cover may be applied throughout the year, subject to weather and ground conditions being suitable.

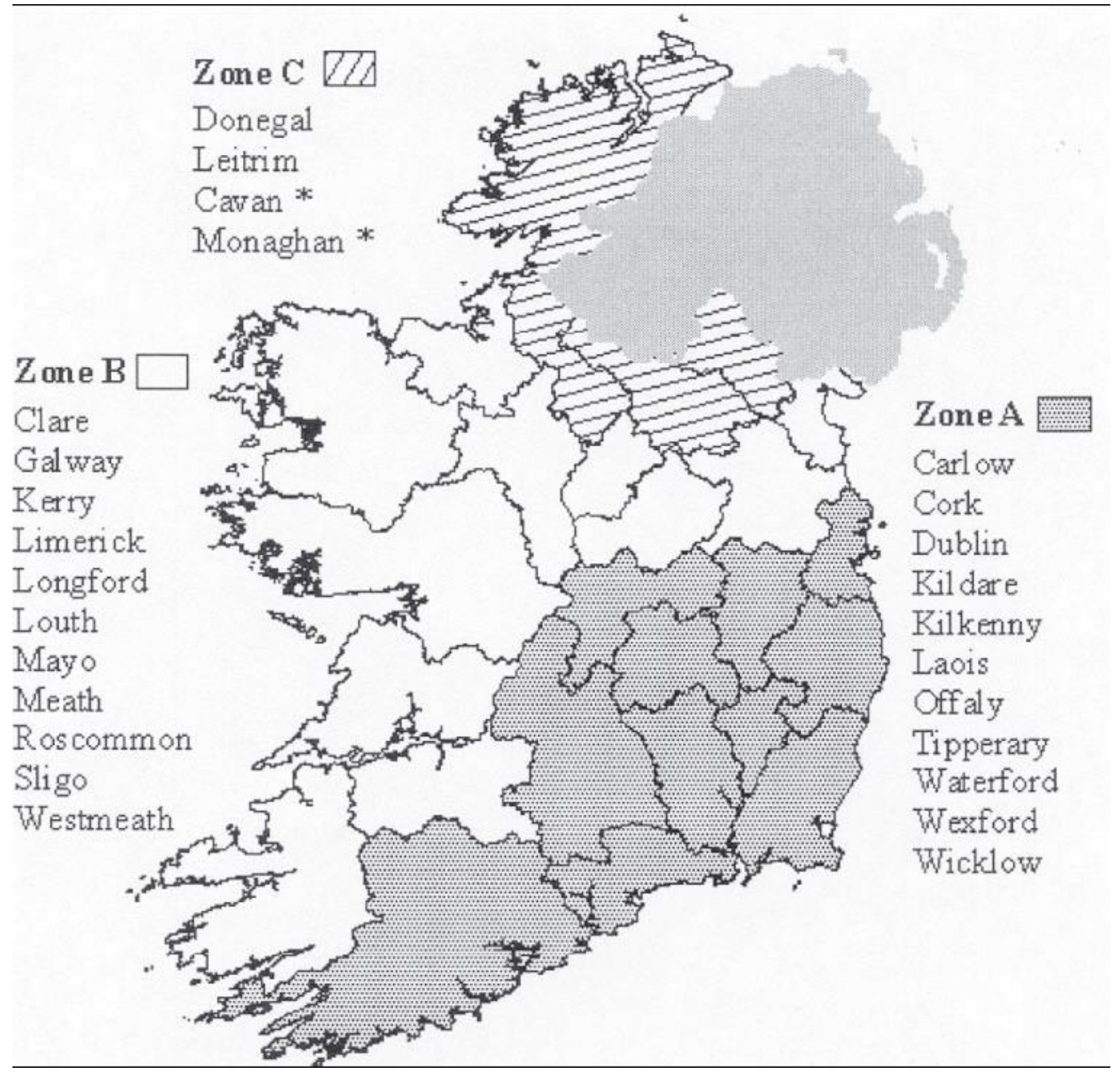

Figure 5.1: Zones Governing the Application of Regulations

Table 5-3: Prohibited Application Periods in National Zones

Zones	Storage Capacity Required	Prohibited Application Periods		
		Chemical Fertilisers	Organic Fertilisers	Farmyard Manure
A	16 weeks	15 Sept –12 Jan	15 Oct –12 Jan	1 Nov –12 Jan
B	18 weeks	15 Sept – 15 Jan	15 Oct – 15 Jan	1 Nov –15 Jan
C (Donegal & Leitrim)	20 weeks	15 Sept – 31 Jan	15 Oct – 31 Jan	1 Nov – 31 Jan
C* (Cavan & Monaghan)	22 weeks	15 Sept – 31 Jan	15 Oct – 31 Jan	1 Nov – 31 Jan

2. Capacity of manure storage, and requirement regarding construction and tightness

NAP 3 and 4

- Storage facilities for livestock manure and other organic fertilisers, soiled water and effluents from dungsteads, farmyard manure pits or silage pits must be maintained free of structural defect and be maintained and managed in such manner as is necessary to prevent run-off or seepage, directly or indirectly, into groundwater or surface water, of such substances.

- Storage facilities built after the introduction of the Regulations must be designed, sited, constructed, maintained and managed so as to prevent run-off or seepage, directly or indirectly, into groundwater or surface water and must comply with such construction specifications for those facilities as may be approved from time to time by the Minister for Agriculture, Food and the Marine.
- In the case of holdings with pigs the required storage capacity is adequate capacity to store all such manure for a period of at least 26 weeks (at least 16/18/20/22 weeks is adequate in the case of holdings with less than 100 pigs).
- In the case of holdings with poultry the required storage capacity is adequate capacity to store all such manure for a period of at least 26 weeks (at least 16/18/20/22 weeks is adequate in the case of holdings with less than 2,000 poultry places).
- In the case of holdings with sheep, deer and goats the required storage capacity is adequate capacity to store all such manure for a period of at least six weeks.
- In the case of holdings with cattle the required storage capacity is adequate capacity to store all such manure for a period of at least 16/18/20/22 weeks (depending on the zone that the holding is in).
- Reduced storage capacity is acceptable in certain circumstances (e.g. where grazing livestock are being out-wintered in accordance with the conditions set out in the Regulations).
- The storage capacity for soiled water must equal or exceed the capacity required to store all soiled water likely to arise on the holding during a period of 10 days.

3. Rational fertilisation

NAP 3 and 4

- An occupier of a holding must take all such reasonable steps as are necessary for the purposes of preventing or minimising the application to land of fertilisers in excess of crop requirement.
- The amounts of available nitrogen or available phosphorus applied may not exceed the maximum fertilisation rates set out in the Regulations.
- In the absence of a soil test for phosphorus index 3 must be assumed (maximum rates of P that can be used in such circumstances are maintenance levels of P).
- The availability of nitrogen and phosphorus in chemical and organic fertilisers is specified in the Regulations (e.g. nitrogen and phosphorus in chemical fertilisers and phosphorus in organic fertilisers is deemed to be 100% available).

NAP 4

- Soil tests are considered valid for a period of four years. The absence of a valid soil test Index 3 must be assumed except in a case where a soil test indicates that soil to be at phosphorus index 4.
- An occupier of a holding located in an area where soils have an organic matter content of 20% an above, as defined on the Teagasc-EPA Indicative Soils map, shall ensure that the soil test undertaken includes organic matter determination. The phosphorus fertilisation rate for soils with more than 20% organic matter shall not exceed the amounts permitted for Index 3 soils.
- Increased phosphorus build-up on grassland on farms with grassland stocking rates of 130 kg nitrogen per hectare and above may be permitted at defined rates provided that certain conditions are met which include: soil analysis results are provided, the occupier participate in related training programme, a FAS advisor’s services are engaged in the development of a detailed farm nutrient plan. P build up annual maximum fertilization rates were included in Schedule 2 (13B).

4. Provisions on application of fertilisers on water-saturated, flooded, frozen and snow-covered ground

NAP 3 and 4

Chemical or organic fertilisers cannot be applied when:

- The land is waterlogged.
- The land is flooded or likely to flood.
- The land is snow-covered or frozen.
- Heavy rain is forecast within 48 hours.
- The ground slopes steeply and, taking into account factors such as proximity to waters, soil condition, ground cover and rainfall, there is significant risk of causing water pollution.

5. Limitation of total fertilisation, by types of crops

NAP 3 and 4

- Maximum fertilisation rates of available nitrogen and phosphorus for grassland, tillage, vegetable and fruit crops are set out in the Regulations.

6. Provisions on fertilisation on slopes

NAP 3 and 4

- Chemical or organic fertilisers cannot be applied when the ground slopes steeply and, taking into account factors such as proximity to waters, soil condition, ground cover and rainfall, there is significant risk of causing water pollution.

7. Provisions on application of fertilizers near watercourses

NAP 3 and 4

- Chemical fertiliser must not be applied to land within 2 metres of a surface watercourse.
- In the case of organic fertiliser or soiled water; site-specific and risk-based approach to be used by Local Authorities in setting setback distances around drinking water abstraction points, following assessment of conditions.
- Organic fertiliser or soiled water cannot be applied to land within 200/100/25 metres of any water supply for human consumption (varies depending on amount of water being supplied or the number of people being served).
- Organic fertiliser or soiled water cannot be applied to land within 20 metres of a lake shoreline.
- Organic fertiliser or soiled water cannot be applied to land within 15 metres of exposed cavernous or karstified limestone features.
- Organic fertiliser or soiled water cannot be applied to land within 5 metres of any other surface watercourse (there are exceptions, e.g. the buffer strip is 3 metres in the case of an open drain).

8. Provisions on procedure for land application of fertilizers, both chemical and livestock manure

NAP 3 and 4

- An occupier of a holding must have regard to weather forecasts issued by Met Éireann when applying fertilisers.
- Organic fertilisers must be applied in as accurate and uniform a manner as is practically possible.
- Organic fertilisers may not be applied with an upward facing splash plate or by use of a sludge irrigator.
- Organic fertilisers cannot be applied from a road or passageway adjacent to the land.

- Soiled water may not be applied at rates that exceed 50,000 litres/ha in any 42-day period or by irrigation at a rate exceeding 5 mm/hour (except in extreme vulnerability areas where the maximum rates allowed are much lower).

9. Winter coverage of soils

NAP 3 and 4

- Arable land ploughed between 1st July and 30th November must have a green cover from a sown crop within 6 weeks of ploughing.
- Grassland ploughed between 1st July and 15th October must have a green cover from a sown crop by 1st November.
- Grassland may not be ploughed between 16th October and 30th November.
- Where a non-selective herbicide is used on arable land or grassland between 1st July and 30th November, there must be green cover from a sown crop or from natural regeneration within six weeks of application of the herbicide.
- Where green cover is provided to comply with the rules concerning ploughing or use of a non-selective herbicide, it must not be removed by ploughing or by use of a non-selective herbicide before 1st December, unless a crop is sown within two weeks of removing it.

NAP 4

- When a non-selective herbicide is applied to land after 15th October, the land area required to for the emergence within 6 weeks of the application of green cover shall be reduced to 75% of the relevant cereal area where a contract is in place for seed crops or crops producing grain destined for human consumption which prohibits the application of a non-selective herbicide preharvest.

10. Other preventive measures for all holdings

NAP 3 and 4

- Certain records must be maintained.
- Farmyard manure may not be stored in a field during the prohibited application period for farmyard manure (1st November to 12th/15th/31st January, depending on zone – see **Error! Reference source not found.**).
- Farmyard manure may not be stored in a field, during the permitted application period, within certain specified distances from water sources.
- Silage bales may not be stored outside of farmyards within 20 metres of a watercourse or drinking water abstraction point in the absence of adequate facilities for the collection and storage of any effluent arising.
- The soil sampling area permitted for the taking of a soil sample for the analysis of phosphorus or organic matter content is 5 hectares (in the previous Nitrates Action Programme a maximum sample area of 8 ha was allowed).

NAP 4

- No cultivation shall take place within 2m of a watercourse identified on the modern 1:5000 scale Ordinance Survey Ireland (OSI) mapping or better, except in the case of grassland establishment or the sowing of grass crops.
- There shall be no direct runoff of soiled waters to waters resulting from the poaching of land on the holding.
- There shall be no direct runoff of soiled water from farm roadways to waters from 1st January 2021. The occupier of a holding shall comply with any specification from farm roadways

specified by the Minister for Agriculture, Food and the Marine pursuant to this requirement.

11. Other preventive measures for holdings at 170 kg nitrogen per hectare or above

NAP 4

- The required use of low emission slurry spreading equipment has been phased in since 2019 for holdings in derogation, and 2021 for non-derogated holdings.
- Maximum crude protein content permissible in concentrate feedstuff fed to grazing livestock on the holding between 1st April and 15th September was set to 16% for derogated holdings in 2020, 15% for all holdings at 170 kg nitrogen per hectare or above in 2021.
- Completion of Farm Advisory Service training in nutrient use efficiency and grassland management is required for derogated holdings from 2020 and 2021.
- Grass reseeding on derogated grassland farms must include a minimum clover content not exceeding 50% of the sward mixture.
- Hedgerow maintenance to support biodiversity on derogated farms is required from 2020.
- In the case of holdings with grassland stocking rates of 170 kgs nitrogen per hectare from livestock manure or above, bovine livestock shall not be permitted to drink directly from waters from 1st January 2021 onwards.
- A fence shall be places at least 1.5m from the top of the riverbank or water's edge to exclude livestock shall be in place by 1st January 2021.
- In the case of holdings required to exclude bovine livestock from watercourses, supplementary drinking points may not be located within 20m of surface waters from 1st January 2021.
- A whole farm liming programme is required to correct soil pH from 1st January 2020 on derogated holdings, and 1st January 2021 for non-derogated holdings.

6 EVALUATION OF ACTION PROGRAMMES

6.1 Agricultural Inspections

Table 6-1: Summary of Agricultural Inspections

	Previous Reporting period 2012-2015	Current Reporting period 2016-2019
Number of farmers concerned[1]	2013 139,600 (70,300 main occupation)	2016 137,500 (72,500 main occupation)
Farmers with livestock[1]	Total number of farms (000s) with: Year - 2013 Specialist beef 78.6 Specialist dairy 15.6 Specialist sheep 15.0 Specialist tillage 5.2 Mixed grazing livestock 13.1 Mixed crops and livestock 2.6 Mixed field crops 8.3 Other 1.2	Total number of farms (000s) with: Year - 2016 Specialist beef 78.3 Specialist dairy 16.1 Specialist sheep 15.1 Specialist tillage 4.7 Mixed grazing livestock 11.6 Mixed crops and livestock 2.1 Mixed field crops 8.2 Other 1.3
Percentage of farmers visited each year[2]	• 1% (DAFM only)[2] • 1% (DAFM on behalf of competent authority, i.e. Local Authority) • 5% of derogation farm applicants (DAFM)	• 1% (DAFM only)[2] • 1% (DAFM on behalf of competent authority, i.e. Local Authority) • 5% of derogation farm applicants (DAFM)

Notes:

[1] Based on Farm Structure Survey 2013 and 2016 (Farmer=Farm holder)

[2] Inspections carried out by DAFM in the context of cross-compliance arrangements under the Single Payment Scheme; the frequency of inspections is based on the Recommended Minimum Criteria for Environmental Inspections Plan.

As part of the controls under the Good Agricultural Practice Regulations, DAFM carries out checks on the application rates of all herdowners with livestock on an annual basis. Herdowners in breach of the 170/250 kg per hectare limit incur penalties.

- **Previous Reporting period 2012 – 2015**

  The average number of penalties issued was 1,830 per annum.

- **Current Reporting period 2016 – 2019**

  Figures for 2019 are not yet available. The average number of penalties issued for the 2016-2018 period was 1,810 per annum.

Regarding inspections for compliance with the Nitrates Derogation terms and conditions, the following information is currently available.

- 2017 - 93% Compliance;

- 2018 - 97% Compliance (55% of non-compliances due to insufficient storage for livestock manures);
- 2019 - 93% Compliance (73% of non-compliances due to insufficient storage for livestock manures).

Reasons provided by farmers for non-compliance

- There can be a lack of up to date knowledge and understanding around new measures and their purpose and therefore a reluctance to engage.
- Some farmers indicate that they did not get the correct up to date advice from their advisors.
- Financial constraints limit farm improvement in some cases e.g. upgrading or expanding slurry storage facilities.

Proposals to improve compliance

- Further collaboration between government departments and agencies to allow for better targeting of measures e.g. data sharing.
- Enhanced industry support in meeting environmental targets should be enhanced e.g. via the Agricultural Sustainability and Advice Programme (ASSAP).
- Further development of Agricultural Knowledge and Innovation Systems (AKIS) facilitate timely, relevant and practical knowledge transfer.
- Continuing professional development of the advisory service will be enhanced and updated to reflect the AKIS activity and ensure that legislation and measures are understood.
- The continued support of results-based schemes will have a demonstrable benefit but need to be simple to understand and easy to implement.

6.2 Measurable criteria for assessing impact of the programmes on practices in the field

- At least 57,000 nutrient management plans based on soil test results and agricultural practice are submitted to DAFM and checked on inspection.
- Soils must be tested at least every four years and the Nutrient Management Plan updated to reflect the soil test results. A maximum of 5 ha per soil test is permissible.
- The obligatory use of low emission slurry spreading (LESS) equipment has been phased in for derogated farms, so that in 2021 all slurry must be spread using LESS. This obligation is being phased in to include non-derogated holdings at 170 kg nitrogen per hectare or above starting in 2021.
- No cropland is permitted to be bare during the winter. Cover crops or post-harvest stubble is required to remain in place.
- No land is permitted to be cultivated at a distance less than 1.5m from watercourses.

6.3 Difference between input and output of nitrogen (mineral + organic) for farms

Table 6-2 presents the national Irish nutrient budgets that have been calculated by DAFM and previously submitted to Eurostat[2].

Table 6-2: National Nitrogen Budget

	Previous period 2012-2015	Current period 2016-2019*	
National Gross Surplus	45	62	kg/ha/yr
National Net Surplus	22	38	kg/ha/yr

*2019 figures not available, so this is the average from 2016-2018

6.4 Individual cost-effectiveness studies carried out on certain practices (beyond the minima of the code of practice)

No representative national data is currently available on the cost-effectiveness of practices beyond the minima of the code of practice.

6.5 Objectives of the Action Programme

The objective of the Action Programme is to protect waters against pollution caused by agricultural sources and assist in meeting Ireland's WFD targets. The set of measures in the regulations provides a basic level of protection against possible adverse impacts to waters arising from the agricultural expansion targets set under Ireland's agri-food strategy. The measures included have been based on best practice in agriculture to support water quality.

National WFD water monitoring, in conjunction with the monitoring results within agricultural catchments under the Agricultural Catchments Programme (ACP), allow for an assessment of the impact of measures in the NAP and inform further development of measures to address known areas of concern.

6.6 Agricultural Catchments Programme

EU Member States are required to monitor the effectiveness of their Nitrates Regulations, under Article 5 (6) of the EU Nitrates Directive. Ireland monitors the implementation of the Nitrates Regulations in part through the Agricultural Catchments Programme (ACP) tasked with monitoring the effectiveness of Ireland's measures since 2008. The ACP has been delivered by Teagasc (the Agricultural and Food Development Authority) since its inception and funded by the Department of Food, Agriculture and the Marine (DAFM). The cycles of the ACP have been as follows: 2008-2011, 2012-2015 and 2016-2019. The fourth cycle of the ACP was approved in November 2019 for a further four-year period, 2020-2023 at a cost of €2.5m.

Phase 4 of the programme will also collect data on greenhouse gas emissions, ammonia emissions and soil carbon sequestration, as well as extending the current baseline monitoring of water quality.

The programme is a collaboration with over 300 farmers in six small river catchments in Ireland. The programme has taken a whole catchment approach to evaluate the efficacy of the Good Agricultural Practice (GAP) package of measures introduced under the NAP. An extensive monitoring programme of nutrient sources and hydro-chemo-metrics have been designed similarly across all six catchments to understand how nutrients are lost from agricultural sources, how they can be mobilised and

[2] https://ec.europa.eu/eurostat/web/main/data/database

transferred via different hydrological pathways, how they are delivered to water and where there may be a negative impact on water quality and aquatic ecology.

The ACP disseminates the findings of the programme widely to magnify their impact on policy and practice in agri-environmental management. The programme integrates the bio-physical and the socio-economic data to better understand the wider impact of the GAP measures at farm and catchment scale across the six catchments that constitute the study area. These catchments include derogated holdings, as required by the European Commission under Ireland's approval to operate under a nitrate's derogation. Measurements, modelling and socio-economic studies are being used to evaluate the efficacy, cost effectiveness and economic impact of the measures. Modifications to national measures will be identified where evidence indicates that water quality targets may not be achieved.

The ACP also explores farmer attitudes to implementation of nitrates regulations, adoption of nutrient management practices, the provision of ecosystem services, and the economic impacts of efficient nutrient management. The main objectives of the ACP can be thus summarised as follows:

- To establish extended baseline information and comparative data on agriculture in relation to both the Nitrates and Water Framework Directives.
- To provide an evaluation of the NAP measures and the derogation in terms of water quality and farming practices.
- To provide a basis for a scientific review of NAP measures with a view to adopting modifications where necessary.
- To achieve a greater understanding of the factors that determines a farmer's understanding and implementation of the NAP.
- To provide national focal points for knowledge and technology transfer and education for all stakeholders in relation to diffuse nutrient loss from agriculture to water.
- To advise on any specific monitoring requirements deemed necessary for the purposes of the Water Framework Directive.

Main findings of the ACP to date

A comprehensive description of ACP findings has been included in Ireland's Derogation Report for 2019, which was submitted to the European Commission in 2020. To summarise:

- Ireland's landscape is heterogeneous in terms of factors controlling N and P transfer pathways, transformation processes and timing of delivery.
- The influence of soil type, subsoil and geology on nutrient loss to water can sometimes override source pressures. At the meso-scale catchment (*ca*. 10 km^2) the link between nutrients source pressures and nutrients monitored in the stream water is not always clear.
- Weather changes can override temporal trends of agronomic pressures and are different for different physical settings. Therefore, both long-term and short-term weather patterns need to be considered when managing nutrients on farms.
- In certain circumstances sediment can have a greater impact on key indicators of water quality than N and P.

- Farm specific information can help refine regional data when identifying appropriate measures.

- The next phase of the ACP will use high temporal resolution water quality data from meso-scale catchments together with spatially high-resolution national data to scale-up from the meso-scale to the regional and national scale.

- Overall, evidence from the ACP indicates that supporting farmers, through technical advice, to make better decisions regarding how they manage nutrient applications is likely to be the single area with the greatest potential to improve outcomes for water quality on Irish farms.

6.7 Measures that support the National Action Programme

Agricultural Sustainability and Advice Programme (ASSAP)

The ASSAP is a government/industry collaborative initiative established to operate from 2018-2021. The programme offers a free support and advisory service, with 30 advisors, and participation is voluntary. Local Authority Catchment Assessment Teams working primarily in 190 areas that have been identified for priority action in the National River Basin Management Plan for 2018-2021 connect with the ASSAP advisors when agriculture is identified as a significant pressure. The programme is designed to work closely with the farming and wider communities in these catchments providing them with a free and confidential advisory service facilitating a far more targeted approach in terms of delivering the right measures in the right place.

Directed research

In addition to the Teagasc core research programme, PhD projects funded by the Teagasc Walsh programme enhance and strengthen the ACP. DAFM, through the Research Stimulus Fund, and EPA through its research programme, have co-funded a significant range of projects related to agriculture and water quality. Examples of recent research projects include:

- Mitigating Agricultural impacts through Research and Knowledge Exchange;

- Roadway Runoff and Nutrient-loss Reduction;

- Management of riparian buffers for the effective management of Irish rivers to ensure the right measure is in the right place;

- Cattle exclusion from watercourses: Environmental and socio-economic implications;

- Harmony is a catchment-based project that integrates research on soils and hydrology with socio-economic factors to derive locally relevant measures for agriculture in sensitive catchments.

Several research projects that were co-funded by the Irish Government and the EU involved working with farmers and other local stakeholders to improve water quality in their catchments. These include European Innovation Partnership (EIP) projects, such as Mulkear EIP, Duncannon EIP and Duhallow EIP, which are supporting local farmers to work collaboratively with other stakeholders to develop catchment-sensitive farming practices to improve local water quality. There were 23 European Innovation Partnership agri-operational groups funded by DAFM in 2019. Several of the projects focus directly on water quality, others which have co-benefits including water quality.

Since 2016, the EPA has funded 65 new research projects relevant to the Water area, including several on the impacts and management of agriculture in relation to water quality. These include:

- Research 330: COSAINT: Cattle Exclusion from Watercourses: Environmental and Socio-economic Implications.
- Research 274: AgriBenchmark: Benchmarking Sustainable Nutrient Management on Irish Farms
- Research 261: A National Roadmap for Water Stewardship in Industry and Agriculture in Ireland
- Research 194: AgImpact Project: A Systematic and Participatory Review of Research on the Impact of Agriculture on Aquatic Ecosystems in Ireland
- Research 175 - AgImpact Project: Identifying Approaches to Improving Knowledge Exchange (KE) in the Irish AgriFood Sector using Expert Opinion

Agri-Environment Measures

Building upon Rural Environment Protection Scheme (REPS), the Agri-Environment Options Scheme (AEOS) the current Green Low Carbon Agri-Environment Scheme (GLAS) offers voluntary agri-environment measures under Pillar II of the CAP designed to encourage farmers to farm in a way that benefits the landscape, biodiversity and water quality. GLAS **is** the largest scheme to date with a budget of €1.4bn with 50,000 participating farmers. It is a menu-based scheme with a more targeted design prioritizing actions which target the preservation of priority habitats and species, sustainable management practices and traditional farming practices. Priority entry to the GLAS scheme was given to applicants on farms with Priority Environmental Assets, including high status objective water areas and vulnerable water areas. Applicants who engaged in priority environmental actions which lessen nutrient pressure on their holdings were also eligible for priority entry to the scheme e.g. use of low emission slurry spreading equipment.

- **The Targeted Agricultural Modernisation Scheme (TAMS)**

  A suite of seven measures are available under TAMS II. The measures provide grants for capital investment in physical assets to assist the Irish agriculture sector to respond to a range of policy challenges. For example, Low Emission Slurry Spreading Equipment is essential to contributing to meeting the challenges of reducing our environmental footprint.

- **Results Based Schemes**

  Results based schemes will become more widespread across Europe under the new CAP regulations with member states afforded more flexibility with design and roll-out – the focus being the result. Ireland and DAFM are EU leaders in this policy area being involved in the Results Based Agri-environmental Pilot Scheme (RBAPS) and funding several schemes and projects under the current RDP.

- **LIFE**

  Ireland has several LIFE projects whereby the farming communities of the focal regions are engaged for the purpose of improving water quality. In 2019, a LIFE-IP Waters of Life programme was approved with the objective to restore high ecological status water bodies in Ireland. DAFM is providing financial and staff resources to support this project.

- **<u>Organic Farming Scheme</u>**

OFS requires strict adherence to organic production methods; the number of applicants and organic farm holdings has increased as a result of this support. Our current Organic Farming scheme under the Rural Development Programme (RDP) has almost doubled the amount of land in Ireland under organic production to 72,000 ha representing approximately 1,886 producers.

<u>Farm Advisory System</u>

- The Farm Advisory System (FAS) continues to advise farmers on land and farm management. The advice must cover at least the statutory management requirements (including advice on compliance with Nitrates Directive) and the Good Agricultural and Environmental Conditions (GAEC).

- Teagasc are in contact with some 80,000 farmers and rural dwellers each year, of which approximately 40,000 avail of their intensive on-farm consultancy service. Some 300 advisers and specialists, located at 50 centres throughout Ireland, help farmers to maximise profit while respecting the environment and to encourage sustainable farming.

6.8 Other developments that may impact positively on water quality

Enforcement

- In addition to the cross compliance inspections outlined in **Error! Reference source not found.**, a further 1,600 risk based nitrates inspections are carried out by DAFM on behalf of Local Authorities. An additional 5% of nitrates derogation applicants are also inspected annually. Approximately 6,500 inspections (including for agri-environment and climate measures (AECM), eligibility etc.) also take place annually and any nitrates breaches noted on these farms in the course of these inspections are cross reported for penalty purposes.

- DAFM also carry out administrative checks on all herd owners to establish if they are adhering to the 170 or 250 kgs Nitrogen per hectare limits as appropriate. Total Nitrogen figures from the Departments Animal Identification System (AIM) and the areas declared under the Single Payment Scheme are used to identify herd owners exceeding these limits are subject to penalties.

Other Developments

- The abolition of dairy quotas in 2015 resulted in an increase in the size of the dairy herd with only a slight decrease in other bovine livestock. This has result in an overall increase in livestock in the country. Measures introduced in the third and fourth NAP were largely focused on farm infrastructure, nutrient use efficiency and uniform country wide measures.

- Brexit is expected to have a significant impact on the agri-food sector. Depending on the outcome of discussions and trade arrangements many farmers relying on the UK as an export market may feel driven to change farm systems to, for example, dairy farming in order to remain financially viable.

6.9 WFD Implementation

In April 2018, Ireland published the WFD River Basin Management Plan 2018-2021. While, acknowledging that agriculture was the largest land use, the Plan indicated that agriculture was the most significant pressure on water quality in Ireland. Over half of the 1,460 water bodies at risk of not meeting their environmental objectives had agriculture listed as a significant pressure. The Plan set out five key objectives:

1. Compliance with relevant EU legislation;

2. Prevent deterioration;

3. Meet objectives for protected areas;

4. Protect high status waters;

5. Implement targeted action programmes and schemes in water bodies close to achieving or failing to meet their environmental objectives.

In relation to the targeted action programmes, a new local authority shared service, the Local Authority Waters Programme (LAWPRO) was established to investigate and identify / promote action to protect or improve water quality. LAWPRO focus their efforts on 190 priority sub-catchments (some containing several water bodies). Where water quality problems caused by agricultural activities are found, LAWPRO work with the Agricultural Sustainability Support and Advice Programme (ASSAP) advisors, who interact with farmers and identify actions that the farmer can take to reduce impacts on water quality.

Overall, there have been positive signs, with water quality improvement in 152 of 726 water bodies that were prioritised areas for action in the WFD River Basin Management Plan (RBMP) 2018-21 (EPA, 2020). It is envisaged that this work will continue and will be expanded upon in the next RBMP cycle.

The draft River Basin Management Plan 2022-2027 is scheduled to be published early in 2021, with the final Plan expected to be published by the end of 2021.

The EPA continues to monitor water quality to inform WFD characterisation and has developed a structured management system to capture information on the pressures and impacts on the water environment. Part of this catchment characterisation assessment work includes the ability to undertake nutrient source load apportionment and this has allowed areas to be identified within catchments and sub-catchments that have source pressures and are susceptible to nutrient loss to the water environment. These "critical source areas" are typically not in the same location for nitrogen and phosphorus but help identify which areas and farm holdings could be targeted for further detailed farm assessments and specific actions i.e. the right measure in the right place. The LAWPRO and ASSAP teams use these critical source area maps to target relevant actions. Work is ongoing to identify what reductions in nutrient load loss would be required in each sub-catchment to meet the environmental objectives of the water bodies in that sub-catchment.

The characterisation approach, together with selection and successful implementation of measures and management strategies involves integration of datasets and knowledge at a national scale. The EPA continues to work with the various public authorities to help coordinate and provide a platform for delivery of the RBMP. Information, articles and data are captured and made publicly available on www.catchments.ie.

7 FORECAST OF FUTURE EVOLUTION OF WATER BODY QUALITY

Agriculture covers over 65% of the land area of Ireland and Water Framework Directive (WFD) characterisation indicates it is the most prevalent significant pressure affecting 53% of water bodies that are not meeting their WFD targets. The main problems for farming are loss of excess nutrients and sediment to water. Excess ammonium may also be a problem in some water bodies. These losses arise from point sources such as farmyards, or from diffuse sources such as spreading of fertilisers and manures. Excess phosphorus and sediment typically cause problems in rivers and lakes, and too much nitrogen is the main issue for estuaries and coastal waters.

There has been an overall decline in water quality in Ireland since the 2012-2015 Article 10 report, with nitrate concentrations increasing in groundwater, rivers and in some associated transitional waters. There has also been spatial variation, with the highest nitrate concentrations and greatest concentration increases mainly happening in the south east. The south east is also the area that has seen the greatest change in trophic state, with several rivers and transitional waters in the region becoming more eutrophic.

A integrated approach to address water quality issues is being undertaken in Ireland. This includes collaboration between the different environmental and agricultural policy makers, researchers and public authorities, with the aim of informing policy so that the right measures can be undertaken in the right place, at the right time. The aim is to tailor measures to each farm and type of farming, thereby maximising the environmental benefit as efficiently as possible.

Water Quality Analysis to Inform Policy

The EPA national datasets and analysis highlight that there is a good relationship between farming intensity and nitrate concentrations in waters at the catchment scale, but that there is water quality variability within and between sub-catchments. The variability can largely be explained by the soil type and farming practice. Of most concern is that nitrate concentrations are continuing to show a strong increasing trend in our rivers and our groundwaters. This in turn is resulting in increased loads to our transitional and coastal waters. Increased nitrate concentrations are particularly evident in the south east of the country where the main source of nitrate is intensive agricultural practices. The rivers and transitional waters in the south east have also seen the greatest change in trophic state, with more evidence of eutrophication than in 2012-2015.

Elevated phosphorus concentrations are also a key driver of eutrophication, particularly in freshwaters, but the highest phosphorus concentrations are generally found in areas with poorly draining soils and are not necessarily a result of agricultural intensity. This is borne out in the river and lake trophic assessment which show eutrophication in many areas with low intensity agricultural practices.

Overall, to achieve the WFD objectives, mitigation measures need to be targeted to the water quality issues and physical settings where they occur, i.e. the critical source areas. Within a catchment, the critical source areas for phosphorus and nitrate are likely to occur in different locations: poorly draining soils are the riskiest for diffuse phosphorus losses, while freely draining soils are more important for losses of diffuse nitrate. Therefore, any mitigation measures introduced should be tailored and targeted to the critical source area that is relevant to the pollutant of concern.

This has important implications for selecting the right measure for the right place. Ireland's heterogeneous landscape means that measures need to be targeted to achieve the best environmental outcomes. Ireland is adopting a collaborative approach between the different stakeholders to identify these measures and will seek to implement them using a range of policy instruments including the Good Agricultural Practice Regulations, the WFD RBMP and climate action policies.

Progress has been made in understanding better the complexity of the factors affecting nutrient loss to water in the diverse agricultural landscape. There have been some encouraging signs with water quality improvement in 152 of 726 water bodies that were prioritised areas for action in the WFD River Basin Management Plan (RBMP) 2018-21 (EPA, 2020). This reflects the positive efforts of local authorities, other public bodies, local communities and landholders. It is anticipated that the Agricultural Sustainability Support and Advisory Programme (ASSAP) will further build on this work in relation to addressing specific agricultural pressures.

The development of the next CAP is an opportunity to incorporate measures based on research output that are known to benefit water quality. A key learning point to date has been that the right measure in the right place is particularly relevant for the Irish situation. Knowledge transfer mechanisms will be developed to link research and findings to the advisory and farming communities. DAFM will continue to support a number and range of research projects examining the potential of innovative technologies, materials and approaches to further reduce pressure from agriculture on the environment.

Increasingly Agencies and Government Departments are engaging, consulting and sharing data where policy areas overlap to streamline policy and maximise co-benefits in a unified and rational way. In December 2020, DAFM published the National Climate and Air Roadmap for the Agriculture Sector entitled Ag Climatise, publication of which is an important element of Ireland's Programme for Government commitment. The proposed reduction in mineral fertiliser use has a significant co-benefit to water quality, with a focus on maximising grass in the livestock diet to be achieved by better use of manures (using LESS), clover and soil and grass management.

Evolution of Agricultural Policy

The agri-food sector is Ireland's largest indigenous exporting industry, contributing 6.7% (€14.4bn) of Modified Gross National Income (GNI*) and accounting for 9.5% of all merchandise exports in 2019. The 2019 figures mark a growth of over 60% since 2010 and 6% since 2018.

The agri-food sector also makes a significant contribution to employment in rural and coastal areas, accounting for 7.1% of total employment or some 164,400 jobs in 2019. Regionally it accounts for a larger proportion of employment, as high as 14% of total employment in the Border region. The Irish agri-food export sector is marketed using the green and sustainable image. Therefore, from an economic perspective, the agri-food sector wants to ensure that improvements in water quality and other environmental targets are reached.

Brexit is expected to have a significant impact on the agri-food sector. Depending on the outcome of discussions and trade arrangements many farmers relying on the UK as an export market may feel driven to change farm systems to, for example, to dairy farming in order to remain financially viable.

Nitrates Action Programme Development

The development of the third and fourth NAPs had to balance forecast change relating to the ambitious targets of the Irish agri-food sector arising from the abolition of dairy quotas in 2015 with the overall goal of improving water quality. In 2018, the fourth Nitrates Action Programme (NAP) was informed by the findings of the EPA Water Quality in Ireland Report 2010-2015 (EPA, 2017), which indicated that the national picture was relatively stable, although some water bodies had improved while others deteriorated. This highlighted that not enough had been done to prevent deterioration of water quality.

The fourth NAP introduced several significant new measures on a phased basis to allow farmers time to make the necessary changes on holdings. A measure prohibiting the poaching of soil by livestock was introduced to minimise surface loss of nutrients, and for soil enhancement in general. Soil fertility monitoring requirements for derogation farms were also increased. All farms are required to reduce runoff from farm roadways from 2021, with specifications and guidance provided.

In 2021, all farms with stocking rates above 170 kg organic N per hectare will be required to exclude bovine livestock from watercourses.

Interim Nitrates Action Programme Review

In 2019, following the EPA Water Quality in Ireland Report 2013-2018 (EPA, 2019), the multi-agency Nitrates Expert Group was reconvened, and a voluntary mid-programme review of the NAP was undertaken in response to the reported decline in water quality. This group proposed new measures and advisory notices for consideration and some of these measures were introduced in 2020.

New measures were introduced in 2020, such as the phased use of low emission slurry spreading equipment, liming for soil pH correction, the reduction on crude protein content of concentrate feed and clover incorporation to reseeding are expected to increase nutrient use efficiency and limit nutrient loss to water bodies. To supplement the new measures farmers are required to attend training on grassland management, nutrient use efficiency and sustainable agriculture to increase their understanding of the implementation of, and expected benefits from, the new measures. Teagasc has improved nutrient management planning on-line to provide detailed fertiliser plans for farmers and the grass growth model is being used to tailor fertiliser advice for periods of low growth such as drought or cold/wet spring period. Multiple co-benefits are expected from these measures, particularly in relation to biodiversity, air quality and climate change.

In 2020, the Nitrates Expert Group recommended that additional measures should be introduced for non-derogated holdings that have stocking rates of over 170 kg organic N per hectare but export some of the organic N from the farm holding. In 2021, exports and imports of organic manures in Ireland will move to an online system, thereby providing for more robust tracking of movements of organic manures.

The organic nitrogen excretion value for dairy cows in Ireland was evaluated in 2020 and has been revised upwards from 85 to 89 kg per hectare per year for implementation from 1st January 2021.

Fifth Nitrates Action Programme

The first public consultation on the next Nitrates Action Programme commenced in December 2020, this is open until 15th January 2021. The timing of this consultation period should inform the WFD RBMP for the 3rd planning cycle, allowing for better alignment of the overlapping objectives. Both the NAP review and next cycle of the RBMP will be finalised and in effect from January 2022. During the consultation period measures to further enhance nutrient use efficiency on farms including input, storage and application will be considered along with the feasibility of the development of targeted measures where possible.

Scientific Analysis of the Pressures on Water Quality

The outcomes of WFD characterisation assessments undertaken for the 2022-2027 RBMP will inform WFD monitoring during the next WFD planning cycle, and monitoring will evolve to validate the impacts arising from agricultural pressures. Nationally, this work continues to refine our understanding of the nutrient critical source areas within each catchment. Applying the correct measures in these areas should have the greatest impact in relation to nutrient and sediment losses to water.

In addition to updating nutrient load source apportionment data, where nutrients are a significant pressure, the EPA will identify what nutrient load reductions are required in each water body in order to meet the water bodies WFD environmental objectives. These data will help policy makers to determine the best possible measures in different water bodies.

Scientific Evaluation of Agricultural Measures

The Agricultural Catchments Programme (ACP) has been delivered by Teagasc (the Agricultural and Food Development Authority) since its inception and funded by the Department of Food, Agriculture and the Marine (DAFM). The cycles of the ACP have been as follows: 2008-2011, 2012-2015 and 2016-2019. The fourth cycle of the ACP was approved in November 2019 for a further four-year period, 2020-2023, at a cost of €2.5m.

Recent results from the Agricultural Catchments Programme (ACP) have indicated that the hydrological lag time for water quality improvement can be significantly lower than the 5-20 years previously reported in the 2012-2015 Article 10 report. However, the biogeochemical lag time is longer than the hydrological lag time and the ACP continues to assess and evaluate the various controls being implemented under the Good Agricultural Practice Regulations and will refine and significantly improve how these controls are implemented at a farm scale.

Interrelationship between the ACP findings and the Nitrates Regulations

In Ireland, the influence of the Nitrates Regulations and the derogation have been assessed at a small catchment scale by detailed water quality monitoring of surface water and groundwater in agricultural catchments with different physical settings. Ireland has a large variety of soil types and geology. The heterogeneous physical settings largely influence the nutrient transfer pathways and the associated transformation processes along these pathways.

At the scale of the ACP catchments the local physical settings can override the influence of the source pressure causing a poor link between nutrients leaving the root zone and nutrients monitored in the receiving waters. The ACP catchments show that at the meso-scale, the percentage of land in derogation within these small catchments was not always reflected in the water quality of the receiving waters. Therefore, the next phase of the ACP will use high temporal resolution water quality data from meso-scale catchments together with spatially high-resolution national data to scale-up from the meso-scale to the regional and national scale.

The fourth phase of the ACP includes detailed farm-scale experiments and monitoring of N and P concentrations in soil solutions and groundwater on derogation and non-derogation farms.

Future Scientific Evaluation of Agricultural Measures

The current fourth phase of the ACP has received an increased budget of 65%. This will facilitate the recruitment of new researchers, technicians and technologists to conduct new experiments and support the on-going and extended data collection and research. This phase of the programme will include new farm-scale experiments (including on farms outside the ACP) and monitoring of N and P concentrations in soil solutions and groundwater on derogation and non-derogation farms on similar physical settings. These farms will be selected based on the derogation history and current derogation situation as well as on the soil type and location in the landscape. A catchment modeller will further test scenarios of intensification of farming and weather. Above baseline mitigation measures will be tested and evaluated. These temporal data-rich meso-scale catchments (ca. 10 km^2) can be used to scale-up to regional and national scale using the spatially rich national data set provided by the EPA. An important part of the fourth phase of the programme is the inclusion of monitoring and research on greenhouse gas (GHG) emission and carbon sequestration. This will give a comprehensive insight to intensified agriculture on both water quality and GHG emission in representative areas of Ireland.

8 REFERENCES

- DoEHLG/DAFM, 2005. Irelands National Action Programme under the Nitrates Directive, Department of the Environment, Heritage and Local Government and Department of Agriculture and Food, July 2005.
- DHPLG, 2018. WFD River Basin Management Plan 2018-21, Department of Housing, Planning and Local Government, April 2018.
- EPA, 2006. Irelands Water Framework Directive Monitoring Programme, Environmental Protection Agency, Ireland.
- EPA, 2010. Water Quality in Ireland Report, 2007-2009, Environmental Protection Agency, Ireland.
- EPA, 2012. Article 10 Nitrates Directive Report for Ireland, 2008-2011, Environmental Protection Agency, Ireland.
- EPA, 2016. Article 10 Nitrates Directive Report for Ireland, 2012-2015, Environmental Protection Agency, Ireland.
- EPA, 2017. Water Quality in Ireland Report, 2010-2015, Environmental Protection Agency, Ireland.
- EPA, 2019. Water Quality in Ireland Report, 2013-2018, Environmental Protection Agency, Ireland.
- EPA, 2020. Ireland's Environment 2020 - An Assessment, Environmental Protection Agency, Ireland.
- EU Commission, 2009. Guidance Document No. 23 on eutrophication assessment in the context of European water policies, European Commission, Brussels.
- EU Commission, 2018. Article 11 report from the Commission to the Council and the European Parliament on the implementation of Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources based on Member State reports for the period 2012–2015, *COM (2018) 257 final*, European Commission, Brussels.
- European Communities (Protection of Waters against Pollution from Agricultural Sources) Regulations 2003 (S.I. No. 213 of 2003), Stationary Office, Dublin, Ireland.
- European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003), Stationary Office, Dublin, Ireland.
- European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2005 (S.I. No. 788 of 2005), Stationary Office, Dublin, Ireland.
- European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2006 (S.I. No. 378 of 2006), Stationary Office, Dublin, Ireland.
- European Communities (Good Agricultural Practice for Protection of Waters) (amendment) Regulations 2007 (S.I. No. 526 of 2007), Stationary Office, Dublin, Ireland.
- European Communities (Waste Water Discharge (Authorisation)) Regulations 2007 (S.I. No. 684 of 2007), Stationary Office, Dublin, Ireland.
- European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2009 (S.I. No. 101 of 2009), Stationary Office, Dublin, Ireland.

- European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2010 (S.I. No. 610 of 2010), Stationary Office, Dublin, Ireland.
- European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2011 (S.I. No. 125 of 2011) (Amendment), Stationary Office, Dublin, Ireland.
- European Union (Good Agricultural Practice for Protection of Waters) Regulations 2014 (S.I. No. 31 of 2014), Stationary Office, Dublin, Ireland.
- European Union (Good Agricultural Practice for Protection of Waters) Regulations 2014 (S.I. No. 134 of 2014) (Amendment), Stationary Office, Dublin, Ireland.
- European Communities (Water Policy) Regulations 2014 (S.I. No. 350 of 2014), Stationary Office, Dublin, Ireland.
- European Union (Good Agricultural Practice for Protection of Waters) Regulations 2014 (S.I. No. 463 of 2014) (Amendment), Stationary Office, Dublin, Ireland.
- European Union (Good Agricultural Practice for Protection of Waters) Regulations 2017 (S.I. No. 605 of 2017), Stationary Office, Dublin, Ireland.
- European Union (Good Agricultural Practice for Protection of Waters) Regulations 2018 (S.I. No. 65 of 2018) (Amendment), Stationary Office, Dublin, Ireland.
- European Union (Good Agricultural Practice for Protection of Waters) Regulations 2020 (S.I. No. 40 of 2020) (Amendment), Stationary Office, Dublin, Ireland.
- European Union (Good Agricultural Practice for Protection of Waters) Regulations 2020 (S.I. No. 225 of 2020) (Amendment No. 3), Stationary Office, Dublin, Ireland.
- Eurostat, 2013. Nutrient Budgets – Methodology and Handbook. Version 1.02. Eurostat and OECD, Luxembourg.