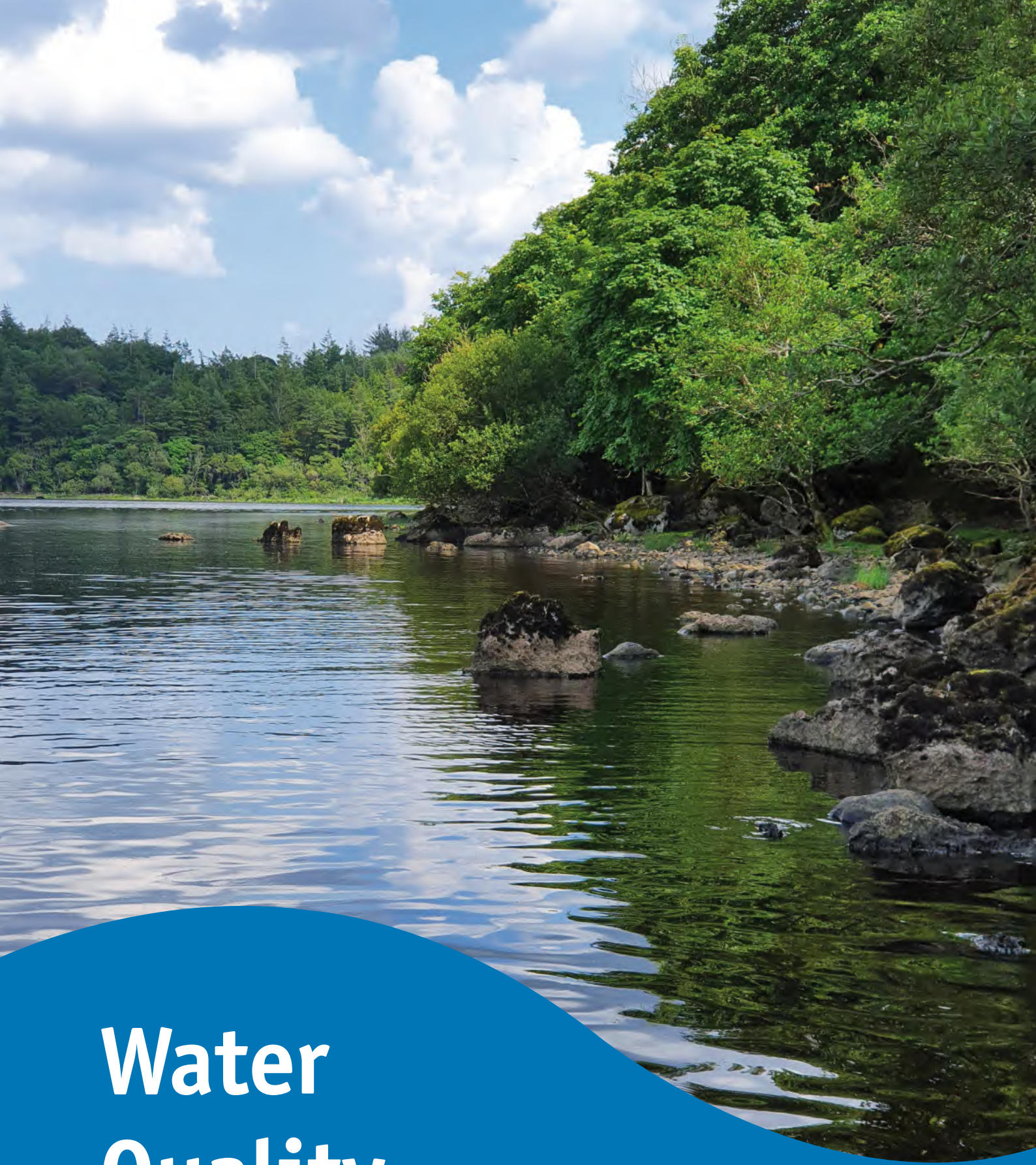

Water Quality in 2023

An Indicators Report

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

Water Quality in 2023
An Indicators Report

ENVIRONMENTAL PROTECTION AGENCY

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Disclaimer

Acknowledgements

The data presented in this report are based on the work of many individuals and organisations involved in monitoring and assessing our waterways. These include:

Staff in the EPA Office of Evidence and Assessment (OEA) and Office of Radiation Protection and Environmental Monitoring (ORM) together with Local Authorities, Marine Institute, Inland Fisheries Ireland and Office of Public Works.

An effort has been made in this report to make the maps more accessible to readers with a colour vision deficiency (colour blindness). Some of the symbols in the maps have changed to facilitate this.

Cover image: Lough Gill, Hugh Feeley

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Contents

Introduction

This report updates the key indicators of water quality using monitoring data collected in 2023. The EPA undertakes a full assessment of the overall quality and ecological status of Ireland's waters[1] every three years. The last full cycle covered the 2019-2021 period. In the intervening years we report on the indicators of water quality to provide an annual update on trends in the biological quality and nutrient levels of our rivers, lakes, estuaries, coastal and groundwaters.

Biological Quality Indicators

The overall ecological health of a water body is assessed by monitoring a range of biological elements which can tell how good the water quality and habitat condition is. The river biological quality indicator is based on the Q value for insects (macroinvertebrates). Changes in Q value are generally indicative of changes in overall river ecological status. The lake indicator is based on the biological elements; fish, macroinvertebrates, aquatic plants, phytobenthos and phytoplankton. These indicators are a subset of the overall lake ecological status assessment.

Nutrient Indicators

The main issue which impacts on the quality of our waters and their biological health is increased concentrations of nutrients, such as phosphorus and nitrogen. Human activities, such as agriculture, waste water (domestic and urban) and forestry, are the primary cause of nutrient loss to our waters.

When too many nutrients enter our waters, they cause an overgrowth of plants and algae that can then clog up our water courses, use up oxygen and harm other aquatic life such as macroinvertebrates and fish in a process known as eutrophication. Elevated phosphorus is a particular concern for the ecological health of our rivers and lakes, while elevated levels of nitrogen are more of a concern for our estuaries and coastal areas. High nitrate concentrations in our drinking water supplies pose a risk to human health. Phosphorus entering our waters is a particular problem associated with poorly treated waste water, industrial discharges and in agricultural areas with poorly draining soils.

This report presents indicators for nitrogen and phosphorus in rivers, lakes, estuaries, coastal and groundwaters using both three-year averages and annual averages at national and regional scale. Nutrients are sampled at least four, and up to twelve, times a year depending on the site; data from 2023 have been included in the analyses. The five regional areas are the Border, Midlands and East, South East, South West and Western Regions[2]. In general, the biological quality of our waters will not improve unless nutrient concentrations reduce.

1 https://www.epa.ie/publications/monitoring--assessment/freshwater--marine/EPA_WaterQualityReport2016_2021.pdf

2 The five regions correspond with the water management structures in place under governance arrangements for the River Basin Management Plan (visit the LAWPRO website here for a map of regions)

Key Findings

Biological indicators

- The proportion of rivers in satisfactory biological condition is relatively unchanged since 2018 and there is no indication yet of an improvement.
- Of the 1,459 river water bodies monitored in 2022 and 2023 there has been a further small net decline in biological quality of 45, with the number of declines (232) exceeding the number of improvements (187).
- There has been a slight decline in the proportion of lakes with satisfactory (high and good) biological quality, driven by a reduction in the number of lakes with high biological quality.

Nutrient indicators – nitrogen

- Annual average river nitrate concentrations nationally were the same in 2023 as in 2022 and there is no sign of an improvement. Nitrate concentrations remain too high in 42% of river sites mainly in the South East and Midland and Eastern regions.
- 20% of groundwater sites still have nitrate concentrations that are considered too high. The national annual average in 2023 was higher than in 2022 with both the South East and Midlands and East regions seeing increases.
- 17% of our estuarine and coastal water bodies assessed were in unsatisfactory condition for nitrogen, while nitrogen loads to the marine environment are largely unchanged over the past four years.
- The elevated levels of nitrogen in our waters are found mainly in the east, south east and south of the country and are too high to support good water quality in our estuaries. This is primarily attributable to intensive agricultural activities on freely draining soils in these areas.

Nutrient indicators – phosphorus

- Annual average river phosphate concentrations nationally were the same in 2023 as in 2022. Average phosphate concentrations remain too high in 27% of rivers. Phosphate levels fluctuate annually but overall there has been no significant change over recent years.
- Total phosphorus concentrations were too high in 35% of lakes which is a small decrease from 36% in the previous period. The majority of lakes with elevated phosphorus are in the border region.
- The vast majority of estuaries and coastal waters have satisfactory concentrations of winter phosphate and annual phosphate loadings to the marine environment have been broadly unchanged over the last few years.

Indicators

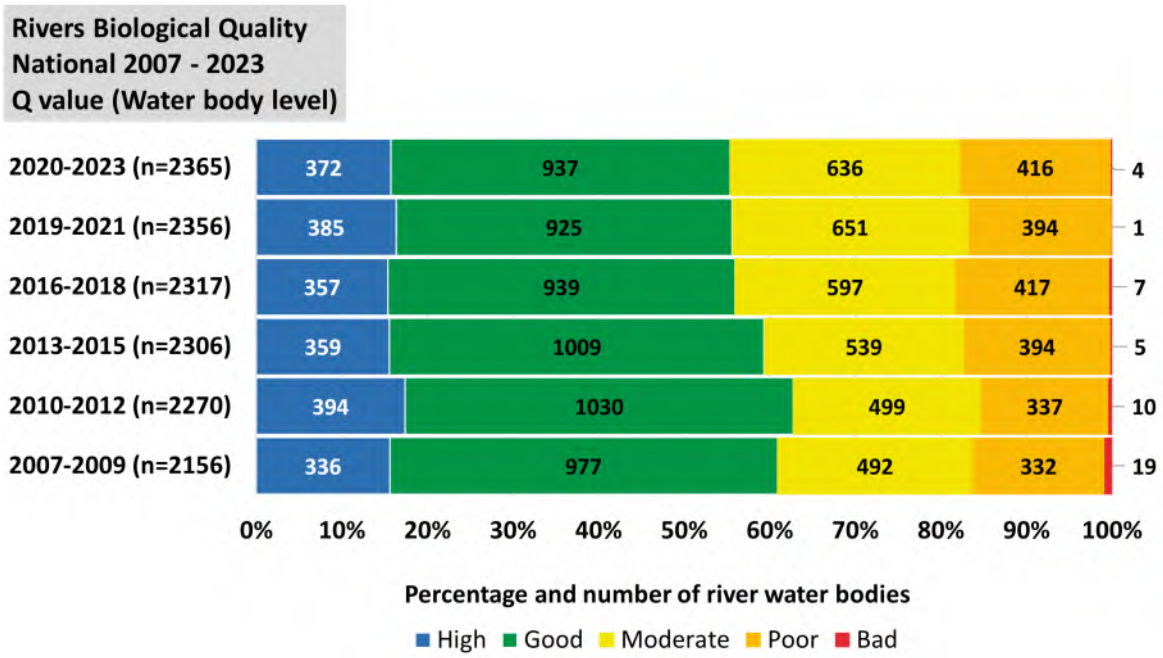
Rivers Biological Quality

The biological quality of river water bodies across the country is assessed as part of the National Water Quality Monitoring Programme. The EPA assesses macroinvertebrate communities to categorise the biological quality (Q value[3]) of a river into five classes: high, good, moderate, poor or bad. Macroinvertebrates are the main biological element used to determine our river water quality. Therefore, changes in Q value are generally indicative of changes in overall ecological status.

This assessment period covers survey updates in 2022 and 2023.

Findings – River Water Body Quality

Of the 1,459 (out of 2,365) river water bodies assessed in 2022 and 2023[4], 1,028 river water bodies remained stable with no change in their quality class when compared to their previous survey. There was a net decline in quality in 45 river water bodies over the two years; 187 improved in quality while 232 declined in quality. Declines and improvements in river biological quality occurred in all major river catchments (known as hydrometric areas) surveyed in 2022 and 2023; net improvements were noted in the Liffey, Slaney, Moy and Erne river catchments and net declines were noted in the Nore, Suir, Barrow, Shannon, Lee, Laune, Feale and Lough Swilly river catchments.

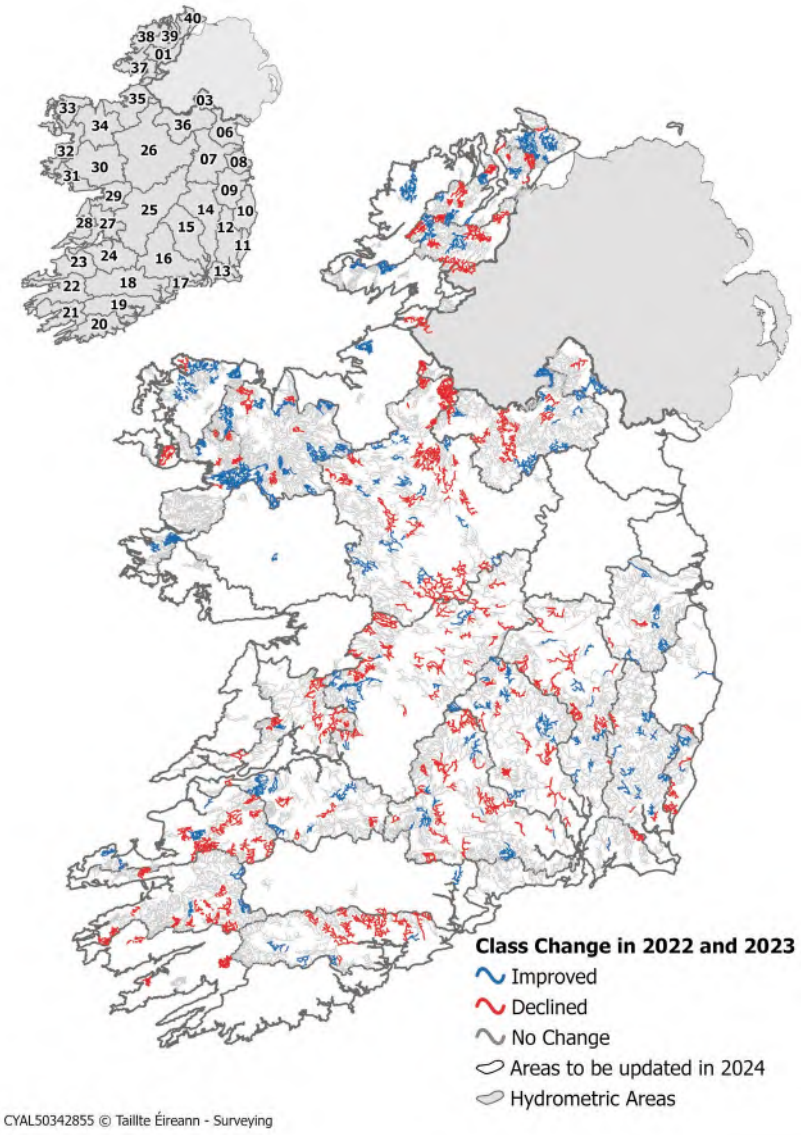


[3] Q value system: Q5 and Q4-5=High; Q4=Good; Q3-4=Moderate; Q3 and Q2-3=Poor; Q2, Q1-2 and Q1=Bad.

[4] The latest assessment period covers the quality of all river water bodies in 2020-2023. This includes the more recent updates from 2022 and 2023. Twelve water bodies last surveyed in 2019 are also included.

Taking the latest data for all river water bodies (monitored between 2020-2023), 55% (1,309) of river water bodies are in high or good biological quality[5]. The remaining 45% (1,056) are in moderate, poor or bad quality.

The number of river water bodies in bad condition has increased to four since the 2019-2021 period. These bad quality river stretches are within the River Laune in Kerry (impacted by urban waste water) and within the Annagh River in Clare, Ahavarraga Stream in Limerick, and the Nenagh River in Tipperary which are impacted by multiple pressures such as agriculture, urban waste water and other human activities[6]. This increase is in part due to targeted monitoring in rivers downstream of known pressures.



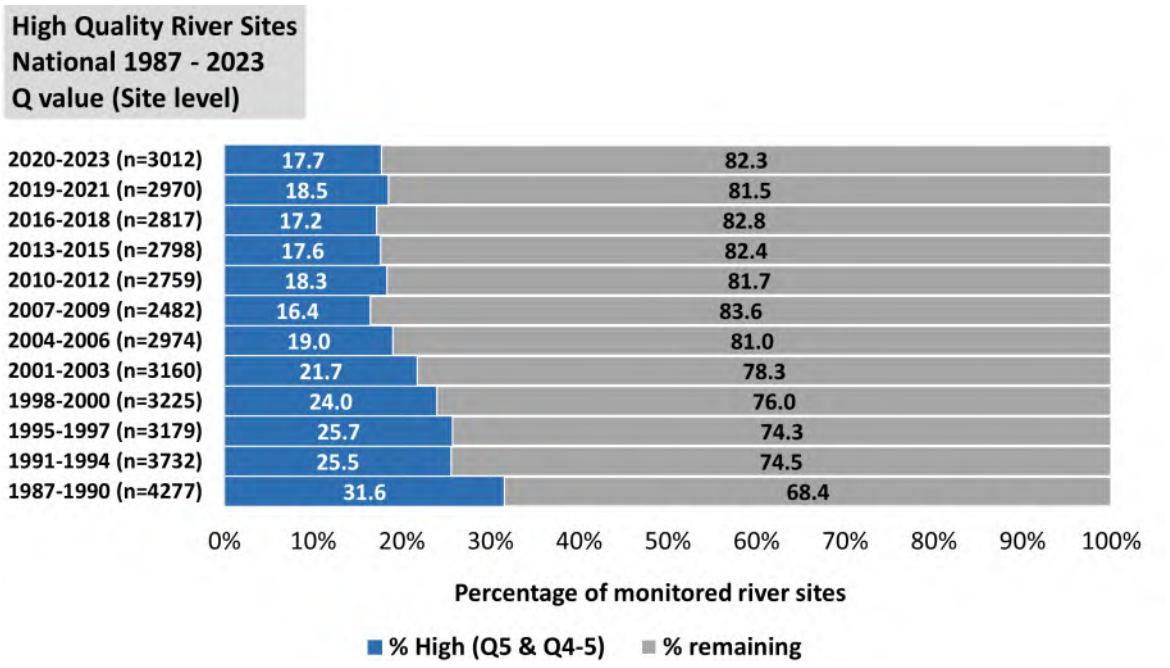
[5] Overall survey period total numbers of river water bodies will take into account any adjustments to the programme since the previous assessment.

[6] Bad quality river water bodies in 2023 are Laune_010 in Kerry, Annagh (Clare)_010 in Clare, Ahavarraga Stream in Limerick, and Nenagh_060 in Tipperary.

Findings – High Quality Sites

Since monitoring began in the 1980s the number of high quality river sites[7] declined steadily until the 2007-2009 period. In the latest assessment period (2020-2023) high macroinvertebrate quality was observed at 533 river sites (17.7% of monitored river sites)[8]. While this is a decline from the previous period the overall percentage of rivers with high biological quality has remained relatively stable since 2010-2012.

There was an increase in the Q5 category[9], bringing the total number of the highest quality sites to 41 at the end of 2023, up from 32 at the end of 2021. These high quality sites are important for supporting sensitive aquatic species such as juvenile salmon and trout and the protected, but declining, freshwater pearl mussel.



7 A 'water body' is the basic assessment unit used to check water quality. Water bodies can have single or multiple monitoring points called 'sites'.

8 Survey period site totals will reflect any updates to the database since the previous assessment.

9 Q values of Q5 and Q4-5 are considered high quality, with Q5 having the highest quality.

Lakes Biological Quality

This indicator is based on the assessment of the biology of 224 monitored lakes for the period 2021-2023. Lake biology is categorised into five classes: high, good, moderate, poor, and bad. Lakes in high and good quality are in a satisfactory condition and lakes in moderate or worse quality are in an unsatisfactory condition.

The biological elements that are assessed for this indicator are aquatic plants, phytoplankton, macroinvertebrates[10], phytobenthos[11], and fish.

Findings

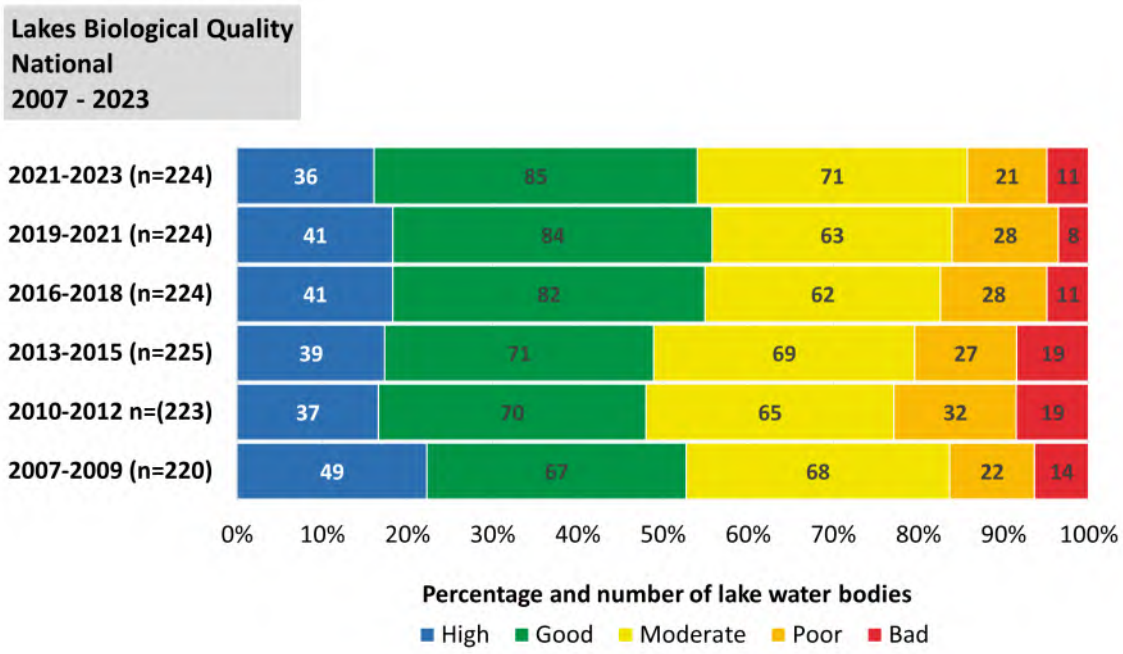
For the period 2021-2023, over half (54%) of monitored lakes are in high or good biological quality with the remaining 46% in moderate or worse quality. Eleven lakes (5%) are in bad biological quality, the worst class. The majority of lakes that are failing to achieve good biological quality are in the Erne and Shannon catchments, which are areas with elevated lake phosphorus levels. The lakes with high quality are predominantly located in the west and south west.

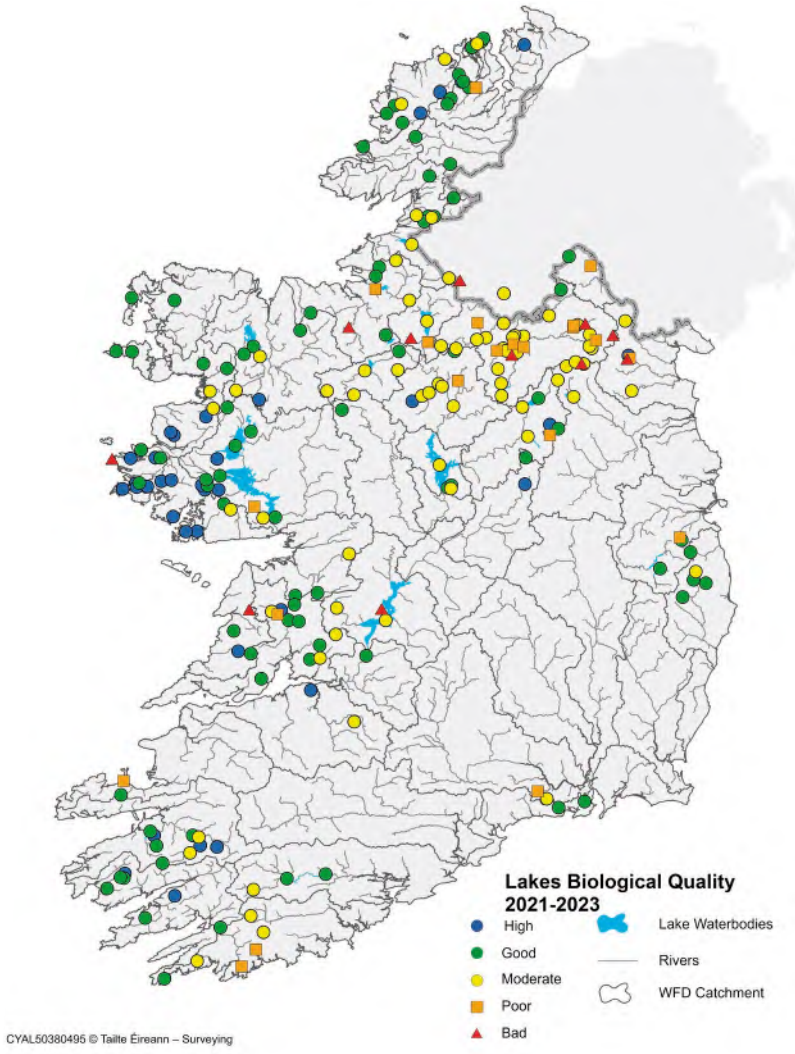
There has been a slight decline in the proportion of lakes at satisfactory quality (high and good) driven by a decline in the number of lakes with high biological quality, the majority of these declines are in the north west and south west.

Lough Na Fooey, Hugh Feeley

[10] The assessment of macroinvertebrates for acidification using Lake Acidification Macroinvertebrate Metric (LAMM) was recently incorporated into the lake assessment tools. More detail available here. This assessment is used on lakes deemed to susceptible to acidification pressures.

[11] Phytobenthos is the name given to the tiny organisms (e.g. diatoms and algae) commonly found on stones on the bottom of rivers and lakes.


Lakes Biological Quality
National
2007 - 2023
2021-2023 (n=224)
36
85
71
21
11
2019-2021 (n=224)
41
84
63
28
8
2016-2018 (n=224)
41
82
62
28
11
2013-2015 (n=225)
39
71
69
27
19
2010-2012 n=(223)
37
70
65
32
19
2007-2009 (n=220)
49
67
68
22
14
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percentage and number of lake water bodies
High
Good
Moderate
Poor
Bad


Lakes Biological Quality
2021-2023
High
Good
Moderate
Poor
Bad
Lake Waterbodies
Rivers
WFD Catchment
CYAL50380495 © Tailte Éireann – Surveying

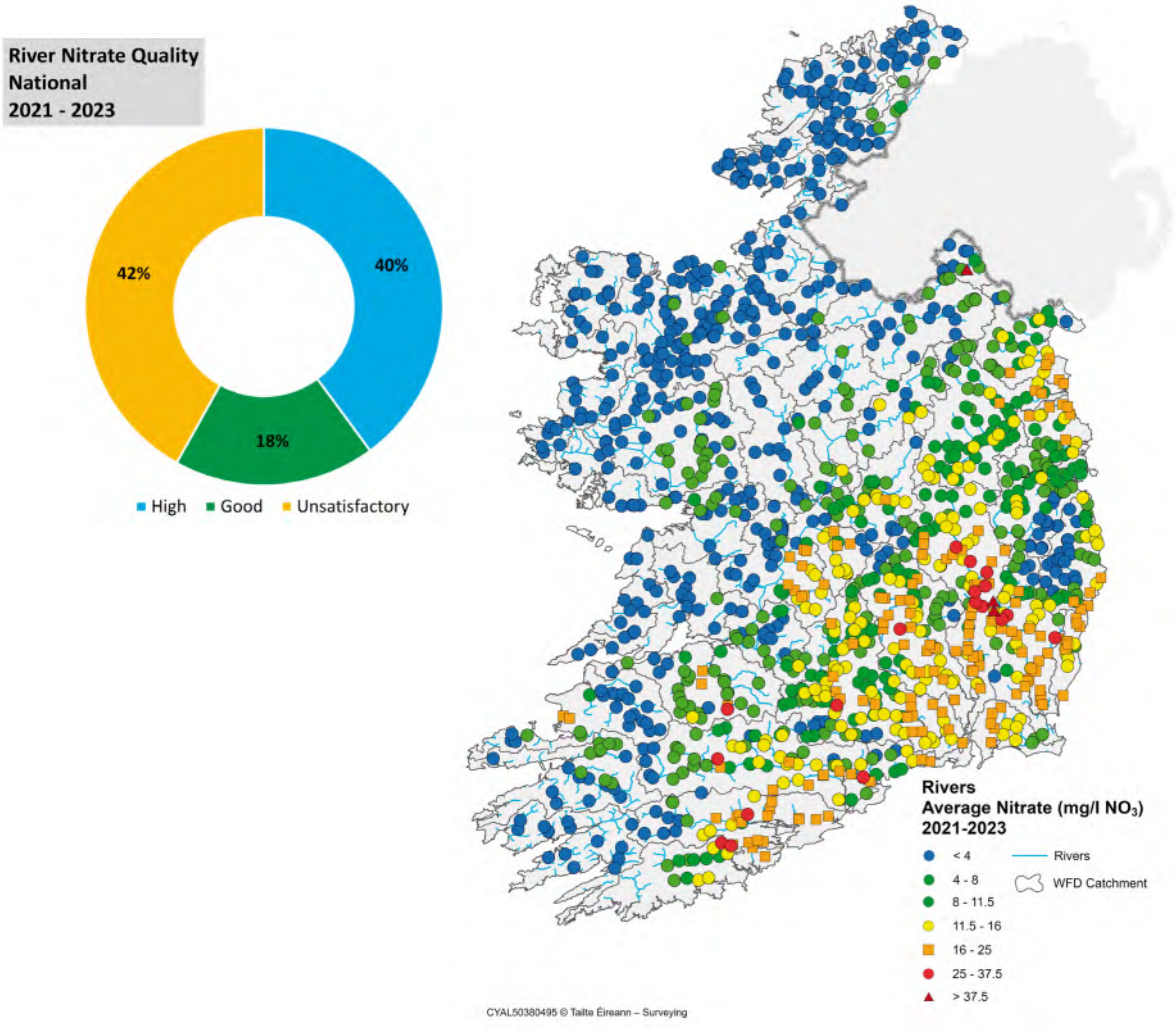
Nitrate in Rivers

This indicator is based on an assessment of average nitrate concentrations (as mg/l NO_3) over three years (2021-2023) at 1,309 river sites. A regional analysis of average annual river nitrate concentrations from 2010 was also undertaken.

Nitrate enters our waterways from the land through free draining soils to our groundwaters where it can then discharge to rivers and ultimately to our marine waters. It mainly comes from agriculture through chemical and organic (manures and urine from livestock) fertilisers or from direct discharges from waste water. The concentration of nitrate (NO_3) in rivers is an indicator of nutrient enrichment and elevated levels in drinking water can pose a risk to human health.

Findings

The three-year average concentrations for nitrate in rivers show that 42% of river sites nationally have unsatisfactory nitrate concentrations (above 8 mg/l NO_3)[12]. This is largely unchanged since the last assessment. The majority of rivers affected are concentrated in the east, south east and south of the country.

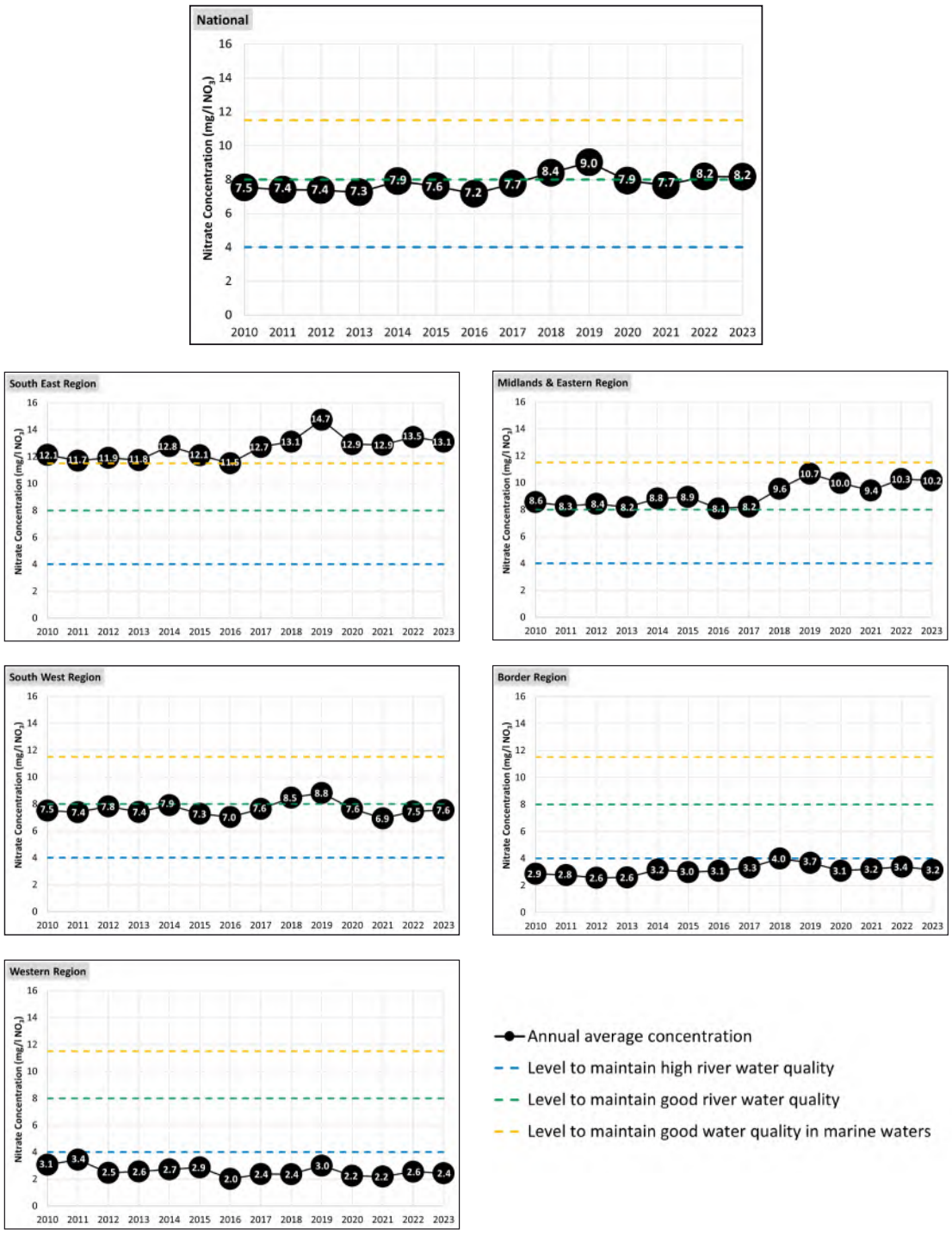


[12] There are currently no environmental quality standards for nitrate in rivers, however, average nitrate concentration values less than 4 mg/l NO_3 (0.9 mg/l N) and less than 8 mg/l NO_3 (1.8 mg/l N) are needed to maintain high and good quality surface waters respectively. The nitrate standard for drinking water is 50 mg/l NO_3. Nitrate concentrations are converted to nitrogen by multiplying the concentration by a factor of 0.2259.

Regional River Nitrate

The graphs below show the national and regional profile of average annual nitrate concentrations between 2010 and 2023. Overall, concentrations nationally have increased since 2012/2013 but in recent years have levelled off. Nationally there was no change in average concentrations between 2022 and 2023.

Regionally, concentrations in the South East and Midlands and Eastern regions have increased since 2012. Despite a slight drop in concentrations in both regions from 2022 to 2023, levels remain too high to support good biological quality, especially in our estuaries and coastal waters.



Nitrate in Groundwater

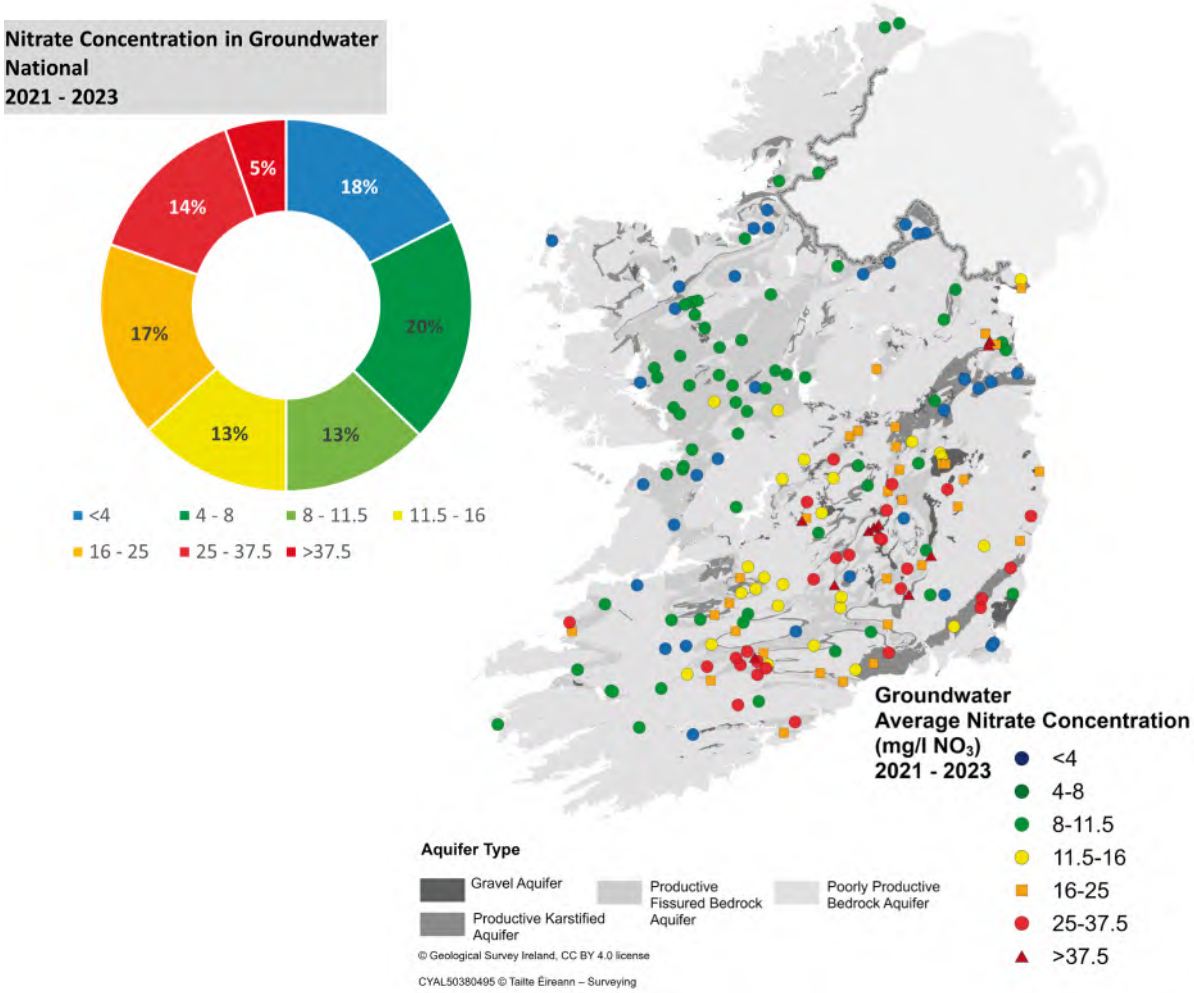
This indicator is based on the three-year average nitrate concentration (as mg/l NO_3) at 188 groundwater monitoring sites for the 2021-2023 monitoring period. A regional analysis of annual groundwater nitrate concentrations since 2010 was also undertaken.

Groundwater flows through the subsoil or bedrock into streams, rivers, lakes, and estuaries. During periods when there is little or no rain, almost all the water flowing in streams and rivers originates from groundwater. Nitrate enters groundwater from the land through free draining soils; groundwater therefore is an important contributor of nitrate into surface water bodies.

Findings

The three-year average nitrate concentrations for the period 2021-2023 saw no real change on the previous period. Eleven (6%) monitoring sites exceeded the threshold value of 37.5 mg/l NO_3 and one (Sheepgrange, Co. Louth) monitoring site exceeded the drinking water standard of 50 mg/l NO_3[13].

One-fifth (20%) of monitoring sites had nitrate concentrations greater than 25 mg/l NO_3 (considered as a high nitrate concentration), which is the same as the previous assessment.



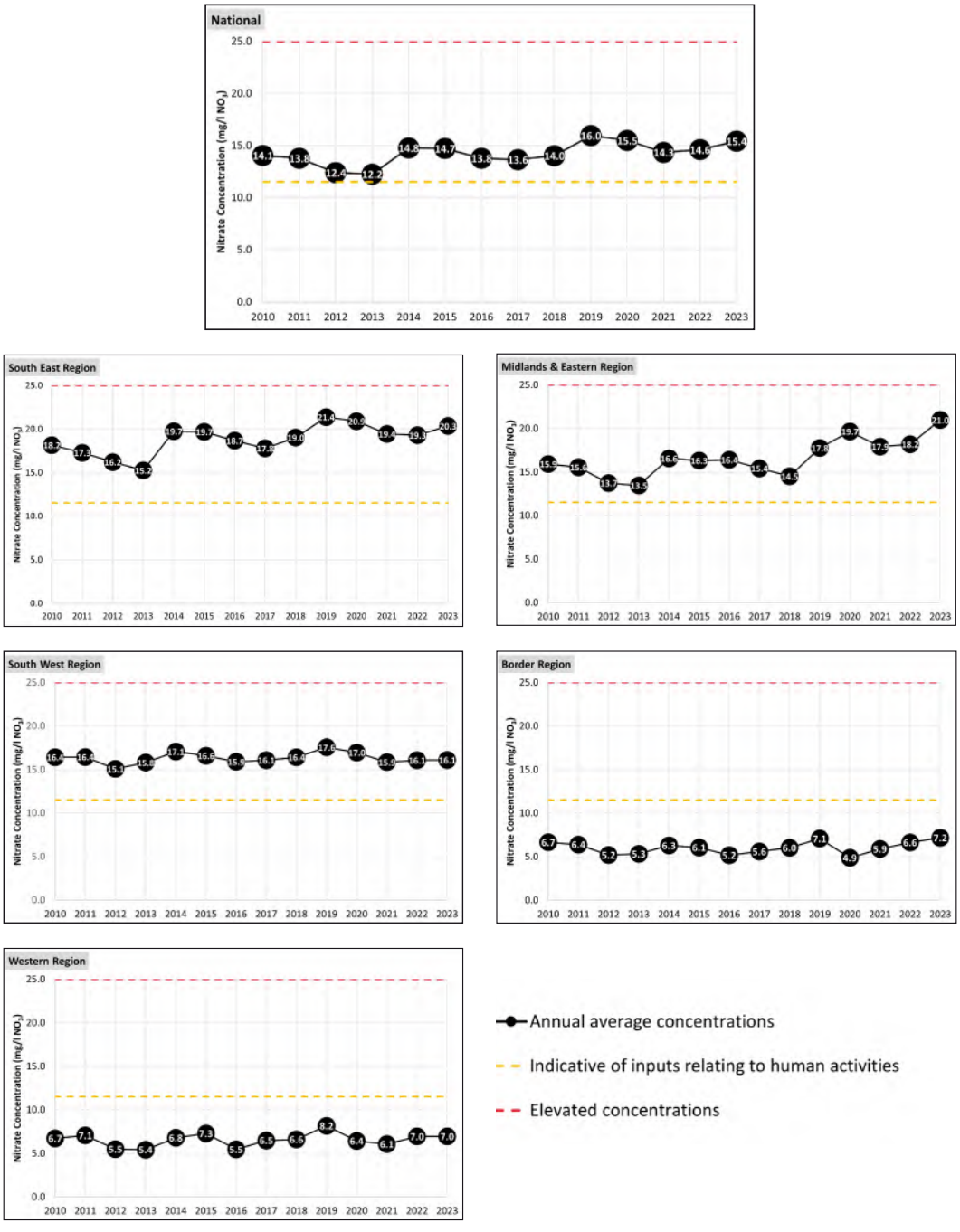
[13] Nitrate concentrations in groundwater that are higher than 11.5 mg/l NO_3 are usually indicative of inputs relating to human activities, anything above 25 mg/l NO_3 is considered an elevated nitrate concentration. The Irish groundwater Water Framework Directive threshold value is 37.5 mg/l NO_3. Groundwater is widely abstracted for drinking water in Ireland and the drinking water standard of 50 mg/l NO_3 relates to the potential for harm to human health.

Regional Groundwater Nitrate

The graphs below show the national and regional profile of average annual nitrate concentrations in groundwater between 2010 and 2023.

Average concentrations of nitrate in groundwater increased nationally between 2022 and 2023. The increased concentration is most notable in the South East and Midlands and Eastern regions with the Midlands and Eastern region exhibiting its highest average nitrate concentration since 2010.

Since 2010, nitrate concentrations in groundwater in the South East, Midlands and Eastern, and South West regions have been consistently above levels that are needed to protect surface water ecology, particularly in our estuarine and coastal waters. Nitrate concentrations in the Western and Border regions have remained low.



Nitrogen in Estuaries and Coastal Waters

This indicator is based on winter levels of dissolved inorganic nitrogen[14] (DIN). The concentration of DIN is expected to be at its highest in winter because of the absence of any significant plant or algal growth at that time of year, therefore less nitrogen is used up and remains in the water.

Increased nitrogen concentrations in our estuaries and coastal waters are an indicator of human activities in the upstream catchments affecting water quality[15]. Any increase in nitrogen will result in increased algal growth, which in turn can lead to problems such as low oxygen levels and the shading of sunlight needed by aquatic plants. These changes can damage the ecology of these systems.

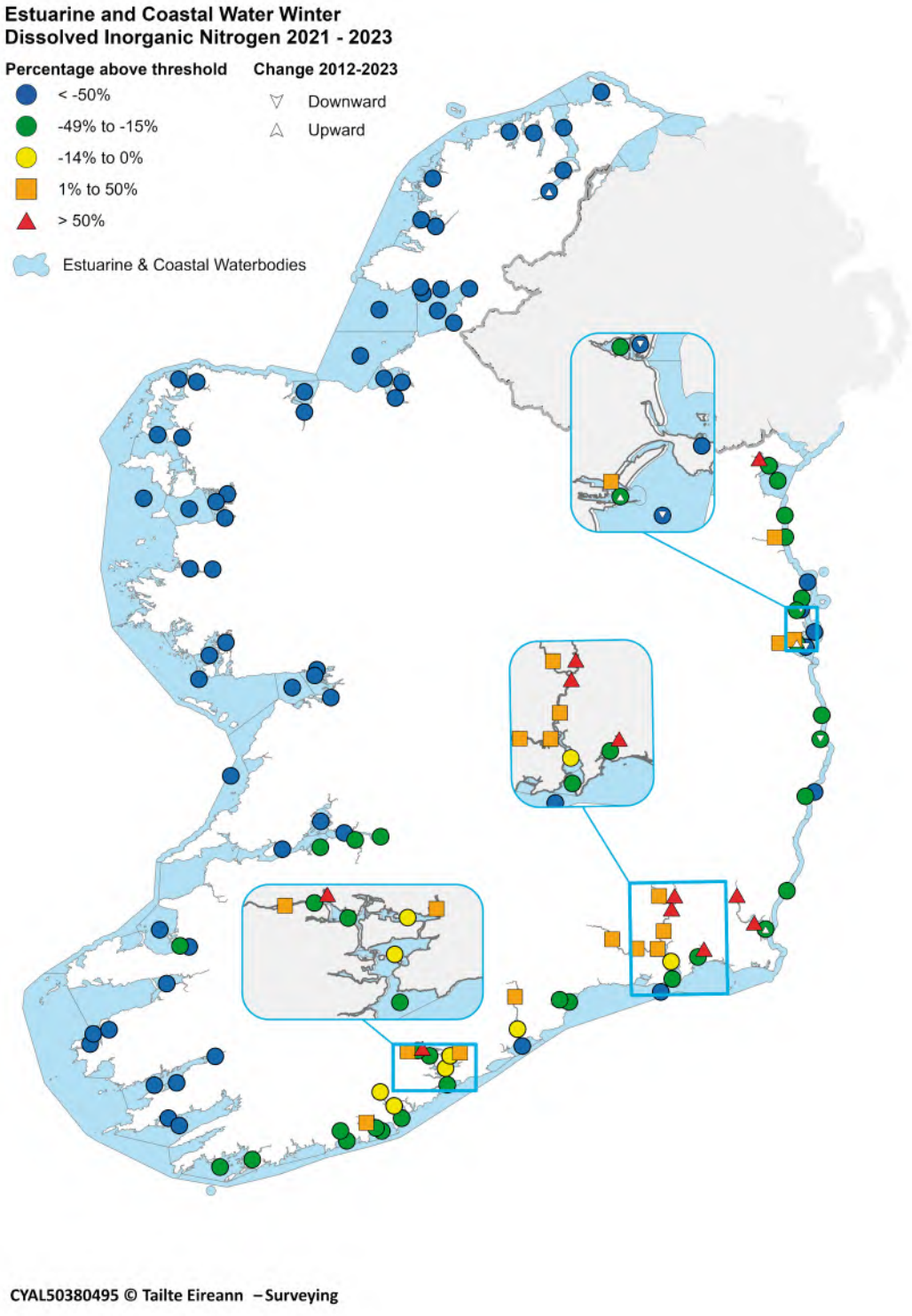
Findings

Twenty of the 117 (17%) estuarine and coastal water bodies assessed were in unsatisfactory condition for DIN. These were located primarily along the eastern, south eastern and southern coastlines. This is an apparent improvement from the previous assessment in 2022 (20% were in unsatisfactory condition for DIN) however this is more likely a result of the inclusion of an increased number of coastal water bodies which generally are less impacted.

Youghal, Robert Wilkes

[14] Dissolved Inorganic Nitrogen is the sum of nitrite, nitrate and ammonia. DIN is expressed as nitrogen (N).

[15] Salinity related thresholds have been defined for DIN in our estuaries and coastal waters. The thresholds range from 2.6 mg/l N in freshwater to 0.25 mg/l N in fully saline waters. DIN concentrations above these thresholds can indicate pollution.


Estuarine and Coastal Water Winter
Dissolved Inorganic Nitrogen 2021 - 2023
Percentage above threshold
< -50%
-49% to -15%
-14% to 0%
1% to 50%
> 50%
Estuarine & Coastal Waterbodies
Change 2012-2023
Downward
Upward
CYAL50380495 © Tailte Eireann – Surveying

Nitrogen Inputs to the Marine Environment

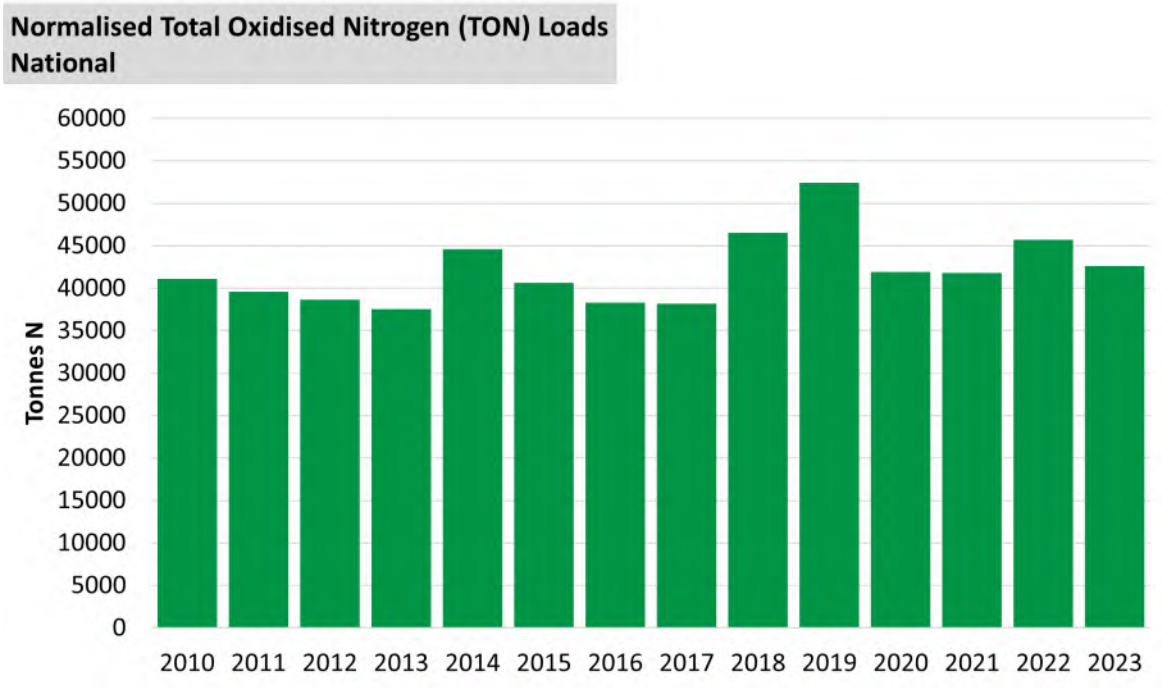
This indicator is based on the inputs of nitrogen[16], expressed as loadings of Total Oxidised Nitrogen (TON), from 19 major rivers into the marine environment[17]. High loads of nitrogen from land based sources can negatively impact our marine ecosystems.

Findings

Nitrogen loads can fluctuate between years depending on the weather, particularly rainfall. To remove the influence of inter-annual changes in river flow, the inputs are normalised by a factor which represents the long-term average flow rate for each river.

In 2023, TON was slightly lower when compared with 2022 but similar to 2020 and 2021 indicating no improvement over the last four years (taking into account the anomaly caused by the drought in 2018 and 2019).

As in previous reports, the largest contributions of nitrogen to the marine environment came from catchments that drain from the south east of the country.



16 Previous reports have used Total Nitrogen (TN). Total Oxidised Nitrogen (TON) has been used here to better align with data used in other indicators. The values for these parameters are lower than for the TN previously shown as TON only represent a portion of the total.

17 The inputs are calculated based on nutrient concentrations, which are measured 12 times a year, and river flow, which is measured continuously.

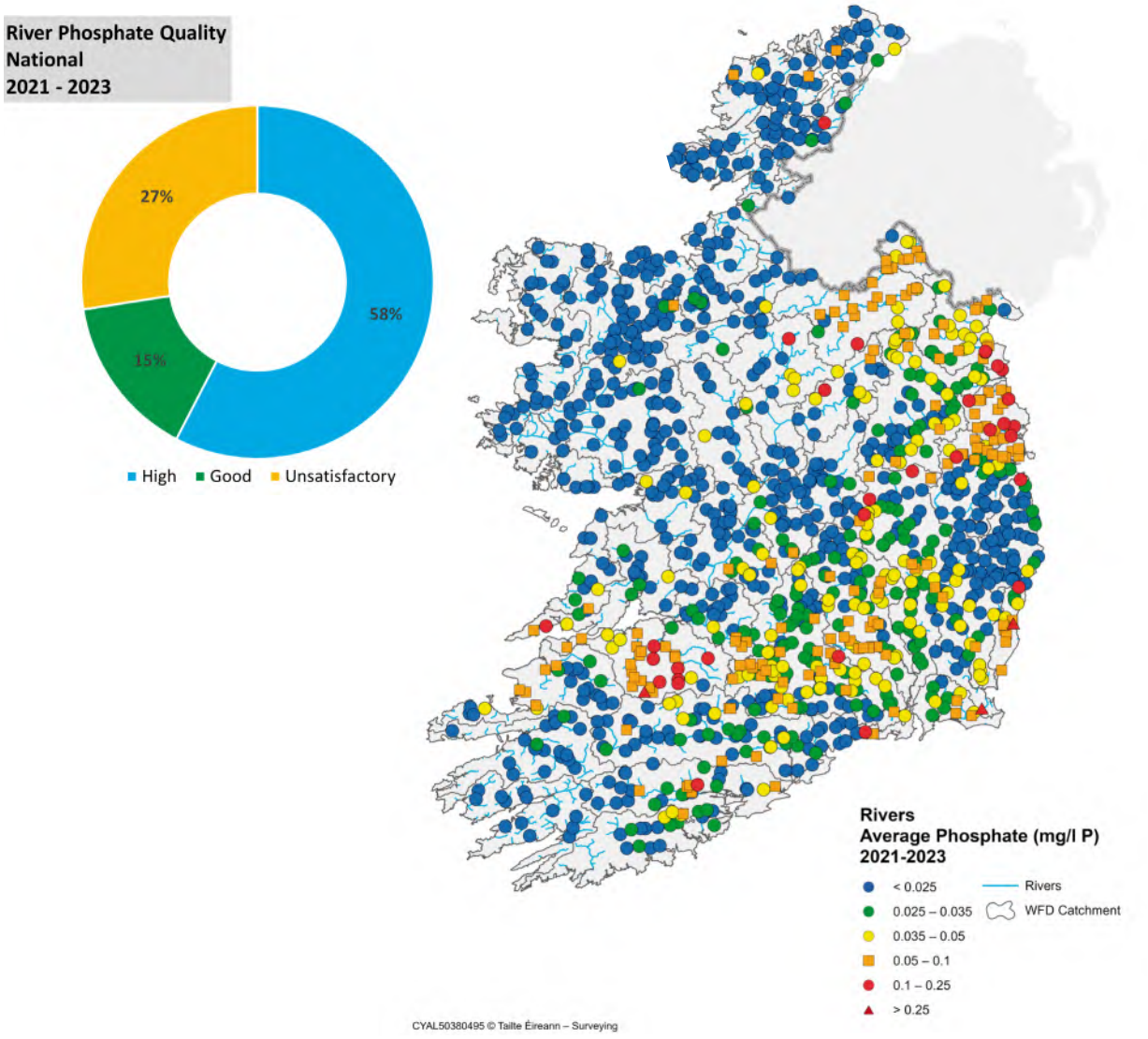
Phosphate in Rivers

This indicator is based on an assessment of average phosphate[18] concentrations over the period 2021-2023 at 1,307 river sites. A regional analysis of average annual river phosphate concentrations from 2010-2023 was also undertaken.

Elevated phosphate concentrations in rivers can be a sign of nutrient pollution from human activities. Phosphate enters our waterways from a variety of sources, but primarily comes from waste water, industrial discharges and from run off of organic and inorganic fertilisers from agricultural land.

Findings

The three-year average concentrations of phosphate in our rivers saw little change for the 2021-2023 period compared to the previous assessment. Over one quarter (27%) of sites have unsatisfactory phosphate concentrations while the remaining sites are at levels which support high (58%) or good (15%) water quality[19].



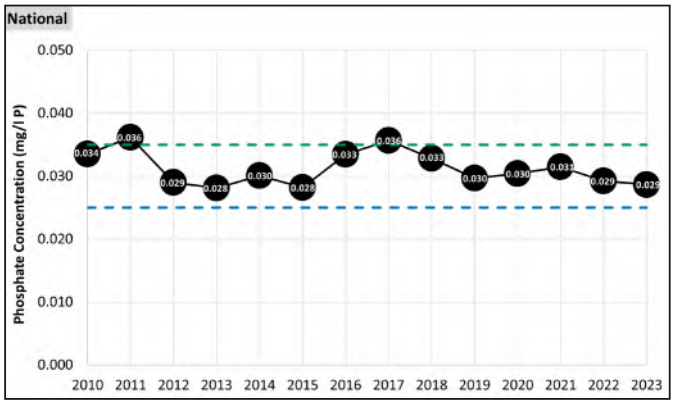
[18] Measured as molybdate reactive phosphate (MRP).

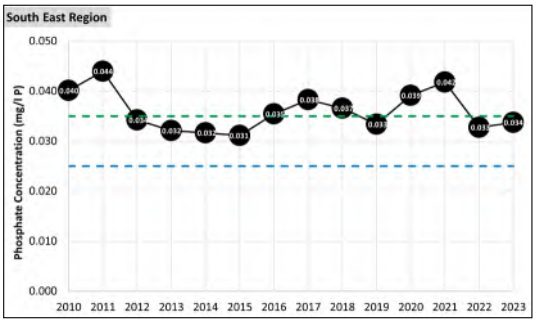
[19] Average phosphate concentrations of less than 0.025 mg/l P and less than 0.035 mg/l P have been established in Ireland as legally binding national standards to support the achievement of high and good ecological status respectively.

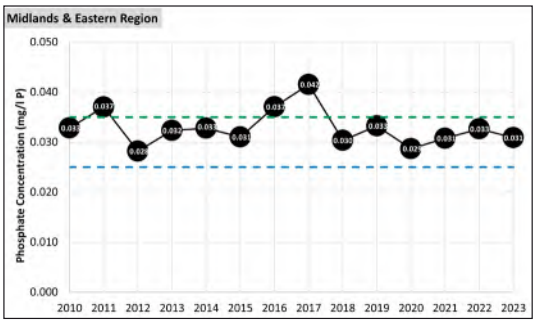
Regional River Phosphate

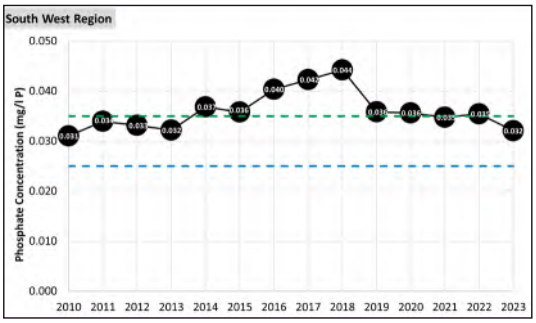
The graphs below show the national and regional profile of the average annual phosphate concentrations between 2010 and 2023.

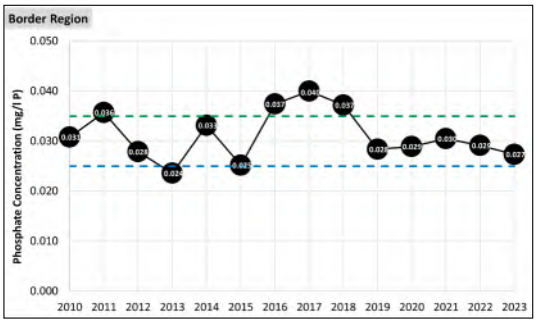
Phosphate levels in rivers fluctuate between years but have been broadly stable over recent years. Nationally the average concentration is the same in 2023 as in 2022. The South East, Midlands and East and South West regions exhibit the highest average river phosphate concentrations in the country.

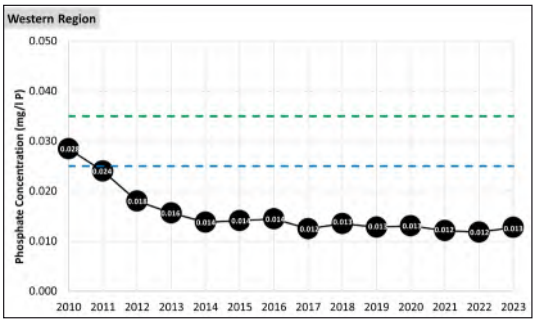


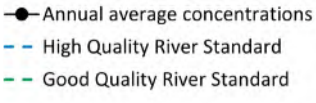












Total Phosphorus in Lakes

This indicator is based on an assessment of the average three-year total phosphorus concentration in 222 monitored lakes during 2021-2023.

Increased concentrations of total phosphorus in lakes is an indicator of nutrient enrichment caused by human activities. If phosphorus is present in excess amounts, it can lead to a significant decrease in water quality due to an overgrowth of plants and algal blooms.

This overgrowth of plants and algal blooms reduces the amount of oxygen available to other biota such as macroinvertebrates and fish and reduces sunlight penetration needed by aquatic plants that grow in deeper waters. This can negatively affect the lake's ecology. Lakes with elevated phosphorus can often have a characteristic 'pea-soup' appearance due to the intense algal blooms that can occur.

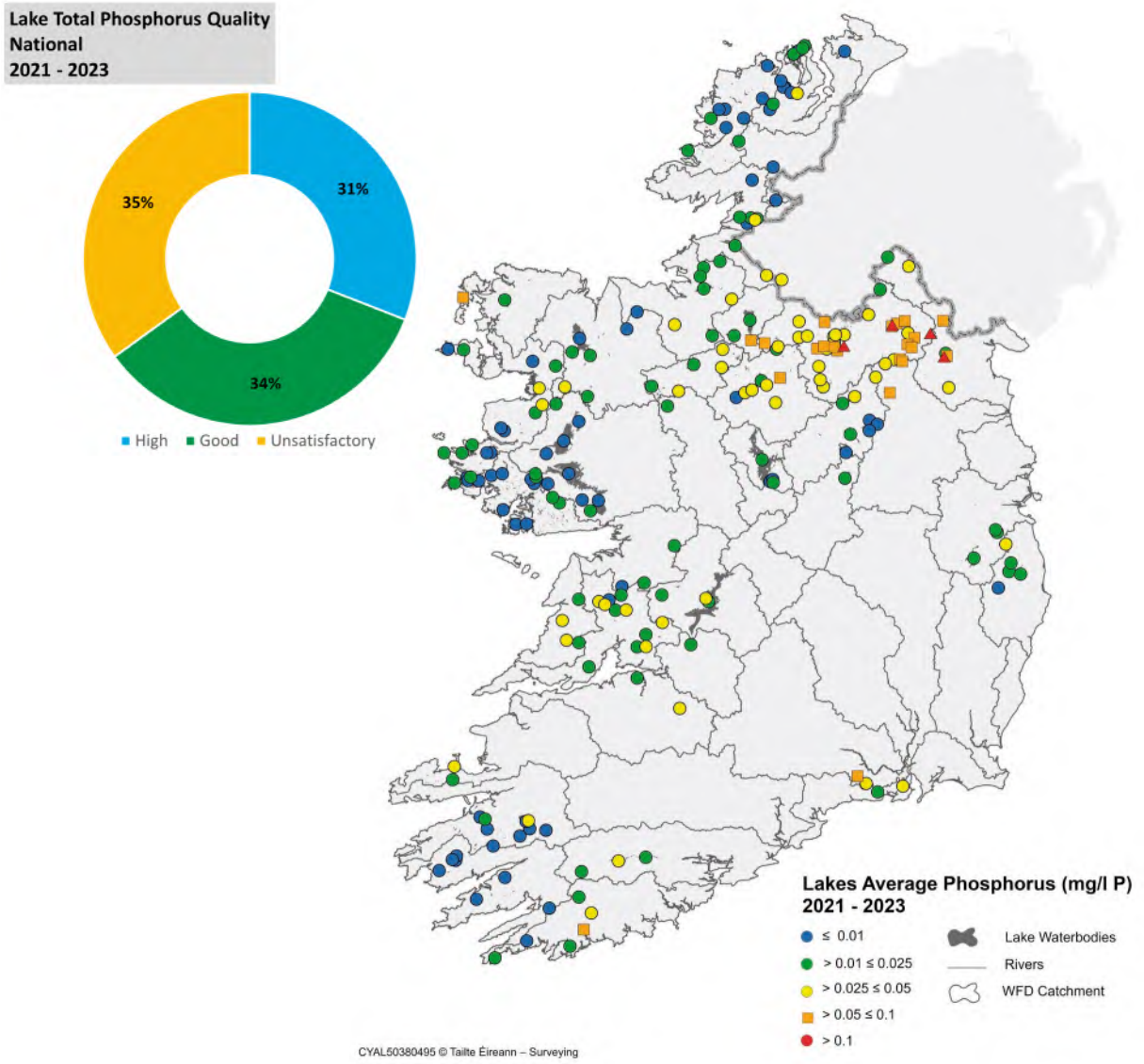
Findings

In the period 2021-2023, over one third (35%) of lakes had unsatisfactory total phosphorus concentrations[20] a small drop from 36% in the previous period. Seventy-eight lakes, the majority of these located in the border region, have average total phosphorus concentrations that are consistently above the good quality standard (0.025 mg/l P). The ecological recovery of these lakes may take a long time due to legacy stores of phosphorus in their sediments, however, reducing the input of phosphorus to these lakes is a key first step.

Lakes with lower total phosphorus concentrations are predominantly situated in the west of the country. This distribution tends to reflect the difference in the level of human activity, hydrogeology, and soil conditions in these areas.

Lough Corrib, Robert Wilkes

[20] Average total phosphorus concentrations in lakes of less than 0.01 mg/l P and less than 0.025 mg/l P have been established in Ireland as legally binding national standards to support the achievement of high and good ecological status respectively.


Lake Total Phosphorus Quality
National
2021 - 2023
31%
34%
35%
High
Good
Unsatisfactory
Lakes Average Phosphorus (mg/l P)
2021 - 2023
≤ 0.01
> 0.01 ≤ 0.025
> 0.025 ≤ 0.05
> 0.05 ≤ 0.1
> 0.1
Lake Waterbodies
Rivers
WFD Catchment
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Phosphate in Estuaries and Coastal Waters

This indicator is based on three-year average winter phosphate[21] levels in estuaries and coastal waters. In winter the concentration of phosphate is expected to be at its highest due to the absence of any significant plant or algal growth.

Increased phosphate concentrations in estuaries can be problematic. If present in sufficient concentrations it can cause eutrophication, in turn negatively affecting the flora and fauna and the healthy functioning of the ecosystem.

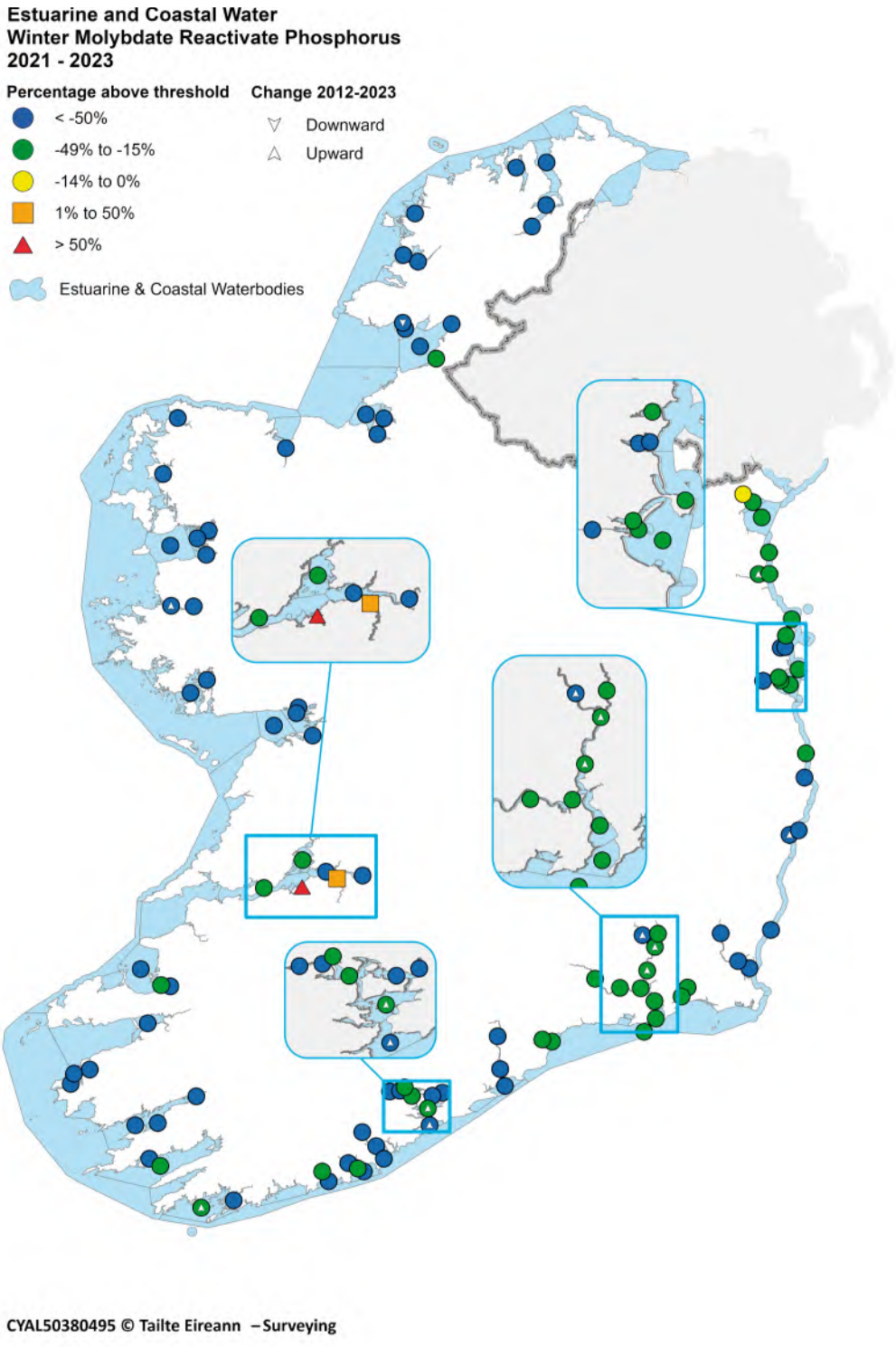
Findings

Nearly all (98%) estuaries and coastal waters assessed were in satisfactory condition for phosphate. This reflected a small (1%) improvement overall compared to the 2022 assessment. Only two estuarine water bodies were in unsatisfactory condition, both having exceeded the relevant threshold[22] over the period. The two estuaries were in County Limerick – Deel Estuary and Maigue Estuary.

Liscannor Bay, Ruth Little

21 Measured as molybdate reactive phosphate (MRP).

22 Salinity related thresholds have been defined for phosphate in estuaries and coastal waters. The thresholds range from 0.060 mg/l P for fresh and intermediate salinity waters to 0.040 mg/l P for fully saline waters. Phosphate concentrations above these thresholds can indicate pollution.


Estuarine and Coastal Water
Winter Molybdate Reactivate Phosphorus
2021 - 2023
Percentage above threshold
< -50%
-49% to -15%
-14% to 0%
1% to 50%
> 50%
Estuarine & Coastal Waterbodies
Change 2012-2023
Downward
Upward
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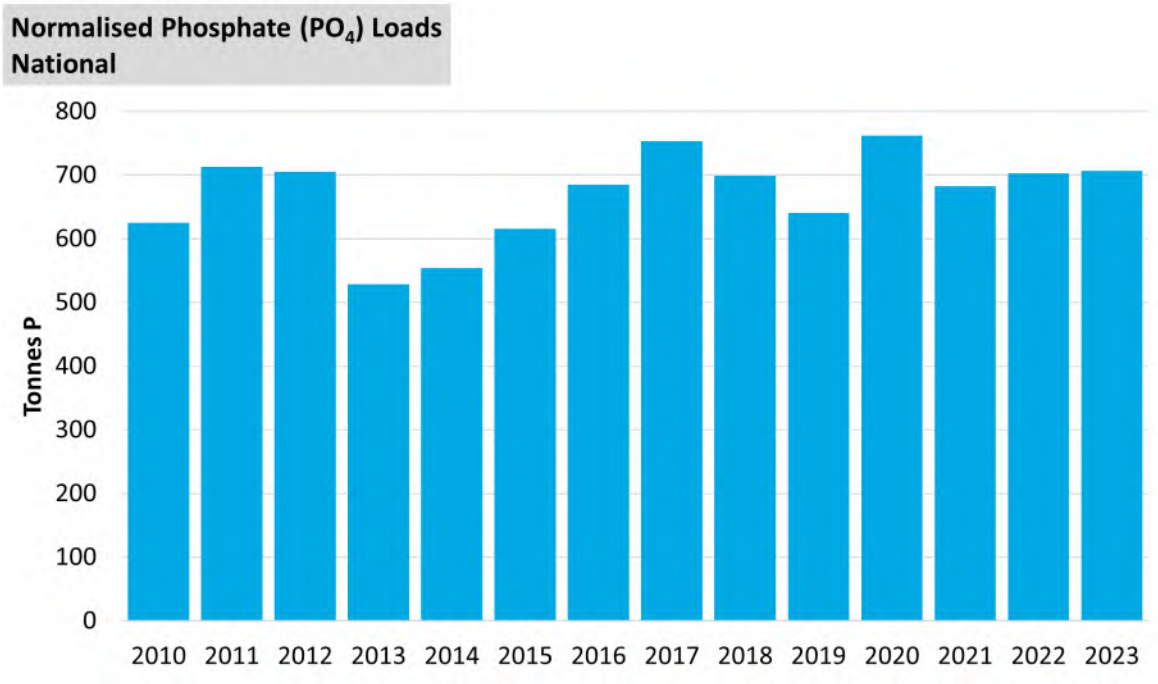
Phosphorus Inputs to the Marine Environment

This indicator shows the inputs of phosphorus[23], expressed as loadings of orthophosphate (PO_4), from 19 major rivers into the marine environment[24]. High loadings of phosphorus from land-based sources can negatively impact our marine ecosystems.

Findings

Phosphate loadings can fluctuate between years depending on the climate, particularly rainfall. To remove the influence of inter-annual changes in river flow, the inputs are normalised by a factor which represents the long-term average flow rate for each river.

In 2023, phosphate loadings were slightly higher than 2022 but have been broadly the same over recent years. As in previous reports, the largest contributions of phosphorus came from catchments that drain from the south east of the country.



[23] Previous reports have used Total Phosphorus (TP). Orthophosphate (PO^4) have been used here to better align with data used in other indicators. The values for these parameters are lower than for TP previously shown as PO_4 only represent a portion of the total.

[24] The inputs are calculated based on nutrient concentrations, which are measured 12 times a year, and river flow, which is measured continuously.

Conclusion

The indicators in this report show that there has been no significant change in the nutrient concentrations or in the biological quality of our rivers and lakes in 2023. As in recent years, any improvements in biological quality are being off set, and at times exceeded, by declines elsewhere. Nationally, average concentrations of nutrients appear to have stabilised, however levels of nitrogen are still too high in 42% of river sites and 20% of groundwaters. Levels of phosphorus are too high in 27% of river sites and 35% of lakes. These losses of nutrients damage the ecology of our rivers and lakes, and make their way into the marine environment, putting continued pressure on our estuarine and coastal waters. We will not see an overall improvement in water quality, or meet our water quality objectives, until nutrient levels reduce. There is no indication as yet that this is happening.

There are a range of pressures from human activities which impact on water quality and all sectors have a role to play in improving water quality. The main source of nitrogen in our waterways is agriculture and the main source of phosphorus is agriculture and waste water so these sectors must do more to reduce nutrient losses to water.

While many efforts are being made to address the main pressures and stressors on water quality it is imperative that the next River Basin Management Plan, now over two years late, is published without further delay. The Plan needs to be clear on what will be achieved by 2027 and must be fully implemented. Progress on the implementation of measures needs to be tracked and reported so that their impact on water quality can be assessed and measures adapted where necessary.

Further information

Detailed information and data on water quality in Ireland can be found at www.catchments.ie.

A series of fact sheets providing information about the different elements of the Water Framework Directive monitoring programme can be found at Monitoring & Assessment: Freshwater & Marine Publications | Environmental Protection Agency (epa.ie).

To find out more about how to get involved in protecting and managing your local waters visit the Local Authority Waters Programme website at www.lawaters.ie.


epa
Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil