Brecks Fen Edge & Rivers Landscape Partnership

CITIZEN SCIENCE: TESTING THE WATER

Final Report: Clean Water Testing 2023

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Executive Summary

In this regional survey of an Important Freshwater Landscape, volunteers helped to gather freshwater biodiversity data, through Freshwater Habitats Trust's Citizen Science: Testing the Water project.

Volunteers carried out water quality testing, across more than 900 sites, to measure levels of two pollutants: nitrate and phosphate in ponds, streams, rivers, lakes and ditches to create a broad impression of water quality across the project area. This created a picture of where existing clean water is located. The key principle of the Freshwater Network is to protect the best - these will be the source populations for dispersal of species back to restored landscapes.

Clean Water is freshwater that is free from nutrient pollution which can pose a major risk to wildlife. It is defined as having a nutrient status of <0.5 mg/l nitrate as nitrogen and <0.05 mg/l phosphate as phosphorous.

Quick nutrient testing kits are increasingly becoming more sensitive, cheaper and easier to use. This provides scope for a wide range of uses: both creating opportunities to discover much more about the levels of pollution in the landscape and democratising water quality testing by making it available to a wide audience and citizen science projects.

The study found standing waters to be the cleanest freshwater habitats in The Brecks with 59% of testing clean and unpolluted, compared with just 27% of running waterbodies. Most clean waterbodies were in nature reserves or on military land; areas of semi-natural habitat mosaics managed for wildlife conservation.

Polluted water is known to be the main cause of the sharp decline in freshwater biodiversity. Most freshwater plants and animals have evolved over millions of years in naturally low nutrient environments and are now struggling to adapt to the high levels of nutrient pollution, particularly caused by phosphate and nitrate, which are now found in most waterbodies.

It is very difficult to clean up rivers and streams, so a more realistic way of giving The Brecks freshwater wildlife a refuge would be to create more clean standing waters – and protect the clean waterbodies we already have. Protecting the best and building out from there will be critical for the conservation of The Brecks freshwater wildlife into the future and this survey has provided invaluable data to help us achieve that.

A key outcome of the project has been the production of a new Priority Ponds map for The Brecks Area – critical to identify and protect the most important freshwater sites. The results have brought the total number of Priority Ponds in this Important Freshwater Landscape up to 159 Priority Ponds. This includes seven new Priority Ponds identified during the eDNA surveys carried out by volunteers in 2022. The overall clean water survey also identified 160 Provisional Priority ponds based on Criteria 6: the presence of clean water.

A large proportion of the Provisional Priority Ponds identified by clean water testing, were located in Important Freshwater Areas, high priority areas for freshwater biodiversity that already have an abundance of Priority Ponds. Just under half of the Provisional Priority Ponds mapped, sit within protected areas (SSSIs), with the vast majority of the remaining Provisional Priority Ponds also found in areas of woodland or semi natural habitats. This highlights the importance of surrounding good quality terrestrial habitat to sustaining ecologically rich clean water ponds.

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1.0 Brecks Fen Edge and Rivers Landscape Partnership Scheme

The Brecks Fen Edge and Rivers Landscape Partnership (BFER LP), is a Landscape Partnership scheme hosted by Suffolk Country Council and focused on The Brecks' fen edge and river corridors area (Figure 1). It aims to deliver a series of new and exciting community-based landscape and heritage conservation projects, over a 5-year period (2020-2024). The partnership is made up of regional, national and local organisations with an interest in the area, community groups and members of the community.

Figure 1: Brecks Fen Edge and Rivers Landscape Partnership Scheme area

Freshwater Habitats Trust is leading on one of these projects, named 'Testing the Water'. This Citizen Science project aims to gather valuable data and raise awareness of habitat loss, pollution and the distribution of rare species, involving people in practical activities to get new information about the project area. Using cutting-edge Environmental DNA (eDNA) sampling and rapid water quality test kits (testing for nutrient pollution), volunteers have been undertaking surveys of freshwaters. Unlike many traditional survey methods, these new technologies make visible the pollution that is otherwise invisible and largely unknown, as well as opening up biological recording of freshwater species to a non-technical audience.

1.1 Freshwaters within the BFER Scheme

The Brecks is a relatively dry region when compared to its surrounding landscapes and is often quoted as having the lowest recorded rainfall of any area in the UK. However, in an interim analysis of Important Freshwater Landscapes, undertaken by Freshwater Habitats Trust, Breckland was one of approximately 24 landscapes in England and Wales recognised for its exceptional freshwater biodiversity (Figure 2).

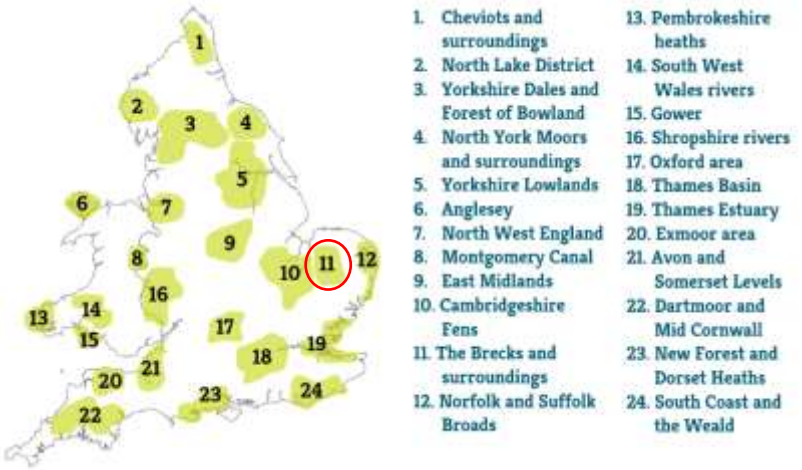


Figure 2: The Important Freshwater Landscapes in England and Wales Number 11: The Brecks and surroundings

The network of fenland fringe, freshwater habitats and river corridors in The Brecks' Fen Edge and Rivers landscape is a conduit for biodiversity in this part of the country. These habitats are sandwiched between the internationally famous wetland landscapes of The Broads and The Fens. There are also a number of Important Freshwater Areas[1] within the region: a product of its geology and management history. Freshwaters are a critical part of the 1000km^2 Brecks National Character Area, fundamental to its unique biodiversity, habitats and cultural heritage.

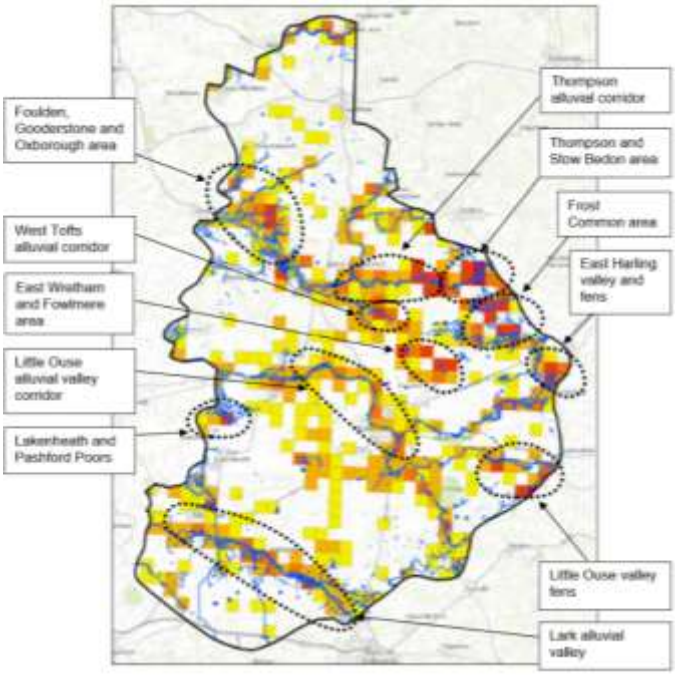


Figure 3: The Brecks Important Freshwater Areas assessment (2018) identified eleven areas that are high priorities for freshwater biodiversity and areas which were data deficient in between

The Brecks is particularly known for its pingos: natural ponds that were formed by freezing and thawing of upwelling groundwater during the last glacial period. The area also contains a number of fluctuating meres: shallow lakes which naturally have no inflows and which would have dried down completely in some years (but are now artificially maintained). The unique hydrology of these waterbodies supports a suite of plant and invertebrate communities which are nationally rare. The Brecks has a number of other important running water waterbodies, including the chalk rivers and streams of the River Little Ouse, River Lark, River Wissey and associated valley fens, springs and ditch networks and cut drains.

The diversity of freshwater communities, and rarity of a number of species found within them, is due in part to the long history of wetlands in this part of England, and the presence of some large patches of uncultivated land, which have remained unimpacted by pollution and development. However, both the running and standing waterbodies in The Brecks are vulnerable to fragmentation, abstraction, pollution, changes in land-use and development, and therefore remain under threat.

In spite of the high biodiversity value and potential threats, information on aquatic habitats is generally scarce in The Brecks, and even more so on small waters: headwater streams, ditches, ponds, springs and flushes. Currently, only a small a proportion of the waterbodies in The Brecks are regularly monitored for the Water Framework Directive, essentially the main rivers and larger tributary streams and two lakes (Stanford Water and Thompson Water).

As part of the Landscape Conservation Action Plan (LCAP) development work for this area, Freshwater Habitats Trust undertook an Important Freshwater Areas assessment (Figure 3) to review existing information and propose a strategy to address data gaps, by engaging communities in citizen science data gathering, to be delivered as part of The Brecks Fen Edge and Rivers Landscape Partnership Scheme.

[111] Important Freshwater Areas – high priorities for freshwater biodiversity, based on concentrations of freshwater species and habitats, designated sites, ponds, waterbodies or sites which have been identified as having high freshwater biodiversity using a set of nationally agreed criteria.

1.2 Priority Ponds within the BFER Scheme

Priority ponds are waterbodies that have a particularly high conservation value: usually because they support important freshwater species or rare community types. These ponds can be permanent or seasonal waterbodies and can span a wide size range: from $1m^2$ to 2ha in area.

The criteria used to identify 'Priority Ponds' under the UKHabs[2] (formerly the UK Biodiversity Action Plan), are listed below. It is estimated that around 20% of the 500,000 or so ponds in the UK (excluding garden ponds) will meet one or more of the criteria, however only a small proportion of sites have been identified nationally.

1. Habitats of high conservation importance. Ponds with specialist habitats that meet criteria under Annex 1 of the Habitats Directive.

2. Ponds supporting species of high conservation importance. These are Red Data Book species, BAP species, species fully protected under the Wildlife and Countryside Act Schedule 5 and 8, Habitats Directive Annex II species, a Nationally Scarce wetland plant species, or Nationally Scarce aquatic invertebrate species.

3. Ponds with exceptional populations or numbers of key species. This is based on:
    i. Criteria specified in guidelines for the selection of biological Sites of Special Scientific Interest (currently amphibians and dragonflies only).
    ii. Exceptionally rich sites for plants or invertebrates (supporting 30 or more wetland plant species or 50 or more aquatic macroinvertebrate species).

4. Ponds of high ecological quality. These are ponds classified in the top category for ecological quality (a score of 75% or more), as assessed by the standardised method for assessing the biological quality of still waters in England and Wales – the Predictive System for Multimetrics (PSYM).

5. Other important ponds. These are individual ponds or groups of ponds with a limited geographic distribution recognised as important because of their age, rarity of type or landscape context e.g. pingos, duneslack ponds, machair ponds.

6. Clean Water Provisional Priority Ponds. Clean Water is freshwater that is free from nutrient pollution which can pose a major risk to wildlife. It is defined as having a nutrient status of <0.5 mg/l nitrate as nitrogen and <0.05 mg/l phosphate as phosphorous.

On the national register of Priority Ponds collated by Freshwater Habitats Trust and Natural England (2019), prior to this eDNA project there were 153 Priority Ponds identified in the Brecks area.

Of these ninety-five are based on ***Criteria 5 (irreplaceable habitats) – pingo pools.*** These are a very rare type of pond, with The Brecks in Norfolk, holding the largest density in the UK, most of which are around Thompson Common. In the Brecks area, pingo ponds, especially around Thompson

[2] The UK Habitat Classification (UKHab) is a unified and comprehensive habitat classification system for all terrestrial, freshwater and coastal habitats in the United Kingdom. It has been developed to improve habitat categorisation, recording and geospatial analysis for land use and habitat survey assessment.

Common and in pockets elsewhere, have been left almost untouched, where in other areas of the UK most pingos have been ploughed up.

Fourteen Priority Ponds in the area are based on **Criteria 2 – *Great Crested Newt presence*.** Of these eleven were identified from District Level Licencing records, (regional surveys to inform DL a new approach to reduce the impact of development pressure on GCN), and 3 from FHT's PondNet GCN Monitoring Programme, the national annual survey for this European protected species.

A further three Priority Ponds are based on ***Criteria 2 – Common Toad presence.*** The records where all taken from the annual Freshwater Habitats Trust Spawn Survey which maps the sightings of Common Frog and Common Toad spawn across the country.

The final forty-one Priority Ponds are based are based on ***Criteria 4 – PSYM (the Predictive SYstem for Multimetrics)*** from Freshwater Habitats Trust surveys commissioned as part of the People, Ponds and Water project.

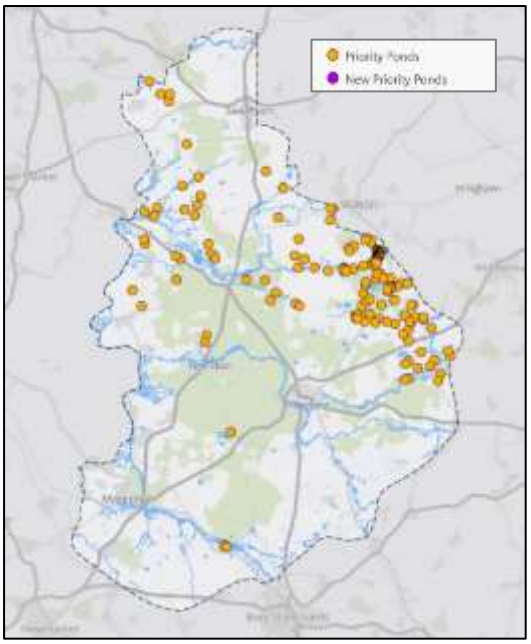


Figure 4: Priority Ponds in the BFER Scheme area prior to eDNA survey

One of the above ponds qualified for Priority Pond Status under both Great Crested Newt presence and a high PSYM score.

2.0 Introduction

This report presents the results of water quality testing carried out by volunteers from 2021 to 2023 as part of the **Citizen Science: Testing the Water** Project. The aim was to assess the water quality across all waterbody types in The Brecks' Fen Edge and River landscape, to create a picture of where existing clean water is located.

The survey forms part of a monitoring programme that is helping to add to baseline data and to inform the delivery of protection for and creation of small clean waterbodies to maximise the chances for recovery of freshwater wildlife in this landscape and to inform river restoration activities to guide future landscape conservation activity in the scheme area.

2.1 About the quick test kits

Quick nutrient testing kits are increasingly becoming more sensitive, cheaper and easier to use. This provides scope for a wide range of uses: both creating opportunities to discover much more about the levels of pollution in the landscape and democratising water quality testing by making it available to a wide audience.

The Kyoritsu PackTest kits measure phosphate-phosphorus with a minimum detection limit of 0.02 mg L-1 and nitrate-nitrogen with a minimum detection limit of 0.5 mg L-1. Tests are based on colourimetry and judged by eye against a colour chart. Each test takes either 5 minutes (phosphate) or 3 minutes (nitrate). In the Testing, the Water survey we used the PackTest phosphate and nitrate

kits to assign a waterbody, surveyed by citizen science volunteers, to one of three nutrient pollution categories:

	Phosphate (mg L-1 PO4-P)	Nitrate (mg L-1NO3-N)
Clean water	<0.05	<0.5
Some evidence of pollution	0.05-0.1	0.5-1
High or very high levels of pollution	>0.1	>1

Freshwater Habitats Trust ran trials to look at how nutrient concentrations measured with the Kyoritsu PackTest low range phosphate and nitrate test kits compared to laboratory analysed water samples (Biggs et al. 2016). The results showed that, when analysing standard solutions (nutrient solutions made up with pure water in the laboratory), the kits performed well, broadly matching the results of laboratory analysed samples. Comparison of the PackTest kits with laboratory analysis of natural waters showed that, overall, the kits can separate clean and polluted sites with sufficient reliability.

Sites where the kits show no colour change are highly likely to be clean waterbodies with low nutrient levels (98% probability for phosphorus, 81% for nitrate). Sites with a moderate or strong colour change are highly likely to be polluted (95% probability for phosphate, 84% for nitrate). However, about a third to a half of the sites bordering the clean water boundary (phosphate: 0.02-0.05 mg L-1, nitrate 0.2-0.5 mg L-1) may be mildly polluted, rather than clean. This means that at landscape scale, the kits will slightly over-estimate the amount of clean water present, but they are highly unlikely to over-estimate the level of either phosphate or nitrate pollution in waterbodies.

Overall, the results suggested that they are a simple, rapid and cost effective way to identify nutrient pollution, especially in large landscape-wide surveys where the costs of laboratory analysis are likely to be prohibitive.

2.2 The problem with nutrients

In the absence of people, most freshwaters would naturally have low nutrient concentrations, and since freshwater plants and animals have evolved over millions of years in these conditions, the majority of species require these naturally low nutrient environments to flourish. Although excess nutrients are not usually directly toxic to freshwater plants and animals, freshwater ecosystems are often radically changed (nearly always for the worse) when nutrient enrichment favours one or a few species, usually plants and algae, which can exploit the excess nutrients. This can lead to less nutrient tolerant plants, normally the majority, being outcompeted and cause knock-on effects by eliminating the habitats of animals and changing the physical and chemical environment of the water.

Today, nutrients, particularly phosphate and nitrate, are amongst the most pervasive pollutants of freshwater across the globe. High levels of nutrients in the water results in excessive growth of aquatic plants, including algae, which suppresses less tolerant species.

This, in turn, causes a raft of biological, health and economic impacts, including loss of plant, invertebrate and fish diversity, declines in the visual appeal and amenity value of waterbodies, and in some cases the development of toxic blue-green algae blooms that are harmful if ingested by humans and animals. Because of their wide-ranging effects, levels of phosphate and nitrate are

widely used measures for assessing waterbody quality in international monitoring programmes such as the Water Framework Directive

2.3. What is clean water?

In the ***Testing the Water*** project we use the term clean water with a specific technical meaning:

What is clean water?

Clean water is defined as water which has a chemistry and biology which would be normal for a given area in the absence of human disturbance. This is commonly referred to as 'the reference condition', 'minimally impaired water quality' or 'natural background levels' (Williams, Biggs and Nicolet, 2010). This definition of clean water is equivalent to the EU Water Framework Directive (WFD) 'High' status.

This natural background water quality is most easily defined by measuring it in waterbodies where there are no, or very slight, impacts from human activity. Often, it is not possible to find present-day examples of 'natural' background levels of nutrients: for example, in lowland England there are probably no large rivers with natural nitrate levels. Fortunately, in these cases, it is often possible to use historical data from rivers or from paleolimnological studies of lake sediments to estimate what the natural levels would be. In the River Thames, for example, there is a 140-year long record of nitrate concentrations upstream of London. This information gives us an idea of how much lower nitrate levels would have been before the industrialisation of agriculture, and show how they rose through the 20th century as a result of ploughing up grasslands for arable farming and increased use of fertilisers from 1.5-2 mg L-1 to around four times that level today. In practice, before widespread agriculture, the natural background nitrate levels were probably even lower – in all probability rarely exceeding 1 mg L-1 of NO3-N.

3.0 Methodology

3.1 Volunteer monitoring network for clean water (2021)

In Spring/Summer 2021 the first round of clean water surveys in the BFER Scheme area were undertaken by volunteers following three online training courses in February, March and April. The training was carried out online rather than in person due to Covid 19 restrictions, with all training resources made available of the Freshwater Habitats Trust website.

The monitoring network required selection of sites that fulfil a range of statistical requirements: they must be representative of the area and not biased towards places most likely to contain clean water.

Our volunteer monitoring network was created from a list of randomly selected 1km grid squares containing waterbodies, such as ponds, lakes, rivers, streams & ditches. We identified approx. 350 1km grid squares containing around 620 different, publicly accessible waterbodies.

Each volunteer was allocated a 'batch' of 1Km grid squares to sample. Each batch contained up to 10 waterbodies. We asked that for each of the grid squares volunteers sampled one of each of the different waterbodies within that square (Figure 5).

PackTest phosphate and nitrate kits were then posted out to volunteers along with survey forms. The results collected were submitted via an online data portal on the Freshwater Habitats Trust website.

GRID SQUARE	Ponds	Lakes	Rivers	Streams	Ditches	Fens	Other	Other		BATCH NAME
TL8070	1	1	1						10	West Stow
TL8071	1		1	1	1					
TL8170	1		1	1						
TL8270		1			1				8	West Stow/Ingham
TL8271				1	1					
TL8273	1									
TL8370		1								
TL8570	1									
TL8571	1									

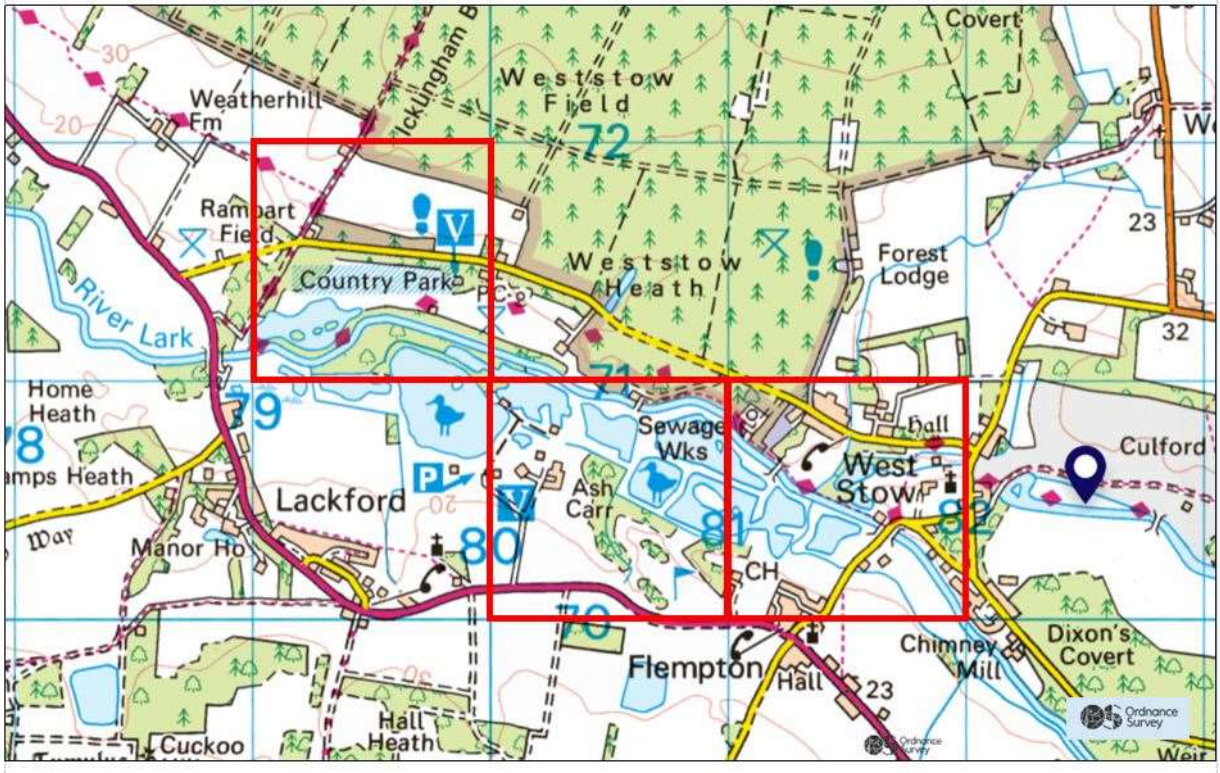


Figure: 5 Allocation of 1 Km grid squares for volunteers to sample.

3.2 eDNA surveys and clean water testing (2022)

In Spring/summer 2022, eDNA 'multi-species' surveys to test for vertebrates (amphibians, mammals, birds and fish) were carried out by volunteers on 71 pre-selected survey sites with landowner access permission. We recruited volunteers to the survey from those that had already taken part in clean water testing (using nutrient test kits) in 2021 and trained them via an online training course.

The sites were located in and around the BFER scheme area, and encompassed six waterbody types: ponds, streams, rivers, lakes, ditches and the cut-off channel. Sampling was undertaken between April and July 2022 by our team of over 60 volunteers. As well as the eDNA surveys, clean water tests were also carried out on each waterbody.

Full details of these surveys can be found in the following document:

Carter A. and Ewald N. 2024. Brecks Fen Edge & Rivers Landscape Partnership. Citizen Science: Testing the Water. eDNA Survey Results 2022. Version 2. Freshwater Habitats Trust, Oxford.

3.3 Targeted surveys for clean water (2022/2023)

In late 2022 and 2023, target areas for further clean water testing were carried out, based on the findings of the 2021 volunteer monitoring network.

These surveys were designed to target areas in the BFER Scheme with the cleanest pockets of water and those that may suffer from pollution issues. Rather than testing one of each waterbody type in a 1km grid square, volunteers were asked to survey as many waterbodies types as possible in the area.

The surveys were also designed to engage with volunteers from different walks of life, including groups with barriers to engagement and schools, via 'in the field' *Clean Water Blitz* and 'in person' training following two years of online training/engagement due to Covid 19 restrictions.

3.3.1 Private Landowners

In December 2022, Freshwater Habitats Trust trainees carried out clean water surveys on waterbodies on private land, predominantly the Elveden and Euston Estates, with permission of the landowners. This survey aimed to build on from the Volunteer Monitoring network, which surveyed publicly accessible waterbodies.

The Elveden Estate covers an area of 9,105 hectares and comprises a mosaic of habitats including arable land (growing potatoes, onions, parsnips and carrots), forestry, shelterbelts and Breckland heathland. The twelve heathlands, each of which are designated as Site of Special Scientific Interest (SSSI), cover around 1,450 hectares and the estate manage 14 County Wildlife Sites.

The Euston Estate covers an area of around 4,250 hectares and grows wheat, barley and sugar beet. The land is also used for free-range pig and poultry farming and potato, carrot and parsnip production. Red Poll cattle, Suffolk Punch horses and the Suffolk sheep, the 'Suffolk Trinity' graze the Estate grassland. The Estate also has over 600 hectares of woodland (including the largest semi-ancient broadleaf woodland in East Anglia) 218 hectares, of which are designated a Site of Special Scientific Interest (SSSI).

3.3.2 BTO Nunnery Lakes (Clean Water Blitz)

On 23rd March 2023, Freshwater Habitats Trust ran a training session and Clean Water Blitz to engage groups with barriers to accessing outdoor environments, including those in social and healthcare systems, to get involved with our BFER LP Citizen Science: Testing the Water project.

Students, teachers and support staff from Damara School, which provides specialist social, emotional and mental health educational provision to children living in Norfolk and west of Suffolk, took part in the session. The session was delivered at the BTO's Nunnery Lakes Nature Reserve, a County Wildlife Site that lies to the south of Thetford. The reserve comprises a series of lakes created by old gravel workings, adjacent to the Little Ouse. A series of ponds were created in 2016 with funding from the Heritage Lottery Fund (HLF) Breaking New Ground Landscape Partnership.

A total of 16 volunteers, students and support staff, from Damara School carried out clean water surveys on 20 waterbodies on the site. Of the running water, 1 ditch, 1 stream and 4 points on the river (Little Ouse) were sampled. Of the standing waters, 10 ponds were samples and 4 points on the lakes.

3.3.3 The Stanford Training Area (STANTA)

Due to the nature of The Stanford Training Area (STANTA), public access for volunteer surveys was not permitted. Dedicated STANTA volunteer Peter Feakes therefore carried out all the sampling on this site on our behalf. Surveys were carried out, initially as part of the 2021 Volunteer monitoring network and continued with more focused surveys of all waterbody types on the site in April and May 2023.

STANTA is owned by the Ministry of Defence (MoD), and covers an area of approximately 12,000 hectares, with just over 4,600 hectares designated as a Site of Special Scientific Interest (SSSI). The site comprises part of the Breckland Special Protection Area (SPA) and is designated as a Special Area for Conservation (SAC) under the EU Habitats Directive. The terrestrial habitat on STANTA comprises extensive areas of calcareous grass-heath and heather heath, including the largest extent of Breckland grass-heath habitat (c. 2,500 ha) remaining today. The site also contains important wetland habitats including internationally important fluctuating meres, numerous small ponds and water filled pits and many springs and streams. STANTA sits within the Thompson and West Tofts alluvial corridors, both areas identified as Important Freshwater Areas (IFA's)

3.3.4 Thompson Common (Clean Water Blitz)

On Thursday 20th April 2023, Freshwater Habitats Trust ran a Clean Water Blitz on Thompson Common to assess the levels of clean water across the reserve. On the day, 16 volunteers and Norfolk Wildlife Trust rangers carried out clean water surveys from 60 waterbodies on the site. The volunteers were split into four groups to sample different compartments of the reserve. In total 12 ditches, 46 ponds, 1 lake (Thompson Water) and 1 wet flush were sampled.

Thompson Common, a site designated as a Site of Special Scientific Interest (SSSI), is managed by Norfolk Wildlife Trust. The 140 hectares site comprises a mosaic of habitats supporting a wide range of plant communities developed in response to variations in topography, soil type and wetness. Its position on a tributary of the River Wissey, Thompson Stream, has lent the site more of a damp lowland grassland character than typical Breckland-heath. The Common is most famous for its pingos, a series of around 400 post-glacial damp and water filled depressions dating back to the last Ice Age. Because the physical landscape here has been unchanged for so long it also has provided extraordinary habitat continuity for wildlife, supporting an exceptional number of plant and animal species, several of them rare, and including an invertebrate fauna of considerable national importance. Like STANTA, Thompson Common has also been identified as an IFA.

3.3.5 School Workshop Surveys

On Wednesday 19th April 2023, Freshwater Habitats Trust ran an in-person Train the Teacher session for schoolteachers in The Brecks area to train them to use quick and easy Kyoritsu PackTest nutrient testing kits as a class activity. The training enabled them to run their own 'Testing the Water' survey lesson to teach their students more about their local freshwater habitats while at the same time adding to data collected by BFER LPS volunteers across the Brecks area.

The session's aims and objectives, included explaining the importance of clean water to wildlife and people, demonstrating the latest cutting edge monitoring technology to test water for nutrient pollution (nitrate and phosphate), and explaining the relevance of data collection and contribution to a "bigger picture"

Five schools took part in the training with 10 teachers going on to engage with over 170 students to collect 79 water samples in May and June 2023.

4.0 Results

4.1 Volunteer monitoring network (2021-2023)

4.1.1 Overview

In total 919 water samples were collected over a three-year period across the BFER Scheme area (Figure 6). The sampling took place between 2nd March 2021 and 6th June 2023.

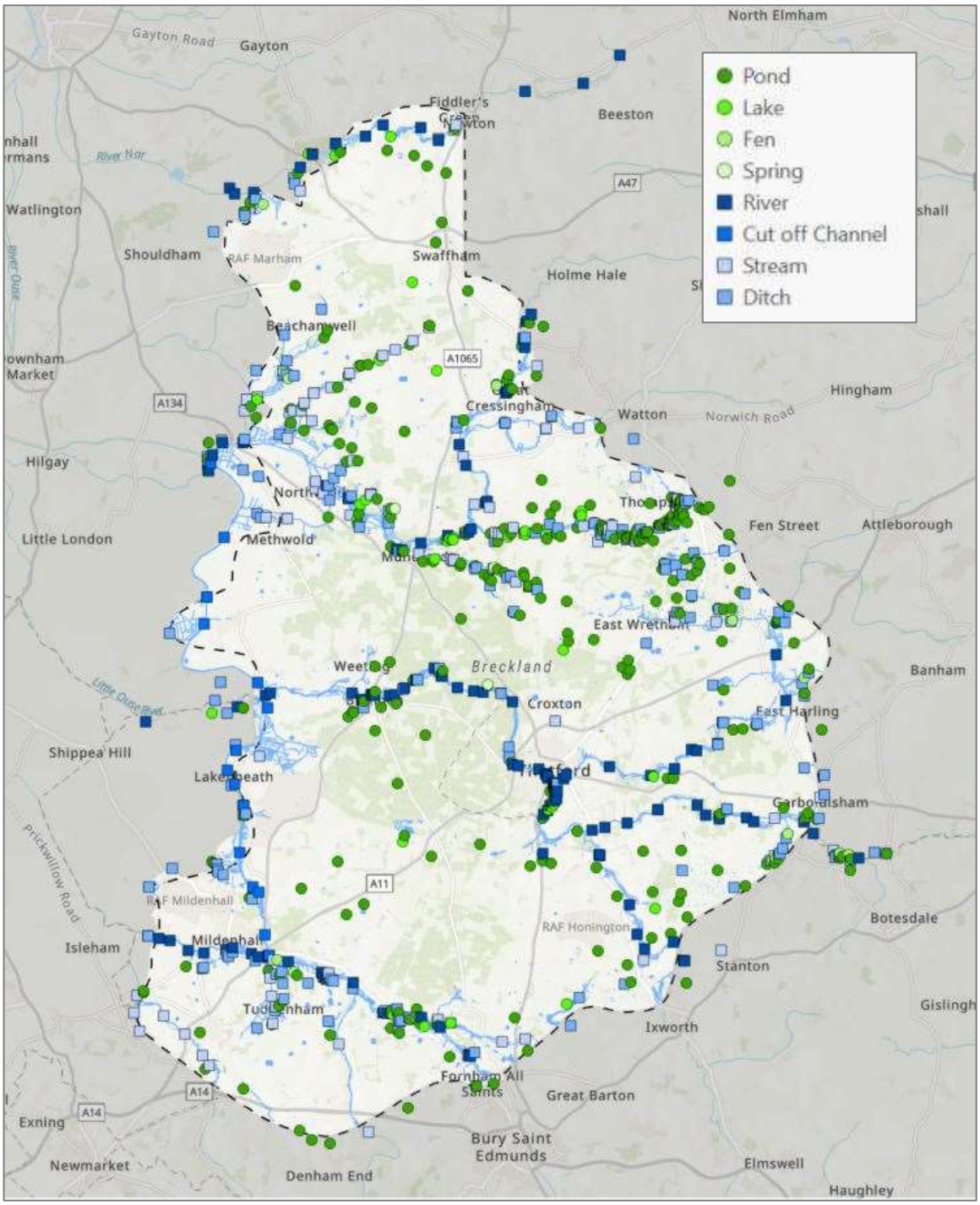


Figure 6: Distribution of water samples taken in the BFER Scheme area between March 2021 and June 2023

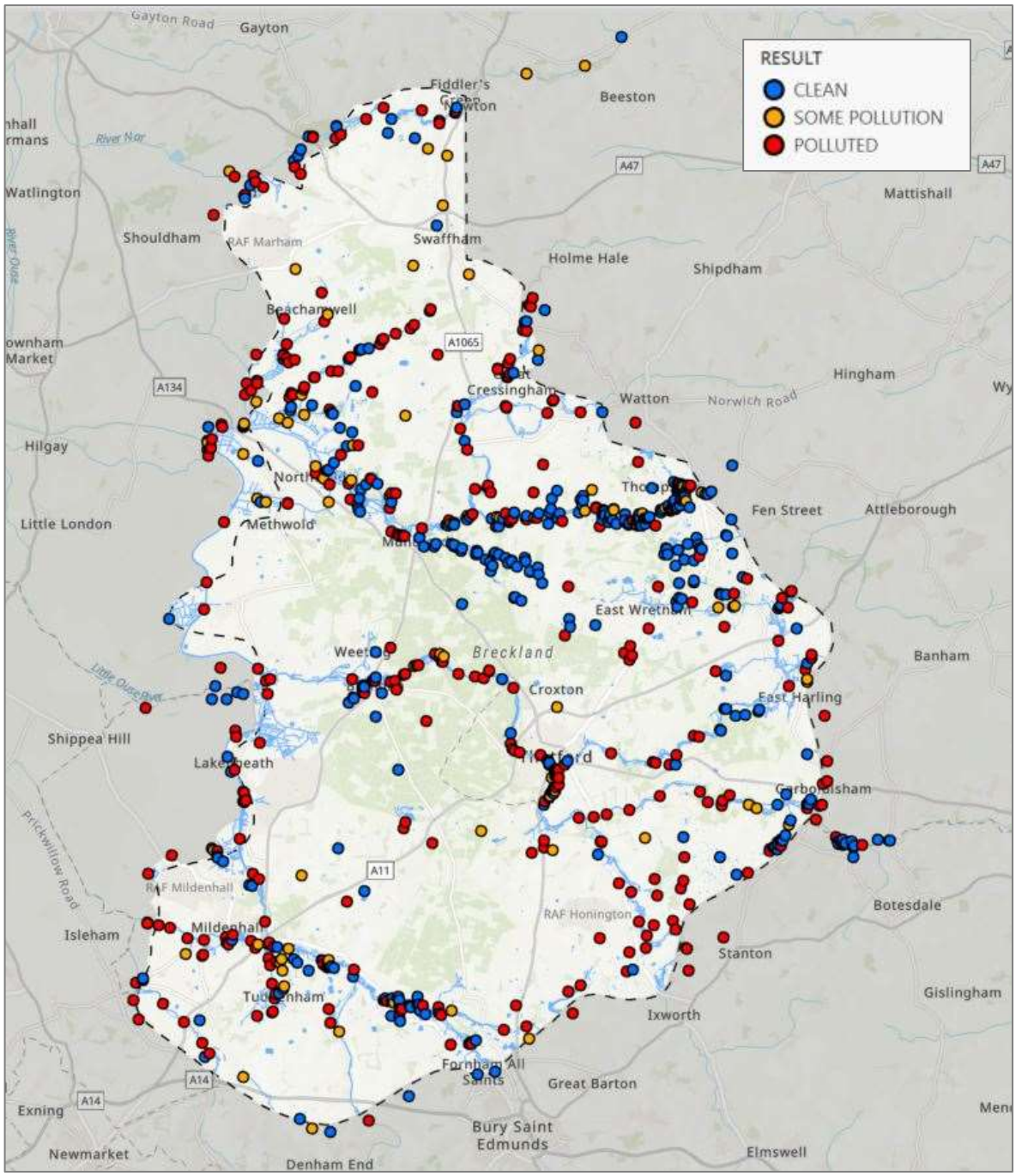


Figure 7: Distribution of nutrient pollution across all waterbodies in the BFER Scheme area

In total samples from 338 ponds (37%), 52 lakes (6%), 170 rivers (19%), 108 streams (12%), 182 ditches (20%), 19 cut-off channels (2%), 18 fens (2%) 6 springs (1%) and 23 other waterbodies (3%) were collected by over 330 individual volunteers (Figure 7).

Overall, 41% of sites sampled showed no evidence of nutrient pollution with 47% polluted and 12% showing some signs of pollution (Figure 8).

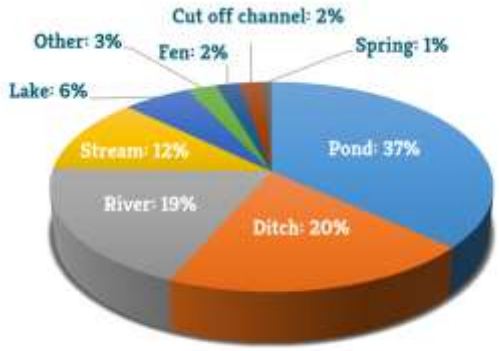


Figure 7: Percentage of all waterbodies sampled in the BFER Scheme area.

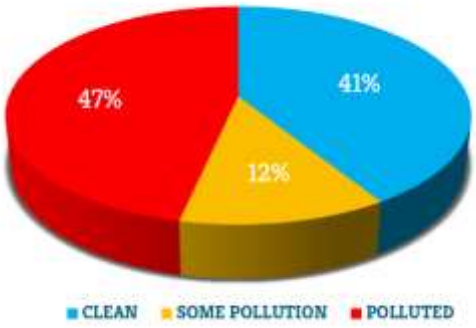


Figure 8: Percentage of nutrient pollution across all waterbody types in the BFER Scheme area.

Comparing standing (ponds, lakes, fens and springs) and running (rivers, streams, ditches and cut off channels) waterbodies, 59% of the standing waterbodies had clean water, whilst 64% of running waters had polluted water (Figure 9).

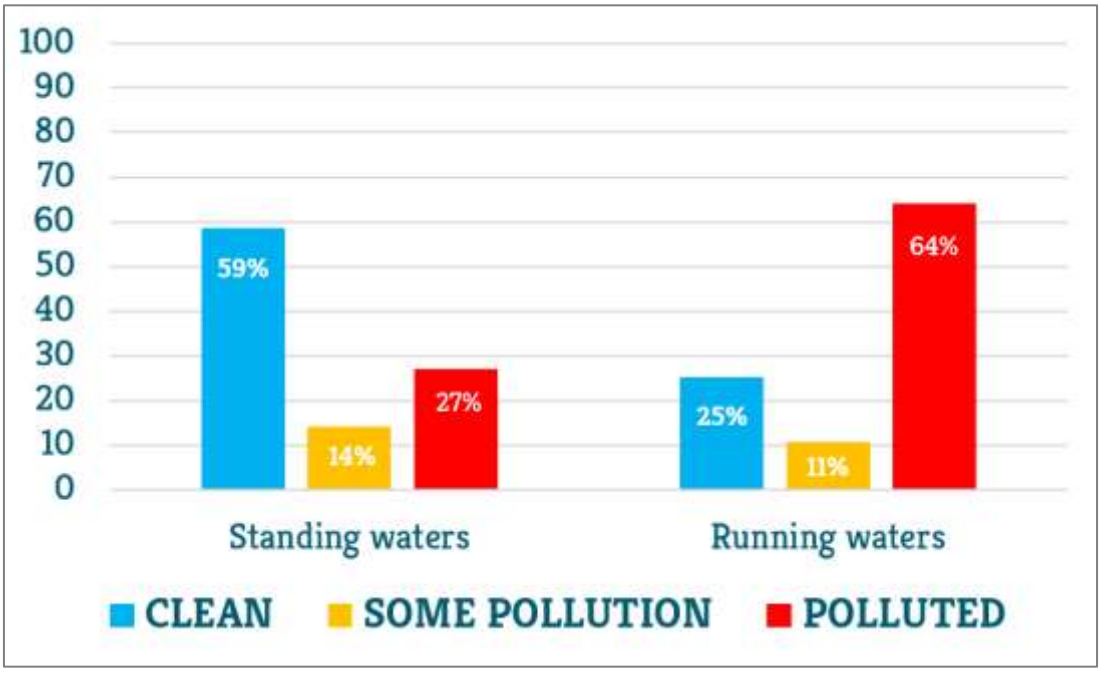


Figure 9: Percentage of nutrient pollution in standing and running waterbodies in the BFER Scheme area

Looking in more detail, out of the standing waterbodies the cleanest were the fens and springs (67%), followed by ponds, 59%. Of the running waterbodies, the cut off channels were the most polluted, 89%, closely followed by rivers, 84%. The cleanest running waters were ditches with half-achieving clean water status (Figure 10).

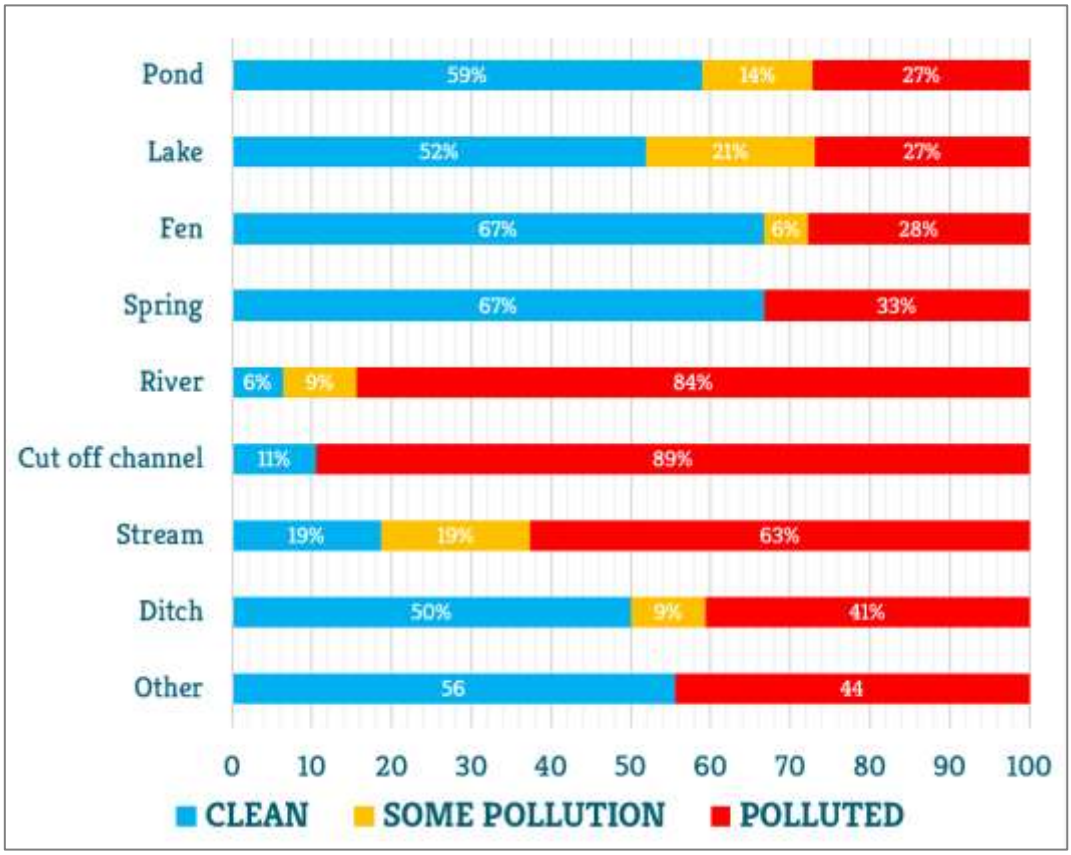


Figure 10: Percentage of nutrient pollution across all waterbodies in the BFER Scheme area

Figure 11: Clean water sample from a pond in the BFER Scheme area.

Figure 12: Polluted water sample from a ditch in the BFER Scheme area.

4.1.2 Rivers and Streams

During this survey, our volunteers sampled various points along the three main river catchments in the Brecks area, The River Wissey, the Little Ouse and the River Lark, along with the River Thet and The Black Bourne, both tributaries of the Little Ouse. Samples were also taken from the River Nar at the northern edge of the BFER Scheme area and the Cut-off Channel, a man-made waterway running along the eastern edge of the Fens. This was constructed in in the 1950s and 60s as part of flood defence measures, and flows from Mildenhall, carrying flood waters from the River Lark, Little Ouse and the River Wissey away from the South Level of the Great Ouse Fens. It connects with Denver Sluice on the River Great Ouse with floodwater discharging into the Tidal River near King's Lynn.

A variety of steams within the BFER Scheme area where also sampled including tributaries of the River Wissey (Thompson Stream, West Tofts Stream, Watton Brook and the Gadder) and the River Lark (Tuddenham Mill Stream and Culford Stream) (Figure 13).

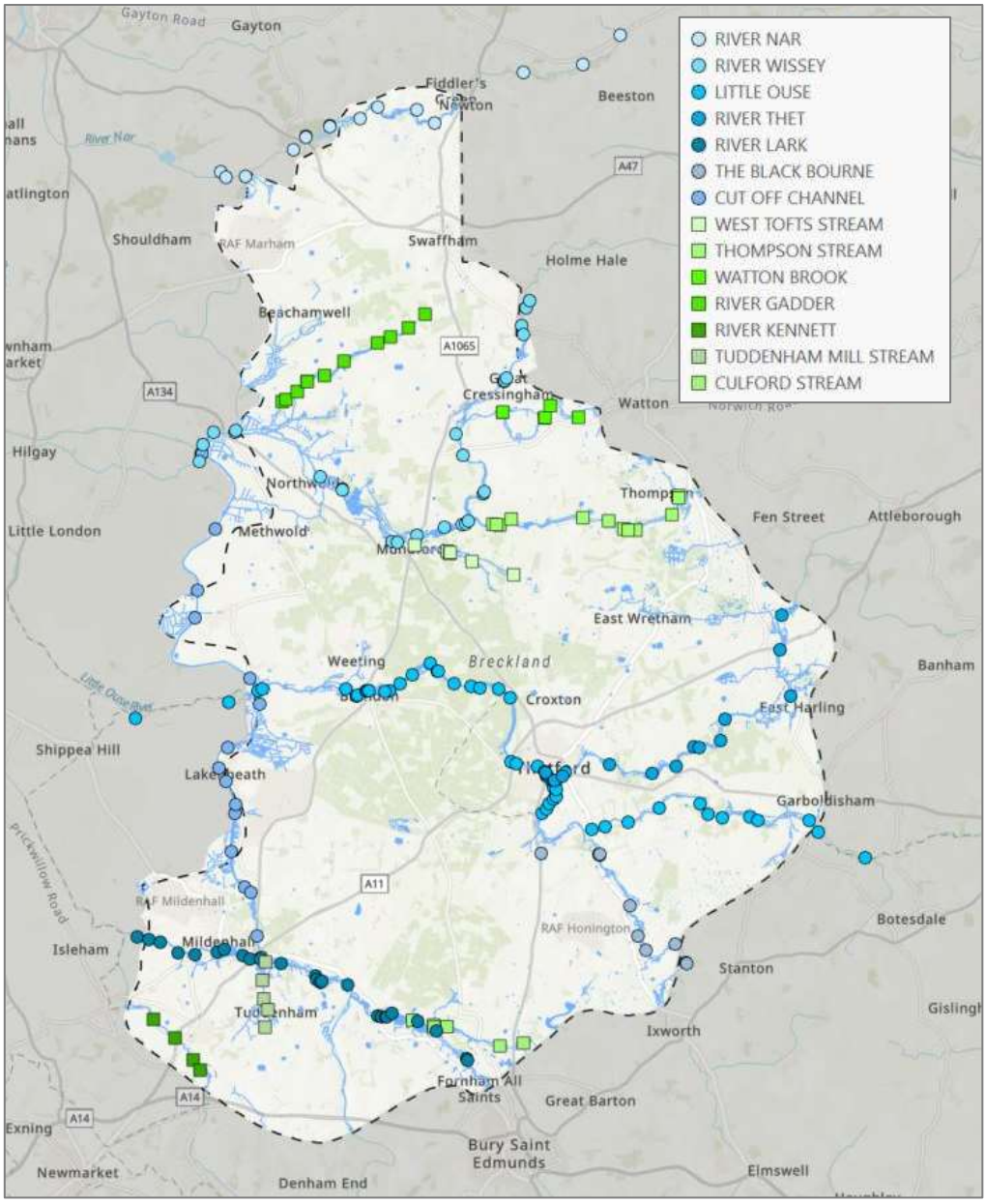


Figure 13: Distribution of water samples taken in rivers and streams in the BFER Scheme area

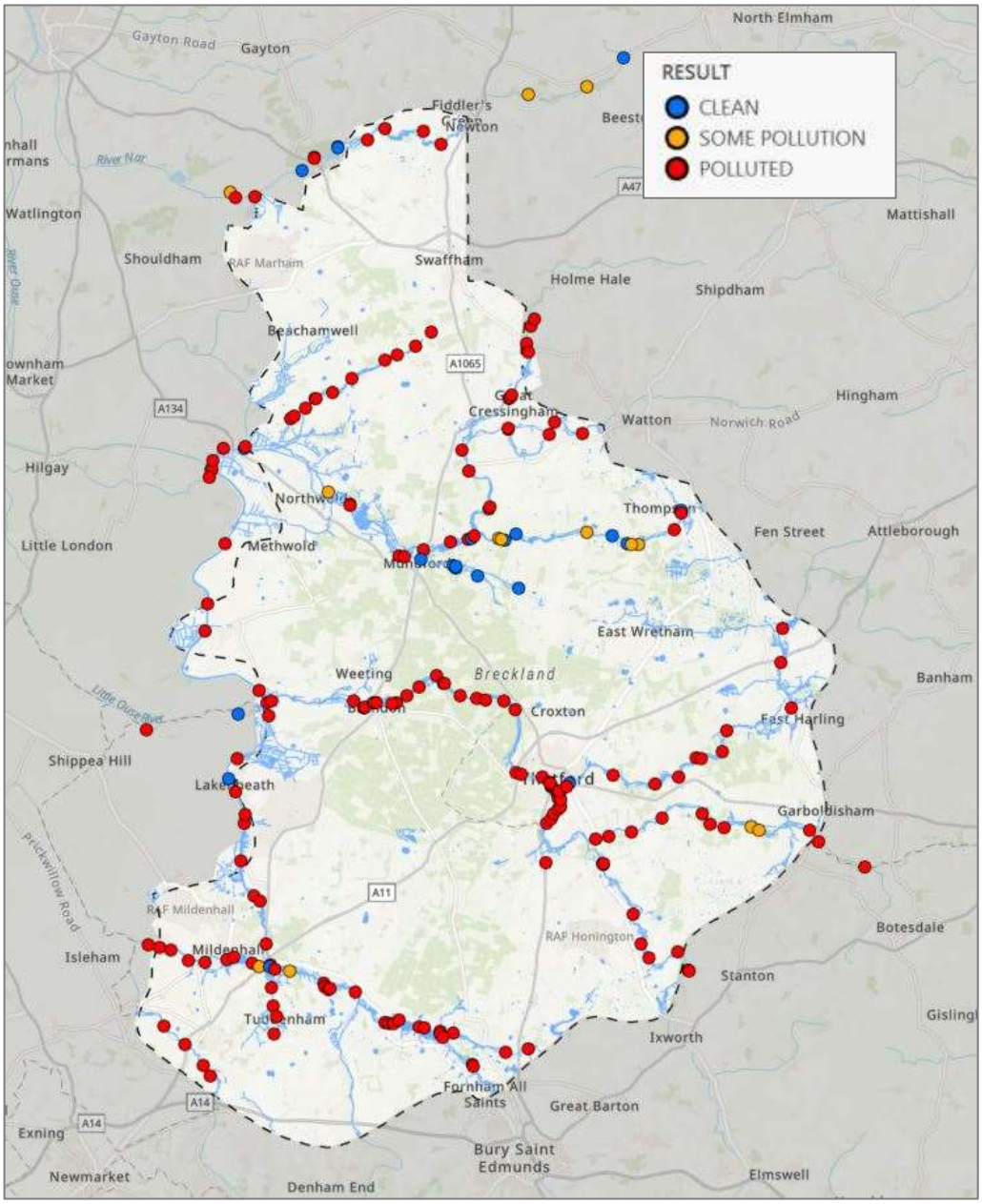
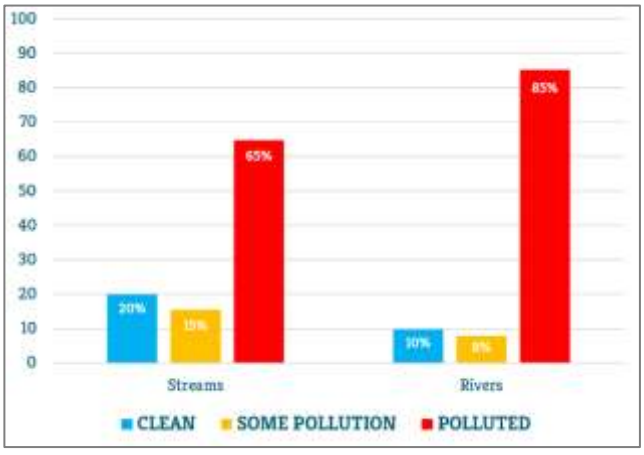


Figure 14: Distribution of nutrient pollution across rivers & major streams in the BFER Scheme area



Of the running waters in this survey 85% of rivers and 65% of streams showed high levels of nutrient pollution, with only 10% of rivers found to have clean water (Figure 15).

Figure 15: Percentage of nutrient pollution in streams and rivers in the BFER Scheme area

Of the rivers tested, the River Nar, just outside the BFER Scheme area, had the greatest proportion of clean water although this was only 20% of the samples collected. The Black Bourne, a tributary of the Little Ouse tested 100% polluted. Of the three main river catchments in the BFER Scheme area, The Wissey and Little Ouse had the cleanest water although this was only 6% of the samples tested. The River Lark had the most polluted water, with only 3% of samples testing coming up as clean water. The Cut-off channel, which runs between the three main rivers, had 11% clean water and 89% polluted water (Figure 16).

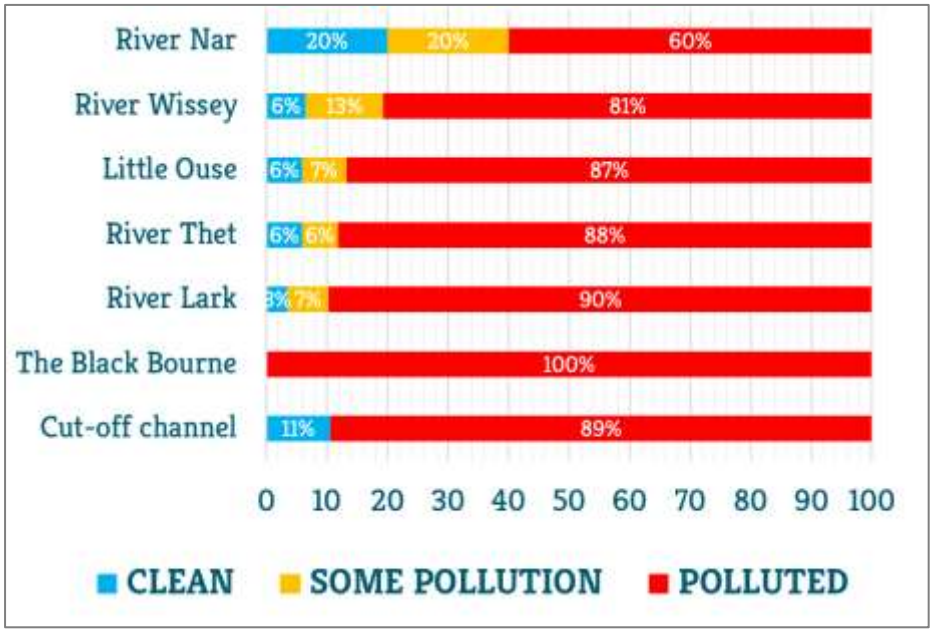


Figure 16: Percentage of nutrient pollution in the rivers tested in the BFER Scheme area

Looking at the main streams within the catchment The West Toft Stream and Thomson Stream, both tributaries of the River Wissey had the most clean water samples, 100% and 46% respectively. The Watton Brook and Gadder, both tributaries of the Wissey, and Kennett, Tuddenham Stream and Culford Stream, tributaries of the River Lark all had 100% polluted water (Figure 17).

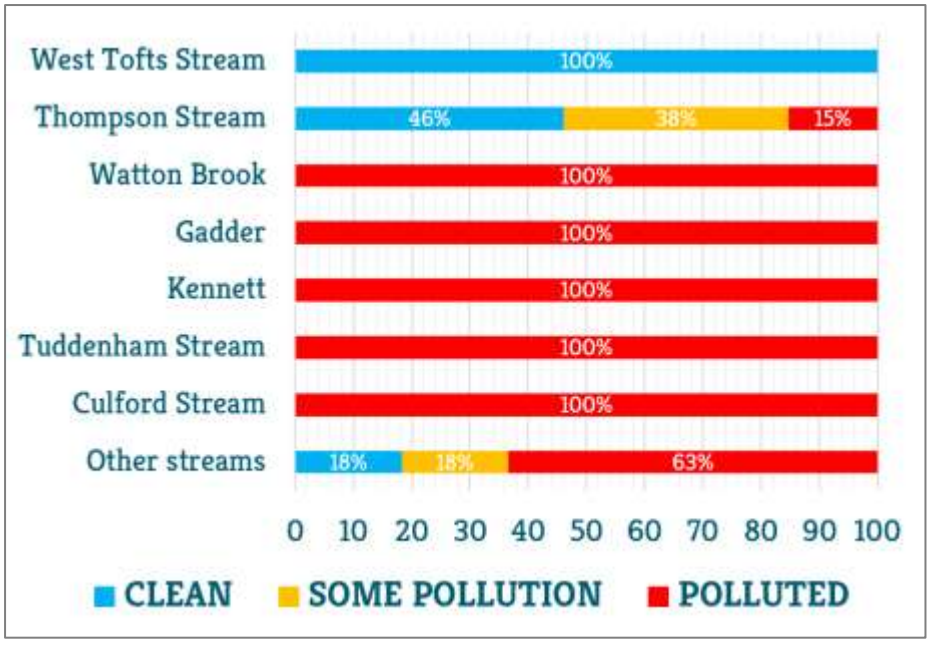
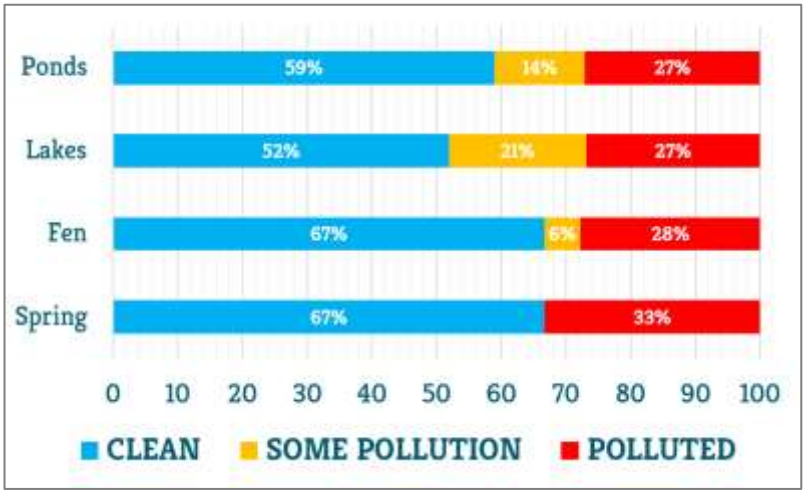


Figure 17: Percentage of nutrient pollution in the streams tested in the BFER Scheme area

4.2.3 Standing Waterbodies



Overall, 59% of the standing waterbodies in the survey tested clean. The cleanest standing waterbodies tested were the fens (67%) and springs (67%), followed by ponds at 59% and lakes at 52% (Figure 18).

Figure 18: Percentage of nutrient pollution in the standing waterbodies tested in the BFER Scheme area

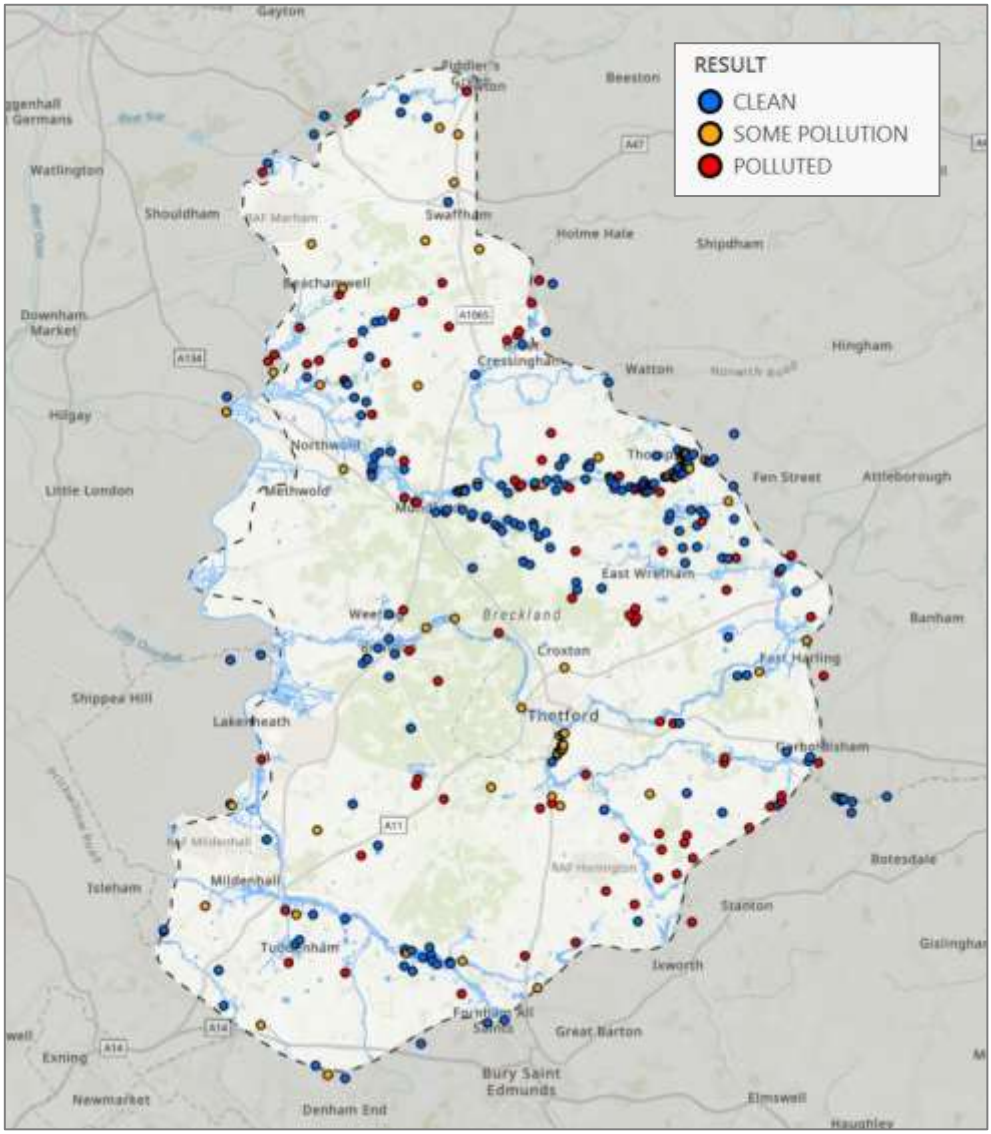


Figure 19: Distribution of nutrient pollution across standing waterbodies in the BFER Scheme area

4.2 Targeted Surveys

4.2.1 Private Landowners

Forty waterbodies in total were visited during the private landowner surveys. Out of the 26 ponds, eight of these were dry at the time of visiting (Figure 20). Of these, 56% were ponds, 13% reservoirs, used by the estates for irrigation, 13% rivers, 9% ditches and 9% streams (Figure 21).

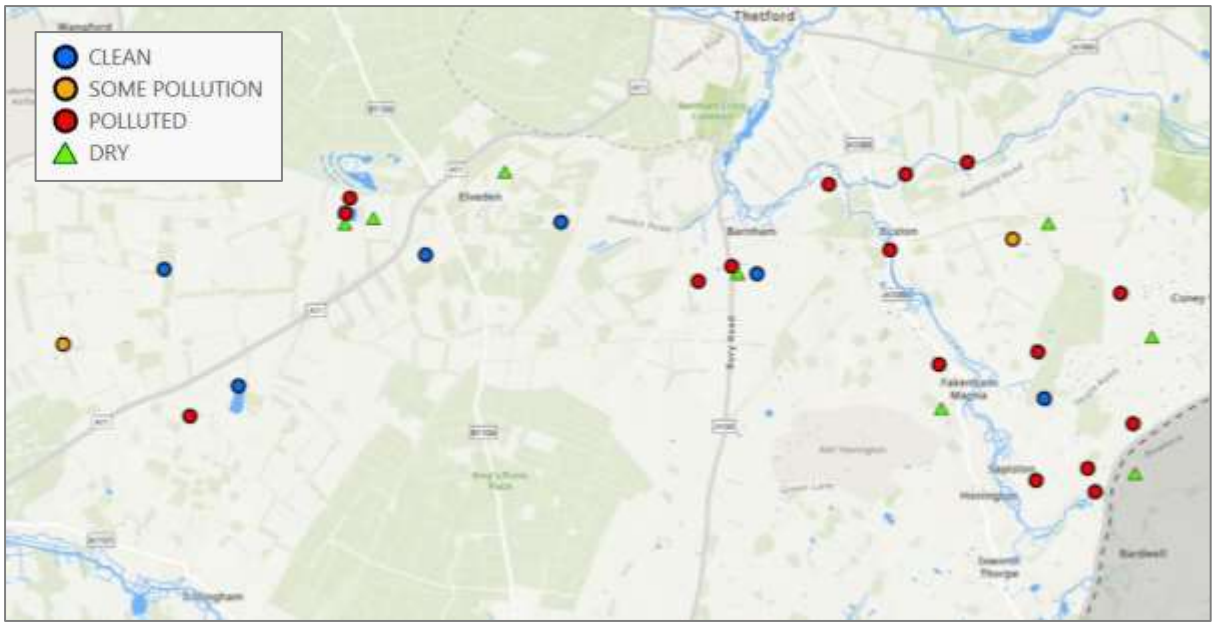


Figure 20: Distribution of nutrient pollution across waterbodies sampled on private estates in the BFER Scheme area

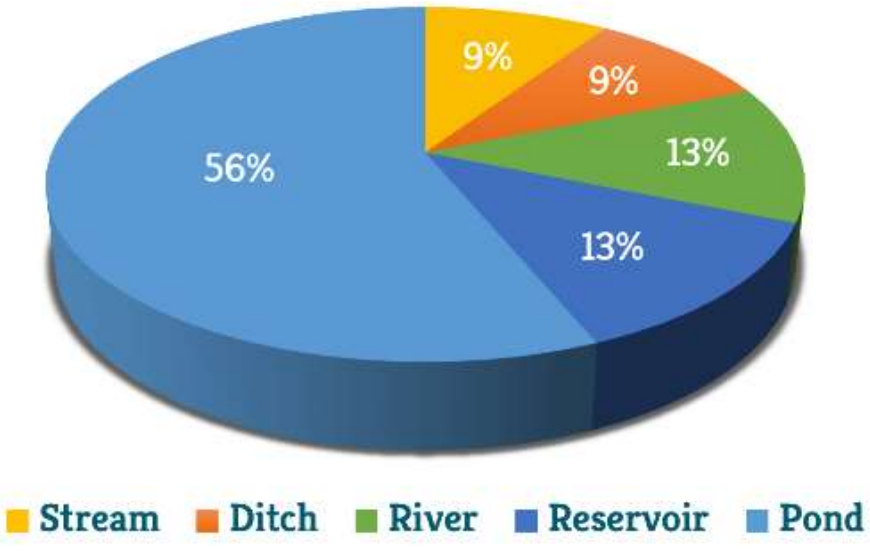


Figure 21: Percentage of waterbodies tested across the private estates in the BFER Scheme area

Across the estate land, 32% of standing waterbodies (ponds & reservoirs) tested clean, with 59% polluted. Only 10% of the running waterbodies (rivers, streams and ditches) tested clean with 80% polluted. (Figure 22).

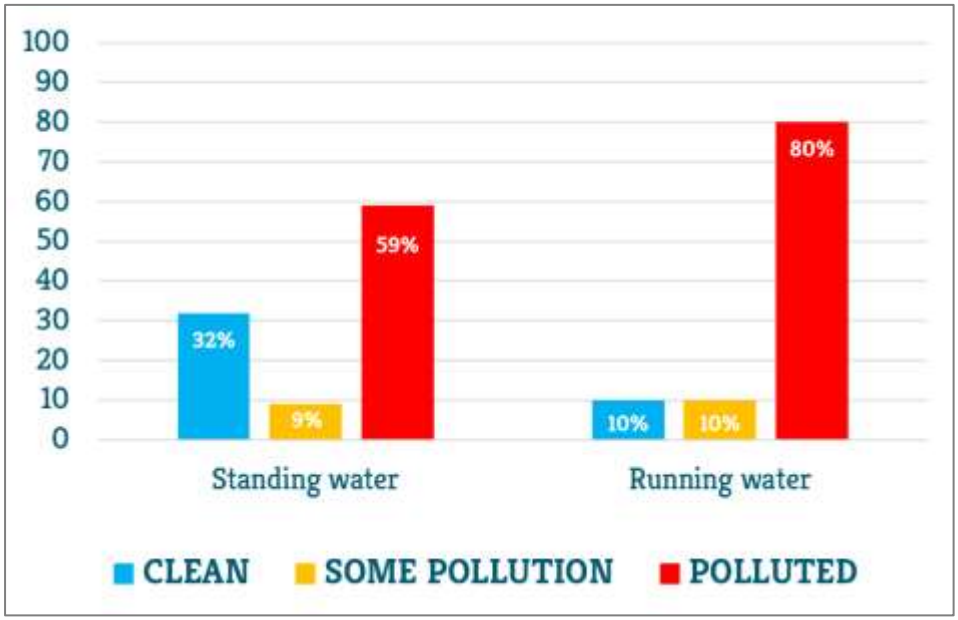


Figure 22: Percentage of nutrient pollution in standing and running waterbodies on private estates in the BFER Scheme area

Out of the running waterbodies, the rivers and streams in the survey all tested 100% polluted, whereas the at least some of the ditches (33%) tested clean. Within the standing waterbodies, 33% of the ponds also tested were clean, whilst only 25% of reservoirs tested were clean (Figure 23).

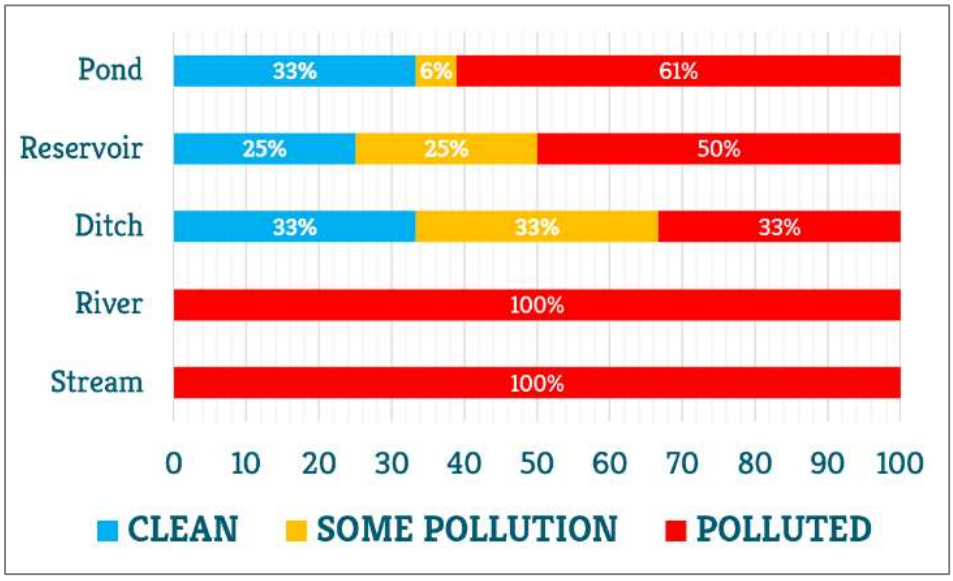


Figure 23: Percentage of nutrient pollution in different waterbodies on private estates in the BFER Scheme area

4.2.2 BTO Nunnery Lakes (Clean Water Blitz)

Of the standing waterbodies, 29% tested clean and 50% showing some nutrient pollution. Ponds and lakes had roughly the same proportion of clean water (30% and 25% respectively). All the running waterbodies, including the Little Ouse, which runs through the reserve, tested high in nutrient pollution (Figures 27 & 28).

Out of the 10 ponds surveyed, two of the ponds in the gardens of the BTO office at The Nunnery tested clean, whilst one, located close to the river, showed some nutrient pollution. Of the new ponds on the Nunnery lakes reserve, none showed clean water.

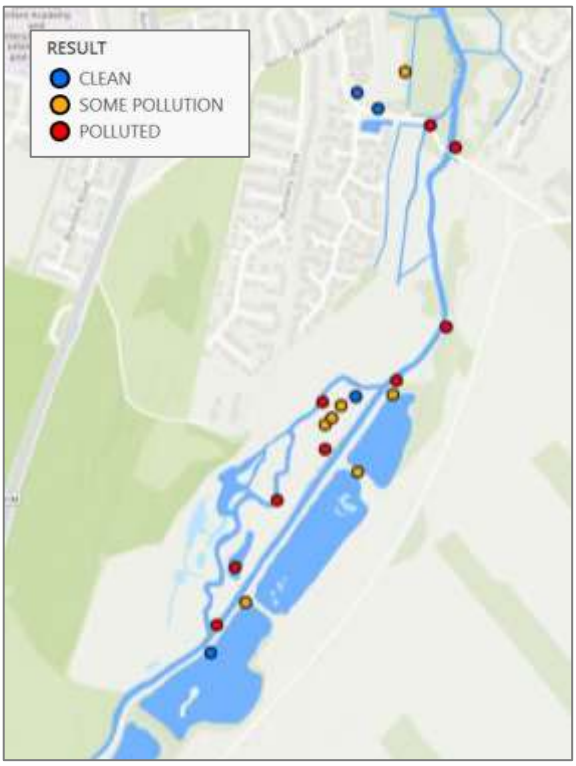


Figure 26: Distribution of nutrient pollution across waterbodies tested at Nunnery Lakes

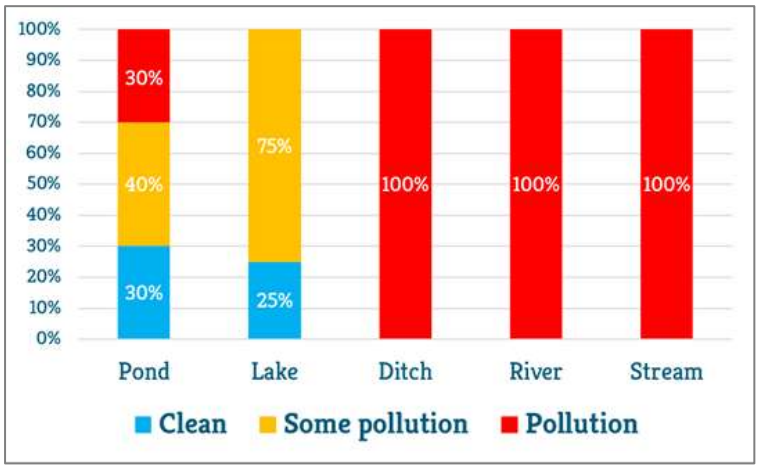


Figure 27: Distribution of nutrient pollution across all waterbodies tested at Nunnery Lakes

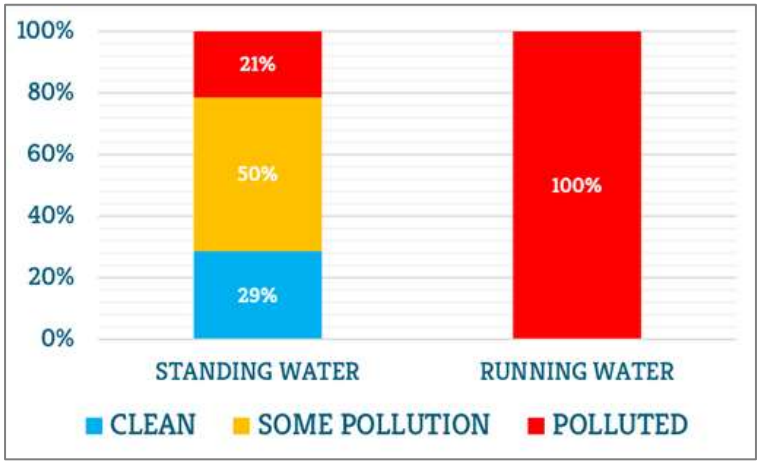


Figure 28: Distribution of nutrient pollution across standing and running waterbodies at Nunnery Lakes

4.2.3 The Stanford Training Area (STANTA)

In total, 104 samples were taken on the STANTA Military Training Area with 71% of waterbodies testing clean in marked contrast to the other focus surveys above (Figure 29 and 30).

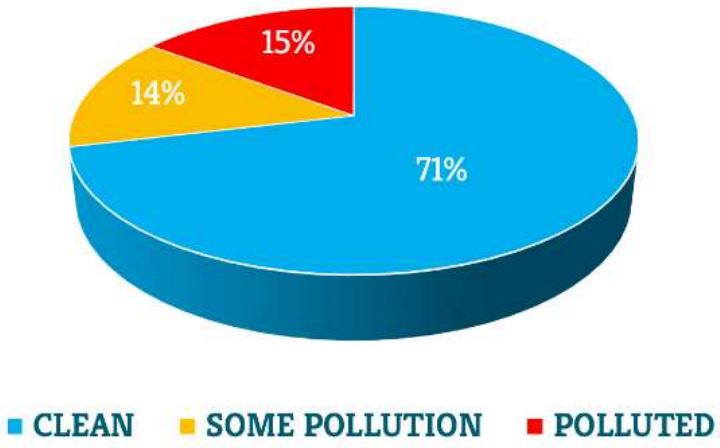


Figure 29: Percentage of nutrient pollution across all waterbody types in the STANTA Military Training Area

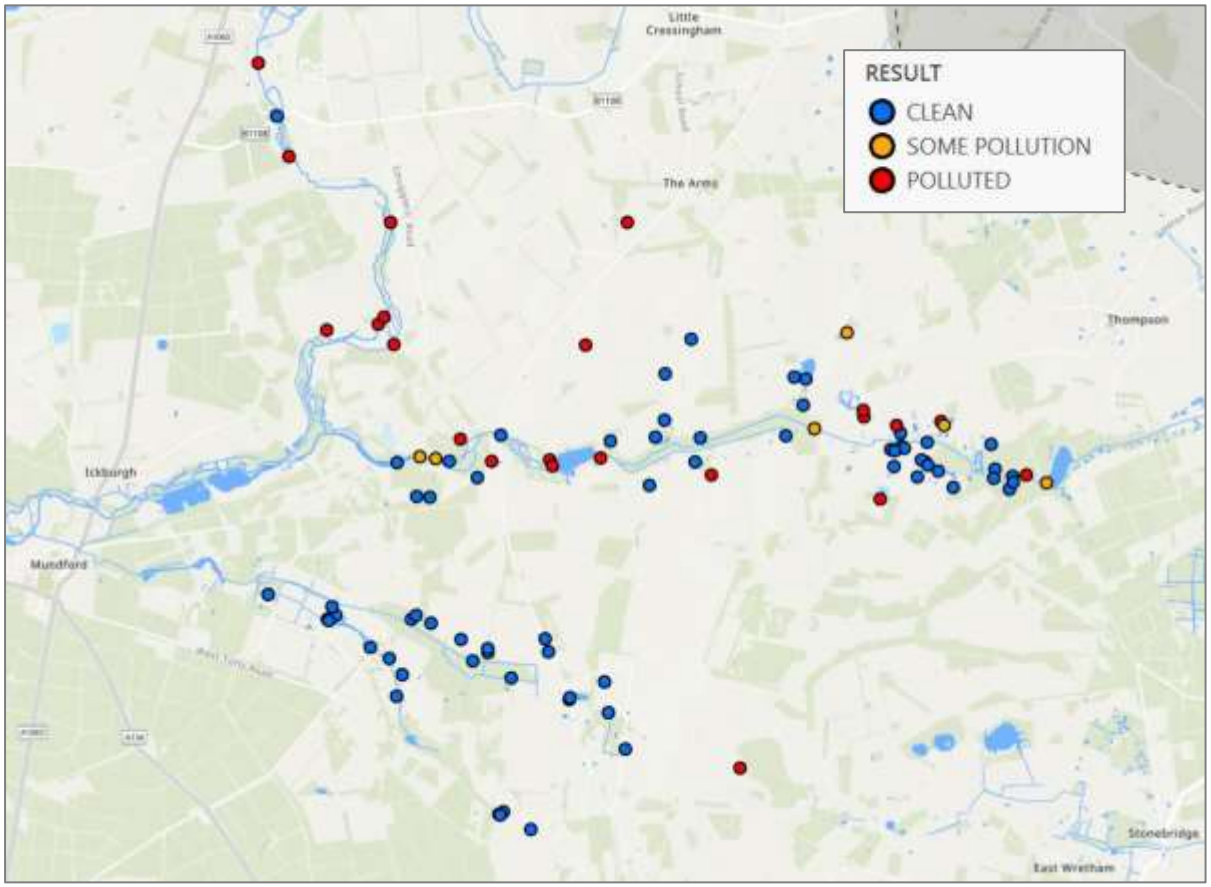


Figure 30: Distribution of nutrient pollution across waterbodies tested on the STANTA Military Training Area

Standing water were predominantly clean water 79%, but the running water network also supported clean water, 60% (Figure 31).

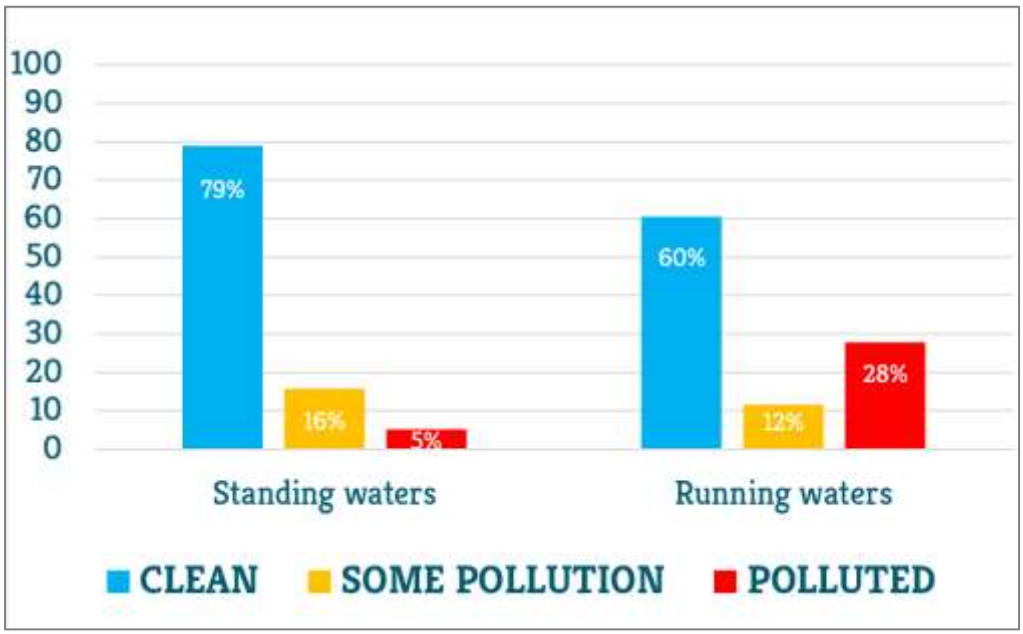


Figure 31: Distribution of nutrient pollution across standing and running waterbodies at STANTA Military Training Area

Of the standing waters, 80% of the ponds and 75% of the lakes tested clean. Two springs and one well were tested which all came back clean. Only one fen was sampled which unfortunately tested polluted. Of the running waters, no clean water was found along the River Wissey within STANTA, but 53% of the streams and 82% of the ditches on STANTA tested clean (Figure 32).

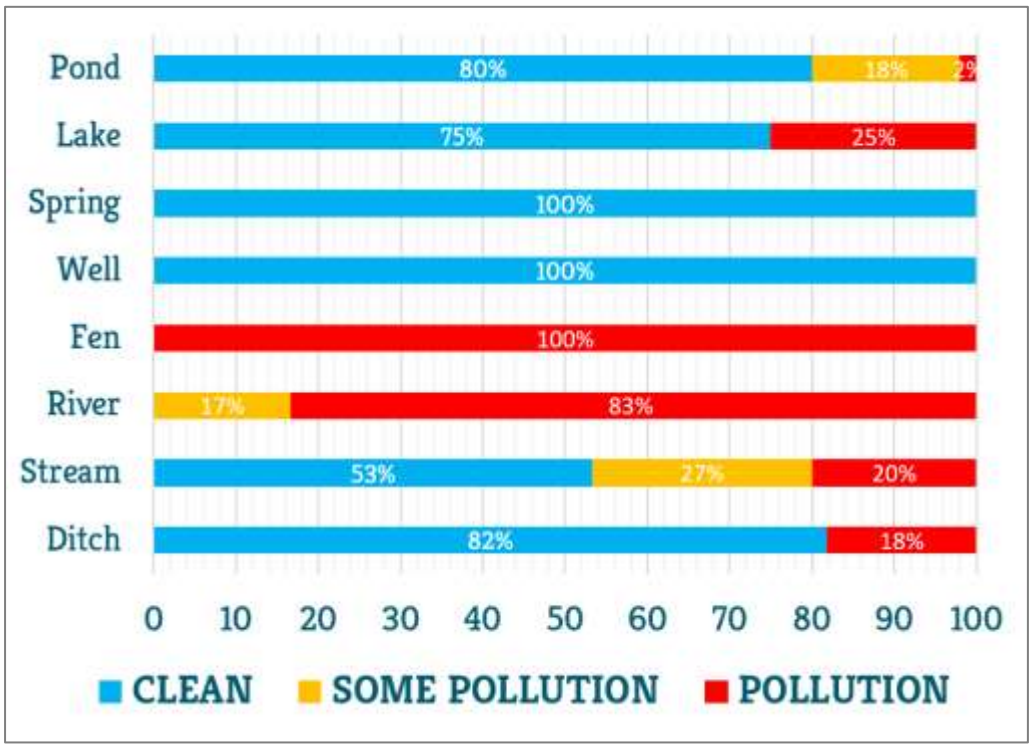


Figure 32: Percentage of nutrient pollution across different waterbody types in the STANTA Military Training Area

4.2.4 Thompson Common (Clean Water Blitz)

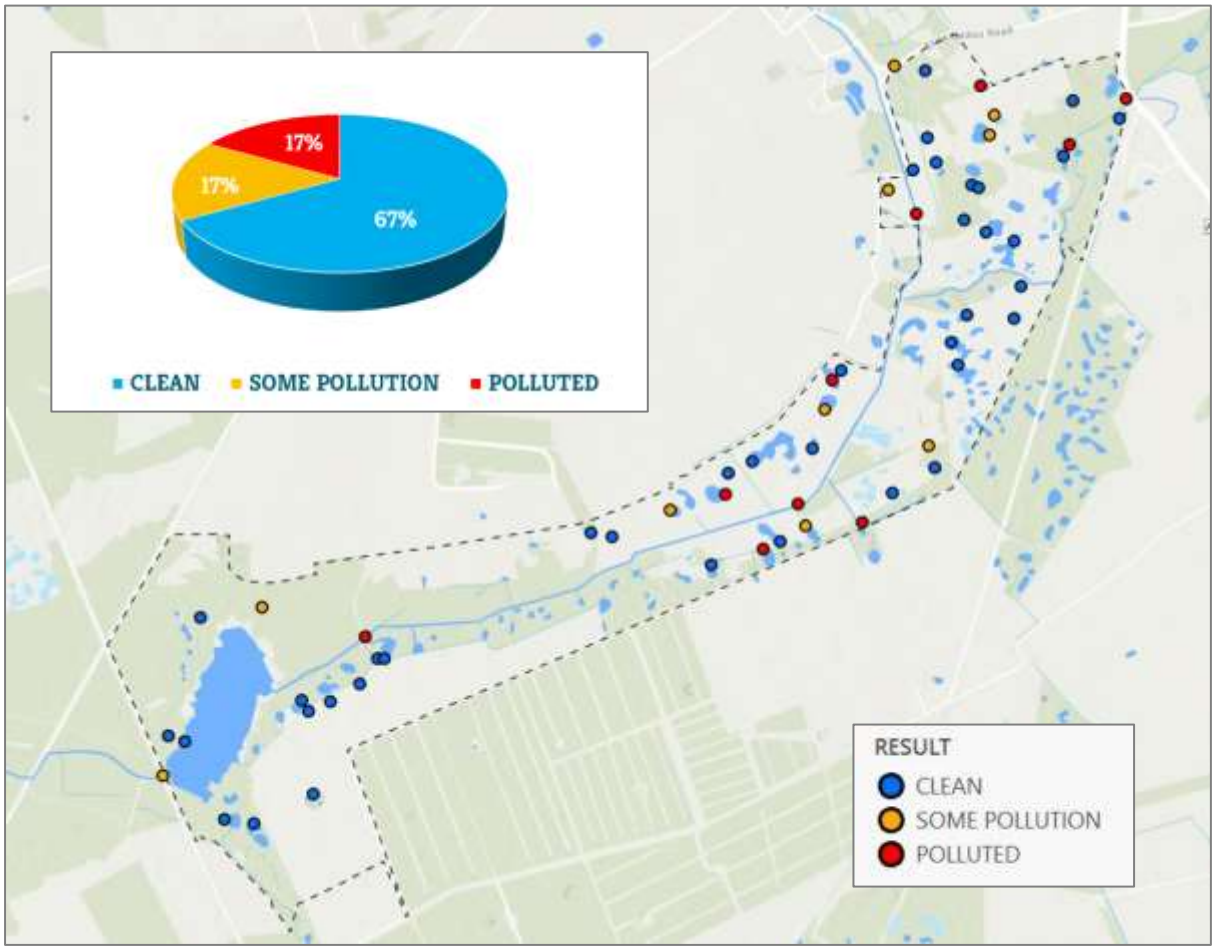


Figure 33: Distribution of nutrient pollution across waterbodies tested on Thompson Common Nature Reserve.

Thompson Common was also different to the wider countryside results. Overall, 67% of all the waterbodies on Thompson Common tested clean (Figure 33).

Of the ponds tested, 76% were clean. Just one lake was sampled, Thompson Water, which also tested clean. Of the ditches, only 25% were clean in this area. The samples taken from Thompson Stream, which runs through the reserve, tested predominantly polluted, 50% (Figure 34).

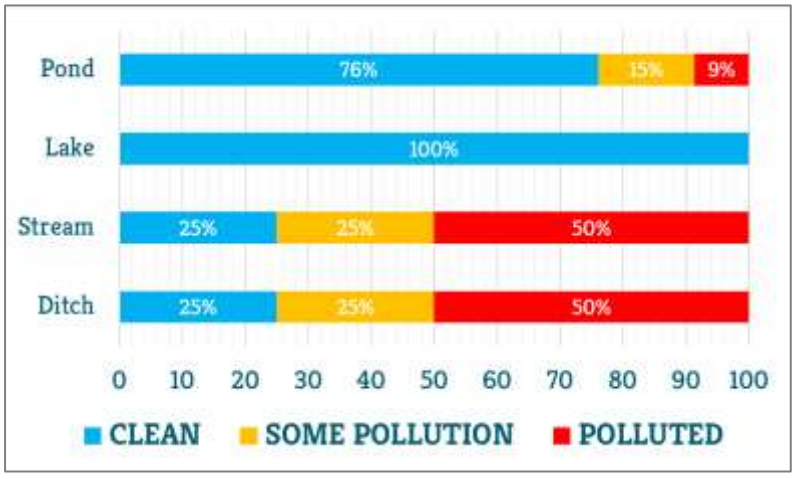


Figure 34: Percentage of nutrient pollution across different waterbody types on Thompson Common Nature Reserve

4.2.5 School Workshop surveys

Samples collected by students came within the BFER Scheme area. Of these, only 30% were clean (Figure 34). 72% of the rivers tested were found to be polluted, whilst 50% of ponds (outside of gardens) and 80% of the lakes tested clean. Some springs and streams also had clean water (53%). Of the ponds tested, three quarters were garden ponds and 58% of these ponds were polluted.

Unlike the Volunteer monitoring network, which concentrated on testing the main waterbody types, the students also tested 'non waterbodies' including tap water and rain water, 100% of the tap water tested polluted whereas rain water (from water buts and bird baths) had lower levels of nutrients with 53% testing clean (Figure 35).

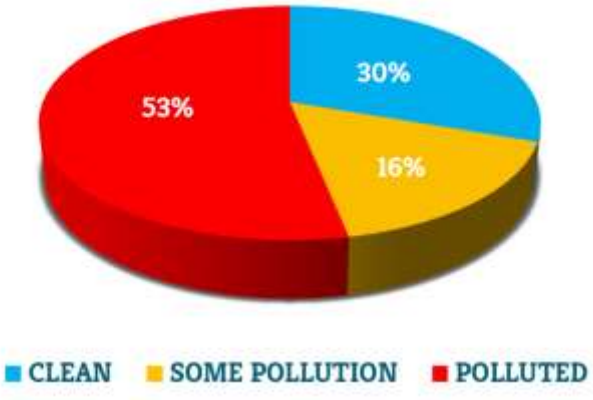


Figure 34: Percentage of nutrient pollution across all waterbody types tested by students in the BFER Scheme area.

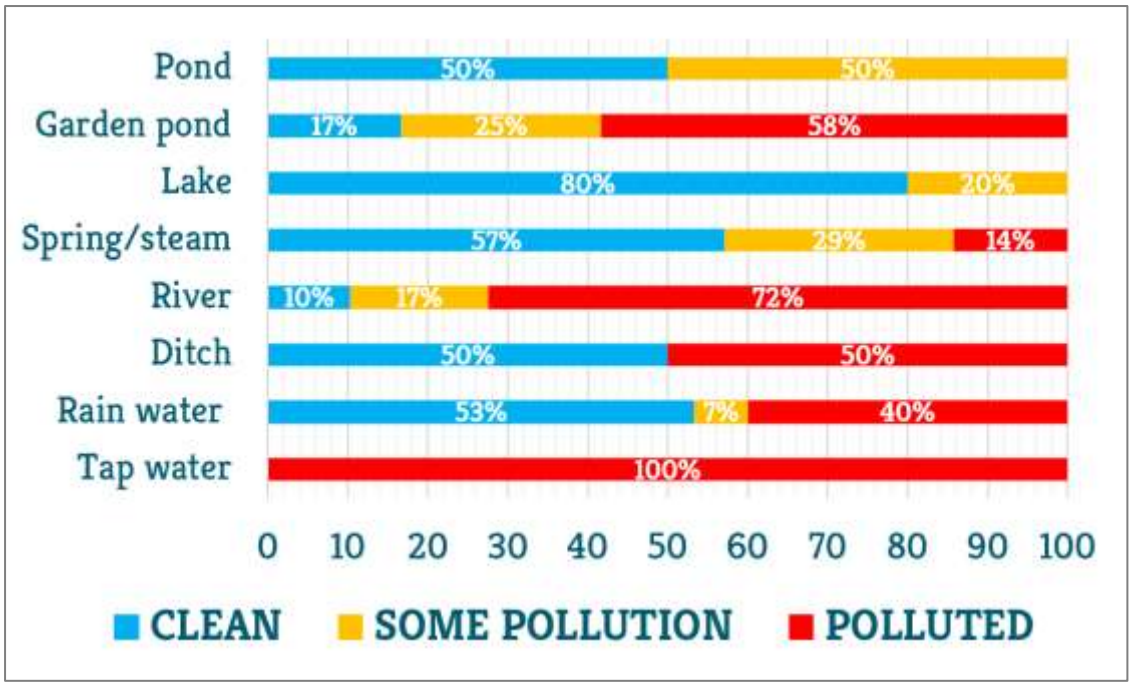


Figure 35: Percentage of nutrient pollution across different waterbody types tested by students in the BFER Scheme area.

4.3 Clean Water Provisional Priority Ponds

The results of The BFER Testing the Water eDNA Survey identified an additional seven ponds qualifying as a Priority Ponds under ***Criteria 2 - Ponds supporting species of high conservation importance*** (namely GCN, Toad, Pool frog, Otter, Water Vole, European eel). All of these new Priority Ponds also had clean unpolluted water, which is a vital prerequisite for healthy biodiverse ponds where wildlife can thrive.

A further pond, sampled for vertebrates, in the study, was also identified as a Priority Pond based on ***Criteria 2 - Ponds supporting species of high conservation importance*** *(an RDB plant species Water-violet (Hottonia palustris)).* This pond also had clean unpolluted water. Water-violet is widespread in the southeast of England but has undergone a significant decline in recent years and is now included on the Red Data List for England. Threats include habitat loss, drainage and poor management. The submerged nature of Water-violet make it very susceptible to water quality.

Prior to clean water testing the BFER Testing the Water Project using eDNA brought the total number of Priority Ponds in this Important Freshwater Landscape up to 159 Priority Ponds.

Full details of these surveys can be found in the following document:

Carter A. and Ewald N. 2024. Brecks Fen Edge & Rivers Landscape Partnership. Citizen Science: Testing the Water. eDNA Survey Results 2022. Version 2. Freshwater Habitats Trust, Oxford.

The results of the clean water survey discussed in this report identified a further 160 Provisional Priority Ponds based on ***Criteria 6: The presence of clean water***.

Presence of clean water is an indicator that the waterbody may be high quality and support high biodiversity value.

Follow up surveys, including PSYM assessment and other priority species surveys, should be undertaken to confirm that the pond has full Priority Pond status under one of the other criteria.

A large proportion of the Provisional Priority Ponds identified by clean water testing, were located in Important Freshwater Areas, high priority areas for freshwater biodiversity (Biggs & Dunn, 2018) which already have an abundance of Priority Ponds.

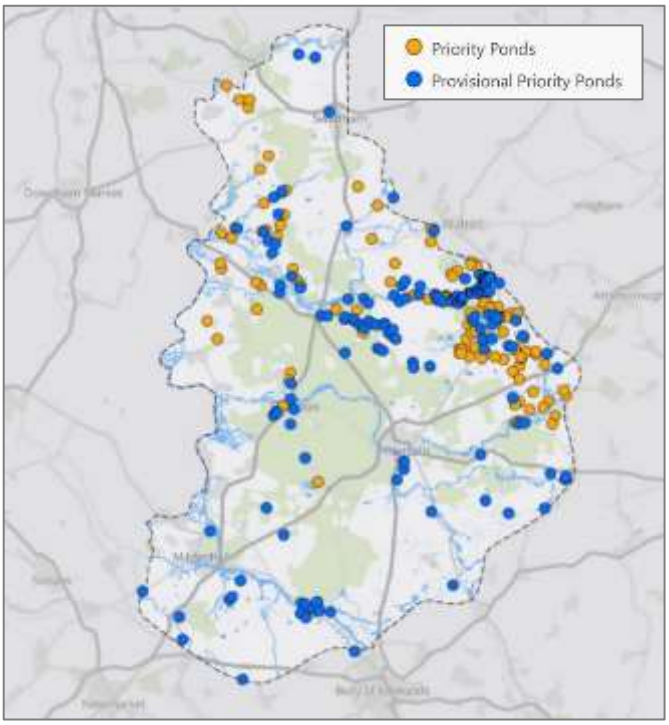


Figure 36: Distribution of Priority Ponds and Provisional Priority Ponds in the BFER scheme area

These areas included Thompson Common, Frost Common and STANTA to the East of the BFER Scheme Area, the Foulden, Gooderstone and Oxborough area, to the North West, adjacent to the River Wissey floodplain and the Lackford/West Stow areas to the South.

54% of the Provisional Priority Ponds were located within SSSIs, 72% of which were located within the Thompson Common and STANTA SSSIs. A further four ponds lay just outside the Thompson Common SSSI and seven outside the STANTA SSSI designated areas (Figure 37).

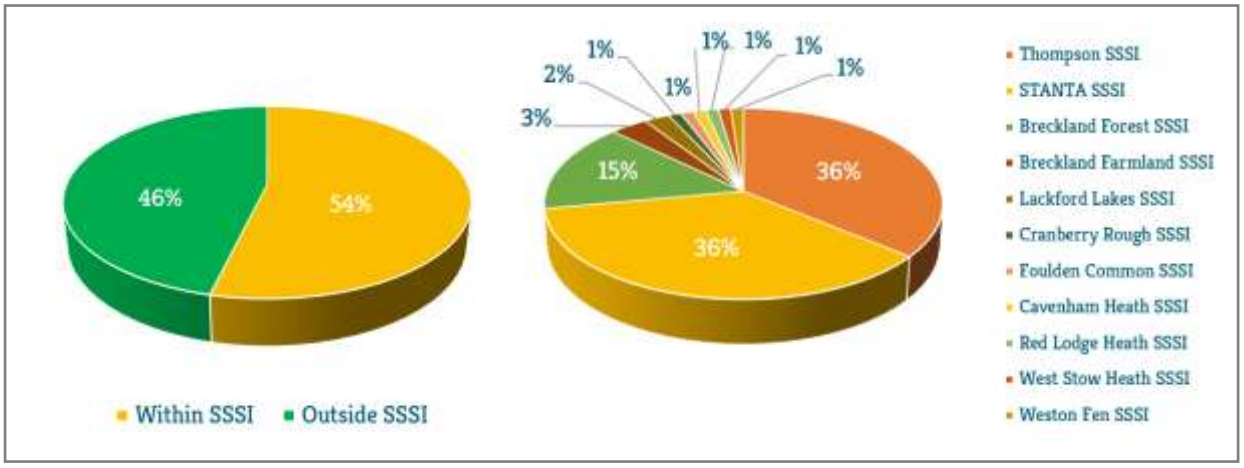


Figure 37: Distribution of Provisional Priority Ponds within SSSIs in the BFER Scheme Area

15% of Provisional Priority Ponds occur within the Breckland Forest SSSI. This is one of the largest SSSI within the BFER Scheme Area, covering over 1,800 hectares and lies between Bury St Edmunds in Suffolk and Swaffham in Norfolk. The majority of the site is within Thetford Forest, the largest commercial forest in lowland England, managed by Forestry England. Four ponds with clean water were identified within the Forest itself (with two just outside the designation, in Brandon Country Park). There may be more ponds that were not mapped and may therefore not have been sampled.

Nine of the Breckland Forest SSSI clean water ponds were located in mixed plantation woodland & heathland, managed by Forestry England, to the south of Thompson Common, including Frost's Common, Spong Heath, Hockham Heath, Bragmere Pits and Queen's Close. A further pond in the Cranberry Rough SSSI, managed by Norfolk Wildlife Trust also had clean water. Frost's Common has over 40 natural pingo ponds, supporting many rare freshwater plants and animals including invertebrates associated with Pingo systems.

A further six smaller SSSIs within the BFER Scheme Area, including Lackford Lakes, West Stow Heath Foulden Common, Cavenham Heath, Red Lodge Heath, and Weston Fen also have Provisional Priority Ponds within their boundaries.

In the Lackford/West Stow area, eight Provisional Priority Ponds were identified with half of these within SSSIs. Lackford Lakes SSSI consists of a series of lakes, managed by Suffolk Wildlife Trust, formed by sand and gravel extraction in the valley of the River Lark. The lakes are set within a mosaic of sandy acid grassland, marshy grassland, scrub, wet and dry woodlands, ditches, bare ground and steep sandy banks. West Stow Heath SSSI, to the north of the River Lark, adjacent to Lackford Lakes also contains a very wide range of grassland and heath vegetation as well as an area of well-developed wet woodland and open water created by gravel workings. Foulden Common SSSI, to the North West of the BFER scheme area, is situated close to the floodplains of the Oxborough Drain, a tributary of the River Wissey. The site encompasses a wide mosaic of habitats, including open water, rich fen, both acidic and calcareous grassland, birch woodland and pingo ponds.

5.0 Discussion

The Testing the Water project has helped to engage volunteers in collecting valuable, accurate data on the distribution of clean unpolluted water in The Brecks Fen Edge and Rivers landscape area.

Overall, the project has also produced a new Priority Ponds map for The Brecks Area – critical to identify and protect the most important freshwater sites. The results have brought the total number of Priority Ponds in this Important Freshwater Landscape up to 159 Priority Ponds. This includes seven new Priority Ponds identified during the eDNA surveys carried out by volunteers in 2022. The overall clean water survey also identified 160 Provisional Priority ponds based on Criteria 6: the presence of clean water.

Most freshwater plants and animals have evolved over millions of years in a world where the natural level of nutrients in ponds, lakes, streams and rivers was very low. When more nutrients, like phosphate and nitrate, are added to the freshwater environment this can cause profound changes and freshwater wildlife struggles to adapt.

Although in this study, nutrient pollution was found in all the freshwater habitat types tested, standing waterbodies, especially ponds, were overall the cleanest freshwater habitats found in The Brecks. Like most of lowland Britain, rivers and some ditches and streams in the BFER Scheme Area were found to be proportionally more polluted by nutrients.

In the UK, a large part of the threat to freshwaters is due to pollution especially from intensive agriculture, run off from urban areas and roads, and sewage. Most of England's rivers and other running waterbodies are highly polluted – too many nutrients, heavy metals, pathogens, pesticides and sediment. Waterbodies, which drain large catchments, are exposed to multiple sources of pollution and by their very nature, will pick up these pollutants.

All the rivers sampled in the BFER scheme area are chalk streams that flow into the River Ouse. A chalk stream is generally defined as one that originates most of its flow from chalk-fed groundwater and exhibits the 'classic' chalk stream characteristics of alkaline, crystal-clear water, flowing consistently and evenly over clean gravel beds. They are recognised as having high conservation value for wildlife, water supply, recreation and culture; however, England's chalk streams are, overall, in a dreadful state of health. More than three-quarters are failing to meet the required Good status, as set out by the Water Framework Directive (WFD). Only 12 out of England's 224 chalk streams are protected and of these only 15% are classed as adequately protected and meet conservation objectives.

Of the four 'chalk stream' rivers sampled, the River Nar was the cleanest. This is also the only river in the study which is designated as a Site of Special Scientific Interest (SSSI) for its high conservation value. The Nar has been modified along most of its length with sections of unchanged natural river seen in only a few places. It is also under pressure from abstraction, and diffuse pollution, which all constrain the ecological potential of the river. Arable land dominates 75% of the total catchment area, alongside sheep and cattle grazing in the upper valley and pig farming is increasingly present. In recent years, however, the Norfolk Rivers Trust, supported by funding from WWF-UK and the Catchment Restoration Fund, has begun to address some of the issues that date back to the draining of the land for food production over a century ago. The Trust has: restored many key reaches, in places, re-meandering the river across its original floodplain and mapped hot spots where silt is running off fields and roads and entering the river. They have also delivered bespoke farm advice to help farmers change practices and bring hundreds of acres under better stewardship, allowing millions of litres of rainwater to replenish the aquifer, and preventing river pollution. As part of

BFER, Norfolk Rivers Trust, along with other organisations, have also created a *'Riparian Landowner Advice'* project to join-up land management advice for the Brecks' riparian landowners.

In contrast to the River Nar, the River Wissey was predominantly polluted. The river rises as a chalk stream east of Bradenham and flows in a westerly direction through the villages of Necton, North and South Pickenham, Great Cressingham, Bodney, Ickburgh, Didlington, Northwold, Wittington and Stoke Ferry to join the Great Ouse. The area is mainly rural with arable agriculture the main land use. Cereals are the major crop and in summer, up to 14% of the arable area may be irrigated using water from the river or groundwater. The catchment is also a key water source for public water supply.

In contrast to the high levels of nutrient pollution found on the River Wissey, two of its tributaries, West Toft Stream and Thompson Stream showed the least amount of nutrient pollution. With a predominantly rural sub-catchment, both of these streams are predominantly unmodified and flow through the semi-natural and SSSI designated habitats of STANTA Military Training Area and Thompson Common Nature Reserve. On the other hand, the Watton Brook, a heavily modified tributary of the River Wissey, tested 100% for nutrient pollution. Like West Toft and Thompson Streams, it also flows within the STANTA training area, but is outside of the STANTA SSSI and is primarily MoD owner arable and pasture land.

The Little Ouse, and its tributary, The River Thet were both polluted. This catchment is characterised by Breckland and woodlands with varied land use including forestry and agriculture. Many of the samples were taken from the section of the Little Ouse, which flows through the town of Thetford, so as well as agricultural impacts from the wider landscape, the river at this point could be subject to run off from urban areas and roads. Out of all the rivers tested, The Black Bourne, another river tributary of the Little Ouse, was the most polluted with no clean water samples taken between Euston to Sapiston. This is unsurprising as the river predominantly runs through prime agricultural land with issues associated with this land use. Despite the poor water quality found in the river, it is still important for local, national and internationally protected species including European eel, Otter and Water vole, evidence of which were found during the 2022 eDNA survey of vertebrate species.

There are also pockets of clean water in the surrounding catchment. Samples taken, by volunteers at sites managed by the *Little Ouse Headwaters Project (LOHP)* all came back clean. These included ponds, ditches and fens on Blo'Norton Fen, Oak Tree Fen, Hinderclay Fen and Bettys Fen, which are all located adjacent the river at Blo'Norton close to the source of The Little Ouse.

The River Lark had the most polluted results out of the three primary rivers sampled. Three of the Larks stream tributaries, The Kennett, Tuddenham Stream and Culford Stream did not register any clean water samples. The River Lark rises as a chalk stream to the south of Bury St Edmunds and flows North west through Mildenhall to the Great Ouse. Like the Wissey and the Little Ouse, the area is mainly rural, with many small villages and the market towns of Bury St Edmunds and Mildenhall. As well as agriculture, the land use also includes tree belts and woodlands. The dryness of the soils in the Lark valley has limited its land-use and historically there were extensive heaths in the catchment, with Cavenham Heath National Nature Reserve now the largest survivor. Samples taken on waterbodies on Cavenham Heath all tested for clean unpolluted water.

Ponds are threatened by the same issues as running water, however, their small size and isolation means that they have avoided many of the pollution problems faced by other freshwaters. Many species traditionally associated with rivers, find refuge in clean water ponds. Ponds come in all shapes and sizes – whereas rivers are often relatively uniform across the whole catchment. So overall, ponds collectively will be more diverse than the adjacent river in most wider countryside

catchments. Although some clean water ponds were found in the agricultural landscape, the majority of the clean water was found in semi-natural landscapes, including many of the remaining heaths and woodland in the Brecks area, including Hockham Heath, Tuddenham Heath, Cavenham Heath, Thetford Forest and Middenhall Woods.

The targeted surveys carried out in 2022 and 2023 enabled us to drill deeper into where the clean water was found in the BFER scheme area.

On the private estates, the majority of the waterbodies, both standing and running, tested high in nutrient pollution; with no clean water found in the rivers and ditches flowing through both the Elveden and Euston Estates. This is unsurprising as waterbodies in agricultural areas can be exposed to multiple sources of nutrient pollution. The single largest source of nitrate pollution comes from fertilizer, which is used to improve crop growth. The cleanest water again, was found in ponds. On the Elveden Estate, three out of the four ponds that tested for clean water were situated within woodland, or surrounded with semi-natural habitats, offering a buffer from any nutrient pollution in the wider landscape. The majority of the ponds tested on the Euston Estate were situated within arable fields with little or no buffers from any crop inputs and tested high for nutrient pollution. These surveys indicate that, although there are nutrient pollution issues in agricultural landscapes it is still possible to find clean freshwater refuges within these environments.

All the running water sampled during the BTO's Nunnery Lakes *Clean Water Blitz* also tested high in nutrient pollution. Although the reserve has a buffer of semi-natural landscape around it, the majority of the samples from the Little Ouse, which runs through the reserve, came out as polluted, so the result is not unexpected. Out of the 10 ponds surveyed, those located in the BTO gardens, and one on the reserve tested clean. However, the other ponds, although surrounded by semi-natural vegetation and away from the immediate inputs of agriculture all showed signs of pollution. When water levels are high, these ponds are subject to flooding from the adjacent river and are therefore, affected by nutrient pollution carried in the running waterbodies. The clean water ponds in the gardens, show that refuges can exist even in pockets of habitat within a semi-urban landscape.

In complete contrast, the majority of the waterbodies on STANTA tested clean, an indication that compared with samples taken from the whole Brecks area, the water landscape in the STANTA estate is one of the cleanest. This is unsurprising given the scale of semi-natural habitat within the SSSI, which is largely unaffected by intensive agriculture, drainage, pollution, eutrophication or water abstraction. The clean standing waterbodies on the estate include many of the groundwater fed fluctuating meres, such as Fowl Mere, Home Mere and West Mere. These all have unusual plant and animal communities associated with them and have adapted to survive the periodic inundation and drying out that these meres experience.

Of the smaller ponds tested Bagmore Pit, a small shallow depression fed by spring water also tested clean. This pond is known to have an exceptionally rich aquatic fauna. Other small ponds that also tested clean, and are of great botanical interest, include those around Tottington and Waterhouse Plantation.

Of the three larger standing waterbodies (lakes) sampled, Fowl Mere and West Mere, both natural fluctuating meres, had clean unpolluted water whereas Stanford Water, a large artificial lake, tested high for nutrient pollution.

Of the running waters the majority of the river samples collected were polluted. The River Wissey runs to the North West boundary of STANTA, and like all the river catchments in the study predominantly tested high in nutrient pollution. This part of the estate is more agricultural in land

use than the bulk of the estate whereas, in contrast, just over half of the streams sampled, including West Toft Stream and Thompson Stream, both tributaries of the Wissey, run through semi-natural habitats and tested clean. Over 80% of the ditches sampled also tested clean.

Thompson Common is situated to the east of the STANTA military training area. Although it is considerably smaller than its neighbour at only 140 hectares compared to 4,600 hectares (STANTA SSSI), it holds an impressive amount of clean waterbodies with overall 67% testing clean. Just over three quarters of the ponds tested, showed no signs of nutrient pollution, and the majority of the ponds, with pollution issues, were located towards the edge of the reserve north of Thompson Steam. This suggests that there may be some nutrient run off from the adjacent agricultural land. The majority of the ponds within the interior of the reserve, however, tested clean, an indication that they are being buffered from pollution issues by the surrounding semi-natural habitat. Of the ditches, a quarter tested clean. Again, like the standing water on the reserve nutrient pollution was evident towards the edges of the reserve, where ditches were entering the site. The samples taken from Thompson Stream, which runs through the reserve, tested predominantly polluted and as the stream flows though agricultural and semi-urban land before reaching the reserve it is likely that nutrient pollution has been picked up before entering the site. Interestingly as Thompson Stream flows through the reserve and out through the adjacent STANTA military training area, samples were predominantly clean with some signs of pollution.

The findings from the surveys carried out by students following the *'Train the Teacher'* session correlated with the results of the *overall* volunteer data collected. This subset of '*random*' surveys backs up the overall findings of the study. As well as sampling the main waterbody types, the students also tested a number of 'non waterbodies' including tap water and rain water (from water buts and bird baths). All the tap water samples tested had high levels of nutrient pollution, predominantly nitrate, whereas just over half of the rainwater samples showed no signs of pollution. In lowland England, evidence of nitrate pollution is often seen in tap water. Water companies ensure tap water is safe for human consumption, but the levels are not always low enough for wildlife to thrive. Rainwater on the other hand has lower levels of nutrients, but may pick up contaminants from e.g. bird fowling in birdbaths. Around three-quarters of the ponds sampled by the students were garden ponds (including school ponds) and of these, more than half were polluted. It is highly likely that some pollution is caused by fish, the presence of which (in small ponds), can raise nutrient levels, via faeces or fish food. High nutrient levels in these waterbodies could also be attributed to filling or topping up with nutrient rich tap water. If cleaned regularly, rainwater butts should always provide nutrient free clean water to top up garden ponds.

It is very difficult to improve the water quality of running waters. As we have seen, rivers and streams drain large areas of land and are exposed to multiple sources of pollution from urban and agricultural areas. Ponds and lakes are also affected by the surrounding land use, but they naturally drain smaller areas of land so are less likely to be affected by pollution problems if they are located in areas of semi-natural or uncultivated land.

Building up the network of standing waterbodies in the landscape, by creating more ponds in clean catchments would therefore provide a solution to increase freshwater biodiversity in The Brecks area, a refuge for a multitude of species away from pollution issues associated with running waters. Clean water is vital for freshwater biodiversity and these potentially unpolluted small freshwater waterbodies could support rich and valuable wildlife communities.

As we have seen, on Thompson Common the majority of the ponds, with pollution issues, were located towards the edge of the reserve adjacent to agricultural land. In this case, best-case scenario

would be to purchase the adjoining arable fields with a view to restoring the land to semi-natural/wetland habitats. By expanding the reserve in this way, the existing, highly important pingos within Thompson would be further protected from nutrient pollution. On the STANTA estate, although already large in size, clean unpolluted habitats could be expanded to the north by changing the land use from arable farmland to low density grazed pasture with more ponds created in the landscape[3].

In the wider agricultural countryside, we have seen that some pockets of clean water do exist. Expanding these areas and again creating more ponds in unproductive areas of farming estates, with good vegetation buffer would help increase freshwater biodiversity across the BFER Scheme area as a whole.

[3] Since collecting these data and drafting this report, it has transpired that a number of NGOs have purchased land adjoining Thompson helping to achieve one of the core principles of the Freshwater Network to build out from and buffer Important Freshwater Areas.

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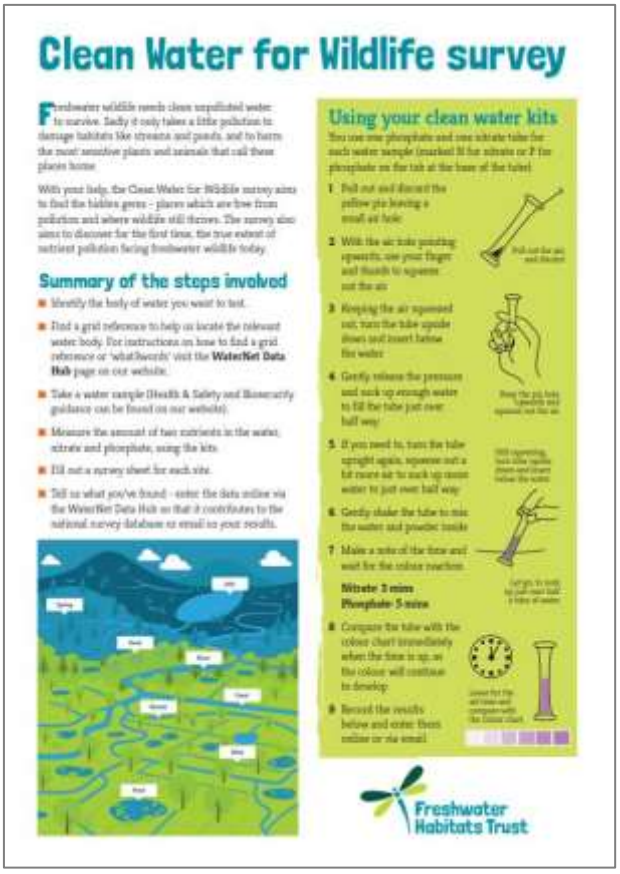
7.0 Appendices

Appendix 1: Clean Water for Wildlife survey form



Clean Water for Wildlife survey

Freshwater wildlife needs clean unpolluted water to survive. Sadly it only takes a little pollution to damage habitats like streams and ponds, and to harm the most sensitive plants and animals that call these places home.

With your help, the Clean Water for Wildlife survey aims to find the hidden gems – places which are free from pollution and where wildlife still thrives. The survey also aims to discover for the first time, the true extent of nutrient pollution facing freshwater wildlife today.

Summary of the steps involved

- Identify the body of water you want to test.
- Find a grid reference to help us locate the relevant water body. For instructions on how to find a grid reference or 'what3words' visit the **WaterNet Data Hub** page on our website.
- Take a water sample (Health & Safety and Biosecurity guidance can be found on our website).
- Measure the amount of two nutrients in the water, nitrate and phosphate, using the kits.
- Fill out a survey sheet for each site.
- Tell us what you've found - enter the data online via the WaterNet Data Hub so that it contributes to the national survey database or email us your results.

Using your clean water kits

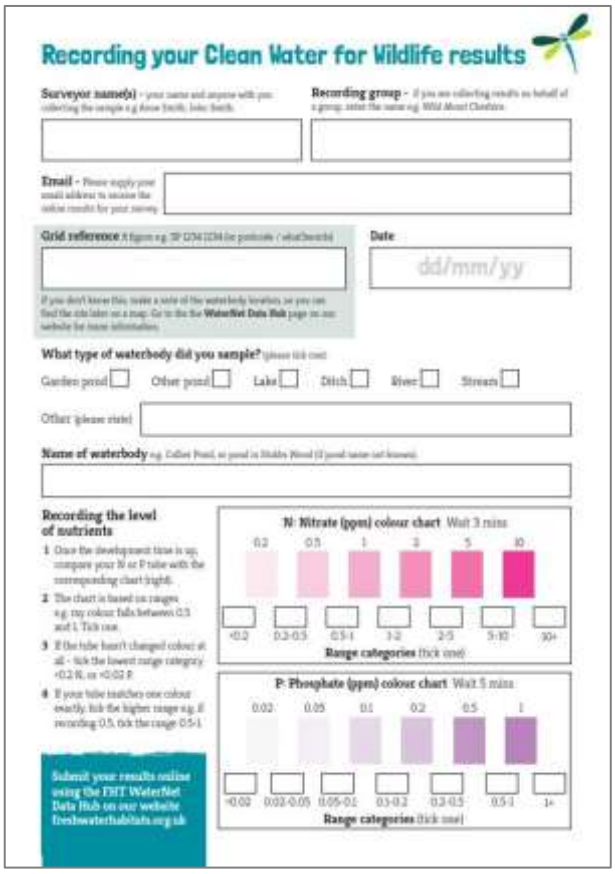
You use one phosphate and one nitrate tube for each water sample (marked N for nitrate or P for phosphate on the tab at the base of the tube).

1. Pull out and discard the yellow pin leaving a small air hole.
2. With the air hole pointing upwards, use your finger and thumb to squeeze out the air.
3. Keeping the air squeezed out, turn the tube upside down and insert below the water.
4. Gently release the pressure and suck up enough water to fill the tube just over half way.
5. If you need to, turn the tube upright again, squeeze out a bit more air to suck up more water to just over half way.
6. Gently shake the tube to mix the water and powder inside.
7. Make a note of the time and wait for the colour reaction.

Nitrate: 3 mins
Phosphate: 5 mins

8. Compare the tube with the colour chart immediately when the time is up, as the colour will continue to develop.
9. Record the results below and enter them online or via email.

Freshwater Habitats Trust



Recording your Clean Water for Wildlife results

Surveyor name(s) - your name and anyone with you collecting the sample e.g. Anne Smith, John Smith.

Recording group - if you are collecting results on behalf of a group, enter the name e.g. Wild About Cheshire.

Email - Please supply your email address to receive the online results for your survey.

Grid reference A figure e.g. SP 1234 1234 for postcode / what3words

Date dd/mm/yy

If you don't know this, make a note of the waterbody location, so you can find the site later on a map. Go to the the **WaterNet Data Hub** page on our website for more information.

What type of waterbody did you sample? (please tick one)

Garden pond ☐ Other pond ☐ Lake ☐ Ditch ☐ River ☐ Stream ☐

Other (please state)

Name of waterbody e.g. Collier Pond, or pond in Hobbs Wood (if pond name not known).

Recording the level of nutrients

1. Once the development time is up, compare your N or P tube with the corresponding chart (right).
2. The chart is based on ranges e.g. my colour falls between 0.5 and 1. Tick one.
3. If the tube hasn't changed colour at all - tick the lowest range category <0.2 N, or <0.02 P.
4. If your tube matches one colour exactly, tick the higher range e.g. if recording 0.5, tick the range 0.5-1.

N: Nitrate (ppm) colour chart Wait 3 mins

0.2 0.5 1 2 5 10

<0.2 | 0.2-0.5 | 0.5-1 | 1-2 | 2-5 | 5-10 | 10+

Range categories (tick one)

P: Phosphate (ppm) colour chart Wait 5 mins

0.02 0.05 0.1 0.2 0.5 1

<0.02 | 0.02-0.05 | 0.05-0.1 | 0.1-0.2 | 0.2-0.5 | 0.5-1 | 1+

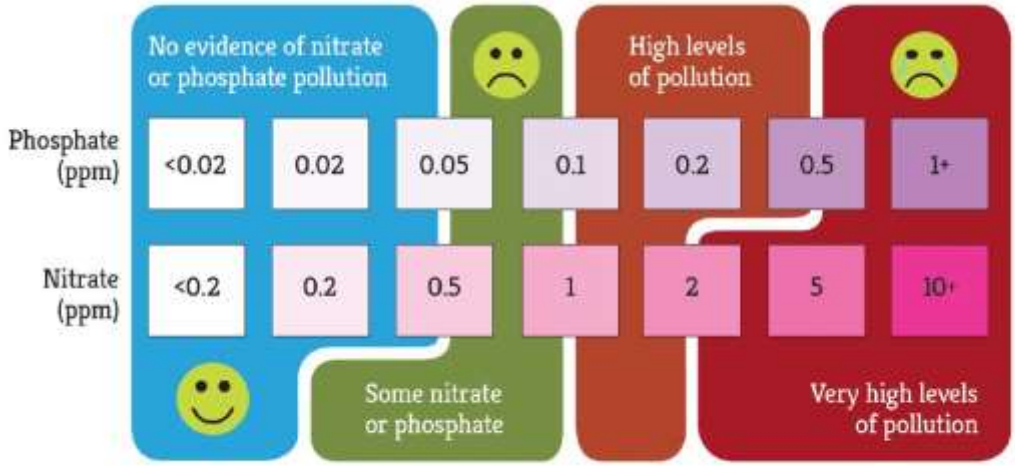
Range categories (tick one)

Submit your results online using the FHT WaterNet Data Hub on our website freshwaterhabitats.org.uk

Appendix 2. What do the results mean?

What do your results mean?

Use the diagram and information on this page to help interpret the results from your kits. Whatever you've found, please tell us about it. Your information is really important to help build a national picture of the levels of nutrient pollution in freshwaters.
See: freshwaterhabitats.org.uk/projects/people-ponds-water



No evidence of nutrient pollution.

Congratulations! You are likely to have found a fantastic clean water habitat.

Water that's not polluted by nutrients will show little or no colour change in either test. This is great news as many animals and plants, especially rare and endangered species, need to live in water that is naturally very low in nutrients.

We really want to find out about these sites as they could be amongst the very few remaining sites, the best of the best undamaged freshwaters in England and Wales.

This information will be valuable for monitoring site condition and making decisions about site management. The next step could be to undertake a biological survey to find out which species are present. Clean water sites often support rich and interesting wildlife communities.

Evidence of some nutrient pollution.

Unfortunately you have found a site where the water is polluted by nutrients at levels that will be damaging to wildlife.

Polluted waters will still have some wildlife – but they won't have the wonderful richness of life, or rare species that live in clean water. At even these moderate levels of nutrient pollution more than half the animals and plants that should be present can be lost.

If this was your garden pond, make sure you're topping it up with rain water, rather than water from the tap (see next page).

If this is a pond in your neighbourhood, find out whether anyone is working with local farmers or the local councils to make the environment as good as it can be. It's very difficult to remove nutrients from polluted habitats, but knowing the limitations can help to guide the way sites are managed.

High or very high levels of nutrient pollution.

Oh dear, this site has high levels of nutrient pollution. Even tougher species sometimes find it hard to make a home in a site like this.

Don't give up! There may be clean unpolluted sites in your neighbourhood waiting to be found. Take another kit and look somewhere else. What about trying a different habitat like a pond or stream? Look at the website to find out if anyone has recorded a clean water site near you – worth a visit if you want to see freshwater habitats thriving with wildlife.

AND FINALLY: Some places with very low nutrient levels, may still be affected by other issues which the kits do not detect. There's more information in our technical guide on the use and reliability of the kits – available on our website.