CLEAN

Catchment Level Environmental Action Network

AFON NYFER RIVER NEVERN

Phase 2 2023

Thriving waterways support flourishing communities, robust businesses and healthy environments.

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Funded by Pembrokeshire Coast National Park Enhancing Pembrokeshire Fund

Contents

Introduction

The water quality and overall ecological health of waterbodies in Wales, and indeed the UK as a whole, has come increasingly to the fore in recent years. Issues include controversy and outrage over water companies spilling raw sewage into rivers; the alarming, and accelerating, decline in biodiversity; and debate about the implementation and future direction of land management, agriculture and food policy, including the future of the government's Sustainable Farming Scheme in Wales due to be available from 2025, and the Water Resources (Control of Agricultural Pollution) (Wales) Regulations, for which the transition period is due to end in August 2024[1].

The CLEAN project (Catchment Level Environmental Action Network) was developed in response to the challenge of restoring and enhancing healthy habitats in and along the Afon Nyfer. A Steering Group of nature conservation and community organisations was created, co-ordinated through the Growing Better Connections project and including representatives from Pembrokeshire Coast National Park, West Wales Rivers Trust, Pembrokeshire Nature Partnership, Newport Area Environment Group and Community Councillors.

By working together, and working at a catchment level to understand habitats, it was hoped to maximise the benefits to both wildlife and communities. The project has been delivered in several phases and is providing opportunities for local volunteers to get involved in a number of different ways.

Thus far the project has essentially been a data gathering exercise, utilising the power of citizen science to gather information on the water quality and other environmental indicators of the rivers and streams of the Afon Nyfer catchment and adjacent land use. Successful programmes of sampling were undertaken in late winter/early spring 2021 (Phase 1) and again in later summer of 2022 (Phase 1b). This provided baseline data and a useful seasonal comparison, in terms of both weather/rainfall and land management. The project also began to focus on the sampling areas with higher pollution levels, with a view to future interventions to limit nitrate and phosphate pollution and target limited resources to greatest effect. This made direct comparisons impossible, but this was deemed a price worth paying given limited opportunities to repeat such an ambitious catchment-wide programme of testing.

It was decided to again work with the Earthwatch FreshWater Watch (FWW) project[2] for the latest phase. The objectives were:

- To see if it were possible to better understand the contribution of sewage treatment works as separate from run-off from land use.
- To provide a longer period of sampling, providing a full 6 months of testing, and also filling the months not included in the previous sampling periods. This would enable an almost full year of data across the three phases, from February to September, with its differing rainfall and land management.
- To take a more systematic approach, based on confluences across the catchment, to enable a more thorough assessment.
- To identify the main areas of nutrient pollution, to focus future interventions.
- To broaden the volunteer base, engaging more volunteers and maintain the momentum generated by previous phases, achieved through public meetings and events.

[1] https://www.gov.wales/sites/default/files/publications/2023-10/water-resources-control-agricultural-pollution-wales-regulations-2021-guidance-farmers-and-land.pdf
[2] https://www.freshwaterwatch.org/

- To give the volunteers more say in shaping and steering the project in response to their skills, interests, and concerns.
- To begin to generate awareness of the impacts of river water quality on the marine environment and coastal tourism.
- To lay foundations for an anticipated phase 3, subject to funding.

Why focus on nutrient levels?

One of the biggest threats to freshwater comes from an excessive inflow of nutrients, in particular nitrate and phosphate and, thus far, this has been the main focus of the CLEAN project.

Occurring naturally in small amounts, nitrate and phosphate are essential for aquatic plant life. However, excessive levels entering watercourses due to human activity can cause excess growth of algae which, in turn causes smothering of stream beds, reduced clarity of the water, reduced oxygen levels, and leading to the loss of aquatic life.[3]

Nitrate and phosphate are two of the more important and widespread pollutants associated with diffuse pollution. Importantly, it is possible to detect these two often indicative pollutants, quickly and cheaply with a simple test kit.

'*Nitrates and phosphates are commonly present in domestic and industrial waste and sewage, as well as in the fertilisers that wash off farmland and into our waterbodies.*

Through understanding which areas are being affected by pollution, we can direct targeted mitigation to improve water quality and protect freshwater environments.'[4]

Introduction to 2023 sampling

This report focuses briefly on the data gathered over the 2023 sampling period, which ran from February to August. More significantly, perhaps, it also draws from the sampling data from the previous sampling periods, in 2021 and 2022, offering a comprehensive picture of nutrient loads in the Afon Nyfer catchment over three years of sampling.

Before that, however, for those who have not yet explored the beautiful Afon Nyfer river valley, this excerpt from the Phase 1 report will provide a little context:

The Afon Nyfer wends its way from its source near Crymych on the slopes of the Preseli Hills in the east, to the estuary at its mouth in Newport/Trefdraeth to the west. From the bare slopes and wide views of Frenni Fawr, 395m above sea level, the Afon Nyfer descends swiftly through the tightly packed fields of Blaenffos, Pontyglasier, and Ffynnon-Groes (Crosswell), then on into the wooded valley that characterises much of its route to the sea.

The Nevern Valley, along with the Gwaun Valley to the south and west, forms part of an extensive lowland wooded valley system, narrow and enclosed, often characterised as intimate. Said to be some of the best examples of semi-natural oak woodland in the region, much of it is ancient woodland (i.e., woodland that has persisted for at least 400 years), often wet, and dominated by alder, sessile oak and willow.

[3] https://www.freshwaterwatch.org/pages/why-fresh-water (accessed 04/11/23)
[4] https://www.freshwaterwatch.org/pages/why-fresh-water (accessed 04/11/23)

The wooded valley sides are interspersed with small agricultural fields, predominantly improved and semi-improved pasturelands on the lower slopes, merging to rough pasture on the higher ground.[5]

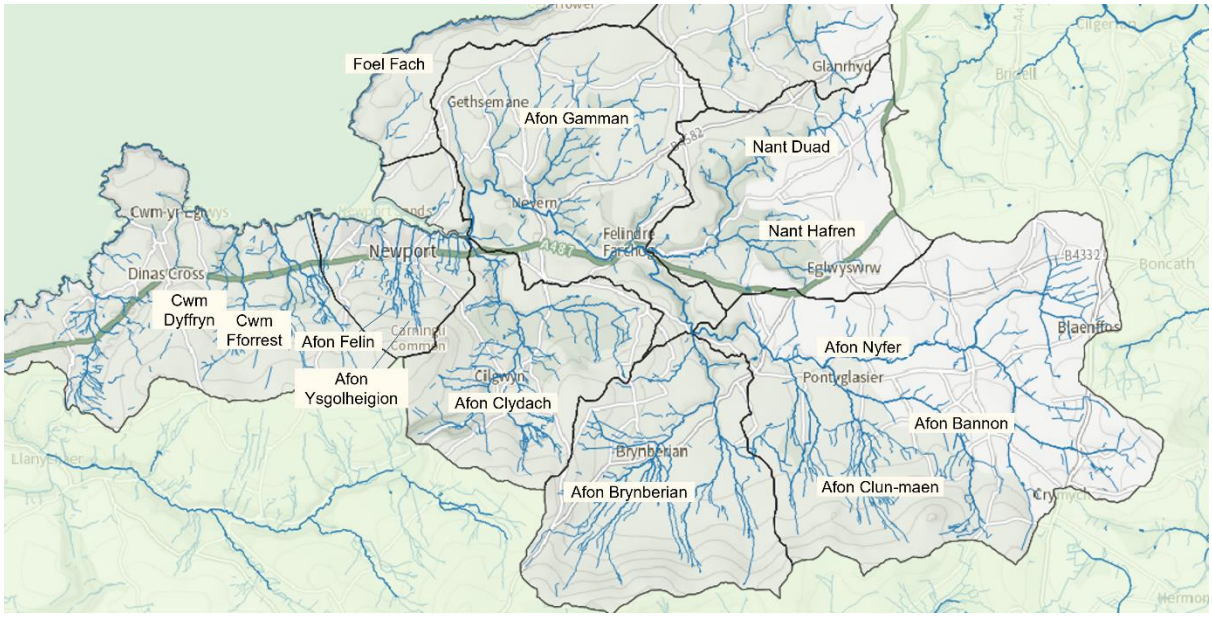


Figure 1: Map of Afon Nyfer catchment, with names of rivers and streams

Despite its largely rural character, large sections of the Nyfer catchment fail to achieve 'Good' ecological status, as required by the Water Framework Directive (WFD – see the first CLEAN report for more detail of the WFD and its assessments[6].) There are multiple reasons for a failure to achieve Good ecological status, but many are directly associated with poor water quality, particularly high levels of pollutants.

Water quality is intimately connected with the condition and management of the surrounding terrestrial habitats. Within the Afon Nyfer catchment the vast majority of land is used for (increasingly intensive) agriculture or forestry or is common land – these being by far the biggest influence on land and land use.

A second major influence on water quality, and one that has been much in the public eye over the last year, are discharges from sewage treatment works, in particular the spills from Combined Storm Overflows (CSOs). It is now accepted that many of these Water Treatment Works spill during dry weather when CSOs should not be operational. There are 8 water company storm sewage overflows that empty into the Nyfer catchment.

Nitrate is easily dissolved and transported in surface water and groundwater. Sources include animal wastes, sewage effluent, fertilisers, and the primary source of nitrate pollution is agriculture and land management practices.

Sources of phosphate include sewage sludge and treated water from sewage treatment works (primarily from food waste, urine and excreta, and detergents) – generally point sources. Diffuse sources include animal waste and slurry, particulate and soluble phosphorus fertilisers and, since phosphorus freely attaches to soil particles, in eroded soils via field run-off:

[5] *Pembrokeshire Coast National Park LCA 26 - Cwm Gwaun/Afon Nyfer*, PCNP 2011
[6] https://www.cwmarian.org.uk/_files/ugd/2e19a6_eb31a6d4557c48cea03f6afb0067a8d8.pdf

"Activities which disturb soil can also contribute to losses of phosphate via erosion and surface water runoff. P(hosphate) is also lost by direct deposition or runoff of dung, fertiliser or farm dairy effluent to waterways."[7]

Clearly, both point-source nutrient pollution from CSOs and diffuse pollution from field run-off are likely to be greater during wet weather.

When found in excessive quantities nitrate and phosphate profoundly change the freshwater environment.

According to NRW research[8], within the Teifi, Cleddau and Pembrokeshire Rivers catchment, the biggest point source of pollution affecting water quality is discharges from sewage treatment works and the biggest source of diffuse pollution is agricultural land management.

The first CLEAN report identified significant levels of nitrate and phosphate in many of the rivers and streams of the Afon Nyfer catchment. For this reason, subsequent rounds of sampling continued to focus on nitrate and phosphate levels across the Nyfer catchment.

Sampling points were identified with these factors in mind, using data from the previous rounds of sampling to identify areas meriting further investigation.

A brief recap of the Phase 1 sampling survey

Excerpt from the Conclusion of the first CLEAN Report:

Although stretches of the Afon Nyfer are reported as being in good health, large parts are ecologically degraded and under pressure, as established by the WFD assessments. More precise understanding of the reasons why parts of the Nyfer catchment failed to achieve Good status is crucial if the waters are to be improved.

Tellingly, the sub-catchments that are reported as failing to achieve 'Good' status, according to WFD assessments are those that show the highest levels of nitrate pollution – in the Headwaters to the Brynberian and the Nant Duad, 76.9% and 95.2% of samples taken indicate High or Very High nitrate pollution respectively. In the 'Nyfer, from the Nant Duad to the Tidal Limit' sub-catchment, 88.2% of samples taken record a High or Very High level of nitrate pollution.

One likely source of the water pollution is the sewage discharges from Dŵr Cymru and other private sewage discharge points throughout the catchment. Figures from Dŵr Cymru show that storm sewers and Combined Sewer Overflows and been activated and spilled untreated sewage into the waters of the Nyfer catchment on 283 occasions in 2020. It seems clear that work is required to reduce the impact of these spillages.

There also seems little doubt, given evidence of an increase in intensification of dairy farming[9], an increase in the dairy cattle numbers and a likely increase in slurry production and use, that agriculture and land use practices are a significant source of much of the pollution found. There are numerous reports and studies that highlight agriculture as a major source of diffuse pollution.'

[7] https://www.dairynz.co.nz/environment/reducing-footprint/reduce-p-loss/ (accessed 6/11/23)
[8] *Cleddau and Pembrokeshire Coastal Rivers Management Catchment Summary Updated*, 2016, NRW
[9] https://cdn.cyfoethnaturiol.cymru/media/685890/interim-report-from-wlmf-subgroup-on-agricultural-pollution-final.pdf

Methodology

As in the 2022 round of sampling, the Earthwatch FreshWater Watch protocols were used, which include testing for levels of nitrate and phosphate as well as making observations regarding weather conditions, surrounding land use, bank vegetation, potential pollution sources in the immediate vicinity, water colour, as well as observations of any wildlife seen. In addition, the presence of Invasive Non-Native Species was requested. The opportunity to gather in-situ and 'in the moment' observations of the water bodies samples is well understood to be a significant advantage of citizen science research.

In order to provide a comparison with previous sampling periods in 2021 and 2022, the same Koritsu PackTests as in previous sampling periods were used to measure levels of nitrate and phosphate. These simple and easy to use testing kits have been established as providing an adequate measure of nitrate and phosphate levels and, if anything, they underestimate the pollution levels present. During the SWEPT programme of sampling on the Cleddau River in 2020 it was found that the kits tended to underestimate the level of pollution when compared to NRW laboratory sample results:

"*This means that it is highly unlikely that a PackTest result will give a false positive (i.e. show that a clean freshwater source is polluted when it is not) but it is also very likely to underestimate the extent of any pollution that* is *present.*"

Analysis by The Freshwater Habitats Trust during their Clean Water programme also found that the kits were unlikely to overestimate the levels of nitrate or phosphate in a sample.

A very important caveat must be noted regarding the results when comparing year on year. In order to focus and pinpoint potential problem sites, each round of sampling has generally chosen sampling sites that registered higher levels of nitrate and phosphate in the previous round.

While not an ideal methodology, with limited resources, both in terms of volunteers and testing kits, it was judged the most effective way of guiding future resources and interventions to achieve the biggest impact.

Do bear that in mind, when considering the results.

One further piece of data was included in the 2023 sampling, turbidity. Turbidity is a measure of the cloudiness of the water, an indication of solids suspended in the water column. Sources of these suspended solids include algae, soil particles and sediments from agricultural run-off or construction sites, slurry, sewage effluent discharges, septic tank discharges and industrial discharges. The colour of the water is often an indication of the reason for high turbidity.

The CLEAN volunteers were provided with a turbidity tube, a clear plastic tube with a disk with alternating black and white quadrants (a Secchi disk) at the bottom.

A sample of water is poured slowly into the tube until, when looking directly down the tube from above, the quartered disk can no longer be seen. A reading is then taken, corresponding to the depth of the water in the tube at this point, measured in Nephelometric Turbidity Units (NTUs).

In simple terms, turbidity is a result of the scattering of light entering the water column. High turbidity means less light penetrating the water column, affecting photosynthesis rates of water

plants. Suspended solids also absorb more heat from sunlight, increasing water temperatures and thus reducing dissolved oxygen levels in the water, having negative effects on aquatic life.[10]

Results of nitrate and phosphate sampling

The PackTest kits, WAK-PO4(D) and WAK-N03 respectively, 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}. The tests are based on colourimetry and judged by eye against a colour chart. The phosphate test takes 5 minutes and the nitrate test, 3 minutes.

Water samples were judged to have no evidence of pollution, or some, high or very high levels of pollution (see Figure, below). The CLEAN project based its results on the categories used by the Freshwater Habitats Trust during their Clean Water for Wildlife project (below).[11]

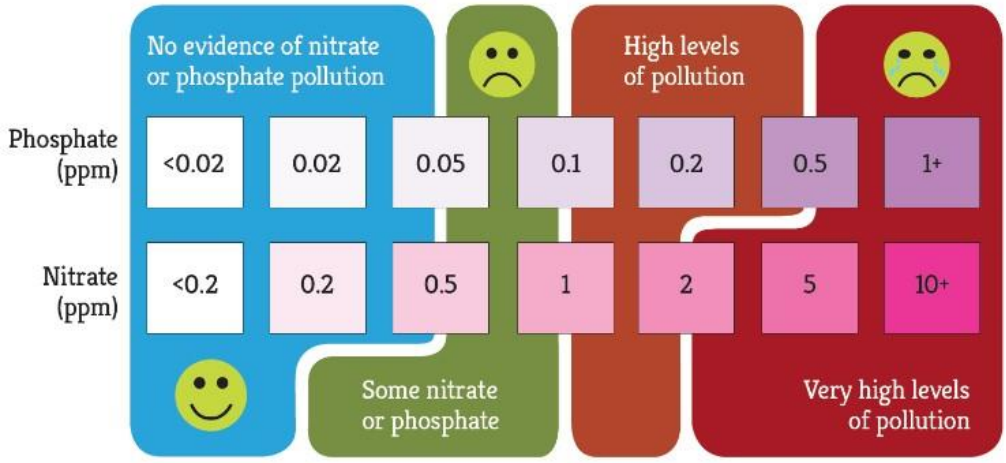


Figure 2: Thresholds for nitrate and phosphate pollution, (as used by the Freshwater Habitats Trust Clean Water for Wildlife project)

2022. This testing found some level of nitrate pollution in a large proportion of sampling sites, and high or very high levels in approximately half of sampling sites. Phosphate pollution was less prevalent, although still significant in a few sampling sites. A summary from the first report states:

In 2021 82 sample sites were surveyed, and 298 nutrient tests undertaken. Despite some reservations due to the relatively small sample of data across such a large area, and the short sampling period, it became clear that nutrient pollution in the Nyfer catchment was an issue.

The tests showed considerable levels of nitrate pollution – 114 of 195 samples (58.5%) showed High or Very High levels of nitrate pollution, with a further 27 (13.8%) showing some nitrate pollution. Less than a third, 54 (27.7%) showed no evidence of nitrate pollution.

Although phosphate pollution was less of an issue, still 22.3% showed High or Very High levels of pollution, with a further 17.5% showing some level of pollution. Notably, the higher levels were found only in the first sampling period, soon after rainfall and when water levels were highest.

[10] https://cdn.cyfoethnaturiol.cymru/media/694218/information-note-turbidity.pdf (accessed 4/11/23)
[11] https://freshwaterhabitats.b-cdn.net/app/uploads/2023/06/What-do-your-results-mean.pdf

The second phase of sampling was designed to note any difference between the late winter streams of 2021 with a late summer in 2022, enhanced by a particularly dry summer that year. The second report, late 2022 noted that:

'211 data records were submitted, 12 of which recorded no water to sample, an indication of the dry summer extremes. 199 samples were tested for nitrate and phosphate over 3 sampling periods between 4th August and 9th September (although a handful were taken a little after this date.)

Initial analysis of the data showed that, overall, nitrate and phosphate levels in the late summer season were significantly lower than in later winter/early Spring (see Figure 3, below). This was despite the fact that the sampling sites were selected, in part, because they recorded higher levels of nitrate in 2021.' This was part of ongoing effort focus on areas with higher nutrient levels to improve understanding of the sources of pollution, and to make any future interventions most meaningful.

A comparison of results from the first two sampling periods can be seen below. Note the significantly fewer samples with High or Very High nitrate levels in the late summer records, likely due to a reduction in run-off and the infrequent action of Combined Sewer Overflows (CSOs).

Nitrate

	Late February - early April '21 Total Samples 187			August - early September '22 Total Samples 199			
mg/l	**n**	**%**	Proportion of Low, High and Very High	**n**	**%**	Proportion of Low, High and Very High	
<0.2	27	14.4	**28.3**	20	10.1	**35.2**	**Low**
0.2-0.5	26	13.9		50	25.1		
0.5-1	22	11.8	**11.8**	48	24.1	**24.1**	**Some**
1.0-2.0	26	13.9	**13.9**	59	29.6	**29.6**	**High**
2.0-5.0	39	20.9	**46.0**	18	9.0	**11.1**	**Very High**
5.0-10.0	37	19.8		4	2.0		
10+	10	5.3		0	0.0		
	187	**100**		**199**	**100**		

2023 Results

In the 2023 sampling period 205 samples with accompanying observations were taken at 53 sample points, roughly once a month from late February to late August/early September (included here in the August results.)

Phosphate

	Late February - early April '21 Total Samples 32			August - early September '22 Total Samples 198			
mg/l	**n**	**%**	Proportion of Low, High and Very High	**n**	**%**	Proportion of Low, High and Very High	
<0.02	5	15.6	**40.6**	54	27.2	**64.1**	**Low**
0.02-0.05	8	25.0		73	36.9		
0.05-0.1	10	31.3	**31.3**	30	15.2	**15.2**	**Some**
0.1-0.2	6	18.75	**25.0**	19	9.6	**17.2**	**High**
0.2-0.5	2	6.25		15	7.6		
0.5-1	1	3.1	**3.1**	5	2.5	**3.5**	**Very High**
1+	0	0.0		2	1.0		
	32	**100**		**198**	**100**		

Initially the intention was to collect samples within the first week of the month but ultimately the samples recorded were spread across the month so any direct comparison with month and weather conditions and rainfall is difficult.

The long commitment required by volunteers to take samples over six months was always a big ask and it must be noted that sampling was more sporadic than previous sampling periods. However, more than enough results were recorded to provide an invaluable record of nitrate and phosphate levels over 2023 and a useful addition to previous sampling periods.

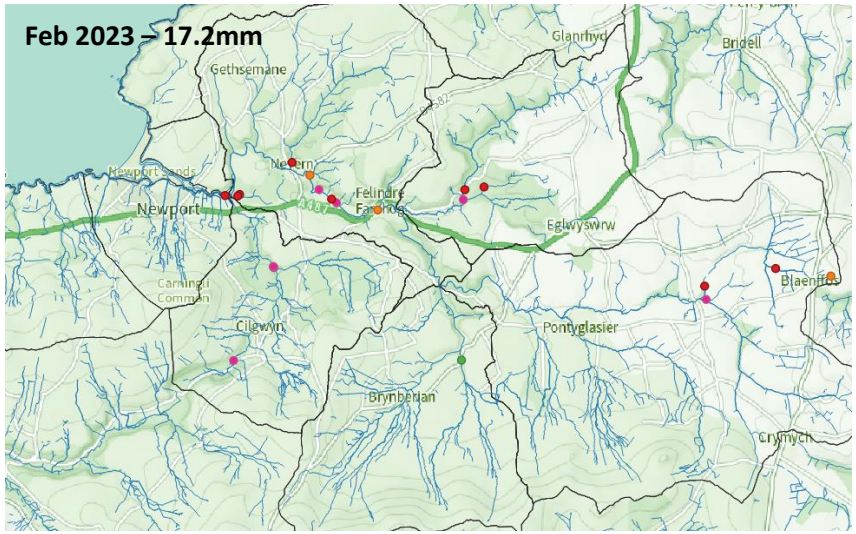
Below, the month-by-month results are mapped. As in previous periods, the worst affected areas, in terms of nutrient pollution, are the streams entering the Afon Nyfer from the north, the Nant Duad and its tributaries, and various streams and tributaries that slowly combine in the upper reaches of the catchment from the source to the confluence with the Brynberian.

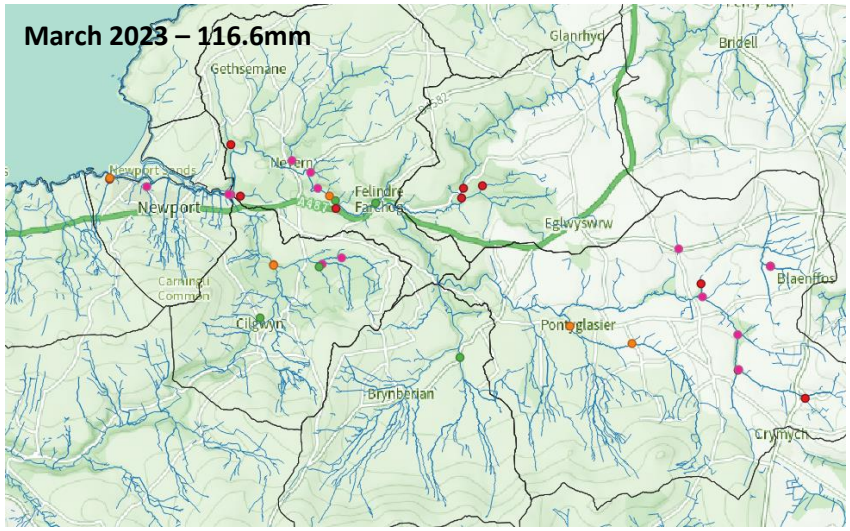
It is notable that the nutrient pollution begins to affect the waters of the Afon Nyfer right from the very start of its journey to the sea. As the waters descend to Newport Bay there are occasions where the cleaner waters of some of its tributaries, the Clyn Maen, the Brynberian and, to a lesser extent, the Clydach, appear to dilute the nutrient-loaded waters but, in the main much of the land of the Afon Nyfer catchment contributes to high nutrient levels, particularly nitrate.

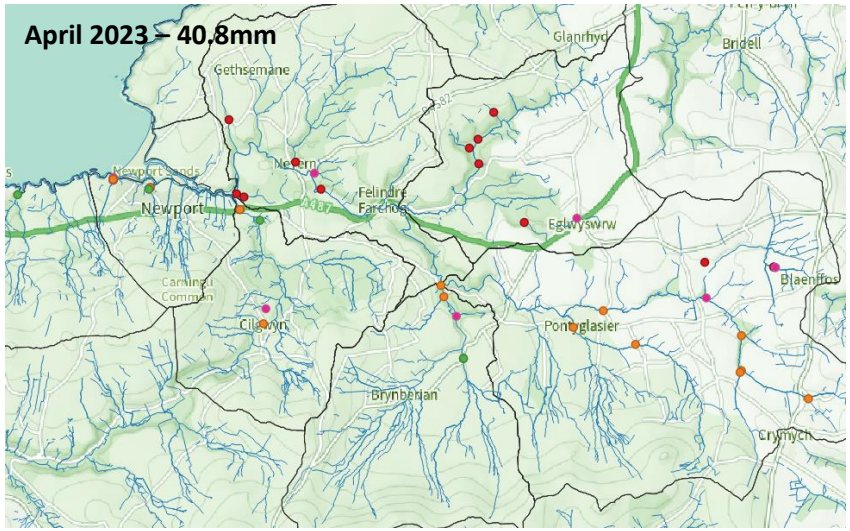
Assessment of the monthly results is difficult given the variables of sample date, weather and the inability of this study to distinguish point source nutrient pollution from Water Treatment Works and diffuse nutrient pollution from agricultural run-off. However, as observed in previous sampling periods, high to very high levels of nitrate are found throughout the catchment and throughout the year. Phosphate pollution is more ambiguous – although less prevalent than nitrate pollution, there are a few sites that show more consistently high levels, particularly near Water Treatment Works at Blaenffos, Crymych and Eglwyswrw.

Valuable though the 2023 data are, adding the 2023 data to that collected in 2021 and 2022 gives a much fuller and more valuable picture of nutrient pollution in the catchment – see next section.

Nitrate by month, 2023, with rainfall (Met Office Aberporth)

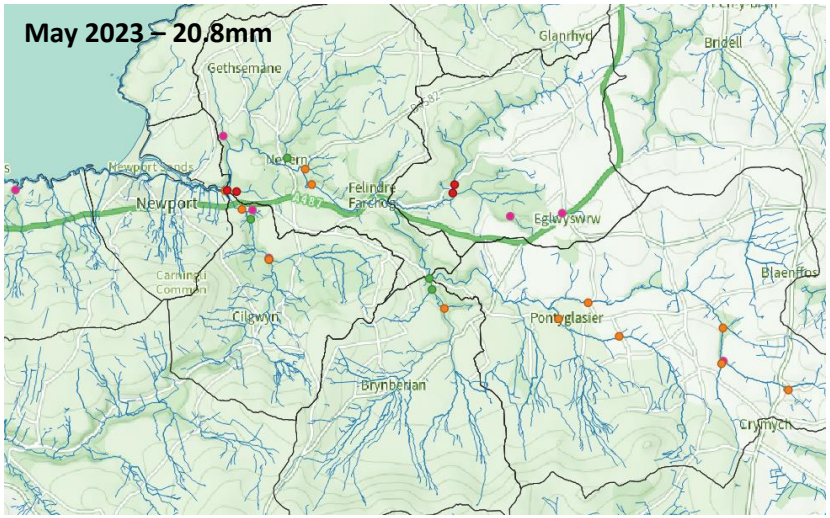


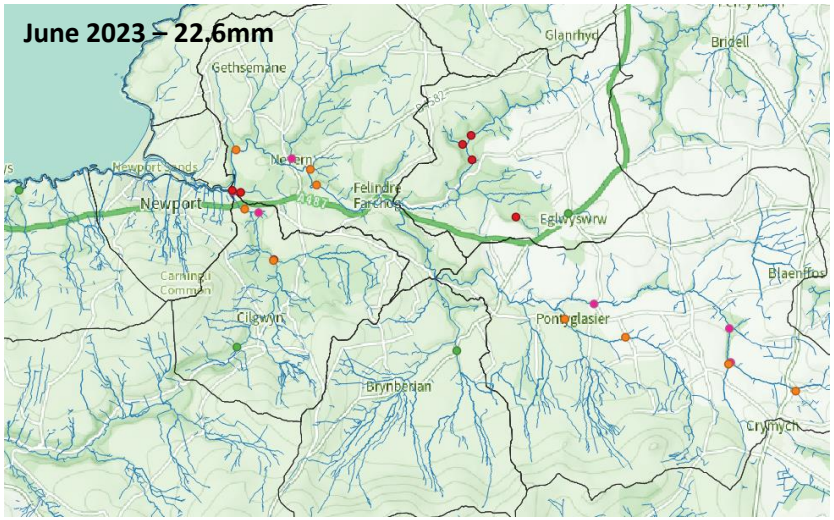




Nitrate by month, 2023, with rainfall (Met Office Aberporth)

●	<0.2	No pollution
●	0.2-0.5	No pollution
●	0.5-1.0	Some pollution
●	1.0-2.0	High pollution
●	2.0-5.0	Very high pollution
●	5.0-10.0	Very high pollution
●	>10.0	Very high pollution


May 2023 – 20.8mm
Glanrhyd
Bridell
Gethsemane
Newport Sands
Nevern
Felindre Farchog
Newport
A487
Eglwyswrw
Carningli Common
Blaenffos
Cilgwyn
Pontyglasier
Brynberian
Crymych


June 2023 – 22.6mm
Glanrhyd
Bridell
Gethsemane
Newport Sands
Nevern
Felindre Farchog
Newport
A487
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Blaenffos
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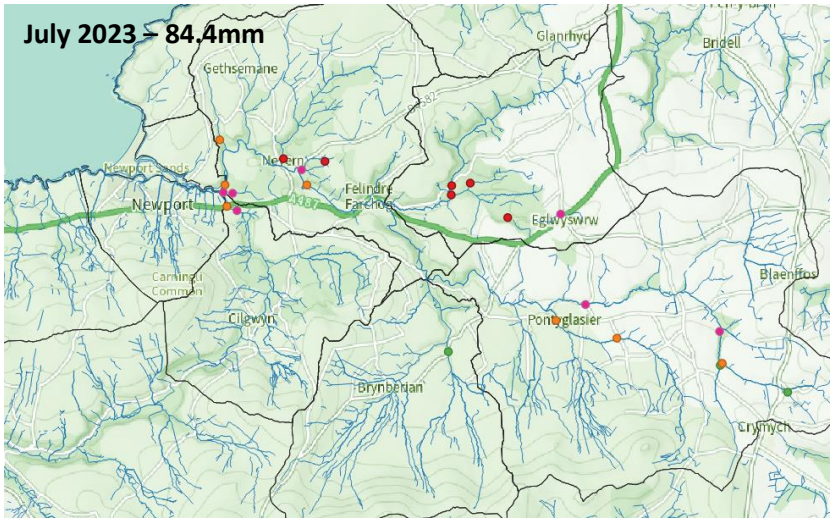
July 2023 – 84.4mm
Glanrhyd
Bridell
Gethsemane
Newport Sands
Nevern
Felindre Farchog
Newport
A487
Eglwyswrw
Carningli Common
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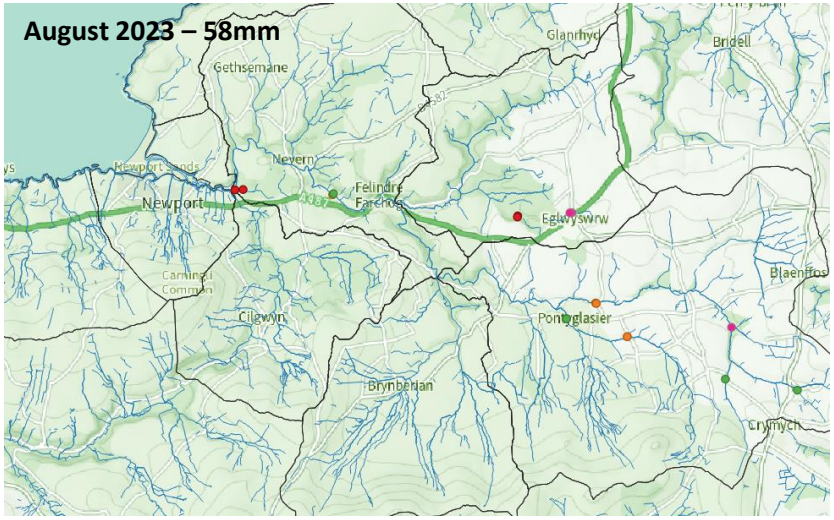
August 2023 – 58mm
Glanrhyd
Bridell
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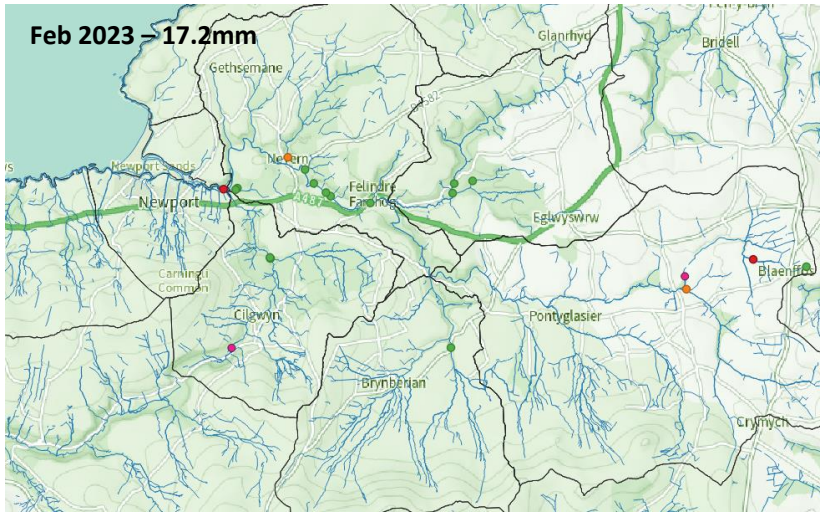
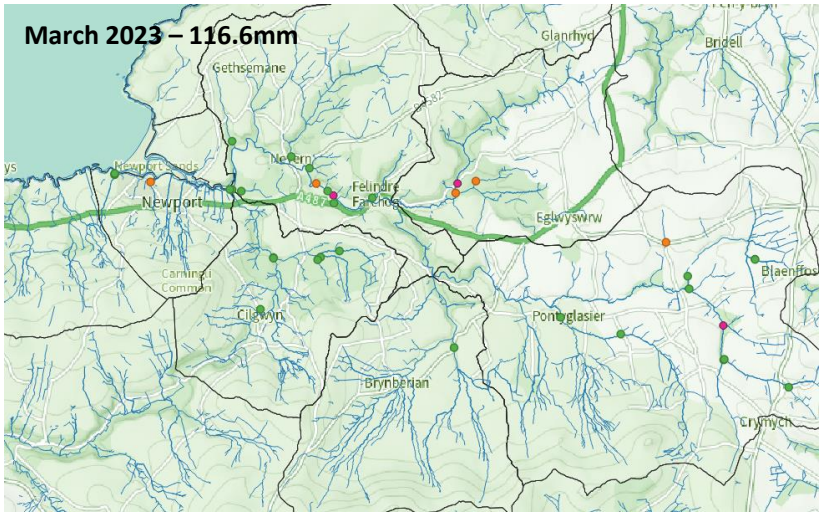
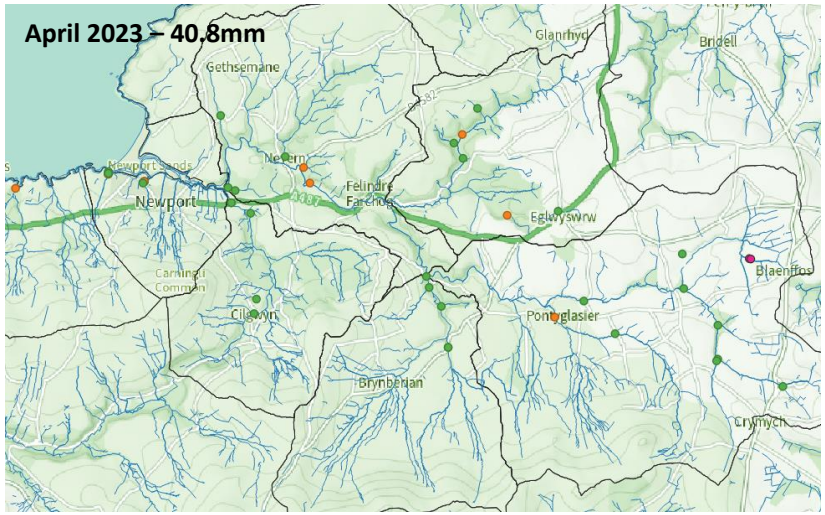
Phosphate by month, 2023, with rainfall for that month (Met Office Aberporth)







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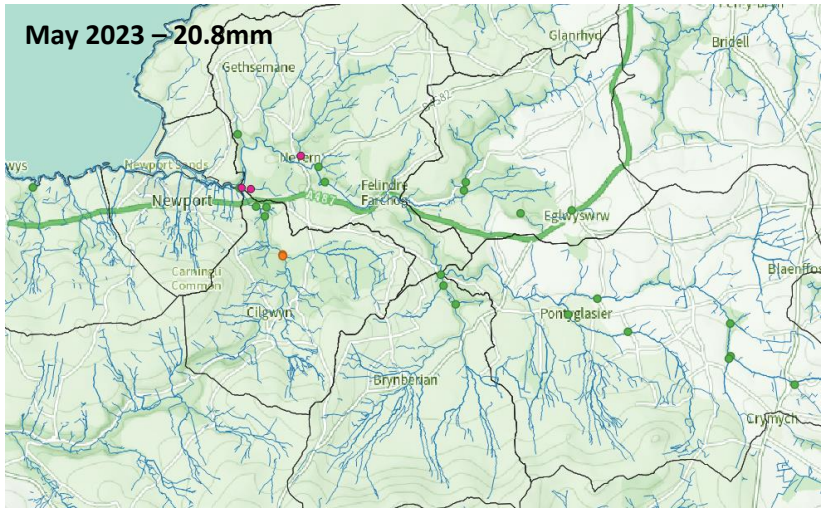
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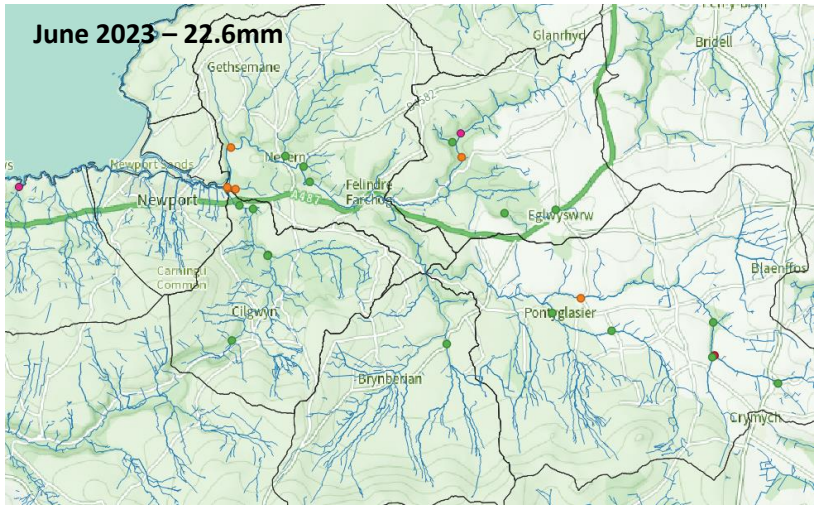
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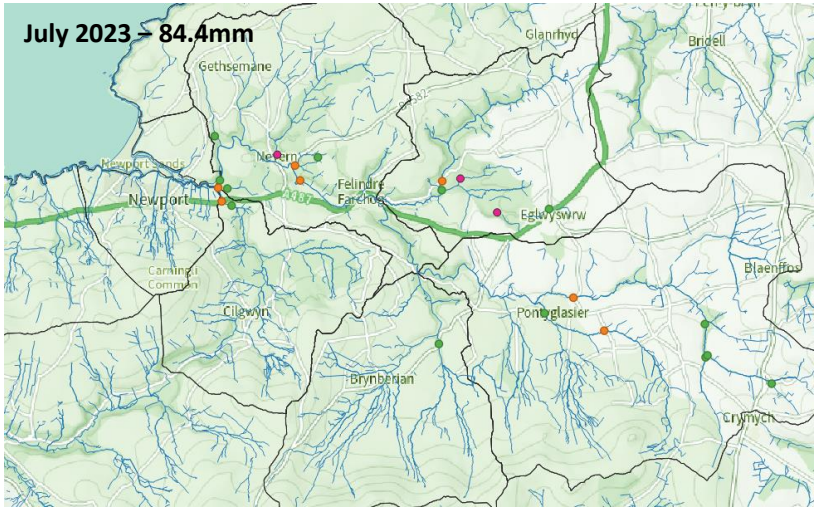
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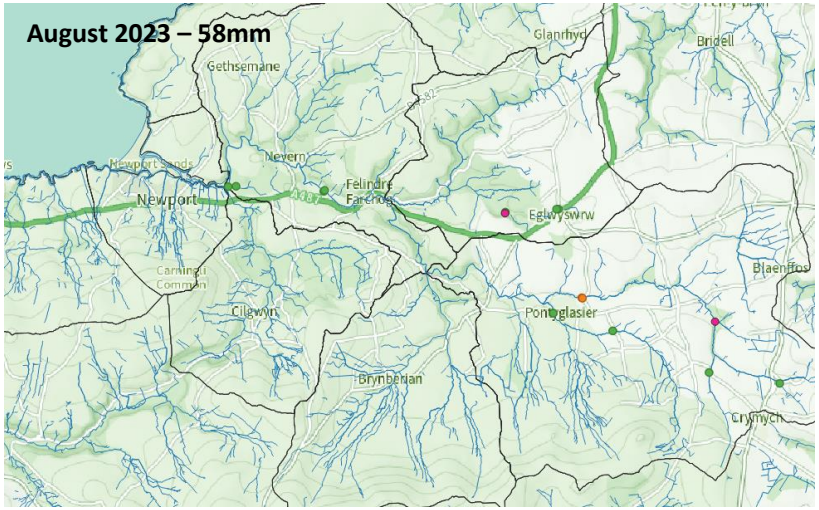
Cilgwyn
Pontyglasier
Brynberian
Crymych


August 2023 – 58mm
Glanrhyd
Bridell
Gethsemane
Nevern
Newport Sands
Felindre Farchog
Newport
Eglwyswrw
Carningli Common
Blaenffos
Cilgwyn
Pontyglasier
Brynberian
Crymych

Combining all samples and sampling sites, 2021-23

If we include the data from all three sampling periods, 2021 to 2023, the CLEAN volunteers have collected 634 samples and observations at 130 sampling sites (this includes where samples have been taken from the main channel and from an incoming stream.)

A detailed assessment of the many separate sample results over a three-year period is no easy task and beyond the scope of this summary report. However, in order to provide a picture three sampling periods and 600+ samples across the whole Nyer catchment, two methods were adopted: first, the median of the results from each and every sampling point was calculated; secondly, for sites where 3 or more samples have been taken, the percentage of samples indicating High or Very High nutrient pollution was calculated (i.e. above 1.0mg/l nitrate, 0.1mg/l phosphate.)

The results across the sampling periods have been broadly consistent over the 3 years of sampling, and also, to some extent, with the categorisation of the last WFD assessments in 2013 and 2015.

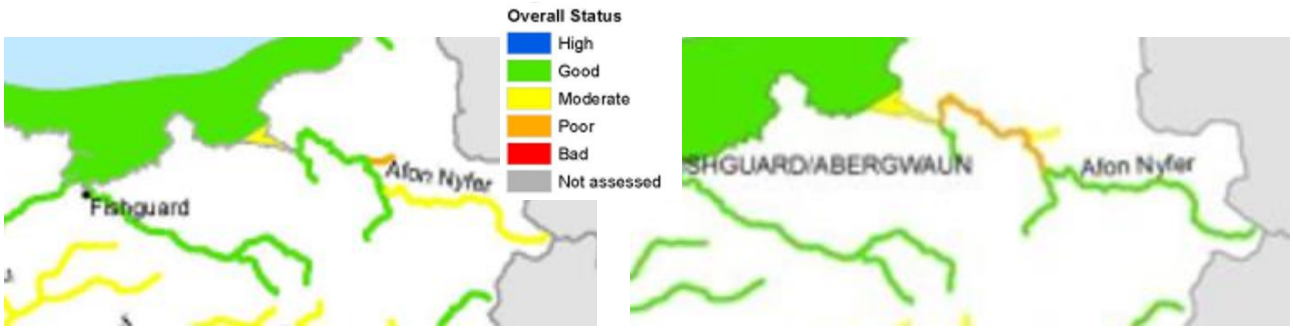


Figure 4: Water Framework Directive assessments, 2013 and 2015

The WFD assessments do report moderate/poor ecological status on the Nant Duad and main Afon Nyfer from source to tidal limit as well as the estuary, somewhat contradictory though they are– see Figure 4, above.

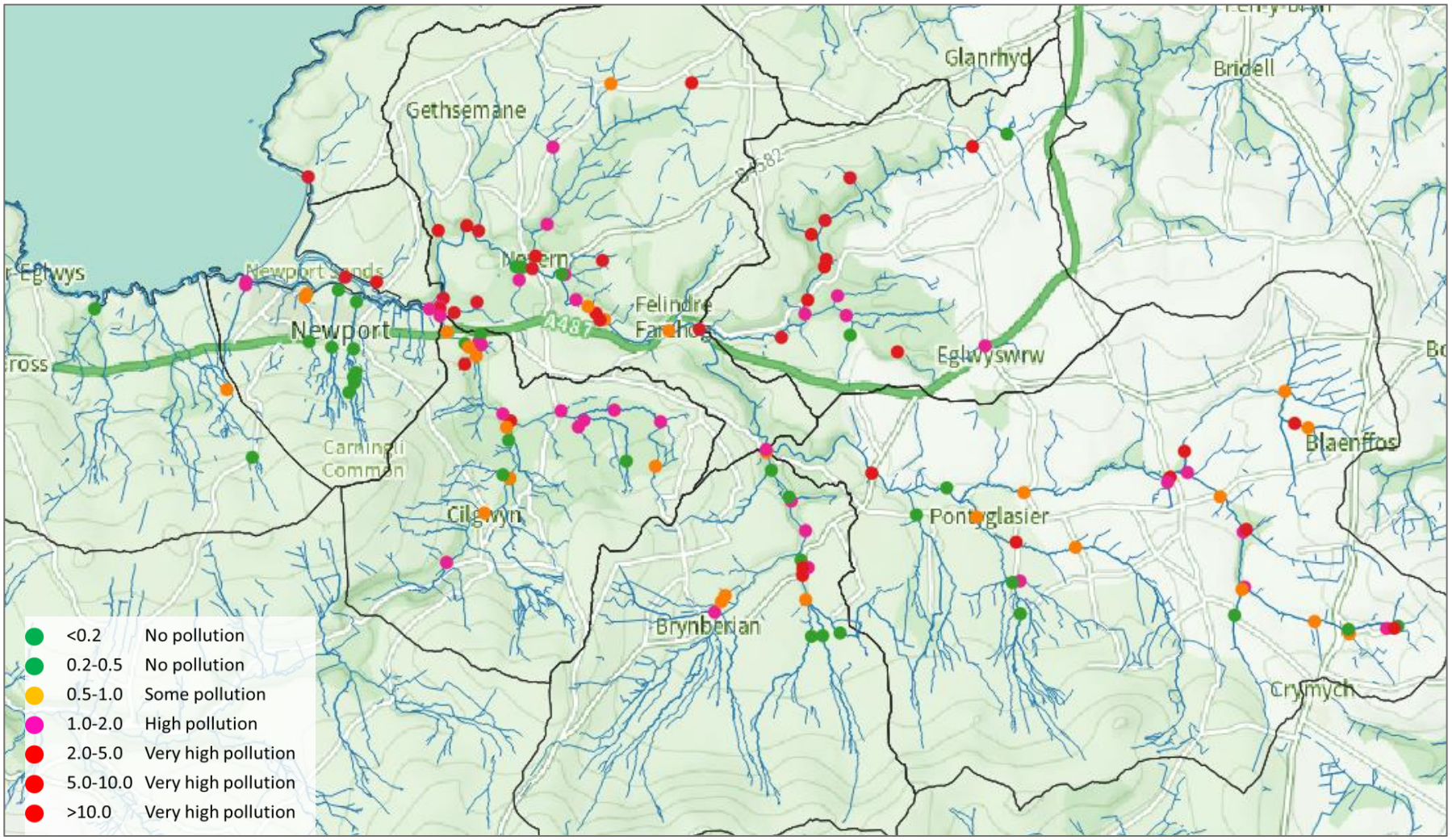
Maps of the CLEAN nitrate and phosphate sampling results follow –a 'traffic light' system has been used*:

- ***Green*** for low median levels (i.e. less than 0.5mg/l nitrate, less than 0.05mg/l phosphate) or no samples recorded with High or Very High pollution levels,
- ***Yellow and amber*** for some pollution (i.e. 0.5-1mg/l nitrate, 0.05-0.1mg/l phosphate) or <50% samples recorded with High or Very High pollution levels
- ***Pink*** for High median levels (i.e 1-2mg/l nitrate, 0.1-0.5mg/l phosphate) or 50-75% samples recorded with High or Very High pollution levels,
- ***Red*** for Very High median levels (i.e. >2.0mg/l nitrate, >0.5mg/l phosphate) or 75-100% samples recorded with High or Very High pollution levels.)

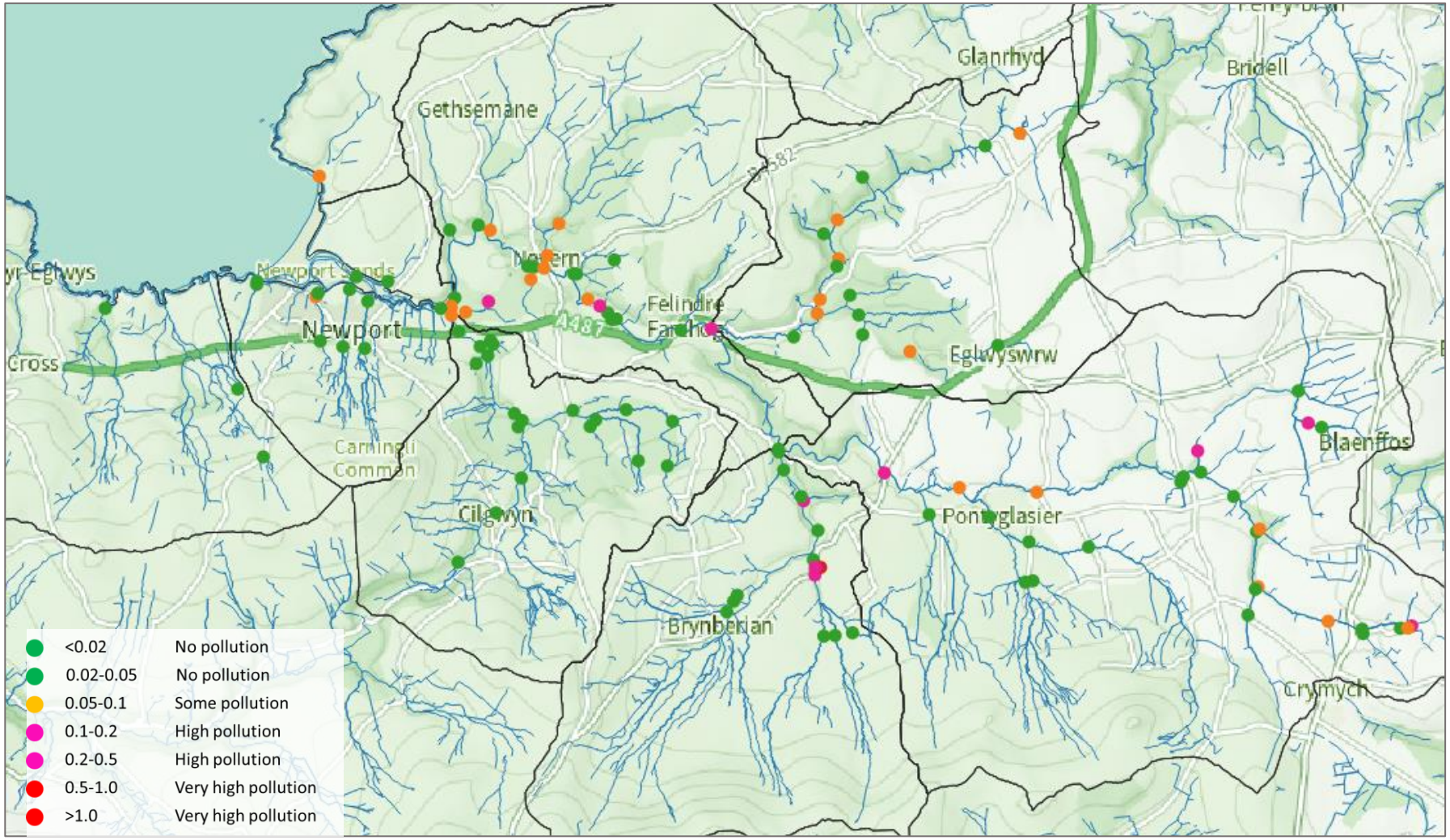
*based on the Freshwater Habitats Trust methodology indicating Low to Very High pollution levels (see Figure 2 above).

The Maps

Map 1: Median nitrate levels – Whole catchment, all sites

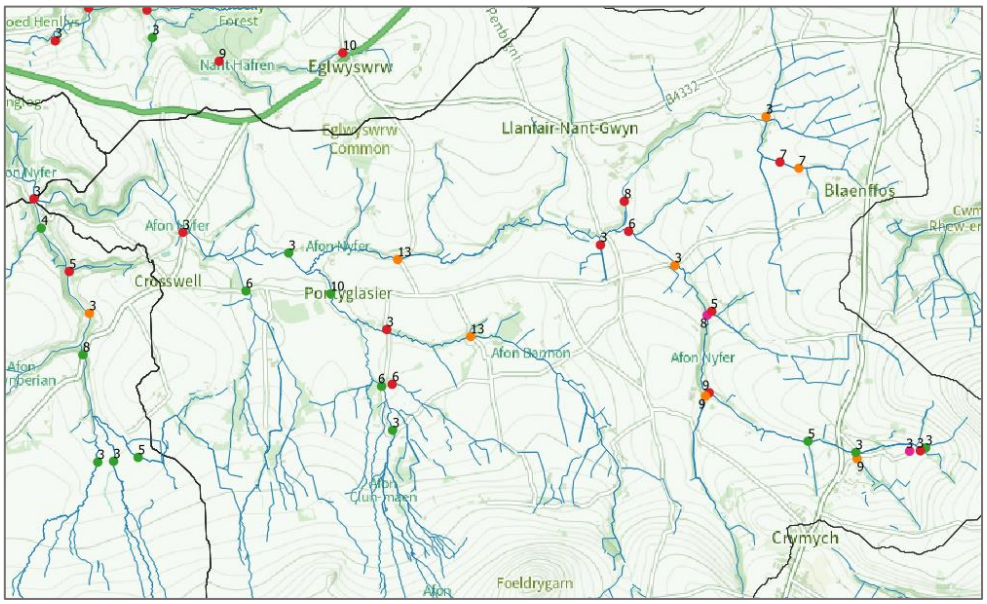


Map 2: Median phosphate levels – Whole catchment, all sites

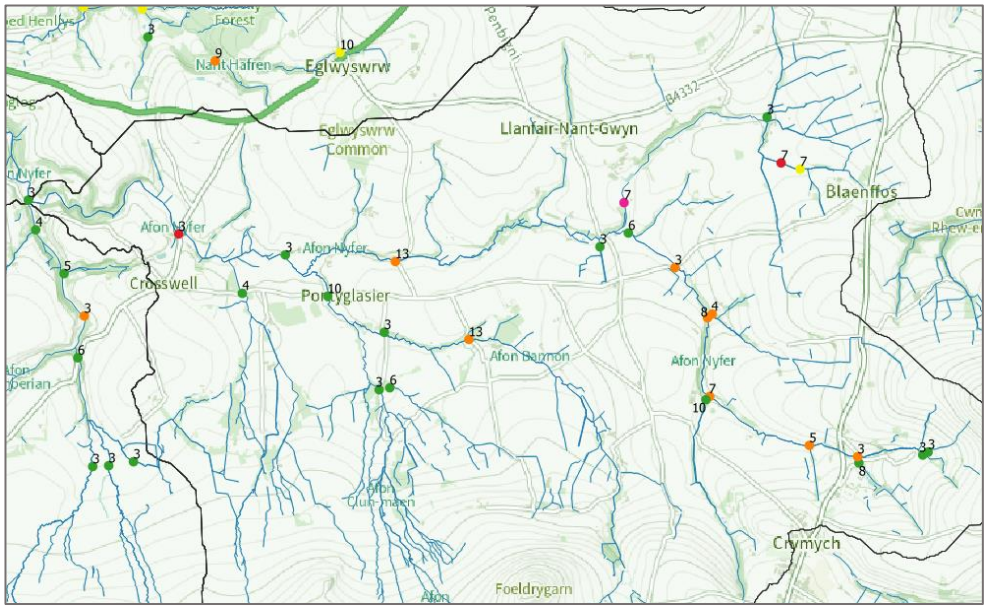


Map 3: Upper catchment from source to confluence with Afon Brynberian

Percentage of samples recording high pollution levels – i.e. ≥ 1.0mg/l nitrate or ≥ 0.1mg/l phosphate.



(Nitrate *(top*) and Phosphate (*bottom)* - Labels indicate the number of samples taken.)

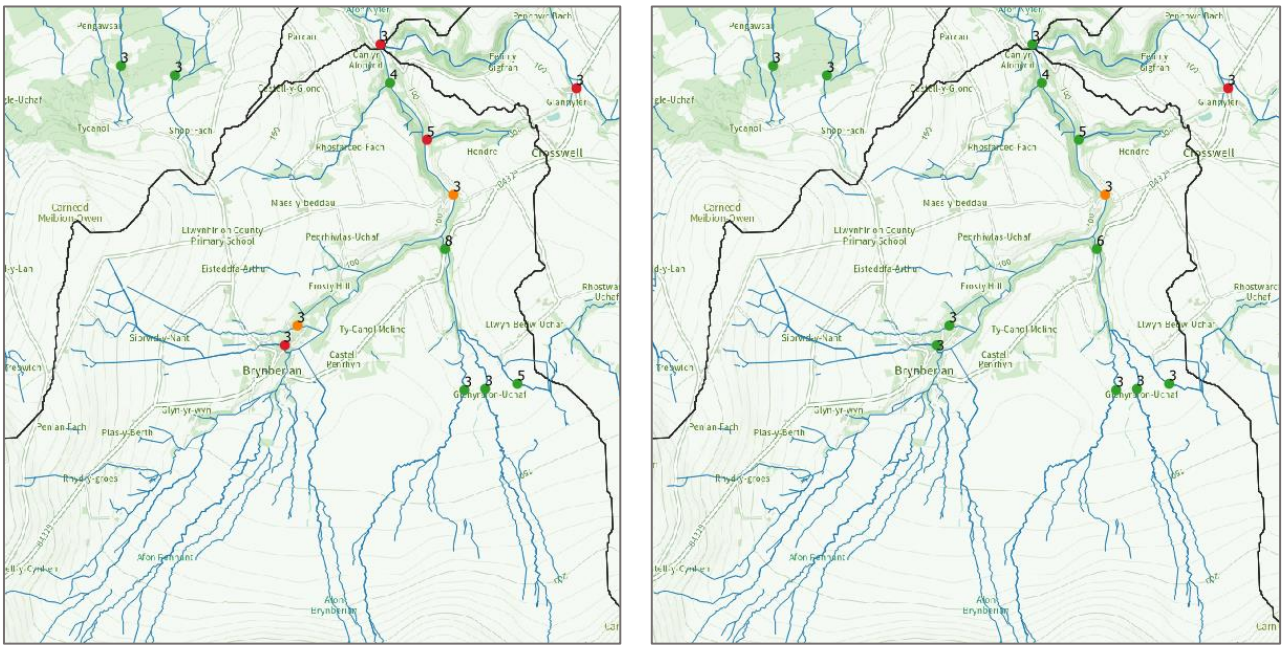


- 0%
- Less than 25%
- 25-50%
- 51-75%
- More than 75%

Map 4: Afon Brynberian

Percentage of samples recording high pollution levels – i.e. ≥ 1.0mg/l Nitrate or ≥ 0.1mg/l phosphate.

(Nitrate *(left*) and Phosphate (*right)* - Labels indicate the number of samples taken.)



Map 5: Nant Duad

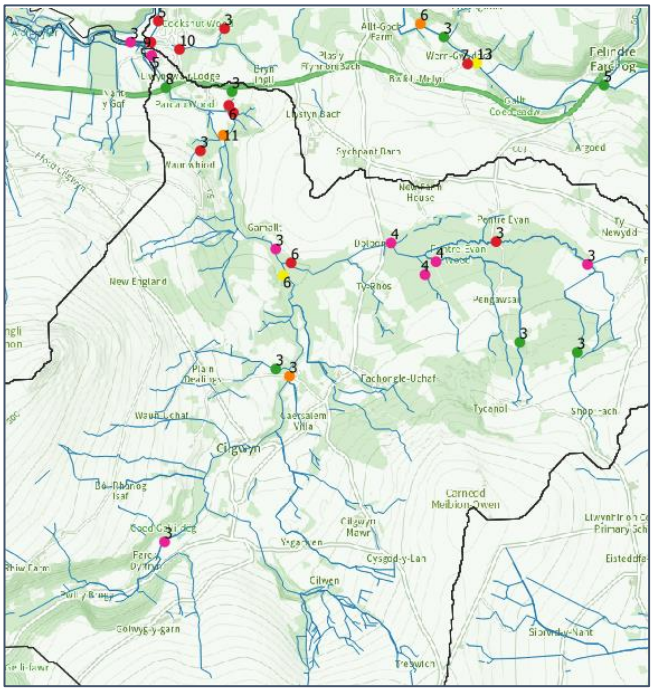
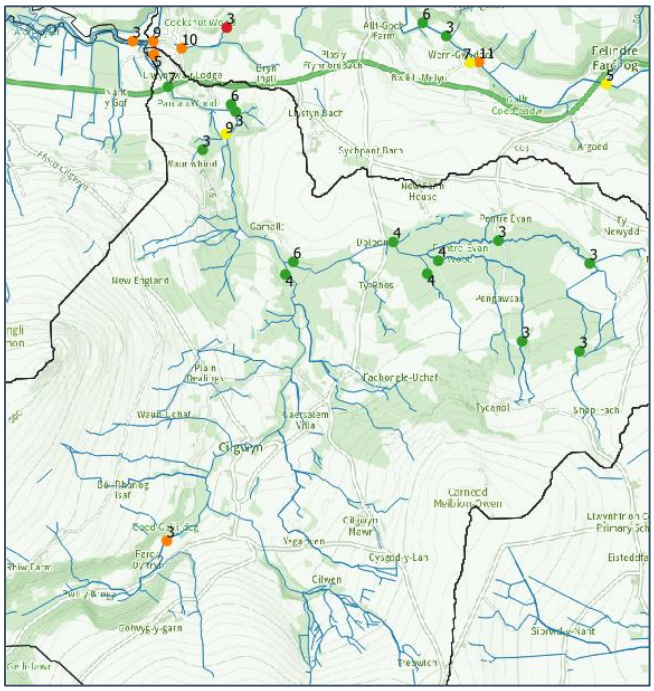
Percentage of samples recording high pollution levels – i.e. ≥ 1.0mg/l nitrate or ≥ 0.1mg/l phosphate.

(Nitrate *(left*) and Phosphate (*right)* - Labels indicate the number of samples taken.)

Map 6: Afon Clydach

Percentage of samples recording high pollution levels – i.e. ≥ 1.0mg/l nitrate or ≥ 0.1mg/l phosphate.

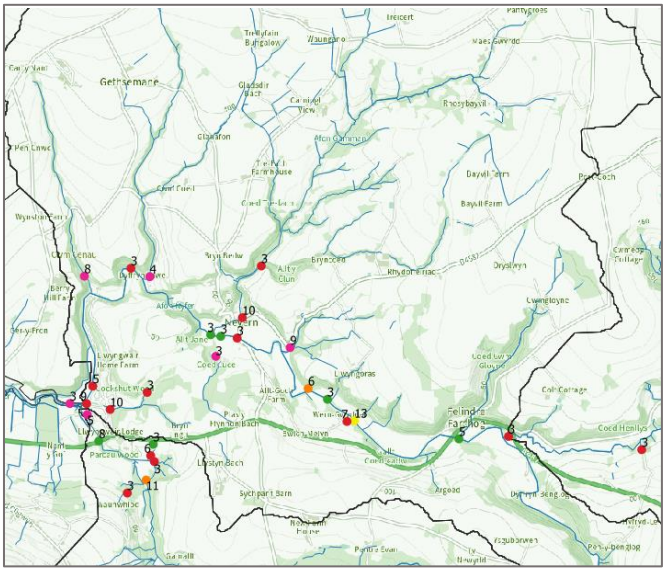
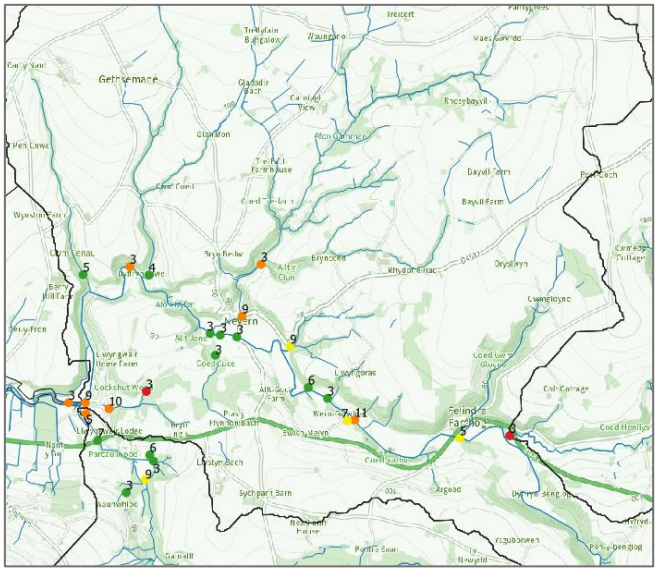
(Nitrate *(left*) and Phosphate (*right*) – Labels indicate the number of samples taken.)

Map 7: Afon Nyfer, from Brynberian to tidal limit

Percentage of samples recording high pollution levels – i.e. ≥ 1.0mg/l nitrate or ≥ 0.1mg/l phosphate.

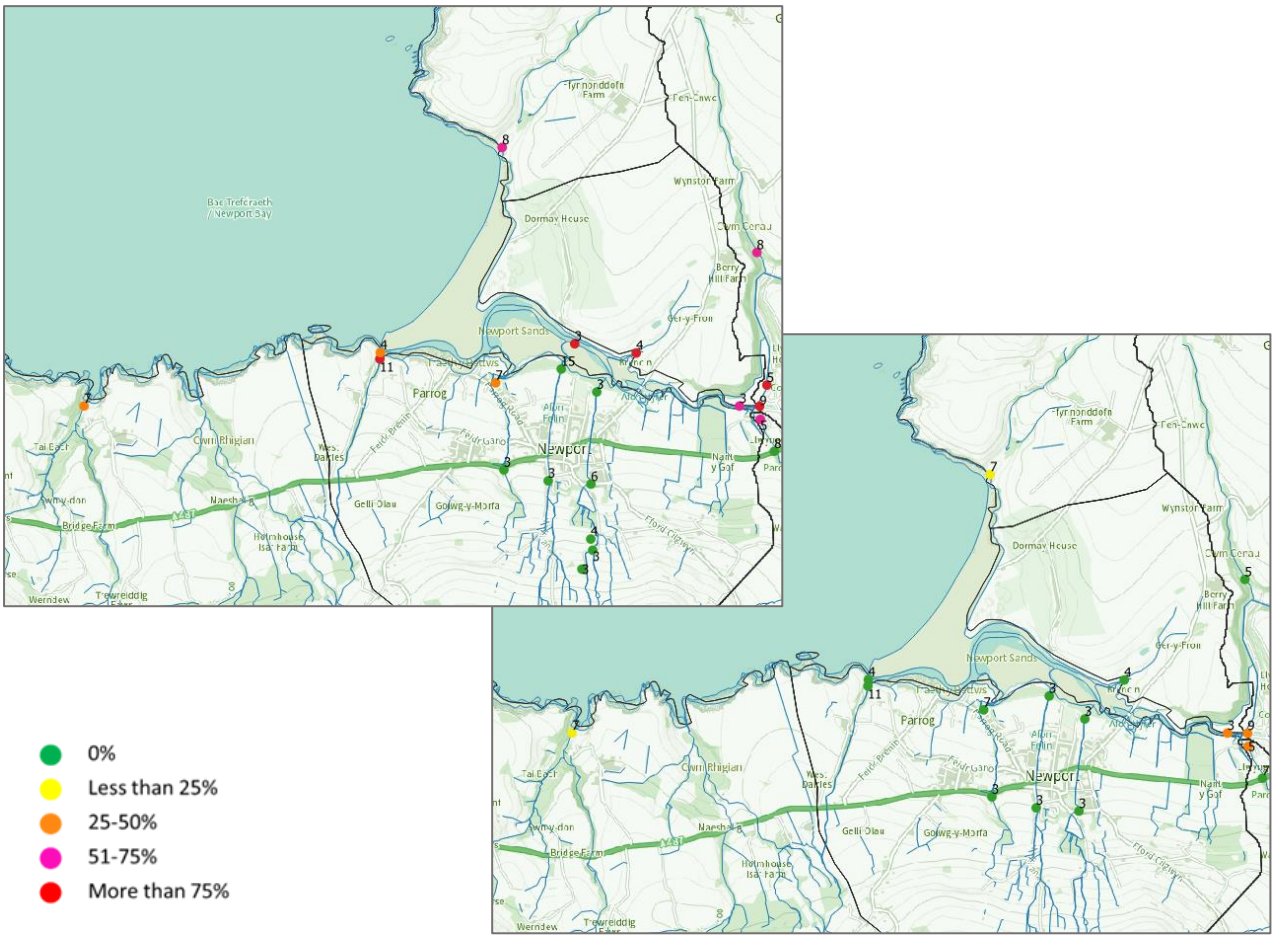
(Nitrate *(left*) and Phosphate (*right*) - Labels indicate the number of samples taken.)

Map 8: Afon Nyfer, estuary and Newport Bay

Percentage of samples recording high pollution levels – i.e. ≥ 1.0mg/l nitrate or ≥ 0.1mg/l phosphate.

(Nitrate *(left*) and Phosphate (*right*) - Labels indicate the number of samples taken.)



Discussion

In essence, the results over the longer testing period of February to August/early September 2023 merely confirmed what had been observed in previous sampling periods, namely that there are concerning levels of nitrate pollution across the catchment of the Afon Nyfer. Again, as previous testing has suggested, high phosphate levels are significantly less prevalent than nitrate levels, but there are a few notable exceptions.

Many of sample sites where high nutrient levels have been recorded correlate with localised land use, run off vulnerability due to topography and underlying soil conditions, and discharges of untreated sewage from CSOs. High rainfall triggers the activation of CSOs and increases the likelihood of run-off so wet weather is likely to make both issues more acute. It is, however, worth noting that even water which has been treated to agreed standards and released from Water Treatment Works into rivers is relatively high in nutrients, relative to unpolluted water.

The second CLEAN Report[12] noted the importance of run-off and nutrient loss risk, following work done by the West Wales Biodiversity Information Centre (WWBIC[13]). The Nutrient loss risk map combines three key risk factors, soil type, slope and land use/land cover, where green colours indicate low risk, pink, red and purple indicate increasing high risk.

If we place the median nitrate levels recorded in the various streams of the Afon Nyfer catchment over the top of the nutrient loss risk map, it is evident that many, though not all, of the streams with the highest levels of pollution are in areas of high risk of run-off, particularly in the northern and eastern part of the catchment. This is not greatly surprising but, again, if we are looking to prioritise interventions to reduce nitrate pollution, perhaps we should focus of these higher run-off risk areas.

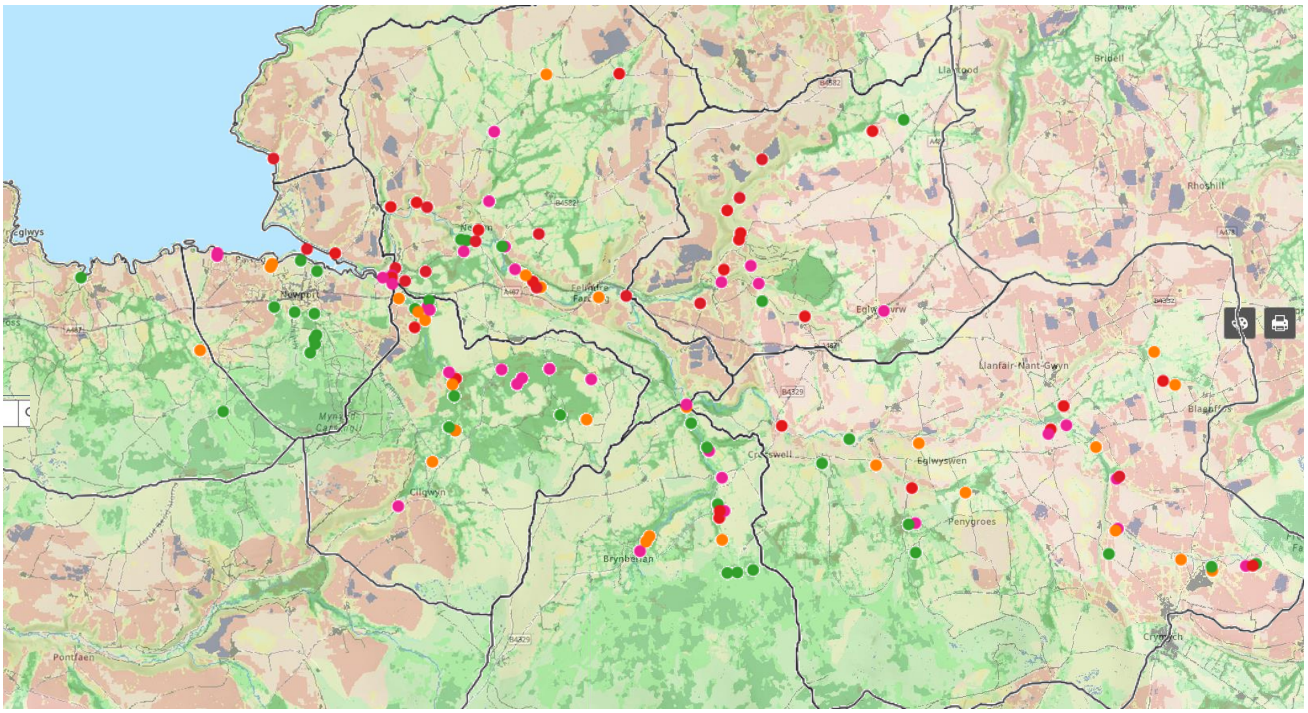


Figure 5: Nutrient loss risk overlaid with median nitrate levels (all sites)- green colours indicate low risk, pink, red and purple indicate increasing high risk

[12] https://www.cwmarian.org.uk/post/clean-afon-nyfer-summer-sampling-report-2022

[13] https://www.wwbic.org.uk/

Turbidity

Closely associated with nutrient loss and run-off is soil erosion and resulting suspended solids in rivers and streams. As mentioned in the Methodology, in 2023 for the first time, volunteers took a measure of turbidity, i.e. the cloudiness of the water.

In ponds, lakes and slow-moving rivers, turbidity, particularly sediment and algal blooms, have a significantly negative effect on biodiversity. However, the local streams and the Afon Nyfer itself are 'spate' rivers, rising and falling quickly after heavy rains, and are generally fast-flowing. With the exception of specific pollution events and after heavy rains the waters are generally found to have low turbidity.

In 2023 testing, using the turbidity tube, some level of turbidity (i.e. >14NTUs) were recorded on 33 of 197 samples where a turbidity reading was recorded, with observations of brown, yellow and grey/milky coloured waters on 24 of these. No significant algal blooms were identified in the catchment itself.

Turbidity was not measured in the first two phases of the CLEAM programme but observations were made as to the colour of the water. Of 635 samples taken over the three sampling periods, 93 (15%) recorded the water as not colourless/clear.

The relatively high levels of nutrients may not appear to be causing significant algal blooms in the fast-moving tributaries and waters of the Afon Nyfer. That said, 60 (9.4%) of the observations record the presence of algae or brown slime covering rocks, and algae can often be observed on the rocks and mudflats of the Nyfer estuary and at Aberfforest at low tide. Also, high nutrients entering Newport Bay are likely to be having an effect on the marine environment.

It would be of interest to better understand the impact of nutrients, sediment, slurry and other suspended solids entering Newport Bay - the waters north and south of Newport are designated as a Marine SAC (Special Area of Conservation). As well as a source of joy and recreation for local people, the town and local area is a significant tourist destination in large part for its beaches and rivers, which is a major source of income for local people. Unfortunately, investigation of the bay and was beyond the scope of this project.

Certainly, any future interventions within the Afon Nyfer catchment must take into account the surrounding landscapes, SSSIs and SACs, including the marine SAC, which are all effected by issues further up the catchment.

Invasive Non-Native Species

Among the many observations asked of volunteers was the presence of invasive non-native species (INNS). INNS are recognised as a significant threat to biodiversity. In particular, Himalayan Balsam is found throughout the catchment, a fact underlined by the fact that 34 of the sample sites note the presence of Himalayan Balsam, virtually from source to sea (see Figure 6 below).

Of equal concern is the 14 sites that record the presence of Japanese Knotweed.

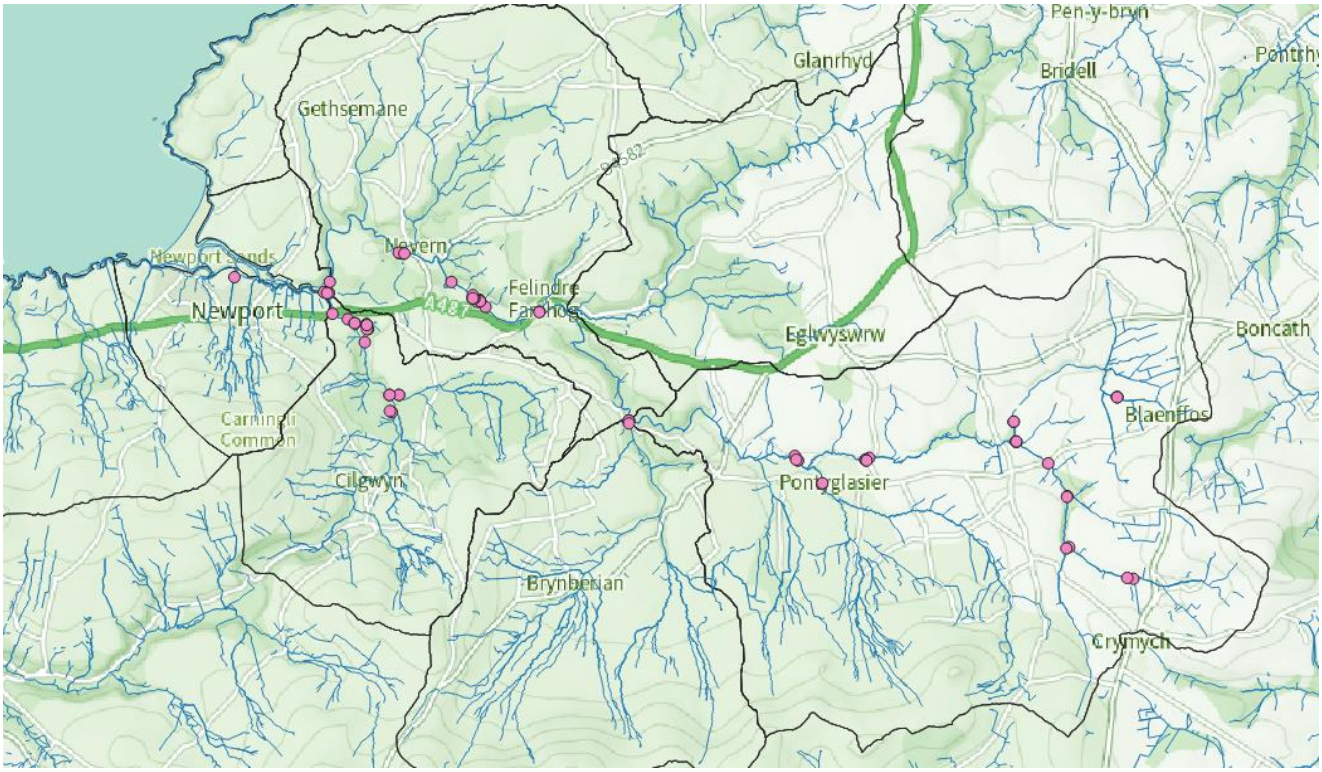


Figure 6: Observations of the presence of Himalayan Balsam

It is noted that the Pembrokeshire Coast National Park's 'Stitch in Time' project has previously worked in the catchment, but in addition to work to reduce nutrient levels flowing into the river, a coordinated and continuing effort to tackle Himalayan Balsam in particular would be beneficial.

On a more positive note, it is again worth noting (as it has been in previous reports), that incidents of litter in the catchment were few and far between – only 25 records at 15 sites of the 207 in the 2023 sampling period.

More encouraging, and delightful – otters were twice observed in the catchment.

Where to go from here?

The extensive data collection of the last 3 years has made a clear case for money and time to be spent on interventions that will reduce and draw attention to the worst of the nutrient pollution that is blighting the Afon Nyfer and its many tributaries.

These interventions should start by focussing on the worst areas, such that limited resources can have the largest impact.

As highlighted in the recommendations of the previous CLEAN reports, interventions should include:

1. Engage with the farming community regarding challenges and opportunities affecting water quality and ecological health in the Nyfer catchment, including support to implement best practice in infrastructure, land and nutrient management.
2. Encourage, and source funding for, the establishment of livestock fencing, riparian and other types of buffer strips.
3. Engage with Dŵr Cymru/Welsh Water to better understand and address challenges with Combined Sewer Overflows (CSO), including increasing capacity for intense rainfall events, and the more accurate and useful monitoring of spillage duration and volume.

4. Engage with and lobby Dŵr Cymru/Welsh Water and Natural Resources Wales on the matter of permitted nutrient levels in treated water released into rivers, and on the maintenance and upgrade of existing water treatment works within the Afon Nyfer catchment, to ensure maximum efficacy of nutrient-stripping and reedbeds.

5. Consider a comprehensive awareness-raising programme designed to raise water quality issues and inform members of the public of actions they can take to reduce the risk of CSO spills, water-wise interventions, habitat improvements, etc. Engage with schools and seek out the voices of people within the community who have previously been unheard.

6. Facilitate the creation of a community catchment management plan which brings together the aspirations, views and needs of all stakeholders within the catchment and identifies clear pathways to change.

14 sites of future focus

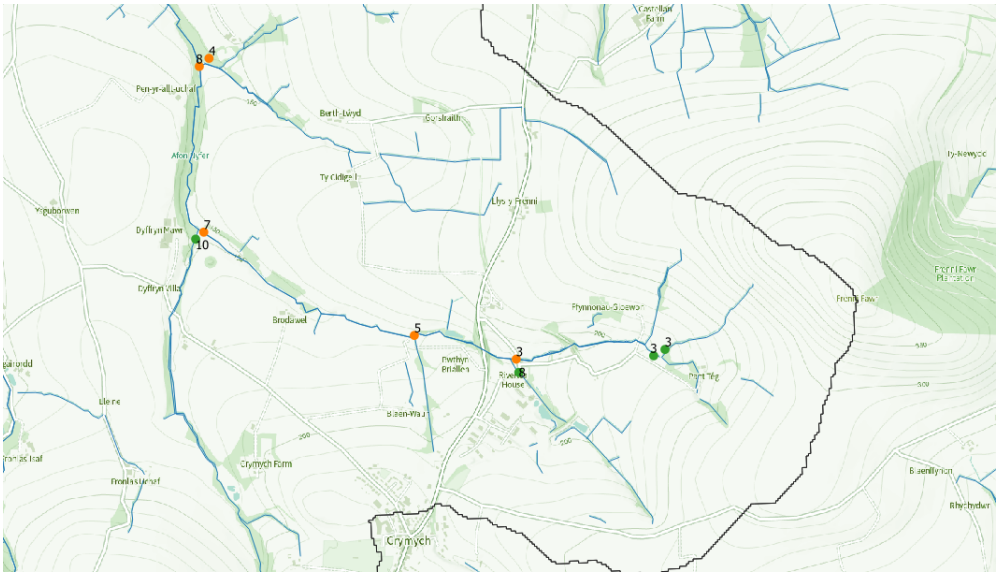
From the evidence gathered in the last three years by the volunteers of the CLEAN project, this report highlights the following sites for interventions, including site visits where possible to investigate possible pollution sources, including septic tanks, point source and diffuse pollution/run-off. It is suggested that any funding, assistance and mitigating interventions (e.g. infrastructure improvement and repair, riparian buffers and fencing, etc.) should be focussed on the following (see detailed maps on the following pages):

1. Investigation of the streams, run-off risk and other possible pollution sources from the industrial estate to the north-east of Crymych (Map 9).
2. Investigation of the streams, run-off risk and other possible pollution sources entering Afon Nyfer from the north-west of Crymych (Map 9).
3. Waters entering the Afon Nyfer from water treatment works at Blaenffos (Map 10).
4. Investigation of the streams, run-off risk and other possible pollution sources to the west of Blaenffos (Map 11).
5. Investigation of the streams, run-off risk, septic tanks and other pollution sources in Brynberian (Map 12).
6. Investigation of the streams, run-off risk, septic tanks and other possible pollution sources entering the Nant Hafron around Eglwyswrw, including from Eglwyswrw Water Treatment Works (Map 13).
7. Investigation of the streams, run-off risk and other possible pollution sources on the Afon Duad, entering Pengelli Wood (Map 14).
8. Investigation of the streams, run-off risk and other possible pollution sources along Afon Gammon and its tributaries north of Nevern village (Map 15).
9. Investigation of the streams, run-off risk and other possible pollution sources running through Pentre Evan and Tycanol Woods, and pollution sources arising from the tributary entering Afon Clydach from the west (Map 16).
10. Investigation of the streams, run-off risk and other possible pollution sources entering the Clydach from the east and south of Parcau Wood (Map 17).
11. Investigation of the streams, run-off risk, septic tanks and other possible pollution sources entering and leaving Llwyngwair Manor (Map 18).
12. Investigation of the streams, run-off risk and other possible pollution sources entering the Nyfer estuary from the north, including around Berry Hill (Map 19).

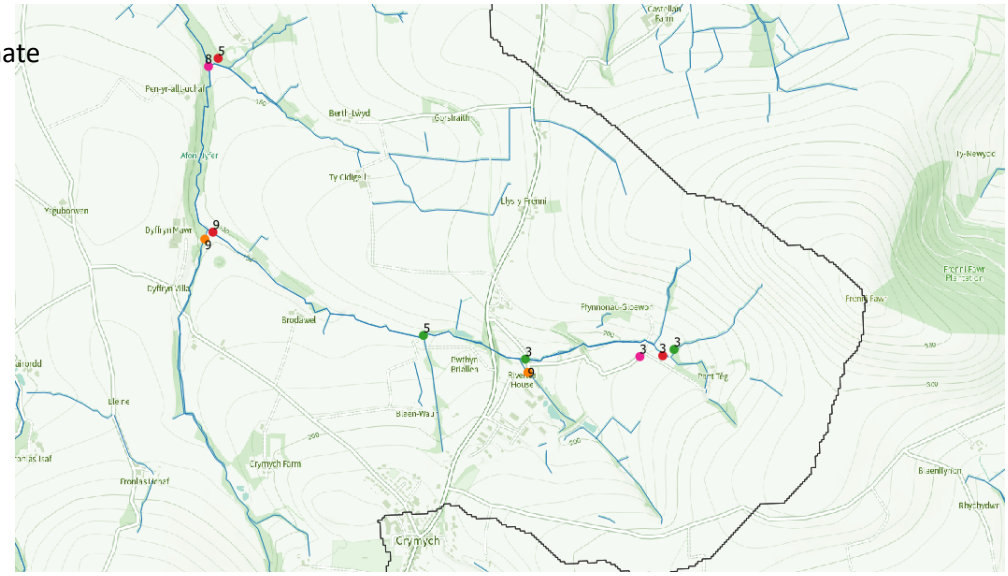
13. Investigation of the streams, run-off risk and other possible pollution sources entering Newport Bay from Foel Fach (Map 19).
14. Investigation of the streams, run-off risk and other possible pollution sources along stream entering Newport Bay by the old lifeboat station (Map 19).

Map 9: Upper Afon Nyfer to north and west of Crymych

Nitrate



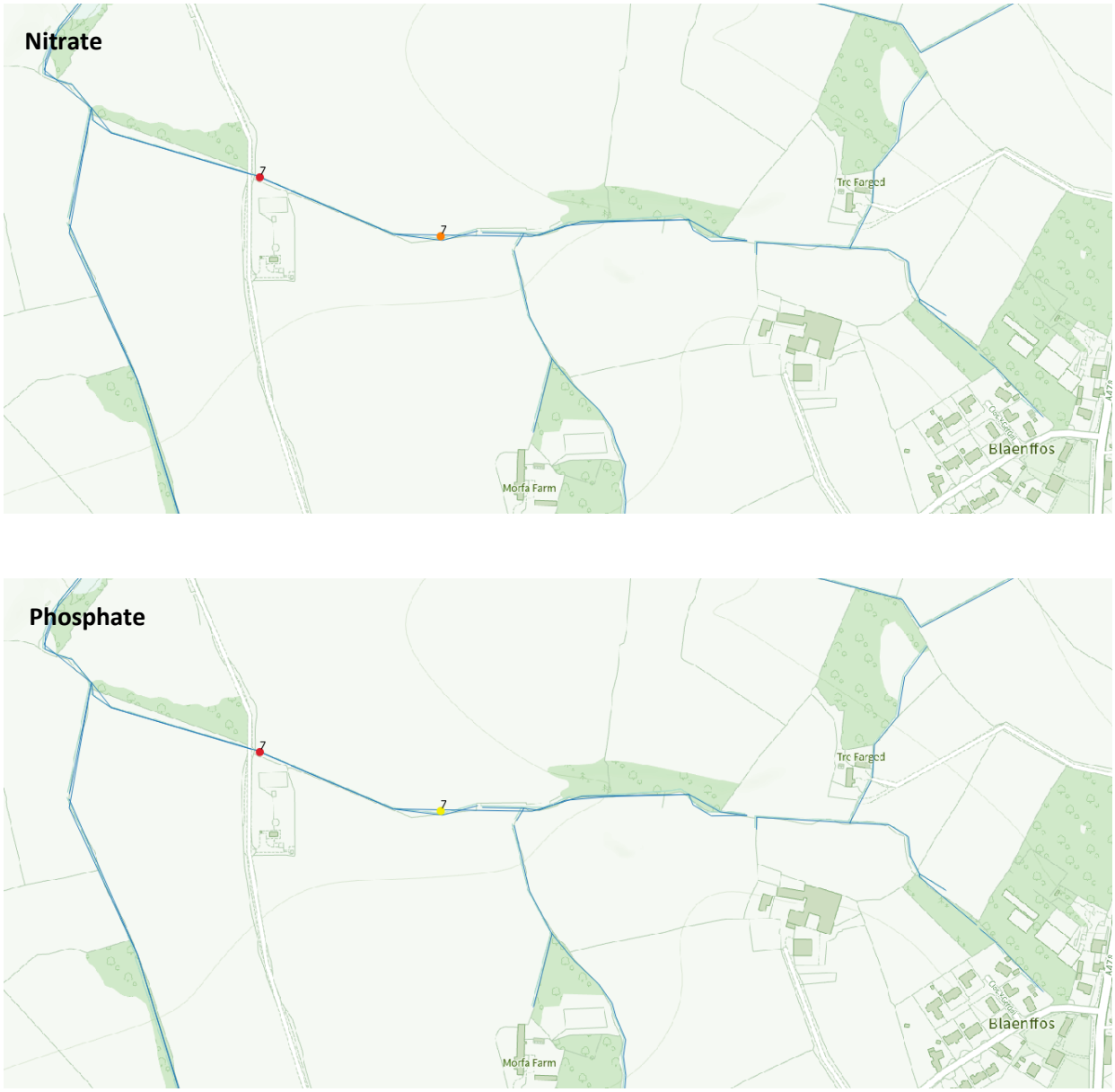
Phosphate



Proportion of samples recording high pollution levels
(i.e. ≥ 1.0 mg/l Nitrate or 0.1 mg/l Phosphate)

- 0%
- Less than 25%
- 25-50%
- 51-75%
- More than 75%

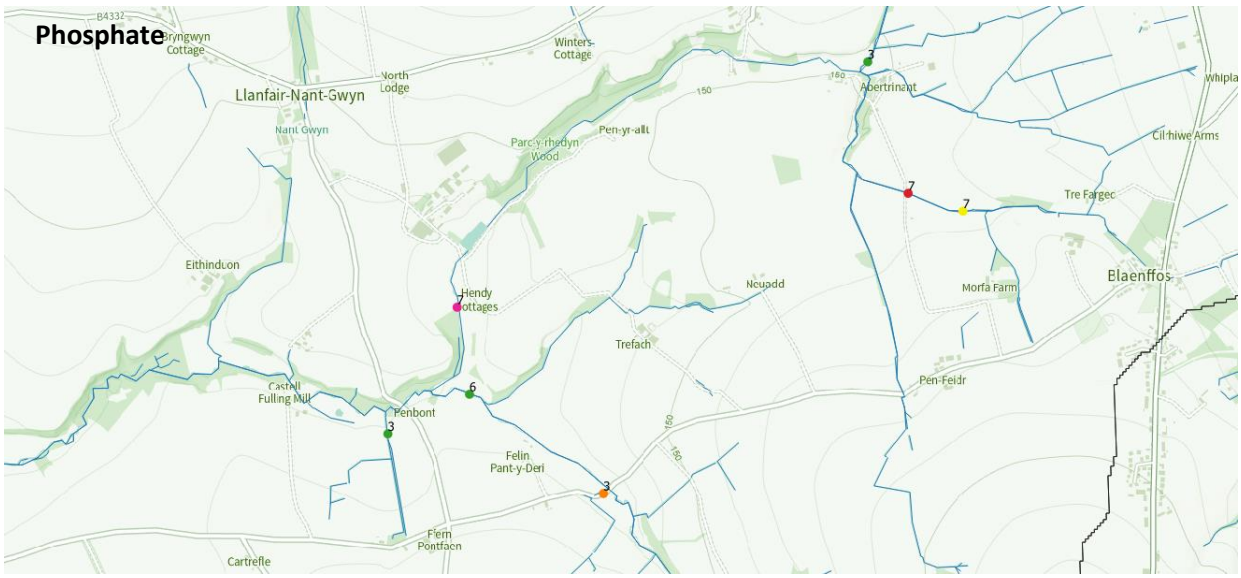
Map 10: Blaenffos WtW



Proportion of samples recording high pollution levels
(i.e. ≥ 1.0 mg/l Nitrate or 0.1 mg/l Phosphate)

- 0%
- Less than 25%
- 25-50%
- 51-75%
- More than 75%

Map 11: Upper Afon Nyfer, south and west of Blaenffos



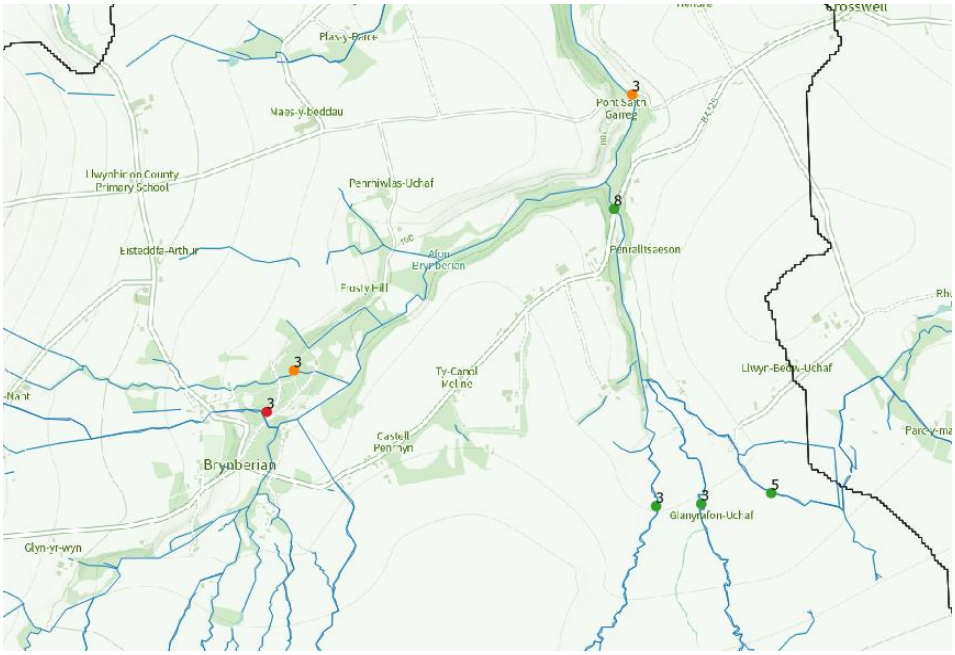
Proportion of samples recording high pollution levels
(i.e. ≥ 1.0 mg/l Nitrate or 0.1 mg/l Phosphate)

- 0%
- Less than 25%
- 25-50%
- 51-75%
- More than 75%

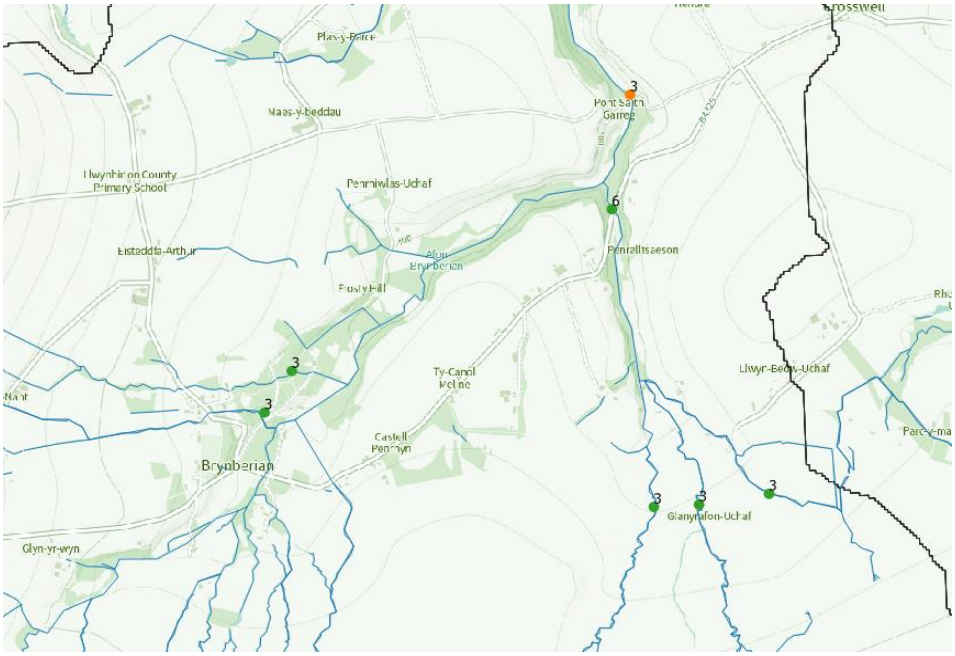
Map 12: Brynberian

Brynberian

Nitrate



Phosphate

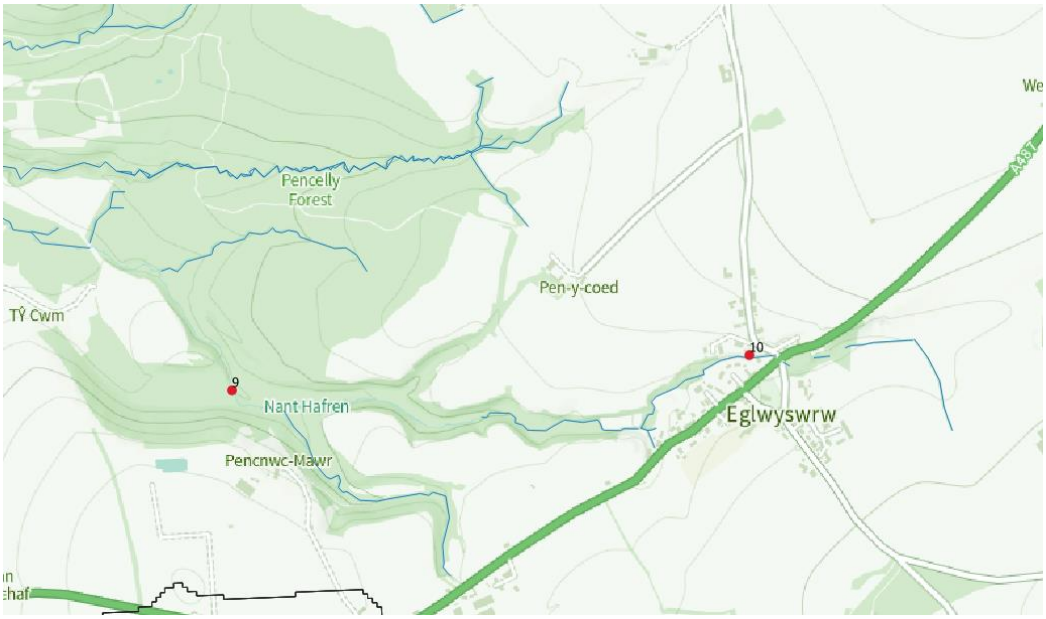


Proportion of samples recording high pollution levels
(i.e. ≥ 1.0 mg/l Nitrate or 0.1 mg/l Phosphate)

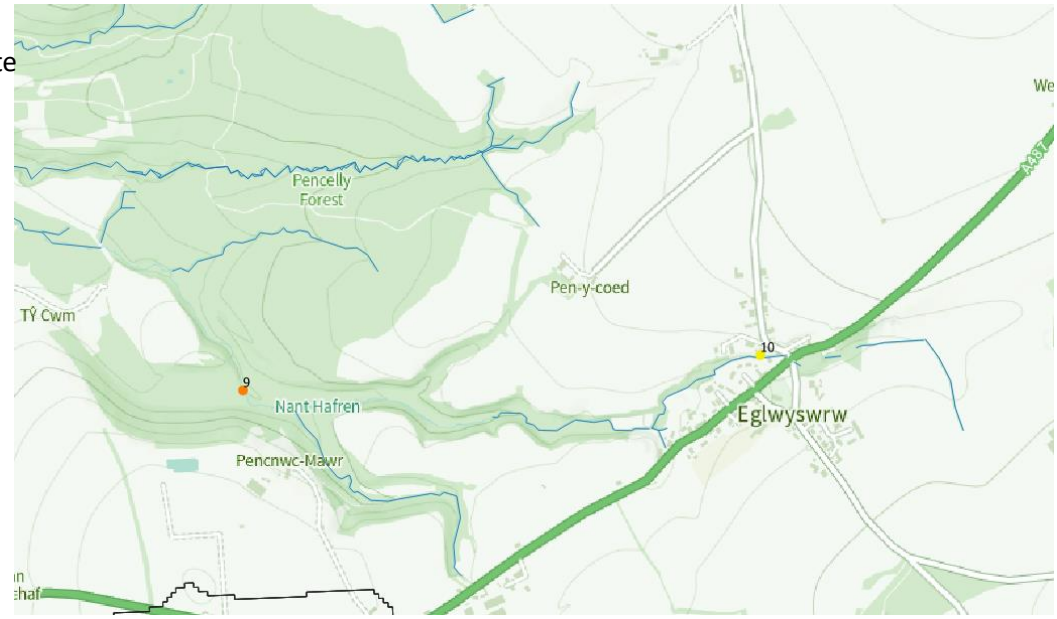
- 0%
- Less than 25%
- 25-50%
- 51-75%
- More than 75%

Map 13: Nant Hafron, east of Eglwyswrw WTW

Nitrate



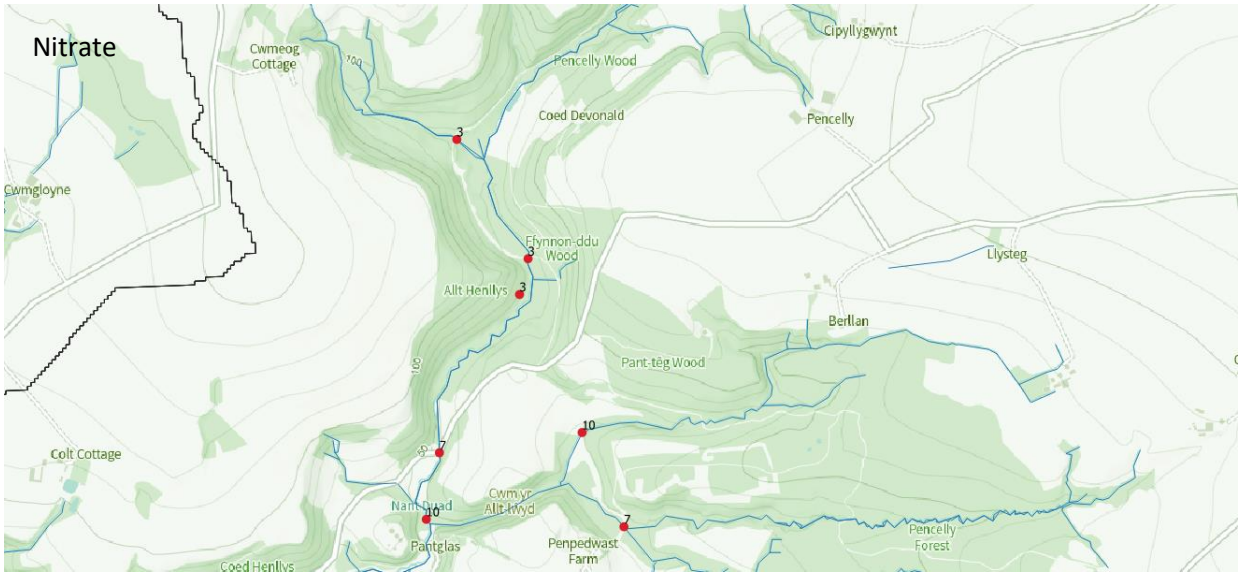
Phosphate



Proportion of samples recording high pollution levels
(i.e. ≥ 1.0 mg/l Nitrate or 0.1 mg/l Phosphate)

- 0%
- Less than 25%
- 25-50%
- 51-75%
- More than 75%

Map 14: Nant Duad and tributaries through Pengelli and adjacent woods

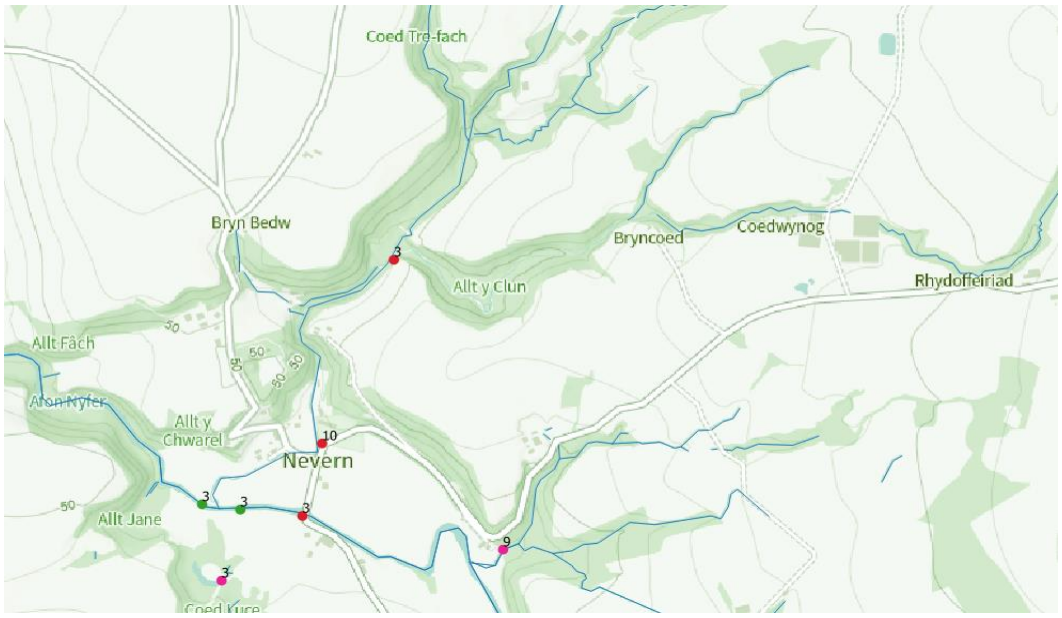


Proportion of samples recording high pollution levels
(i.e. ≥ 1.0 mg/l Nitrate or 0.1 mg/l Phosphate)

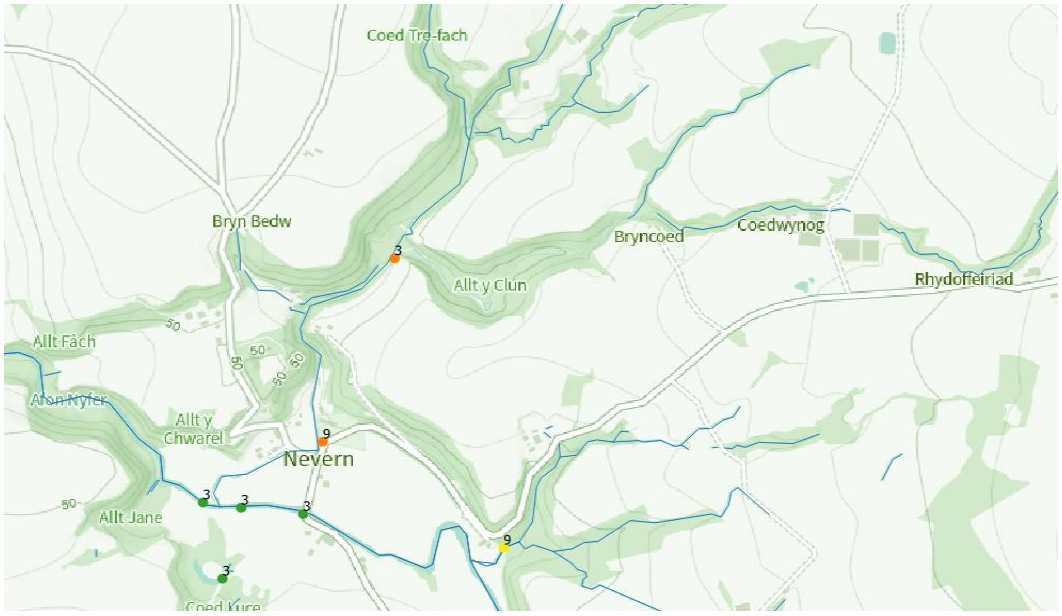
- 0%
- Less than 25%
- 25-50%
- 51-75%
- More than 75%

Map 15: Afon Gammon and streams to north-east of Nevern village

Nitrate



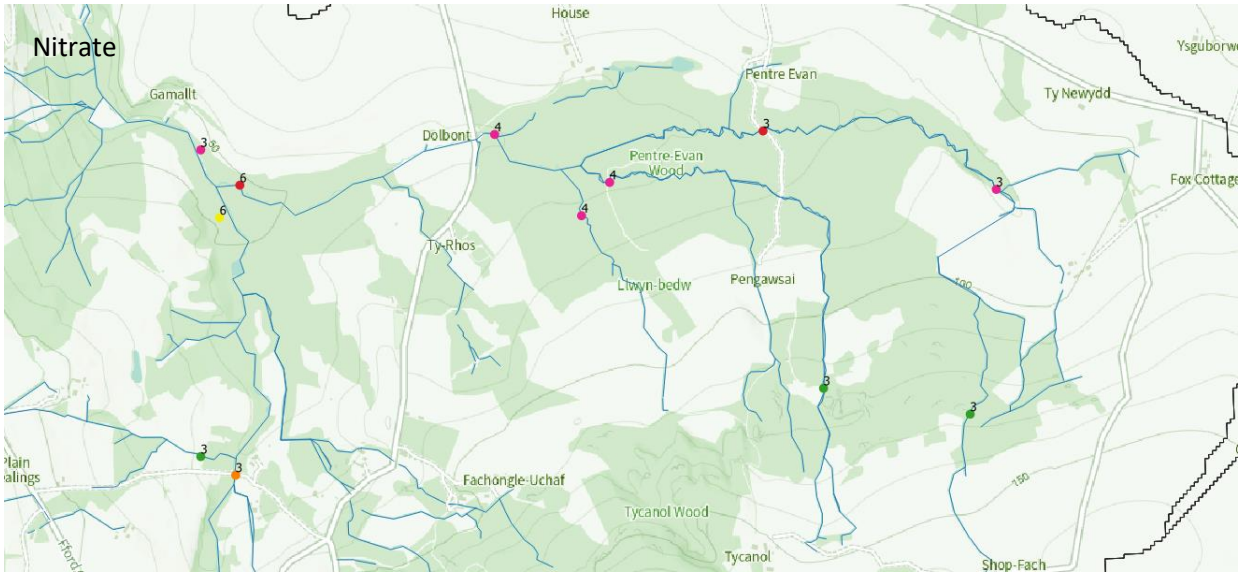
Phosphate

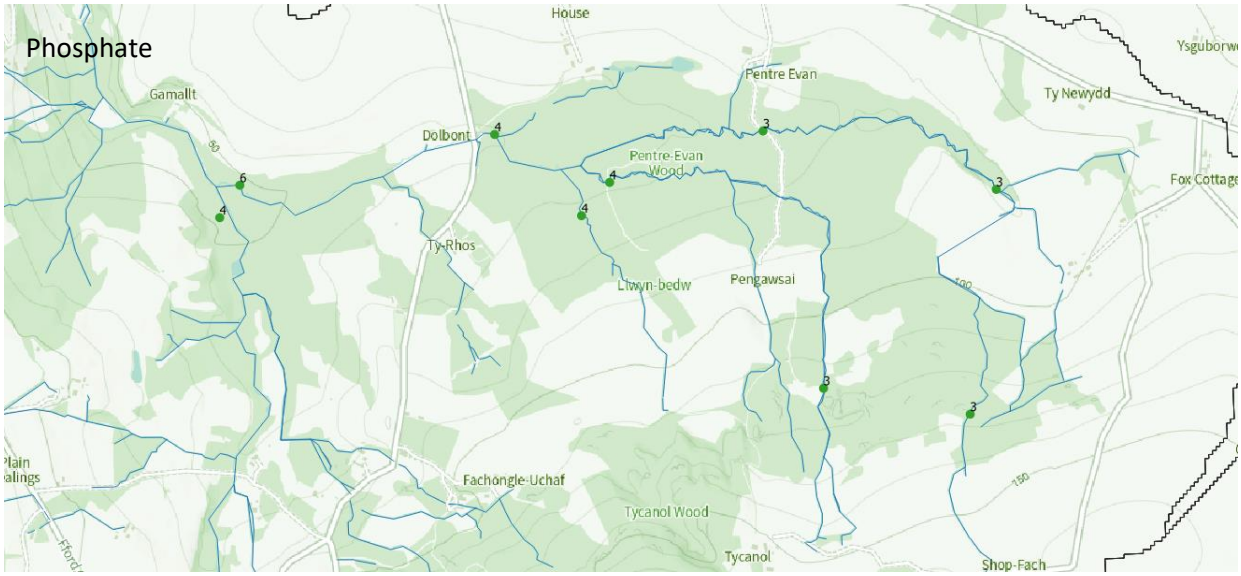


Proportion of samples recording high pollution levels
(i.e. ≥ 1.0 mg/l Nitrate or 0.1 mg/l Phosphate)

- 0%
- Less than 25%
- 25-50%
- 51-75%
- More than 75%

Map 16; Afon Clydach – Tycanol and Pentre Evan Woods



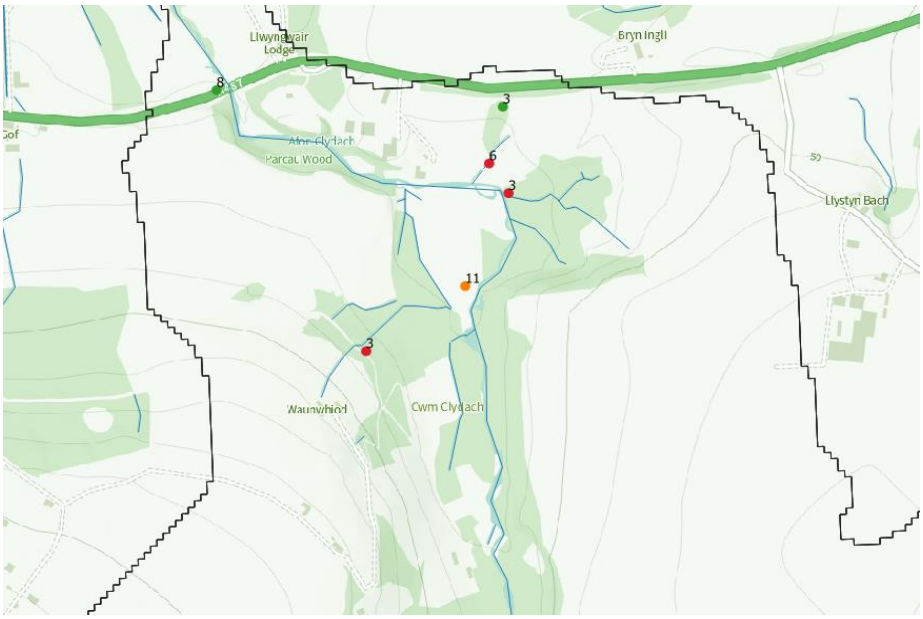


Proportion of samples recording high pollution levels
(i.e. ≥ 1.0 mg/l Nitrate or 0.1 mg/l Phosphate)

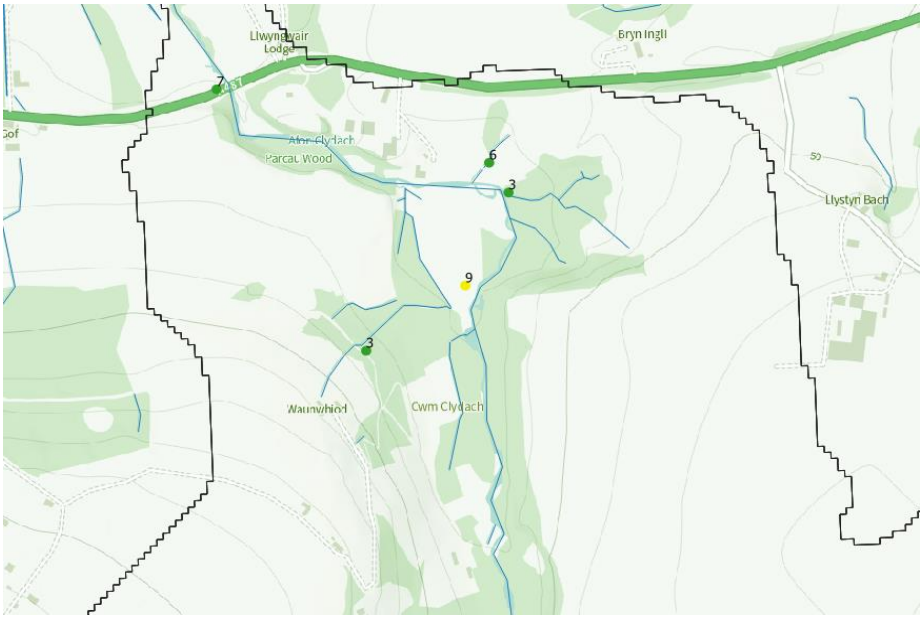
- 0%
- Less than 25%
- 25-50%
- 51-75%
- More than 75%

Map 17: Afon Clydach south of confluence with Afon Nyfer

Nitrate



Phosphate



Proportion of samples recording high pollution levels
(i.e. ≥ 1.0 mg/l Nitrate or 0.1 mg/l Phosphate)

- 0%
- Less than 25%
- 25-50%
- 51-75%
- More than 75%

Map 18: Streams entering Afon Nyfer east of Llwyngwair Manor

Nitrate

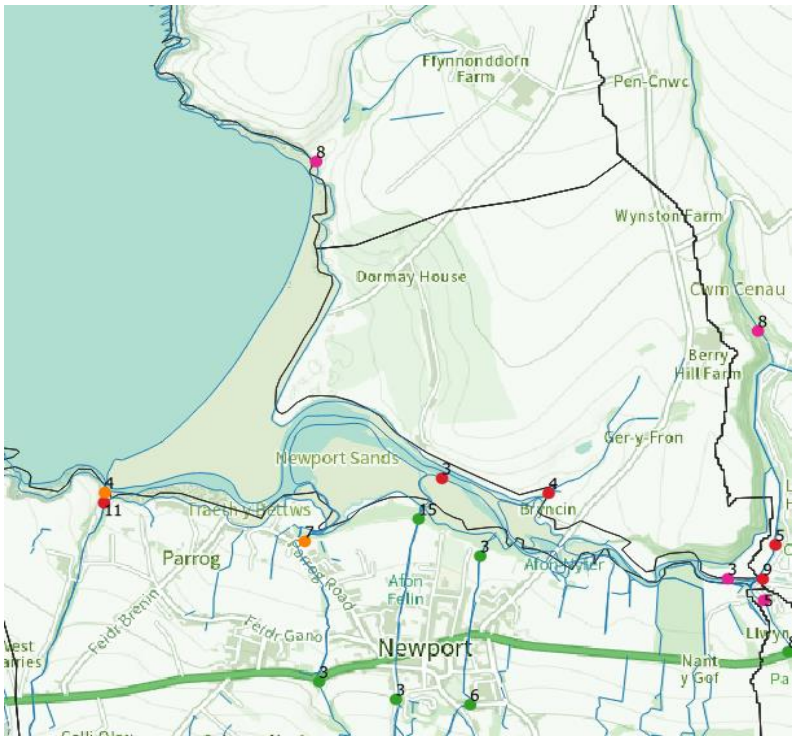
Phosphate

Proportion of samples recording high pollution levels
(i.e. ≥ 1.0 mg/l Nitrate or 0.1 mg/l Phosphate)

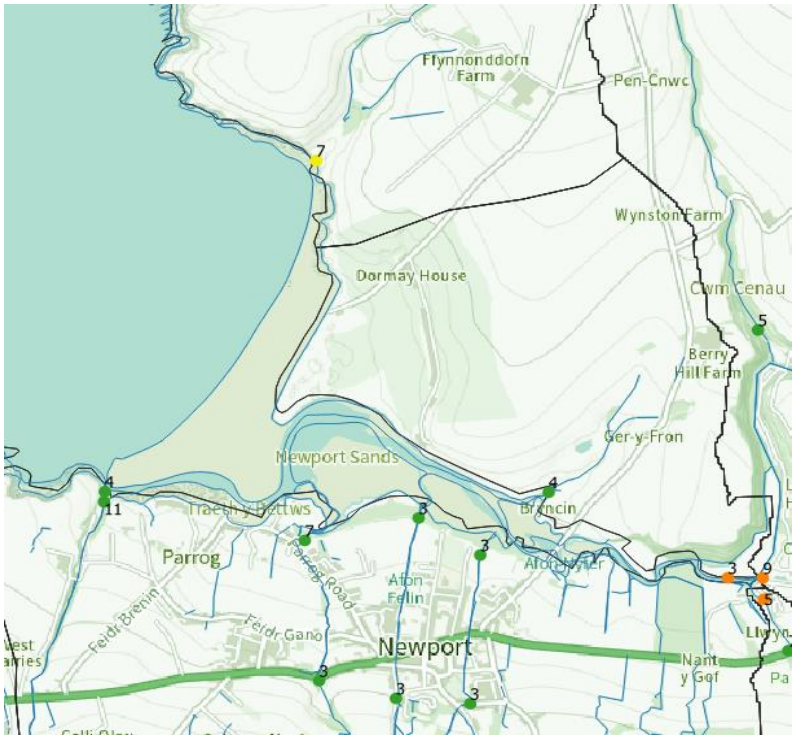
- 0%
- Less than 25%
- 25-50%
- 51-75%
- More than 75%

Map 19: Streams entering Afon Nyfer estuary and Newport Bay

Nitrate



Phosphate



Proportion of samples recording high pollution levels
(i.e. ≥ 1.0 mg/l Nitrate or 0.1 mg/l Phosphate)

- 0%
- Less than 25%
- 25-50%
- 51-75%
- More than 75%

Conclusion

Despite the data collected as part of the Water Framework Directive as well as by the CLEAN project citizen scientists that demonstrates high levels of nutrients, the catchment is arguably still in *relatively* good health ecologically when compared with the general trend in UK rivers and riparian habitats.

As discussed in the first CLEAN report, in common with most of Pembrokeshire, there has been a significant increase in intensive dairy farming in recent years in the Nyfer catchment, with a corresponding shift in land management practises, including an increase of indoor as opposed to pasture fed systems.

The pros and cons of, and attitudes to, indoor dairy systems are complex and not the focus of this report. However, one question does, perhaps, deserve some consideration – has the increase in intensity of production and in head of size of herd outpaced the ability of the land bank to absorb the extra animal waste, in particularly slurry?

While such questions are either left unaddressed or merely a subject of debate, and the economics of the UK food system continues to be out of balance with the natural environment, biodiversity in the UK countryside continues to bear the brunt.

Three significant developments have come to pass in recent months that illustrate both the threat that faces Welsh waterbodies and their biodiversity, and the argument that greater action on water quality in Wales is both urgent and possible:

- The implementation of the Water Resources (Control of Agricultural Pollution) (Wales) Regulations 2021 SI 2021/77 (W.20), which includes measures to address agricultural pollution and apply to all farm businesses in Wales. Provisions are included around the following:
    - nutrient management planning;
    - sustainable fertiliser applications linked to the requirement of the crop;
    - protection of water from pollution related to when, where and how fertilisers are spread; and
    - manure and silage storage standards.[14]
- The increasing public outcry over the flow of raw sewage into the UK's rivers, and the recent admission by Dŵr Cymru that they have been illegally spilling raw sewage from dozens of Water Treatment Works, including between 40 and 50 plants currently operating in breach of their permits.[15,16]
- The publication of the 2023 State of Nature report, which highlights the continuing devastating loss of biodiversity in Wales, and states that one in six species are at risk of being lost from Wales; more than 2% of almost 3,900 species assessed using IUCN Red List criteria are already extinct; 11 bird species have been declared extinct in Wales; and the abundance of moths (important pollinators and a key indicator of wider invertebrate health) having declined by an average of 43% since 1970.[17,18]

For the Afon Nyfer, there is a critical but brief window of opportunity to halt or even reverse the decline in water quality and enhance habitats for the rich diversity of life within the catchment. Achieving this aim could make the Afon Nyfer a river of refuge for many species that are facing population declines to the point of extinction elsewhere across the country.

[14] https://thecompliancepeople.co.uk/updates/legal/the-water-resources-control-of-agricultural-pollution-wales-amendment-regulations-2023/
[15] https://www.bbc.co.uk/news/science-environment-67077510
[16] https://afonyddcymru.org/wp-content/uploads/2023/10/FINAL_SUMMARY_Welsh_Water_Overview_WwTWs_Oct_17th_2023.pdf
[17] https://www.wildlifetrusts.org/sites/default/files/2023-09/State-of-Nature-Press%20release%20-%20Wales_1.pdf
[18] https://stateofnature.org.uk/wp-content/uploads/2023/09/TP25999-State-of-Nature-main-report_2023_FULL-DOC-v12.pdf

A prime example of the wildlife refuges within the Nyfer catchment is its wooded valleys, which include three components of the North East Pembrokeshire Woodlands Special area of Conservation (SAC) – Pengelli, Ty Canol woods and adjacent woodlands in Cilgwyn that are part of an extended woodland matrix that meet Pentre Evan and Parcau woods and continue the length of the Afon Clydach sub-catchment to join the Afon Nyfer valley and thence onwards almost to the sea.

The streams that run through these precious woodland habitats and SSSIs are among the more polluted stretches of the Nyfer catchment, particularly in terms of nitrate pollution. It is these streams, at the very least, that should be the focus of future interventions and mitigations.

Recommendations

A full suite of recommendations was included in the reports for previous Phases of CLEAN and are not repeated. Further recommendations based on our increased understanding of the catchment, informed by feedback from volunteers and organisations, are outlined below and have formed the basis of pending funding applications.

1. Engage with the farming community regarding challenges and opportunities affecting water quality and ecological health in the Nyfer catchment, including support to implement best practice in infrastructure, land and nutrient management.

2. Encourage, and source funding for, the establishment of livestock fencing, riparian and other types of buffer strips.

3. Engage with Dŵr Cymru/Welsh Water to better understand and address challenges with decoupling surface and foul water systems, Combined Sewer Overflows (CSO); including increasing capacity for intense rainfall events, and the more accurate and useful monitoring of spillage duration and volume, especially during dry weather.

4. Engage with and lobby Dŵr Cymru/Welsh Water and Natural Resources Wales on the matter of permitted nutrient levels in treated water released into rivers, and on the maintenance and upgrade of existing water treatment works within the Afon Nyfer catchment, to ensure maximum efficacy of nutrient-stripping and reedbeds.

5. Consider a comprehensive awareness-raising programme designed to raise water quality issues and inform members of the public of actions they can take to reduce the risk of CSO spills, water-wise interventions, rainwater harvesting, habitat improvements, etc. Engage with schools and seek out the voices of people who have previously been unheard.

6. Work with Natural Resources Wales to develop a protocol for citizen science data collection that can be used to inform how they target resources.

7. Facilitate the creation of a community catchment management plan which brings together the aspirations, views and needs of all stakeholders within the catchment and identifies clear pathways to change.

Finally, after three years of increasingly focussed sampling, the mapping of water quality across the catchment has highlighted 14 sites that should be targeted for maximum impact.