River Wye SAC
Nutrient Management Plan
Phosphate Action Plan

Natural Resources Wales, Environment Agency & Natural England

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Contents

Summary

This Phosphate Action Plan forms the third part of the Wye Nutrient Management Plan and as such should be read in conjunction with the Evidence Base, Options Appraisal, and the first cycle of the Action Plan. It sits under the River Basin Management Plan and Special Area of Conservation Management Plan. It is a first step towards a full river restoration plan.

Phosphate levels in the River Wye catchment need to be reduced. Phosphate limits are already being exceeded at 31 points in the river catchment, with further failures likely in the future. The River Wye Nutrient Management Plan 2014 demonstrates that the river phosphate limits are technically achievable. However, recent case law known as the Dutch Nitrogen Judgement[1] has clarified that where a site is already exceeding its environmental limits, further inputs are 'necessarily limited'. Furthermore, the judgement clarifies that plans such as the Nutrient Management Plan (NMP) can only be relied upon as strategic mitigation where there is sufficient certainty actions will be delivered, and the target will be met. The River Wye NMP does not give this certainty and therefore cannot be relied upon as strategic mitigation. Plans and projects that increase phosphate discharges into failing parts of the River Wye Special Area of Conservation (SAC) will have adverse effects on the integrity of the site and cannot proceed, unless they provide their own mitigation – i.e., unless they are nutrient neutral.

The aim of the Phosphate Action Plan is to give certainty that river targets will be achieved. Plans and projects will then be able to rely on the Action Plan as strategic mitigation, passing through the Habitat Regulations Assessment with no adverse effects on integrity. It should be noted that legacy phosphate is a significant issue in the catchment, and this may mean that despite a programme of actions, physical improvements in the river are not seen for some time.

As of yet there are no Diffuse Water Pollution Plans or Nutrient Management Plans in the UK that have enough certainty to be relied upon as strategic mitigation. The Wye Phosphate Action Plan is blazing a trail and open collaborative working is essential as we explore how we can achieve this end goal. This is the first re-draft of the Action Plan since the Dutch Nitrogen judgement, and it is likely to take several versions before the plan delivers enough certainty. The Action Plan sits in a changing context and revisions to the Government's approach to fair share, the ongoing Judicial Review Consents Order work and the work around River Basin Management Planning will change the landscape and may trigger reviews of this plan.

This Action Plan starts by outlining the current situation regarding phosphate levels in the River Wye catchment. The main body of the Action Plan is subdivided into sections on point

[1] The CJEU judgment on the joined *Coöperatie Mobilisation for the Environment* cases (often referred to as the Dutch Nitrogen cases) affects how the assessment of plans and projects under the Conservation of Habitats and Species Regulations 2017 (as amended) ('the Habitats Regulations') must be interpreted and applied by competent authorities (local planning authorities in relation to planning matters).

sources, diffuse sources, evidence and monitoring and action plans for the main sub-catchments. A list of practical measures available to reduce phosphates is provided in an Annex. The certainty of each of the measures listed has been assessed and ranked. Sub-catchment action plans should be populated with measures listed in Annex 1 that are deemed sufficiently certain, thus demonstrating how the target will be met. Over-delivery will be required in order to account for uncertainties, and in accordance with the precautionary principle.

This Phosphate Action Plan has been drafted by the representatives from NE, EA and NRW who sit on the Technical Advisory Group (TAG) that sits under the Nutrient Management Board. Comments from the wider TAG have been incorporated. Considerable further work would be required to turn this Action Plan into a full river restoration plan. The plan authors propose that the TAG revisits this plan when vital contextual work including target reviews have been concluded, likely to be Autumn/Winter 2021. From then on the Action Plan should be reviewed annually, to tie in with the monitoring dashboard.

The next steps to be undertaken as a priority are:

- **Project officer** – Employment of a project officer to coordinate and drive this work.
- **Other point sources** – TAG to discuss the potential for prioritised actions on specific point sources, such as industry, septic tanks or CSO's.
- **Base flows and abstractions** – TAG to discuss.
- **Regulation** - Fuller application of regulatory powers around agricultural practices in the catchment. Build collaboration between farmers and regulators to raise levels of regulatory compliance.
- **Farm advice** – Consider undertaking a review of the successes and shortcomings of farm advice and voluntary action in the catchment. This may need to be commissioned by Defra.
- **Modelling** – Further modelling may be required to increase confidence in the measures and mechanisms required, including Source Apportionment Geographic Information Systems (SAGIS) tool recalibration and further Farmscoper scenario modelling.
- **Lugg actions** – Partners should explore what additional measures should be employed to reduce phosphate in the Lugg, with enough certainty to meet the requirements of the Habitat Regulations in light of the Dutch Nitrogen Judgement.
- The other **sub-catchment plans** should be significantly worked up.

Introduction

The River Wye is an area of special importance for nature conservation. The Wye and the Lugg are designated as Sites of Specific Scientific Interest (SSSIs), with the River Wye and the lower stretches of the River Lugg designated as a Special Area of Conservation (SAC) under the European Community (EC) Habitats Directive (see Appendix 2 meeting Favourable Condition Status).

The River Wye SAC is primarily designated for being a largely unmodified river. It has a geologically mixed catchment, including shales and sandstones, and shows a clear transition between its upland reaches, with characteristic bryophyte-dominated vegetation, and the lower reaches, with extensive *Ranunculus* beds. The river channel includes gorges and significant areas of associated woodland. Annex 1 species covered by the designation are white-clawed crayfish, sea lamprey, brook lamprey, river lamprey, twaite shad, Atlantic salmon, freshwater pearl mussel, bullhead and otter. The SAC designation also extends to its largest tributary the river Lugg, up as far as Hope under Dinmore.

The River Wye stretches for 134 miles from Plynlimon in mid-Wales to the Severn estuary. For much of its lower length it forms the border between Wales and England. The Wye is the largest SAC river in Wales, with a catchment covering much of southern Powys and part of the Brecon Beacons National Park before crossing the border into England near Hay-on-Wye. It is divided into 43 water bodies in Wales, two of which straddle the border, and four water bodies entirely in England. The principle towns in the Wye catchment are Rhayader, Llandrindod, Builth Wells, Hay-on-Wye, and Hereford city, with Presteigne and Leominster on the River Lugg, and Ross-on-Wye then Monmouth near to the confluence with the River Severn.

As a part of measuring the rivers condition, limits have been set for nutrients and other water quality markers. The limits set for phosphate are currently being exceeded along parts of the River Wye SAC, and there are risks of further exceedances without adequate mitigation. The work that went into producing the NMP in 2014 established that phosphate limits were achievable, including when considering growth plans across the catchment. The NMP established that a combination of discharge reductions from wastewater treatment works (WwTW), land use change and changes to agricultural practice would be required to meet the targets. Improvements to WwTW were included in Dwr Cymru - Welsh Water's (DCWW) work plans for investment in 2020-2025, whilst land use changes and changes to agricultural practice were to be progressed on a voluntary basis with support from schemes such as Catchment Sensitive Farming. At the time, this was considered an adequate level of information to allow development proposals to proceed and councils to plan for growth.

However, recent case law known as the Dutch Nitrogen Judgement has clarified the interpretation of the Habitats Regulations. The European Court concluded that where the conservation status of a natural habitat is unfavourable, the possibility of authorising activities which may subsequently affect the ecological situation of the site seems "necessarily limited". The CJEU concluded that an Appropriate Assessment (AA) allowing

deterioration may not take into account the benefits of conservation, preventative or other measures if the expected benefits of those measures are not “certain” at the time of the assessment. This means that where an Appropriate Assessment relies on delivery of a strategic plan (such as the Nutrient Management Plan) to avoid or mitigate for an impact on a European site that is already failing to meet its favourable conservation status, there must be sufficient scientific and practical certainty that the measures identified in that plan will achieve the required reductions and that the measures will be in place at the relevant time. Absolute certainty is not required; a competent authority could be certain that there would be no adverse effects even though, objectively, absolute certainty is not proved.

This Action Plan is first and foremost about restoring the ecological functioning of the River Wye, by reducing phosphate to below set limits. It is not designed to facilitate further growth and development as such. However, if it can set out how Favourable Conservation Status will be achieved, with adequate certainty to satisfy the Habitat Regulations in light of the Dutch Nitrogen Judgement, and if it can be shown that further growth and development in the catchment does not compromise this, then the Phosphate Action Plan will be able to be relied upon as strategic mitigation. In this scenario a Habitat Regulations Assessment could refer to the Action Plan, and it could be concluded that the plan or project had no adverse effects on integrity. The development would be able to proceed in a more business as usual way.

If certainty cannot be achieved, then the Plan still achieves its main aim of driving river restoration. Plans and projects (development) on failing stretches of the watercourse could still proceed by offsetting their impacts, i.e., taking a nutrient neutrality approach. This Action Plan is iterative in nature, and it is likely to take several versions before the plan has enough certainty to be relied upon as strategic mitigation.

The Phosphate Action Plan needs to:

- Quantify the phosphate reductions required, taking all possible inputs into account,
- Identify all possible actions/measures to reduce phosphate levels,
- Rate the ‘certainty’ of the measures, defining measure that have enough certainty to be used in a plan that complies with the Dutch Nitrogen Judgement,
- Quantify the phosphate reductions from the measures listed,
- Add up the total phosphate reductions from measures that have good levels of certainty, aiming to demonstrate how the target will be achieved,
- Demonstrate over-delivery against targets to provide a buffer, thereby applying a precautionary approach,
- Set out a programme of monitoring and ensure it is funded,
- Use monitoring results to track actual phosphate levels in waterbodies, in order to steer ongoing actions.

This Phosphate Action Plan is a first step towards a full plan to restore the river. It should be recognised that phosphate is not an end in itself to achieving the favourable conservation status of the designated features in the River Wye SSSI/SAC. It is recognised as an important factor in reaching this goal due to failing its target values across the catchment.

The solution is not simply one of reducing the flow of nutrients into the system, but rather understanding and responding to the complex interactions that determine the overall SAC condition. It will be important to take a more holistic ecosystem approach to implement the most appropriate suite of actions at any given location. For example, restoring and improving river and floodplain habitat and physical processes through for example river restoration works, floodplain re-connection and floodplain and riparian woodland, natural flood management and river regulation, to help to lessen the negative impacts of nutrients in the system.

Phosphate limits for the River Wye SAC

The River Wye and Lugg targets must be met as an annual average, a 3-year rolling mean and as a growing season mean (March to September inclusive). Common Standards Monitoring Guidance (CSMG) from which targets are derived can be found here: mailto:https://hub.jncc.gov.uk/assets/1b15dd18-48e3-4479-a168-79789216bc3d. Water Framework Directive and SAC water quality targets differ but for SAC sites the higher target is the one monitored against.

A summary of the targets for soluble reactive phosphorus (SRP) for the Wye and Lugg can be found in the appendices, along with information on the river levels in comparison to targets. Throughout this report levels are given in milligrams per litre, in line with the original NMP.

The current situation

Data used to inform this section comes from the following sources:

- Dwr Cymru Welsh Water's Asset Management Programme 6 (AMP6) investigation, 2018.
- Evidence review undertaken by EA in June 2020.
- Phosphate compliance review for SAC rivers in Wales (NRW, 2020).
- Herefordshire Council Interim Phosphate Delivery Plan (Ricardo, 2021).
- This section will be updated with information from the recent re-runs of SAGIS modelling.

As part of developing the programme of work for AMP7 and AMP8, Dŵr Cymru Welsh Water (DCWW) commissioned a project to update and calibrate the SAGIS model for Upper River Wye sub-catchment using the latest river quality data (for phosphate) collated by Natural Resources Wales (NRW), under the JNCC target. The ultimate objective is to use the updated model to improve confidence that proposed/planned phosphorus removal schemes will deliver the intended outcomes.

In Wales, comparison of orthophosphate concentrations against targets indicate failures, some of them significant. Fourteen water bodies met their targets, twenty-seven failed and

three were unknown. Water bodies achieving their orthophosphate targets were in the Upper Wye above Rhayader, about half of the Ithon, and two water bodies in the Irfon. All of the middle Wye tributaries, the remaining Irfon and Ithon and the Llynfi failed to meet their targets. The most significant failures were the Wye near Newbridge, the Cammarch, Clettwr Brook, Mithil Brook, lower Irfon, Garth Dulas and the three water bodies in the Llynfi catchment. Failing waterbodies in Wales can be found in the NRW SAC Phosphate Compliance Report at: Natural Resources Wales / Compliance Assessment of the River Wye SAC Against Phosphorus Targets.

In England, the River Wye achieves its target along most of its length. The most upstream site for EA monitoring at Bredwardine Bridge is very close to the target. From here there is a reduction in orthophosphate at the next downstream site at Sollars Bridge from where it increases gradually down the course of the river until the target is exceeded at Hoarwithy Bridge (downstream of the Lugg confluence). Orthophosphate levels then gradually reduce along the length of the Wye.

The River Lugg in Wales achieves mainly 'good' Water Framework Directive status for Soluble Reactive Phosphorous with only the Norton Brook at 'poor' status (2016-2018 data). The River Lugg in England is exceeding its phosphate targets. Highest mean values occur in the lower reaches of the Lugg but results suggest that even at the most upstream monitoring point in England orthophosphate levels significantly exceed the target.

The 'reasons for failure' attributed to the River Wye and its tributaries suggest nutrients are likely to be from a diverse range of sources, including mains sewerage, septic tank discharges and diffuse agricultural pollution. In both the Upper Wye sub-catchment and the Lugg sub-catchment, source apportionment modelled analysis suggests that 66% of the total Phosphate load comes from agriculture, 25% from Wastewater Treatment Works and 9% from other sources. DCWW AMP 7 improvements will be completed between 2020 – 2024 and these percentages will change slightly to 67% agriculture, 23% WwTW and 10% other. In the Lower Wye sub-catchment, 61% is from agricultural sources, 33% is from WwTW, with 6% other[2]. Much of the Wye catchment is rural and until recently has been predominantly farmed for sheep and beef cattle, with a rapid expansion of chicken farms and pig production more recently.

'Other' sources include highway discharges, industry and intermittent sewage discharges which includes combined sewer overflows (CSO's). CSO's contribute up to 7% of this figure. However, it should be noted that although SAGIS is a Standard modelling tool used by Environmental Regulators and Water Industry, it is not well suited to assessing intermittent discharging assets like storm overflows. The more recent SAGIS reruns give the contribution of CSO's as a separate figure.

[2] Evidence Review - Phosphate in the Wye/Lugg SAC Catchment. Environment Agency & Natural England. June 2020.

DCWW have recently commissioned a revised River Wye SAGIS model using more recent data and calibration to review the funded improvements that were identified on the NEP (National Environment Plan) for AMP7 (Asset Management Plan 7) for delivery over the period 2020-2025. The Model build and calibration phase is complete. NRW are currently reviewing 'modelling rules' for modelling scenarios that are consistent with Habitats Directive Review of Consents principals. These rules will be subject to Policy review and legal test to ensure that they are robust and appropriate in light of the 'Dutch Case'.

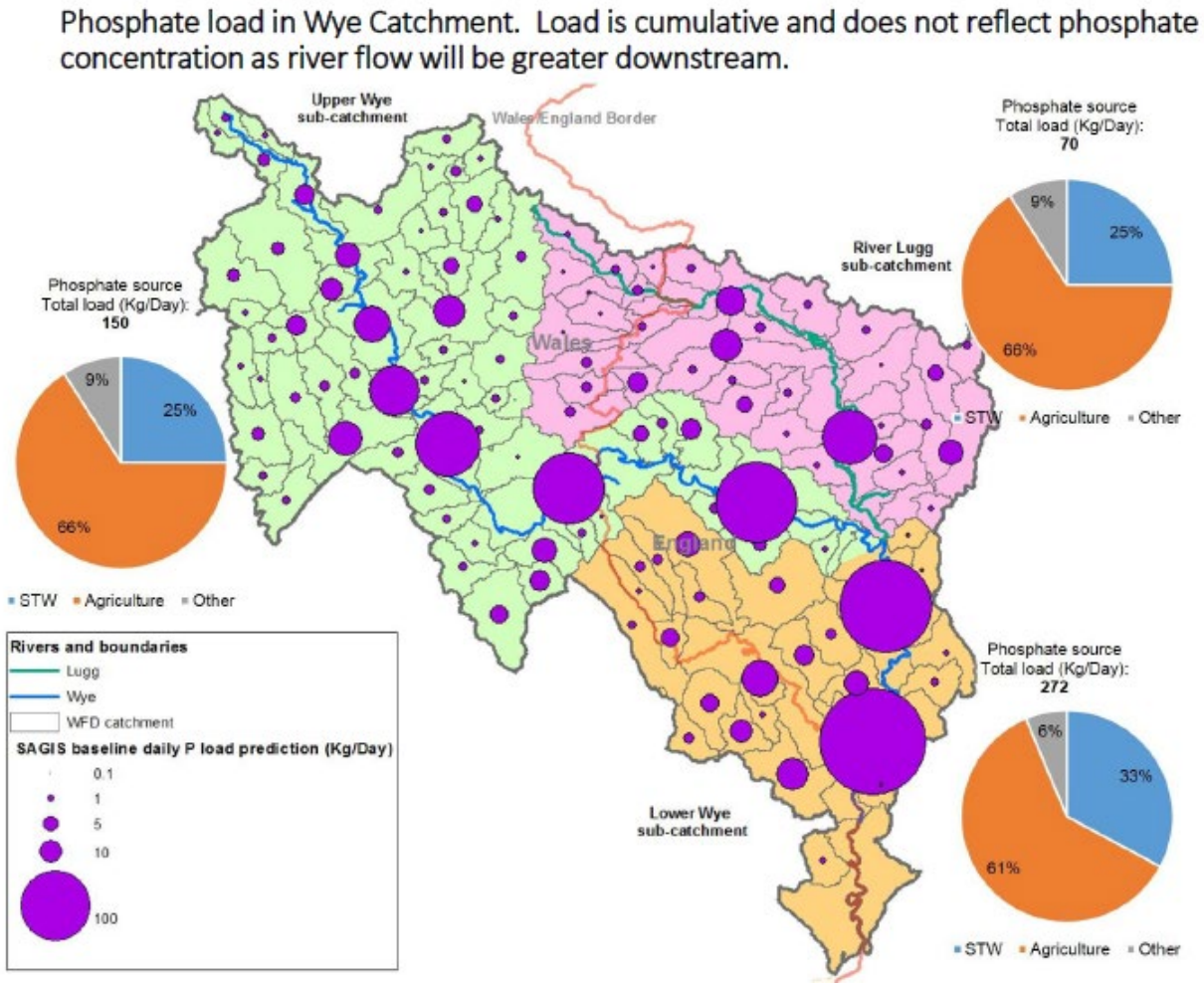

Figure 1: Phosphate load in Wye Catchment.

The Changing Context

This Action Plan does not exist in isolation. There are critical discussions and pieces of work underway across the Defra arms-length bodies and Natural Resources Wales at a national level, the conclusions of which could mean that the Phosphate Action Plan needs to be revised.

River Basin Management Plans
River basin management plans (RBMPs) set out how organisations, stakeholders and communities will work together to improve the water environment. There are 11 River Basin Districts (RBDs) in England and Wales. The Environment Agency manages the 7 RBDs in England. Natural Resources Wales (NRW) manage the Western Wales RBD. NRW and the Environment Agency jointly manage the Dee and Severn RBDs.

There is a recognised issue where targets applied on the lower Wye in Wales by Natural Resources Wales are tighter than those applied on the other side of the river, in England, by the Environment Agency and Natural England. The Environment Agency and Natural England are discussing the targets set for the Wye as a part of the objective setting work for RBMP. If the river targets change, this Action Plan will need to be revised.

Fair share
To date, the starting point for assessing the action required to reduce phosphate levels to targets has been to establish what the proportional reductions are, in line with each sector's contribution, to the overall load of a pollutant. This is in line with Government's general policy principles around the 'polluter pays' and 'fair share'. The expectation is that each sector will reduce their phosphate inputs in proportion to their contributions, so every sector has to make reductions in phosphate entering the catchment. However, the 'fair share' approach is currently being reviewed. If the fair share approach is amended, then this could substantially change the actions that are taken on the river. In addition, amended phosphate limits through the RBMP could mean an update to what is considered fair share for the river.

Judicial Review Consent Order Work
The outcome of this ongoing legal challenge from WWF-UK, The Angling Trust and Fish Legal could influence future iterations of this plan.

Oversight and Engagement

Responsibility for the production of the NMP and its Action Plan and the delivery of its actions sits with the Nutrient Management Board. The Board comprises representatives from Herefordshire Council, Monmouthshire Council, Forest of Dean District Council, Powys and the Brecon Beacons National Park Authority, Dwr Cymru/Welsh Water (DCWW), Natural Resources Wales (NRW), the Environment Agency, Natural England, the Wye and Usk Foundation (WUF), the National Farmers Union (NFU), the Country Land and Business Association (CLA), Farm Herefordshire and the Herefordshire Construction Industry Lobby

Group. The Board is currently chaired by Herefordshire Council. The Board's purpose is to focus specifically on nutrient management within the Wye catchment and enable the different sectors to develop the necessary strategies to secure delivery; ultimately the Board is responsible for the delivery of the plan.

The Action Plan – how it works

This Phosphate Action Plan is subdivided into sections on point sources, diffuse sources, evidence and monitoring and sub-catchment plans. A long list of all the potential practical measures that could reduce phosphate in the River Wye SAC is provided as an Annex to this report. The idea is that if a measure is required for site restoration, it is drawn up from this long list and added into the relevant sub-catchment plan. Sub-catchment plans should be populated with measures that have a defined phosphate reduction figure and are sufficiently certain, thus demonstrating how the target will be met.

Table 1: Example action plan table

Action	**Detail**	**Lead organisation**	**Phosphate reduction**	**Certainty**	**End date**	**Progress**	**Next steps**
Name	*Further description as necessary*	*Named organisation or individual*	*Amount of Phosphate the measure will remove*	*How scientifically and practically certain is the action? Is there a named lead? Can the measure be secured?*	*Date for completion*	*Progress against the action to date.*	*What needs to happen next to progress the action.*
			Running total of reductions against target				

Point Sources

The vast majority of the known point source phosphorus load arises from water company discharges via Wastewater Treatment Works (WwTW). Dwr Cymru - Welsh Water (DCWW) carried out studies to investigate the effectiveness and practicalities of phosphate reduction and other load reducing measures at WwTW and in their sewerage catchments, as a part of AMP6. These studies informed the development of a suite of schemes at various WwTW within the catchment that DCWW proposed to the Water Service Regulation Authority (OFWAT) to form part of their AMP7 programme. Modelling was re-run to support the development of proposals by DCWW to address the point source element as part of their AMP7 (Asset Management Plan) which runs from 2020 to 2025.

DCWW will be investing circa £50m in Phosphorus removal at 11 WwTW during the period 2020-25. Six DCWW WwTW in the catchment have had Phosphorus reduction schemes already (prior to 2020). In combination, the reductions proposed for these works in the 2014 Action plan means that water company discharges have been reduced by their 'fair share'. However, this does not mean that further reductions cannot be made. Fair share is a policy position and is currently being reviewed. The list of sewage works below shows where a phosphate limit will be introduced by 2027 at works that do not currently have a limit on phosphate discharged to surface water. WwTW sites in the catchment that had phosphate removal installed prior to AMP7 (i.e., before 2020) are represented in the table overleaf.

Table 2: Sewage works receiving phosphate limits between 2025 and 2027

WwTW	Regulator	Current P limit (mg/l)	New P limit (mg/l)	In-river load saving (kg/d)	Delivery date
EIGN STW	EA	1	0.40	**12.38**	2025
KINGSTONE & MADELY STW	EA	none	2.00	**1.98**	2025
LEOMINSTER STW	EA	1	0.50	**1.75**	2025
PONTRILAS STW	EA	none	1.80	**1.07**	2025
ROTHERWAS STW	EA	1	0.40	**20.14**	2025
WEOBLEY STW	EA	none	1.50	**2.39**	2025
ABERLLYNFI (THREE COCKS) STW	NRW	none	1.50	**0.33**	2027
BEULAH STW	NRW	none	0.80	**0.29**	2027
BUILTH WELLS STW	NRW	none	2.50	**5.06**	2025
CROSSGATES STW	NRW	none	0.80	**0.78**	2027
DINGESTOW STW	NRW	none	2.00	**0.20**	2027
LLANDEWI YSTRADENNY STW	NRW	none	2.00	**0.20**	2027
LLANDRINDOD WELLS STW	NRW	1.25	0.30	**2.07**	2025
LLANGAMMARCH WELLS STW	NRW	none	1.00	**0.22**	2027
LLANWRTYD WELLS STW	NRW	none	0.30	**0.41**	2027
PRESTEIGNE STW	NRW	none	1.00	**3.11**	2025
RHAYADER STW	NRW	none	0.70	**2.38**	2025
TALGARTH STW	NRW	2	0.60	**1.44**	2027

Point source							
Action	**Detail**	**Lead**	**Phosphate reduction**	**Certainty (RAG)**	**End date**	**Progress**	**Next Steps**
Practical actions							
Improvements to WwTW listed above.			All schemes above will deliver 56.2kg/d		2027		Continue to update NMP on site-by-site progress, and impact of investment programme due to JNCC SAC target assessment.
Ongoing compliance work on trade effluent discharges in the catchment.	Limited number of sites. Talgarth AD plant.	NRW		No details.			
Action	**Detail**	**Lead**	**Phosphate reduction**	**Certainty (RAG)**	**End date**	**Progress**	**Next Steps**
Investigative actions							
DCWW Storm Overflow Assessment Framework (SOAF)	Investigation of highly and frequently spilling discharges from WwTW and Combined Sewer	DCWW		None given, as this is an investigative action.	2025		DCWW will keep TAG informed, with a view to identifying practical actions for inclusion in the Action Plan.

Point source							
	Overflows (CSO's). Over the next 5 years (2020-2025) this programme will use data from the Event Duration Monitor sites to prioritise wastewater assets for investigation, with the aim to reduce both the number and volume of storm water discharges to the environment.						
Investigations into Combined Sewer Overflows and spills in England		DCWW			Not identified		DCWW should report on this to TAG, with a view to identifying practical actions for inclusion in the Action Plan.
Investigation into inputs from septic tanks		Not identified			Not identified		TAG to discuss.

Point source							
Investigation into inputs from Industry		NRW / EA			Not identified		TAG to discuss. Review data to determine actions.
Investigations based on geography i.e. ‘hot spots’.		Not identified			Not identified		TAG to discuss.

Diffuse phosphate sources

Diffuse sources are sources of phosphate that are widespread within the catchment and arise from multiple sites. Each individual source of phosphate may be small however the widespread nature of the sources contributes significant phosphate to the catchment.

Modelling at the present time suggests that a 13-20% reduction in Phosphates from diffuse sources in conjunction with the AMP7 point source reduction measures proposed should achieve the current Phosphate targets for the whole of the Wye SAC in England. In Wales, similar work is underway with DCWW through the AMP process to prioritise and define actions across their assets that will be most effective in reducing phosphate loading. Event Duration Monitoring and permit improvement conditions are other areas of work contributing to the management of phosphate.

Modelling indicates that most of the diffuse phosphate load to the catchment arises from agriculture. The short-term ambition for managing agriculture's contribution is to increase the uptake of targeted mitigation measures and advice to improve soil management, water management and the storage and spreading of organic manures, bio-solids, alongside effective implementation and enforcement.

It is important to be aware of the impact of 'legacy phosphate' in the catchment, which is essentially excess phosphate stored in catchment soils and sediment that will be slowly released over many years and will extend the period between actions to reduce phosphate and measured in-river orthophosphate. Currently unpublished research by Lancaster University has raised issues around the potential impacts of legacy phosphorus in specific soil types. Research shows that the Wye catchment is currently in phosphate surplus by about 2000t P/year (7.7 kg/ha) and therefore continuing to add to legacy phosphate[3].

Regulation and enforcement

The regulatory controls for nutrient management are complex and some aspects differ in Wales and England. The *Environmental Permitting Regulations (England & Wales)* are an existing mechanism for controlling activities that release emissions to land air and water or waste management. This includes discharges to ground or surface waters and includes the recovery to land by landspreading of listed waste materials. It is an offence to cause or knowingly permit the entry of polluting matter to inland freshwaters or coastal waters. Application of biosolids to agricultural land is controlled under the Sludge Use in Agriculture Regulations and the industry Biosolids Assurance Scheme (BAS).

On 1 April 2021 the Welsh Government introduced the *Control of Agricultural Pollution (Wales) Regulations, 2021.* These regulations detail the construction and capacity

[3] RePhOKUS presentation, Lancaster University

standards for the storage of organic manures and silage and set limits and conditions for spreading all fertilising materials containing nitrogen.

From April 2018 all farmers in England have needed to comply with *The Reduction and Prevention of Agricultural Diffuse Pollution (England) Regulations, 2018*, commonly referred to as the 'Farming Rules for Water'. The rules were introduced with a view to reducing agricultural pollution and have standardised good farming practices that many farmers already carry out. They encourage farmers to think about the risk of water pollution, how to keep valuable topsoil on their fields and to apply fertilisers only when it is required. The Environment Agency is the regulator for these rules and ensures farmers comply through an existing targeted programme of work. Farmers in England must also comply with the regulations on *Storing silage, slurry and agricultural fuel oil*, *2018.*

Compliance with existing regulations will need to play a significant role in achieving a 13-20% reduction from agricultural activities. Compliance with any regulation is directly related to the level of enforcement. Regulatory inspections are carried out by the Environment Agency in England and Natural Resources Wales in Wales, but also some regulations are included with industry led Quality Assurance Schemes such as Red Tractor Standards which are also assessed for compliance. Farmers, regulators and assessors are responsible for compliance with regulatory requirements.

Lack of enforcement is an issue and a source of uncertainty. Low levels of enforcement results in uncertainty in compliance rates. Resources will always be an issue for all concerned so additional approaches to traditional enforcement are required and being explored in England and Wales. NRW is developing additional enforcement measures relating to landspreading activities.

NRW is working with Welsh Government and key stakeholders through the Wales Land Management Forum Agricultural Pollution sub-group on alternative approaches to gaining compliance and reducing agricultural pollution, accepting that it cannot be delivered through regulation alone. They are also developing Advice and Guidance, Voluntary Approaches, Investment and Innovation which evidence has shown need to be utilised in combination not isolation of each other. The future agricultural regulation in Wales is currently under review as part of the EU exit programme which is also looking at additional enforcement powers for NRW.

In England, the enforcement of Farming Rules for Water, Nitrate Vulnerable Zones and regulations around the storage of silage, slurry and agricultural fuel oil is the responsibility of the Environment Agency. There is a need for greater funding of officers to carry out inspections. Supporting methods could be used to collect evidence of non-compliance to help target in-person farm inspections. For example, for SSAFO regulations, where there is a need for a national survey of silage and slurry stores, aerial photography could be used to locate and provide some information on the condition of the tanks. The information gathered could then be used to make an initial assessment and identify which farms require a full inspection.

Farm Herefordshire have advised seriously considering whether to take a similar approach on the Lugg to the approach taken on the River Axe[4], where the EA ran a 3-year, £120,000 campaign of regulatory audits. Despite over a decade of advisory visits in the Axe catchment, there had been no significant improvement in farming practices and the river had continued to decline. 95% of farms did not comply with storage regulations and 49% of farms were polluting the river. As a result of these advice-led but regulatory visits, farmers in the catchment made infrastructure investments estimated to total nearly £4 million[5]. A similar approach could be taken in the Wye catchment, which is a similarly high priority work area. The full application of existing regulatory powers might be considered a necessary step before considering the implementation of additional regulation i.e., through a Water Protection Zone.

There are also a number of civil actions under a number of regulatory regimes that could be utilised to protect the Wye. Where damage is occurring a Special Nature Conservation Order (SNCO) and follow-up Stop Notice could be utilised. This provides a strict, regulatory way of stopping damage to a protected European site. They can be used to limit activities both on and near to a European site (SAC or SPA). A SNCO Stop Notice would need to be applied to a specific action and requires approval by the Secretary of State.

Water Protection Zone

If additional regulation is deemed to be necessary, then a Water Protection Zone could be established. This would require polluters to start, stop or limit certain activities. Breaching the requirements of a WPZ is an offence. If the EA wants to implement a Water Protection Zone, a business case would need to be prepared for Defra to show that additional measures to reduce pollution are needed. Each WPZ is bespoke. It might cover a whole catchment or target localised areas. If Defra agrees, a draft WPZ order is produced for public consultation and parliamentary approval. So far, only one WPZ has been designated. The River Dee WPZ was designated in 1999 to control the storage of dangerous substances in the freshwater catchment area to protect drinking water abstractions.

New basic minimum measures enforced by a WPZ could include:

- not leaving land bare over winter,
- mandatory physical buffer strips of semi-natural habitat next to rivers,
- annual calibration of fertiliser spreaders,
- certification of slurry stores,
- no sediment dredging from rivers without consent.

[4] Proposals from Farm Herefordshire to the Nutrient Management Plan Technical Advisory Group, Options to reduce phosphate levels in the Wye Catchment from Diffuse-Agri Sources; July 2020
[5] River Axe N2K Catchment Regulatory Project Report

Voluntary measures – Land Management schemes

In addition to regulatory measures, agricultural practices in the Wye catchment can be positively influenced through advice and voluntary schemes. Increased uptake of further voluntary measures will be required. Non-regulatory measures are not intended as a blanket requirement for all farms but to develop a suite of measures that are specific to the individual farming situation and targeted at the most vulnerable areas. Further work is needed identify the measures, the scale of uptake and where to target them with more confidence, how these can realistically be implemented, over what timescale and the resources required, so that measures can be secured with sufficient certainty in subsequent iterations of this Action Plan.

In England, the most relevant land management scheme is Catchment Sensitive Farming (CSF). CSF is a partnership approach between Defra, the Environment Agency and Natural England that works with farmers and other partners to improve water and air quality in high priority areas. CSF offers farmers free training, advice and support for grant applications. CSF advice seeks to encourage appropriate mitigation options, funded (where appropriate) through the appropriate grant aid e.g., Countryside Stewardship and the new Environmental Land Management Scheme, but is primarily reliant on voluntary uptake.

The Wye is a Catchment Sensitive Farming (CSF) high priority catchment and has had high levels of investment for the last 14 years. The monitoring dashboard indicates that there were 580 CSF visits in 2019. As part of the NMP options appraisal, FARMSCOPER modelling was used to identify possible phosphate reductions for different farming types. Further work is required to increase confidence in the measures and mechanisms required, the resources needed to implement these and the timescale for delivery. This could include some further FARMSCOPER scenario modelling (which can be done using latest FARMSCOPER 4, which is available to anyone).

A key concern with voluntary mechanisms is the lack of confidence in the uptake of measures. A lack of un-biased information on uptake and compliance rates within specific catchments contributes to these uncertainties, for example there is an issue with the accuracy and reliability of self-reporting in farm surveys. Uncertainty in uptake and compliance data leads to further uncertainty in model outputs and predictions. What is certain is that 100% uptake of measures through a solely voluntary scheme is highly unlikely. An uptake of voluntary measures of around 70% within a catchment is considered high through CSF; in a 2016/17 CSF audit the highest implementation rates across the regions studied were 68-69% for Anglian North and Anglian South regions. It is generally agreed that approximately a 20-30% nutrient reduction is the maximum achievable through voluntary measures[6].

To gain a better understanding of uptake and compliance in the Wye catchment, regular checks on a greater number of farms in a catchment should be carried out by trained

[6] Catchment Sensitive Farming Audit 2016-17,WRc for the Environment Agency, October 2017. Report reference UC12569.03.

officers. Monitoring of the level of uptake of advice given by EA, NRW, NE, Farming Connect, WUF, CSF and CFE needs to be undertaken to understand the effect the voluntary approach is having within the catchment. This could be funded through either voluntary agri-environment schemes or government funded regulatory audits/assessments of compliance with regulatory measures. Provision of a greater number of trained officers to provide advice and to collect un-biased information on the level of uptake would be an improvement. Increased funding to incentivise specific measures identified as having both poor uptake and the capability of achieving the greatest reductions in nutrients would also be valuable. One measure with poor uptake and potential for significant nutrient reductions is land use change. This is being considered within the new Environmental Land Management Schemes.

Targeted projects

There have been numerous targeted / specific projects delivered in the Wye catchment.

In Wales, Farming Connect delivered a targeted pollution prevention campaign during 2018/19/20 in NRW priority WFD failing waterbodies. This included the Wye catchment, namely the Ithon, Arran, Llynfi, Ennig and Trothy focussing on nutrient and soil management. Farming Connect held on farm events, hosted local discussion groups, produced e learning, fact sheets and a video on pollution sources and prevention. The Farming Connect Advisory service continues to provide technical advice on a range of subjects including infrastructure and nutrient management to farmers and foresters frequently following NRW inspections.

An NRW, Welsh Government funded Dairy Project is in progress providing infrastructure, silage, slurry and fuel oil improvement plans for individual farms. These reports have a regulatory follow up component. A programme of Poultry and Pig farm Regulatory visits will be undertaken in targeted sub-catchments.

The Wye and Usk Foundation WISE project ran until June 2021, with plans to visit at least 275 farms covering 41,000 hectares of agricultural land in mid Wales: The Wye Ithon Severn Ecosystems (WISE) Project | The Wye and Usk Foundation (wyeuskfoundation.org). Another example is the River Ithon Opportunity Catchment Programme project, which was designed to deliver multiple benefits in this sub-catchment. The Living Wales project on mapping of land-use / geoscience satellite mapping of vegetation change trends and locations to identify nutrient changes may be useful in enabling supplier to farm data, land use data and impacts of farming land use change to be understood.

In England, the Environment Agency continue to use satellite imagery and Lidar data to identify areas of land at high risk from soil run off and contact is made with landowners where necessary to provide advice, guidance and regulatory advice when appropriate. During 2021/22 the Environment Agency provided an additional 60 site visits to farms in the Lugg catchment and to all anaerobic digestion plants in Herefordshire. As a part of ‘Soil

Patrol', all landowners in the Lugg catchment were written to, 164 high risk fields were visited, 29 potential breaches in compliance were identified, and 1 referral was made to the Rural Payments Agency.

Citizen Science Project
Action: We now have six established Citizen Science groups set up across the Wye Catchment. These are: Campaign to Protect Rural England (CPRE), Campaign to Protect Rural Wales (CPRW), Friends of the Upper Wye, Friends of the Lower Wye, Friends of the Lugg, and Wye Salmon Association. Information collected will be used to target action measures within the catchment and in particular actions to reduce phosphate from both point source and agricultural diffuse inputs.
Detail: Monitoring Data is being collected by these groups which includes a standard set of parameters (phosphate, nitrate, conductivity, temperature and turbidity) in a range of locations. Data is being recorded using Epicollect with the intention of sharing data more widely in a centralised way through the Wye Catchment Partnership. In addition, the groups are providing reports (eg recent report on the Dore / Worm catchment by WSA) that will help target resources accordingly.
Lead(s): Elle Von Benzon (Cardiff University), Andrew Osbaldiston (EA), Fiona Groves (WUF)
End date: October / November 2021 from Cardiff Uni however funding will be sought to continue the project into 2022 and beyond.
P reduction: The monitoring will drive the targeting of P reduction measures in priority areas. This will be a combination of regulation, guidance and project driven measures.
Certainty (red, amber, green):
Green for delivery of the project and measures. Amber regarding the certainty of P reduction across waterbodies and would need to be calculated on a case-by-case basis. Green for some P reduction.
Progress: On track.
Next steps: In October / November there will be a meeting to review the data collection and to share best practice / lessons learnt. Funding bid through the Environment Programme and key partners / stakeholders to secure funding for 2022.

Desktop Study - Phosphate treatment of Farm wastes
Action: This project is to establish innovative approaches to reducing phosphate losses from agricultural sources. Specifically, supporting field trials and investigating the feasibility of technology for stripping phosphate from agricultural slurries and manures. Information will feed into the wider strategic catchment partnership including the NMP Board and will be used for a range of phosphate modelling scenarios across the catchment, providing greater certainty of the measures.
Detail: Discussions are underway with a number of organisations / businesses including AVARA regarding potential treatment processes eg pyrolysis for the treatment of farm wastes. This also includes the wider benefits of energy production and carbon capture as part of the treatment process. This is being made possible by freeing up some resource enabling WUF to steer and facilitate some of these discussions. An outcomes paper will be produced identifying what can potentially be achieved and how much benefit this can provide for P reduction in the catchment.

Leads: Andrew Osbaldiston (EA), Kate Speke Adams (WUF)
End date: March 2022
Certainty (red, amber, green): Green for project delivery, amber for the effectiveness of large scale take up of the method / technology
Progress: On track

Farm trial to produce "Johnson-Su compost" at Townsend Farm, Brampton Abbots, Herefordshire
Action: This project is to establish a sustainable method to unlock Legacy Phosphate in soils, initially at Farm scale prior to wider engagement and potential wider coverage at a catchment scale. EA have part funded a trial at Townsend Farm, Ross on Wye, to establish the effectiveness of the treatment system that will be demonstrated and promoted more widely with the support of the Wye and Usk Foundation.
Detail: A pilot plant is under construction to produce Johnson-Su compost that effectively creates an enzyme that will free up legacy P in soils therefore allowing phosphate levels to be run down within the catchment. On site farm trials will be run and demonstrated more widely to show the effectiveness of this method which, together with other regenerative farming techniques, enables the nutrients in soils (phosphate) to become more readily available to crops without the need for additional manufactured fertilizers being added.
Leads: Ben Taylor Davies (Townsend Farm), Andrew Osbaldiston (EA), Kate Speke Adams (WUF)
End date: March 2022 although funding bid in place to develop the coordination and demonstration of best practice through 2022 and beyond
Certainty (red, amber, green): Green for project delivery, amber for the effectiveness of large scale take up of the method / technology
Progress: On track
Next steps: Demonstrator event(s) and implementation more widely

Integrated NFM / Working with Natural Processes

- Herefordshire Wye and Lugg Integrated NFM
- Yazor Brook
- Wellington Brook
- Dore
- Garren / Gamber
- Valley Brook

Diffuse							
Action	**Detail**	**Lead**	**End date**	**Phosphate reduction**	**Certainty (RAG)**	**Progress**	**Next steps**
Thinking actions							
Certainty from voluntary actions / farm advice	TAG to consider how much 'certainty' can be attributed to voluntary actions.						TAG to discuss.
Legacy phosphate	Consider outcomes of RePhokUS project and implications.						TAG to seek update.
Water Protection Zone	EA to lead thinking on whether a Water Protection Zone is required.	EA					EA to lead discussion at TAG.
Desk study into Phosphate treatment of Farm wastes	This project is to establish innovative approaches to reducing phosphate losses from agricultural sources. Specifically, supporting field trials and investigating the feasibility of technology for stripping phosphate	Andrew Osbaldiston (EA), Kate Speke Adams (WUF)	March 2022			On track.	An outcomes paper will be produced identifying what can potentially be achieved and how much benefit this can provide for P reduction in the catchment.

Diffuse							
	from agricultural slurries and manures. Information will feed into the wider strategic catchment partnership including the NMP Board and will be used for a range of phosphate modelling scenarios across the catchment, providing greater certainty of the measures.						
Action	**Detail**	**Lead**	**End date**	**Phosphate reduction**	**Certainty (RAG)**	**Progress**	**Next steps**
Evidence actions							
Evidence review	Review existing evidence and define what further work is required.						TAG to discuss whether this has value and should be commissioned.
Farmscoper runs	Consider whether re-runs of farmscoper would add value.						TAG to discuss.

Diffuse							
NRW project to review and map all known data – WQ, farms, discharges.	Review and map all known data – WQ, ecological, agricultural data (livestock numbers) permitted discharges/deploy ments, Biosolids notifications to prioritise work programme.	NRW	March 2021				NRW to provide an update to TAG.
CSF review	Project to increase understanding of the successes, shortcomings of CSF, and future opportunities. Quantify reductions from CSF, list measures that reduce P, rank certainty, forecast future reductions from CSF.	NE / EA / WUF					NE / EA / WUF to discuss. Work may need to be commissioned.
Groundwater /surface water abstractions	Assess potential to effect base flow and dilution of discharges. Need to consider whether there would be any benefits of dilution	NRW/EA					

Diffuse							
	and changing licences.						
Citizen science	There are six citizen science projects in the Wye catchment.	Elle Von Benzon (Cardiff University), Andrew Osbaldiston (EA), Fiona Groves (WUF)	October / November 2021 from Cardiff Uni however funding will be sought to continue the project into 2022 and beyond.	Evidence project will not lead to reductions but is expected to lead to improved enforcement and targeted practical projects.			In October/ November 2021 there will be a meeting to review the data collection and to share best practice / lessons learnt. Funding bid through the Environment Programme and key partners / stakeholders to secure funding for 2022.
Action	**Detail**	**Lead**	**End date**	**Phosphate reduction**	**Certainty (RAG)**	**Progress**	**Next steps**
Practical projects							
Farming Connect: Review of catchments and priorities	Targeted pollution prevention campaign phase 2	NRW/ Farming Connect	March 2021				Farming Connect to report on this to TAG. Future targeted catchments to input to this Plan.

Diffuse							
NRW: Targeted farm inspection programme	Dairy project, Poultry/pig farm visits. Ithon Opportunity Catchment Partnership Programme.	NRW	Funded until March 2022.			Dairy project likely to morph into staff that enforce the Control of Agri Pollution (Wales Act)	NRW to report on this to TAG.
Herefordshire Wye and Lugg Integrated Natural Flood Management (NFM)	A significant number of NFM measures have been and continue to be delivered across the Wye and Lugg Priority Catchments	EA / Herefordshire Council	March 2022 and beyond	Reduces P in catchments by reducing run-off of P laden soil. Would need to be calculated on a case-by-case basis.	Green if P reduction can be calculated.	Significant progress to date.	Business case being developed for six-year funding (FCRM programme). Best practice to be shared.
Farm trial to produce "Johnson-Su compost" at Townsend Farm, Brampton Abbots, Herefordshire	This project is to establish a sustainable method to unlock Legacy Phosphate in soils, initially at Farm scale prior to wider engagement and potential wider coverage at a catchment scale. EA have part funded a trial at Townsend Farm,	Ben Taylor Davies (Townsend Farm), Andrew Osbaldiston EA, Kate Speke Adams (WUF)	March 2022 although funding bid in place to develop the coordination and demonstration of best practice through 2022 and beyond.	Would need to be calculated.	Green if P reduction can be calculated.		Demonstrator event(s) and implementation more widely.

Diffuse							
	Ross on Wye, to establish the effectiveness of the treatment system that will be demonstrated and promoted more widely with the support of the Wye and Usk Foundation.						
Action	**Detail**	**Lead**	**End date**	**Phosphate reduction**	**Certainty (RAG)**	**Progress**	**Next steps**
Other diffuse sources							
Identify highways acting as diffuse pollution pathways and consider potential interventions		Local Authorities					Set this out as a project, with a clear strategy, timeframes and identified lead.

Evidence and Monitoring

There are three main types of monitoring:

- Surveillance: designed to assess general environmental trends or patterns, with no specific targets. Surveillance sites are often monitored long-term and at higher frequency than other types of monitoring.
- Monitoring: where a series of measurements are taken with the aim of comparing them to a specific target. This is used for compliance reporting and to identify whether a problem exists;
- Investigations: these are generally time-limited pieces of work designed to diagnose the causes of failures detected by monitoring or by incident reports, and to identify a suitable course of action.

Monitoring data is collated by the EA and NRW and phosphate levels and trends are reported on the River Wye dashboard. The Dashboard provides data from several sectors including housing development, water undertaker compliance with phosphate limits on their discharges and number of pollution incidents from soil run off in the Wye catchment. The data is updated after April every year, when the figures for the previous calendar year are made available. The primary purpose of this dashboard is to provide information to the Board. For interested members of the public a useful source of information can be found on the Catchment Data Explorer - https://environment.data.gov.uk/catchment-planning/.

Monitoring data will feed into future iterations of this Action Plan and allow an assessment of potential headroom made available as measures take effect. This sampling data will also provide the measure of compliance with the Favourable Conservation Status of the SAC.

Wales

NRW supports several surveillance sites within the Wye catchment, all of which have co-located water quality and biological data. The Afon Gwy Upland Waters Monitoring Network site lies in the Upper catchment and is part of a network of sites targeted at monitoring recovery from acidification. Llangorse Lake, which historically suffered from severe sewage pollution, is also a surveillance site. Finally, NRW operates the Environmental Change Network.

NRW monitors phosphorus at more than 50 sample points in the Wye and its tributaries in Wales. These provide an effective overall picture of phosphorus concentrations in different water bodies across the upper part of the catchment, as recently described by Hatton-Ellis & Jones (2021). Although NRW is facing pressure to its monitoring budget, SAC water bodies – including the Wye – receive priority. As well as monitoring phosphorus, NRW recognises the importance of monitoring other water quality parameters linked to nutrient pollution, notably biochemical oxygen demand (BOD) and ammonia. NRW also recognises the importance of monitoring ecological responses to high nutrient levels, for example by monitoring diatoms and other algae and invertebrates. Finally, rivers differ in their resilience to nutrient pressures depending on other stressors, notably hydromorphology (habitat

structure) and NRW therefore intends to collect data on this so that we can assess areas where poor habitat structure is likely to aggravate the effects of nutrient failures.

NRW has set targets for the Wye following the most recent JNCC Guidance (JNCC 2016). These targets are published in our SAC Core Management Plan for the Wye (NRW 2017).

England

The Environment Agency has a water quality surveillance sampling programme in place to monitor the Phosphate levels within the SAC at 3 points of interest; the River Wye at Carrots Pool and Holme Lacy Bridge, and the River Lugg at Mordiford Bridge. Phosphate levels are monitored on a monthly basis and this data is used primarily to track Phosphate levels and monitor progress of the plan's objectives. There are also other locations within the catchment where phosphate levels are regularly monitored.

In June 2020, the Environment Agency carried out a review of phosphate monitoring in the River Wye catchment and concluded that the existing monitoring was appropriate. It would not be possible to maintain a large network of sample sites utilising traditional chemical sampling techniques. However, moving forwards, this programme will be supplemented with more agile monitoring, directed to areas of highest priority. This will include utilising more agile methods of monitoring and investigations such as targeted use of phosphate sondes, remote sensing and algal surveys. The programme will aim to use all the data sources available from statutory bodies and partner organisations to identify and fill remaining gaps in evidence.

Additional investigative monitoring will be employed where a more detailed assessment is required in order to identify sources and target measures. This could include 'spot-sampling' of orthophosphate to look at relative concentrations across a sub-catchment or could involve the deployment of sondes with phosphate probes or in order to identify areas of increased run-off through the use of turbidity probes.

Monitoring							
Action	**Detail**	**Lead organisation**	**Target end date**	**Phosphate reduction**	**Certainty**	**Progress**	**Next steps**
RBMP working group to agree targets across Wales and England.	Being discussed as a part of the River Basin Management Plan review.	NRW / EA / NE	Autumn 2021				NRW / EA / NE to report to TAG.
Agree monitoring requirements, ensuring consistency across Wales and England.		NRW / EA / NE					

Sub-catchment plan – Upper Wye

The Upper Wye above Rhayader is meeting its orthophosphate targets. All of the middle Wye tributaries, the remaining Irfon and Ithon and the Llynfi failed to meet their targets. The most significant failures were the Wye near Newbridge, the Cammarch, Clettwr Brook, Mithil Brook, lower Irfon, Garth Dulas and the three water bodies in the Llynfi catchment. Failing waterbodies in Wales can be found in the NRW SAC Phosphate Compliance Report at: Natural Resources Wales / Compliance Assessment of the River Wye SAC Against Phosphorus Targets.

In England, the River Wye achieves its target along most of its length. The most upstream site for EA monitoring at Bredwardine Bridge is very close to the target. From here there is a reduction in orthophosphate at the next downstream site at Sollars Bridge from where it increases gradually down the course of the river until the target is exceeded at Hoarwithy Bridge (downstream of the Lugg confluence). Orthophosphate levels then gradually reduce along the length of the Wye.

Generic actions:

- Need for river restoration work along main river and tributaries to reduce pollution risk and ecological resilience;
- Identify potential problem point sources and loading discharging to the river network including DCWW, private works, septic tanks, Combined Sewer Overflows, agricultural units, anaerobic digester plants;
- Encourage natural flood management and natural flooding including creation of floodplain meadows,
- Identify sources discharging to ground including septic tanks, land spreading etc.
- Identify and tackle pathways of runoff from land;
- Target work by sub-catchments based on phosphates evidence report but also taking into account other relevant evidence.
- Where large changes to farming practice are occurring, use catchment officers to approach farmers and encourage changes to farm design, including much wider buffer strips, interception ponds to trap runoff and slow flow etc.
- Ditch blocking and wetland restoration to increase baseflows.

Upper Wye actions							
Action	**Detail**	**Lead**	**Target end date**	**Phosphate reduction**	**Certainty**	**Progress**	**Next Steps**
Monitor levels at Marteg.		NRW					
Ensure agriculture at Marteg is compliant with regulations.		NRW					
Investigate failures / problems at Newbridge and take appropriate action.		NRW			Could lead to projects which then have some certainty.		
Investigate whether reservoir discharges can be modified to flush algae.		NRW			Could lead to projects which then have some certainty.		
Consider delivery of liming at Elan.		WUF / NRW			Could lead to projects which then have some certainty.	WUF have not been able to progress this due to delay in SAF funding from NRW.	
Consider opportunities for wetlands.					Could lead to projects which then have some certainty.		

Sub-catchment plan – River Ithon

About half of the River Ithon is meeting its orthophosphate targets. Failing waterbodies in Wales can be found in the NRW SAC Phosphate Compliance Report at: Natural Resources Wales / Compliance Assessment of the River Wye SAC Against Phosphorus Targets.

Generic actions:

- Need for river restoration work along main river and tributaries to reduce pollution risk and ecological resilience;
- Identify potential problem point sources and loading discharging to the river network including DCWW, private works, septic tanks, Combined Sewer Overflows, agricultural units, anaerobic digester plants;
- Encourage natural flood management and natural flooding including creation of floodplain meadows,
- Identify sources discharging to ground including septic tanks, land spreading etc.
- Identify and tackle pathways of runoff from land;
- Target work by sub-catchments based on phosphates evidence report but also taking into account other relevant evidence.
- Where large changes to farming practice are occurring, use catchment officers to approach farmers and encourage changes to farm design, including much wider buffer strips, interception ponds to trap runoff and slow flow etc.
- Ditch blocking and wetland restoration to increase baseflows.

River Ithon actions							
Action	**Detail**	**Lead**	**Target end date**	**Phosphate reduction**	**Certainty**	**Progress**	**Next Steps**
Opportunity catchment work, including tackling bank erosion and lack of instream habitat diversity.	WUF completing opportunity mapping for Ithon by end of July 2021 (HLF funded).				Could lead to projects which then have some certainty.		NRW to update TAG.
Encourage natural flood management and natural flooding including creation of floodplain meadows.	WUF completing opportunity mapping for Ithon by end of July 2021 (HLF funded).	NRW / WUF			Could lead to projects which then have some certainty.		NRW and WUF to discuss.
Identify sources discharging to ground, including septic tanks, landspreading etc.	WUF have completed SCIMAPs for Ithon.				Could lead to projects which then have some certainty.		NRW and WUF to discuss how best to utilise information.
Identify areas where large changes to farming practice are occurring, use catchment officers to approach farmers and encourage changes	WISE project already delivered in Ithon, need to ensure engagement is understood and shared.				Could lead to projects which then have some certainty.		WUF to speak to NRW.

River Ithon actions							
to farm design, including much wider buffer strips, interception ponds to trap runoff and slow flow etc.							

Sub-catchment plan – River Irfon

Two water bodies in the Irfon are achieving their orthophosphate targets. The remainder is failing, with significant failures in the lower Irfon. Failing waterbodies in Wales can be found in the NRW SAC Phosphate Compliance Report at: Natural Resources Wales / Compliance Assessment of the River Wye SAC Against Phosphorus Targets.

Generic actions:

- Need for river restoration work along main river and tributaries to reduce pollution risk and ecological resilience;
- Identify potential problem point sources and loading discharging to the river network including DCWW, private works, septic tanks, Combined Sewer Overflows, agricultural units, anaerobic digester plants;
- Encourage natural flood management and natural flooding including creation of floodplain meadows,
- Identify sources discharging to ground including septic tanks, land spreading etc.
- Identify and tackle pathways of runoff from land;
- Target work by sub-catchments based on phosphates evidence report but also taking into account other relevant evidence.
- Where large changes to farming practice are occurring, use catchment officers to approach farmers and encourage changes to farm design, including much wider buffer strips, interception ponds to trap runoff and slow flow etc.
- Ditch blocking and wetland restoration to increase baseflows.

River Irfon actions							
Action	**Detail**	**Lead**	**Target end date**	**Phosphate reduction**	**Certainty**	**Progress**	**Next Steps**
Need for river restoration work along main river and tributaries to reduce pollution risk and ecological resilience.	Afonydd Cymru manage river restoration activities under the Fisheries Habitat Restoration Plan.				Could lead to projects which then have some certainty.		NRW to meet with WUF to discuss a programme of restoration across Wales.

Sub-catchment plan – Middle Wye including Tributaries (Builth Wells to Boughrood)

Failing waterbodies in Wales can be found in the NRW SAC Phosphate Compliance Report at: Natural Resources Wales / Compliance Assessment of the River Wye SAC Against Phosphorus Targets.

Generic actions:

- Need for river restoration work along main river and tributaries to reduce pollution risk and ecological resilience;
- Identify potential problem point sources and loading discharging to the river network including DCWW, private works, septic tanks, Combined Sewer Overflows, agricultural units, anaerobic digester plants;
- Encourage natural flood management and natural flooding including creation of floodplain meadows,
- Identify sources discharging to ground including septic tanks, land spreading etc.
- Identify and tackle pathways of runoff from land;
- Target work by sub-catchments based on phosphates evidence report but also taking into account other relevant evidence.
- Where large changes to farming practice are occurring, use catchment officers to approach farmers and encourage changes to farm design, including much wider buffer strips, interception ponds to trap runoff and slow flow etc.
- Ditch blocking and wetland restoration to increase baseflows.

Sub-catchment plan – Llynfi and Hay tributaries

This part of the catchment is failing. Three water bodies in the Llynfi catchment are significantly failing their orthophosphate targets. Failing waterbodies in Wales can be found in the NRW SAC Phosphate Compliance Report at: [Natural Resources Wales / Compliance Assessment of the River Wye SAC Against Phosphorus Targets]

Generic actions:

- Need for river restoration work along main river and tributaries to reduce pollution risk and ecological resilience;
- Identify potential problem point sources and loading discharging to the river network including DCWW, private works, septic tanks, CSOs, agricultural units, AD plants;
- Encourage natural flood management and natural flooding including creation of floodplain meadows,
- Identify sources discharging to ground including septic tanks, land spreading etc.
- Identify and tackle pathways of runoff from land;
- Target work by subcatchments based on P evidence report but also taking into account other relevant evidence.
- Where large changes to farming practice are occurring, use catchment officers to approach farmers and encourage changes to farm design, including much wider buffer strips, interception ponds to trap runoff and slow flow etc.
- Ditch blocking and wetland restoration to increase baseflows.

Llynfi and Hay tributaries actions							
Action	**Detail**	**Lead**	**Target end date**	**Phosphate reduction**	**Certainty**	**Progress**	**Next Steps**
Reduce nutrient inputs into Llangorse Lake; restore the inflow and outflow to encourage nutrient deposition on floodzones.					Unknown.		Discuss at TAG.

Sub-catchment plan – River Lugg

The River Lugg in Wales achieves mainly 'good' Water Framework Directive status for Soluble Reactive Phosphorous with only the Norton Brook at 'poor' status (2016-2018 data). The highest mean values occur in the lower reaches of the Lugg, but results suggest that even at the most upstream monitoring point in England orthophosphate levels significantly exceed the target.

In both the Upper Wye sub-catchment and the Lugg sub-catchment, source apportionment modelled analysis suggests that 25% of the total Phosphate load comes from Wastewater Treatment Works, 66% from agriculture and 9% from other sources. DCWW AMP 7 improvements will be completed between 2020 – 2024 and these percentages will change slightly to 67% agriculture, 23% sewage treatment works and 10% other. In the Lower Wye sub-catchment, 33% is from WWTW, 61% from agricultural sources with 6% other[7]. The other sources include highway discharges, industry and intermittent sewage discharges (which includes combined sewer overflows). Much of the Wye catchment is rural and until recently has been predominantly farmed for sheep and beef cattle. More recently there has been a rapid expansion of chicken farms and pig production.

Post PR19 – Fully Permitted Scenario[8]

- Target Concentration of 0.05mg/l is only predicted to be breached at the Mordiford Bridge sample point
- Predicted concentration = 0.055mg/l
- The predicted load at this location is 67.529kg/d compared with a target load based on the CSMG target of 0.05mg/l and flow of 1362Ml/d of 66.400kg/d
- Load to be removed after sewage works fair share has been achieved = **1.129kg/d**
- Agriculture as a whole appears to be responsible for approx. 90% of this remaining deficit. Load removal from agriculture to ensure compliance with the CSMG = 2.5kg/d which is 5.5% of current agricultural load.
- This represents a fully permitted PR19 scenario. Providing any growth can be accommodated within permitted headroom, we would expect this to be a worst-case scenario.

Next steps:

- TAG needs to explore additional measures that could be employed to reduce phosphate in the Lugg. The long list of measures in annex 1 can be referred to.
- Statutory agencies and other partners need to agree an appropriate safeguarding buffer, i.e., to overshoot the target to allow some flexibility. For example, in the Solent catchment an additional 20% is added on to nutrient neutrality proposals.

[7] Evidence Review - Phosphate in the Wye/Lugg SAC Catchment. Environment Agency & Natural England, June 2020.
[8] Nutrient Management Plan Technical Advisory Group summary paper on updating the NMP Action Plan, June 2020

River Lugg actions							
Action	**Detail**	**Lead organisation**	**Target end date**	**Phosphate reduction**	**Certainty**	**Progress**	**Next Steps**
Practical actions							
Integrated wetlands.	Herefordshire Council is investigating integrated wetlands to provide additional treatment below WwTWs.	Herefordshire Council		The Percentage of the reduction to be reserved for in river benefits has not yet been agreed.	High – Good level of scientific certainty around P removal. Good certainty around delivery as planning permission required.		Herefordshire Council to continue to progress.
Action	**Detail**	**Lead organisation**	**Target end date**	**Phosphate reduction**	**Certainty**	**Progress**	**Next Steps**
Thinking actions							
Strategic assessment of potential Phosphorus reduction interventions in the River Lugg catchment.	To take national datasets and map them against WUF data held at farm level, to try and identify and prioritise practical measures on the ground. To include a range of measures. This is a first attempt to try and see if on the ground knowledge can be mapped and	WUF/Herefordshire	Complete and submitted to Hereford.			Provided to HC on the understanding it is for internal use only due to the nature of the information. To assist with projects to target diffuse pollution.	Herefordshire Council & WUF to lead discussion at TAG.

River Lugg actions							
	used to drive strategic change.						
What further reduction options are there? Refer to shopping list.	List voluntary measures that reduce phosphate, quantify reduction, rank their certainty.	NE / EA / WUF	April 2021				Discuss at TAG.

Sub-catchment plan – Lower Wye

Generic actions:

- Need for river restoration work along main river and tributaries to reduce pollution risk and ecological resilience;
- Identify potential problem point sources and loading discharging to the river network including DCWW, private works, septic tanks, CSOs, agricultural units, AD plants;
- Encourage natural flood management and natural flooding including creation of floodplain meadows,
- Identify sources discharging to ground including septic tanks, land spreading etc.
- Identify and tackle pathways of runoff from land;
- Target work by subcatchments based on P evidence report but also taking into account other relevant evidence.
- Where large changes to farming practice are occurring, use catchment officers to approach farmers and encourage changes to farm design, including much wider buffer strips, interception ponds to trap runoff and slow flow etc.
- Ditch blocking and wetland restoration to increase baseflows.

Next steps

- NRW/EA/NE to keep TAG and NMP Board informed regarding river targets review.
- NRW/EA/NE to lead discussion at TAG on river monitoring programme.
- DCWW to lead discussion at TAG on Combined Sewer Overflows.
- TAG to discuss projects around inputs from septic tanks, inputs from industry, and hot spot localities. NRW & EA to provide data.
- TAG to discuss regulatory enforcement in the catchment and how it can be improved. Input from NRW & EA.
- TAG to consider how much 'certainty' can be attributed to voluntary actions such as land use change / on farm action, for next review of this Action Plan.
- TAG to consider whether there would be value in farmscoper re-runs and who could undertake them.
- TAG to discuss the value of a project to establish successes and failures from voluntary mechanisms e.g., CSF. This may need to be commissioned by Defra, to access data held by the Rural Payments Agency.
- TAG to seek update on RePhOKUS project.
- Farming Connect to update TAG on its catchments and priorities.
- NRW to update TAG on its targeted farm inspection programme.
- LPA's to consider a project around diffuse inputs from Highways.
- NRA & EA to lead discussion on relationship base flows, dilution, and surface/ground water abstractions to water quality in the catchment.
- EA/NE and other partners need to agree an appropriate safeguarding buffer for the River Lugg, i.e., to overshoot the target to allow some flexibility.
- Herefordshire Council to keep TAG informed of progress on integrated wetlands.
- Herefordshire Council and WUF to lead discussion at TAG on potential interventions in the Lugg catchment.
- NRW to monitor levels at Marteg and undertake regulatory enforcement.
- NRW / DCWW to investigate issues at Newbridge and establish actions.
- NRW to lead discussions around the best options for the Upper Wye.
- NRW & WUF to update TAG on River Ithon opportunity catchment work.
- Sub-catchment plans to be worked up.

Annex: Long list of practical measures for phosphate reduction

This section lists all the potential practical measures that could reduce Phosphate in the River Wye SAC. If a measure is required for site restoration, then it can be added into the relevant section of the action plan e.g., the relevant sub-catchment plan. Catchment scale action plans should be populated with measures that have a definable P reduction figure and are considered sufficiently certain.

Point source actions				
Measure	**Detail**	**P reduction**	**Certainty**	**Source / Further information**
Project to list and rank possible additional actions.				
Increased treatment of effluent	Through improvements planned and funded through Periodic Review process.	Would need to be calculated on a case by case basis.	High scientific and practical certainty.	
Foul water inception wetlands	Wetlands can be deployed either “in catchment” to remove phosphorous from surface runoff or stream flow, or to remove phosphorous from final effluent at WwTWs or package treatment plants.	Would need to be calculated on a case by case basis. The main phosphorous removal mechanisms in wetlands are sedimentation of particulate phosphorous, sorption (binding) of dissolved phosphorous to sediment and plant uptake of bioavailable	Wetlands integrated into WwTW have high scientific and practical certainty Assuming maintenance requirements can be secured in perpetuity, wetlands provide a very promising mitigation option that can provide significant reductions in	Stage 2 Mitigation report, Ricardo 2021

Point source actions				
		phosphorous (Kadlec & Wallace, 2008). Reviews of wetland studies have reported median removal rates of around 60% of the inflow phosphorous concentrations for urban wetlands (Strecker, et al., 1992; Shatwell & Cordery, 1999) and 46% for wetlands with a variety of sources of water (Land, et al., 2016).	phosphorous loading to the Wye SAC.	
Diverting surface water flows away from the sewage network	E.g., retrofitting SuDS	Would need to be calculated on a case-by-case basis.	Assumed high practical certainty, as it would be funded and secured.	
Addressing misconnections	This could be an important action.	Difficult to forecast. Might be possible on a case-by-case basis.	Assumed high practical certainty, as it would be funded and secured. More misconnections in the future. Outside of anyone's	

Point source actions				
			control / private occupiers.	
Reducing leakage from foul sewerage network		Difficult to forecast. Might be possible on a case-by-case basis.	Assumed high practical certainty, as it would be funded and secured. More leaks in the future.	
Reducing leakage from potable water supply	Most relevant where abstraction is an issue.	Difficult to forecast. Might be possible on a case-by-case basis.	Assumed high practical certainty, as it would be funded and secured. Likely to be more leaks in the future.	
Highways	Further work required to quantify action.			

On-farm actions				
Measure	**Detail**	**P reduction**	**Certainty** (an initial assessment only)	**Source / Further information**
Continued enforcement of regulations including Farming Rules for Water introduced in 2018		Further work is required to establish P reduction	Regulation so enforceable	
Regulatory controls on agricultural phosphorus		Further work is required to establish P reduction	Regulation so enforceable	

On-farm actions				
Concrete yard renewal	Mid-tier capital option, code RP15	Uptake of measures cannot be forecast. Phosphate reduction across catchment cannot be forecast, but case by case assessment may be possible.	Funded and more permanent due to being concrete.	
Sediment ponds and traps	Mid-tier capital option, code RP7	As above	Funded, which gives higher confidence. Features are likely to have a degree of permanence in the landscape. Management can be secured.	
Do not apply P fertilisers to high P index soils	This could have greater impact & certainty as is a legal requirement that currently lacks enforcement.	Potential.	Potential.	
Roofing (sprayer washdown, manure storage, livestock gathering, slurry stores and silage stores)	Mid-tier capital option, code RP28	As above	Funded, which gives higher confidence. Likely to have a degree of permanence as involves infrastructure. But could be changed in the future without input.	

On-farm actions				
Check dams	Mid-tier capital option, code RP12	As above		
Cross drains	Mid-tier capital option, code RP5	As above	Possibly better permeance due to involving infrastructure.	
Earth banks and soil bunds	Mid-tier capital option, code RP5	As above	Possibly better permeance due to involving earthworks, therefore more difficult to change.	
Piped culverts in ditches	Mid-tier capital option, code RP6	As above	Possibly better permeance due to involving infrastructure.	
Livestock trough pipework	Mid-tier capital option, code LV8	As above	Possibly better permeance due to involving infrastructure.	
Rainwater goods	Mid-tier capital option, code RP16	As above	Possibly better permeance due to involving infrastructure.	
Hard bases for livestock drinkers / feeders	Mid-tier capital option, code LV3/4	As above	Possibly better permeance due to involving infrastructure.	
Gateway relocation	Mid-tier capital option, code RP2	As above	Funded, which gives higher confidence. But easy to change and could be changed in the future without input.	
Livestock tracks	Mid-tier capital option, code RP4	As above	Possibly better permeance due to involving infrastructure. But could be	

On-farm actions				
			changed in the future without input.	
Pasture pumps	Mid-tier capital option, code LV5	As above	Possibly better permeance due to involving infrastructure. But could be changed in the future without input.	
Ram pumps	Mid-tier capital option, code LV6	As above	Possibly better permeance due to involving infrastructure.	
Arable reversion to absorb nutrients in flood water	Also need to be aware of nutrient/manure displacement. Any manure applied to land before reversion would be displaced to another site within the catchment.	As above	Would need to think about how to secure.	
Site solid mature heaps away from watercourses / field drains		As above	Possibly better permeance due to involving infrastructure.	
Do not apply manure to high-risk areas		As above	Would need to think about how to secure.	
Fence off rivers and streams from livestock		As above	Possibly better permeance due to involving infrastructure.	
Promote uptake of rainwater harvesting		As above	Possibly better permeance due to involving infrastructure.	

On-farm actions				
Reducing the intensity of agricultural production		As above	Would need to think about how to secure.	
Transporting excess phosphorous from dairy farms to arable farms		As above	Would need to think about how to secure.	
Livestock troughs	Mid-tier capital option, code LV7	As above	Easy to move.	
Make available compost to improve soil condition		As above	Not permanent.	
Do not spread FYM to fields at high risk times		As above	Not permanent.	
Establish cover crops in Autumn		As above	Not permanent.	
Leave autumn seedbeds rough		As above	Not permanent.	
Manage over-winter tramlines		As above	Not permanent.	
Use a fertiliser and manure nutrient supply		As above	Not permanent.	
Move feeders at regular intervals		As above	Not permanent.	

Land-use change				
Measure	**Detail**	**P reduction**	**Certainty**	**Source / Further information**
Agricultural land abandonment and woodland planting /	The main reductions in phosphorous leaching to the	Varies considerably, would need to be calculated	• Good potential but on a case-by-case basis	Stage 2 Mitigation report, Ricardo 2021

Land-use change				
reversion to semi-natural habitat	environment from agricultural land abandonment come from halting fertiliser applications and removing animal waste inputs. However, there is the risk of nutrients being spread elsewhere in catchment. If land is being purchased, reversion to woodland or other semi-natural habitats, including orchards, can be used to secure the conversion from agricultural use. Woodland planting or facilitating the reestablishment of semi-natural vegetation cover may also increase phosphorous uptake in the short-term.	on a case-by-case basis.	• Would require monitoring to determine short-term reductions in phosphorous export • Maintenance agreements would be required and need to be secured contractually to cover the mitigation scheme in perpetuity.	
Woodland creation or	One of the main benefits of woodland	Woodland planting on agricultural land	Low potential in its own right, however the	Stage 2 Mitigation

Land-use change				
semi-natural reversion	planting is that it makes the cessation of intensive agriculture and associated P inputs more permanent and easier to monitor.	could accelerate the transition back to more natural soil phosphorous export, however there is uncertainty around the time taken for tree planting to reduce phosphorous loading from natural levels and different studies have reported increases, decreases and no effect of afforestation on total phosphorous in soils (Deng, et al., 2017). … It should be noted that woodland planting or semi-natural revegetation have large uncertainties associated with scale of reductions in phosphorous loadings it can achieve.	main benefits are around ceasing the existing inputs rather than through the trees themselves.	report, Ricardo 2021
Wetland creation	Wetlands can be deployed either “in	Reviews of wetland studies have reported	Assuming maintenance requirements	Stage 2 Mitigation

Land-use change				
	catchment" to remove phosphorous from surface runoff or stream flow, or to remove phosphorous from final effluent at WwTWs or package treatment plants. The main phosphorous removal mechanisms in wetlands are sedimentation of particulate phosphorous, sorption (binding) of dissolved phosphorous to sediment and plant uptake of bioavailable phosphorous (Kadlec & Wallace, 2008).	median removal rates of around 60% of the inflow phosphorous concentrations for urban wetlands (Strecker, et al., 1992; Shatwell & Cordery, 1999) and 46% for wetlands with a variety of sources of water (Land, et al., 2016).	can be secured in perpetuity, wetlands provide a very promising mitigation option that can provide significant reductions in phosphorous loading to the Wye SAC.	report, Ricardo 2021
Riparian buffer creation	A riparian buffer is a strip of land with permanent vegetation cover that runs along the edge of a river, separating the river from adjacent land uses. These	Median total phosphorous retention rates of 67% in riparian buffers have been reported (Hoffmann et al., 2009). However, riparian buffers	• Good potential • Needs securing to give practical certainty • Monitoring and maintenance required to meet "in-	Stage 2 Mitigation report, Ricardo 2021

Land-use change				
	buffers reduce surface flow rates and promote various mechanisms of phosphorous removal that lead to an improvement in river water quality.	require maintenance in perpetuity to stop them from switching from a sink to a source of phosphorous (Weigelhofer, et al., 2018).	perpetuity" requirements.	
Short rotation coppice	Energy crops such as poplar and willow can be grown on former arable land or on riparian buffer strips.	These crops can remove up to 15.8 kg P per 10 oven dry tonnes (ODT) per hectare per year (Potter, 1999). agricultural land abandonment.	• Good potential • Monitoring to assess the efficacy of the scheme may be required. • The ~30-year period of productivity of a single SRC planation would require more mitigation/replanting of trees to maintain mitigation in perpetuity.	Stage 2 Mitigation report, Ricardo 2021
Rewilding	See 'Agricultural land abandonment and woodland planting / reversion to semi-natural habitat'.			
Reduced or Non-intensive agricultural use of farming land	See 'Agricultural land abandonment and woodland planting /			

Land-use change				
	reversion to semi-natural habitat'.			

Actions on existing built environment				
Measure	**Detail**	**P reduction**	**Certainty**	**Source / Further information**
Replacing existing drainage system with something better	Such as a Package Treatment Plants (PTPs)	Variable with design, size, conditions. Would need to be quantified on a case-by-case basis. The final effluent phosphorous concentration is dependent on the device used and there are now highly efficient systems available that can reportedly achieve phosphorous concentrations of < 1.5 mg P/l.	High	Stage 2 Mitigation report, Ricardo 2021
Increasing the proportion of green infrastructure	Securing land with no P inputs Could include space for SuDS	Would need to be quantified on a case-by-case basis.	Assuming secured in perpetuity	
Promote update of Rural Sustainable Drainage Systems		Variable with design, size, conditions. Would need to be quantified on	Assuming secured in perpetuity	

Actions on existing built environment				
(RSuDS) / Silt traps on rural land		a case-by-case basis.		
Diverting surface water flows away from the sewage network		Possible to calculate on a case-by-case basis.	Assuming secured and delivered as a standalone.	
Water efficiency measures	Water efficiency measures typically involve installation of water efficient bathroom and kitchen fittings. Reducing water usage reduces phosphorous loading from WwTWs by reducing the flow of wastewater to a treatment works and thus reducing the load. However, it is important to note that increasing water efficiency will only reduce phosphorous loading at works that have phosphorous permits.	Would need to be quantified on a case-by-case basis.	The effectiveness of this method is difficult to measure without household monitoring using smart meters and the potential for changes to less water efficient fittings within the lifetime of a development raises questions over whether this mitigation measure would pass the test of in perpetuity reduction in phosphorous loading.	Stage 2 Mitigation report, Ricardo 2021
Addressing misconnections	See point source actions	Would need to be quantified on a case-by-case basis.	More misconnections in the future.	
Reducing leakage from	See point source actions	Would need to be quantified on	More leaks in the future.	

Actions on existing built environment				
foul sewage network		a case-by-case basis.		
Reducing leakage from potable water supply	See point source actions	Would need to be quantified on a case-by-case basis.	More leaks in the future.	

Actions on new developments				
Measure	**Detail**	**P reduction**	**Certainty**	
Increasing the proportion of green infrastructure	Securing land with no P inputs. Could include space for SuDS.	Would need to be quantified on a case-by-case basis.	Assuming secured in perpetuity	
Sustainable Drainage Solutions	SuDS comprise a range of different types of blue-green infrastructure to reduce runoff rates and provide natural water quality treatment, including phosphorous removal.	Would need to be quantified on a case-by-case basis. The long-term performance of SuDS would also need to be secured through maintenance agreements.	• Compliance is likely if a scheme is well designed and scaled appropriately. • There is an evidence base to support the use SuDS wetlands to phosphorous removal. • Maintenance agreements can secure mitigation in perpetuity.	Stage 2 Mitigation report, Ricardo 2021

Appendix 1: Phosphate levels and targets

Targets from the source to the Welsh/English border can be found here: Natural Resources Wales / Compliance Assessment of the River Wye SAC Against Phosphorus Targets along with additional information. The individual waterbodies in Wales and their targets are also set out below.

Compliance for the River Wye SAC Soluble Reactive Phosphate targets in Wales

Waterbody Name	Sample Point	Target (µg l^{-1})	N Samples	Annual Mean (µg l^{-1})	Growing Season Mean (µg l^{-1})	Assessment
Wye - conf Afon Tarenig to conf Afon Bidno	50361	10*	29	2	2	Pass
Wye - conf Afon Bidno to conf Afon Marteg	50004	10	33	2	2	Pass
Afon Bidno - source to conf R Wye	50003	10	29	1	1	Pass
Wye - conf Afon Marteg to conf Afon Elan	50177	20	34	11	14	Pass
Afon Marteg - source to conf R Wye	50005	13	33	7	6	Pass

Waterbody Name	Sample Point	Target (µg l^{-1})	N Samples	Annual Mean (µg l^{-1})	Growing Season Mean (µg l^{-1})	Assessment
Afon Elan - Caban-coch Rsvr to conf R Wye	50008	10	-	-	-	Not Assessed
Wye - conf Afon Elan to conf R Ithon	50010	10	29	37	38	Fail
Ithon - source to conf Llaethdy Bk	51354	10	29	8	8	Pass
Llaethdy Bk - source to conf R Ithon	51352	10	16	7	6	Pass
Gwenlas Bk - source to conf R Ithon	51353	10	23	24	22	Fail
Ithon - conf Llaethdy Bk to conf Gwenlas Bk	50086	10	29	13	13	Fail
Camddwr Bk - source to conf R Ithon	50820	13	17	20	17	Fail
Ithon - conf Gwenlas Bk to conf Camddwr Bk	50086	10	29	13	13	Fail
Aran - source to conf R Ithon	50084	15	-	-	-	Not Assessed
Mithil Bk - source to conf R Ithon	50825	15	18	40	37	Fail
Howey Bk - source to conf R Ithon	50089	15	16	25	23	Fail

Waterbody Name	Sample Point	Target (µg l^{-1})	N Samples	Annual Mean (µg l^{-1})	Growing Season Mean (µg l^{-1})	Assessment
Nantmel Dulas - source to conf R Ithon	50821	10	17	21	17	Fail
Ithon - conf Camddwr Bk to conf R Wye	50085, 50090	25	31	17	16	Pass
Clywedog Bk - source to conf Bachell Bk	50823	10	17	9	8	Pass
Bachell Bk - source to conf Clywedog Bk	50824	10	8	4	-	Pass
Clywedog Bk - conf Bachell Bk to conf R Ithon	50087	10	26	15	16	Fail
Wye - conf R Ithon to conf R Irfon	50813	15	29	8	8	Pass
Afon Gwesyn - source to conf R Irfon	57103	10	15	12	10	Fail
Irfon - conf Afon Gwesyn to conf Cledan	57712	10	27	8	7	Pass
Cledan - source to conf R Irfon	50818	10	21	18	11	Fail
Tirabad Dulas - source to conf R Irfon	50077	10	19	8	8	Pass
Afon Cammarch - source to conf R Irfon	50078	10	27	46	13	Fail

Waterbody Name	Sample Point	Target (µg l^{-1})	N Samples	Annual Mean (µg l^{-1})	Growing Season Mean (µg l^{-1})	Assessment
Garth Dulas - source to conf R Irfon	50079	10	28	15	22	Fail
Chwefru - source to conf R Irfon	50081	10	29	22	26	Fail
Irfon - conf Cledan to conf R Wye	50080	10	27	24	38	Fail
Builth Dulas Bk - source to conf R Wye	50501	15	16	16	19	Fail
Duhonw - source to conf R Wye	50012	15	29	15[x]	15[x]	Fail
Edw - source to conf Colwyn Bk	51355	15	28	30	39	Fail
Camnant Brook - source to confluence R Edw	50510	15	24	24	32	Fail
Edw - conf Camnant Bk to conf Clas Bk	50815	15				Not Assessed
Edw - conf Clas Bk to conf R Wye	51305	15	28	20	23	Fail
Clettwr Bk - source to conf R Wye	50015	15	21	41	50	Fail
Bach Howey Bk - source to conf R Wye	50016	15	22	29	36	Fail

Waterbody Name	Sample Point	Target (µg l^{-1})	N Samples	Annual Mean (µg l^{-1})	Growing Season Mean (µg l^{-1})	Assessment
Scithwen Bk - source to conf R Wye	50017	15	21	19	21	Fail
Wye - conf R Irfon to Scithwen Bk	50440	16	29	23	29	Fail
Triffrwd - source to Dulas	50811	15	14	70	40	Fail
Dulas Bk - source to conf Afon Llynfi	50094	25	9	74	-	Fail
Afon Llynfi - conf Dulas Bk to conf R Wye	50098	25	26	77	90	Fail
Wye - Scithwen Bk to Bredwardine Br (Wales)	50018[1]	30	34	<21[2]	<23	Pass
Wye - conf Walford Bk to Bigsweir Br	50032	39	34	52	55	Fail

- [1] This is a cross-border unit.

Current Water Framework Directive Soluble Reactive Phosphate targets for the R. Lugg (SSSI) in Wales

WB ID	Waterbody Name	Spt No.	Spt Name	Altitude (m)	Alkalinity (mg/l CaCO3 at pH 4.5)	High (mg/l)	Good (mg/l)	Moderate (mg/l)	Poor (mg/l)
GB109055042100	Lugg Bk - source to conf Bleddfa Bk	50869	RIVER LUGG AT MONAUGHTY	194	128	0.021	0.043	0.12	0.862
GB109055042020	Lugg - conf Bleddfa Bk to conf Cascob Bk	50832	R LUGG AT WHITTON	179	111	0.021	0.042	0.12	0.861
GB109055042010	Lugg - conf Cascob Bk to conf Norton Bk	Not sampled							
GB109055042030*	Lugg - conf Norton Bk to conf R Arrow*	50037	R.LUGG @ ROSSERS BR.PRESTEIGNE	130	117	0.025	0.051	0.137	0.911

* WBs managed by EA

Cyfoeth Naturiol Cymru
Natural Resources Wales

Orthophosphate/SRP targets relating to the Wye and Lugg in England

	Current NMP P target (mg/l)	Common Standards Monitoring Guidance P near natural (mg/l)	Common Standards Monitoring Guidance proposed max P (mg/l).	NRW P target (mg/l)	WFD HES (mg/l)	Water Framework Directive Good Ecological Status (mg/l)	SSSI unit
R.WYE AT BREDWARDINE BRIDGE	0.03	0.03	0.05	0.03			5
R WYE AT BRIDGE SOLLARS BRIDGE	0.03	0.03	0.05		0.024	0.048	5
R WYE AT VICTORIA BRIDGE	0.03	0.04	0.06		0.026	0.051	4
R.WYE AT HOARWITHY BRIDGE	0.05	0.04	0.06		0.033	0.063	4
R.WYE AT WILTON BRIDGE.	0.05	0.04	0.06		0.034	0.065	3
R.WYE 800M D/S KERNE BRIDGE, GOODRICH	0.05	0.04	0.06		0.035	0.067	3
R.WYE,HUNTSHAM BR.SYMONDS YAT	0.05	0.04	0.06	0.039	0.036	0.069	3
							1
R LUGG @ MORTIMERS CROSS BR.	0.05	0.015	0.025		0.03	0.05	2
R LUGG AT FORD BRIDGE	0.05	0.03	0.05		0.037	0.07	2
R LUGG AT WERGINS BRIDGE	0.05	0.03	0.05		0.039	0.074	2

Appendix 2: Habitats Directive

The achievement of Favourable Conservation Status (FCS) is not an objective that applies at the level of the individual sites. Rather it is a wider objective to which each individual site contributes. Therefore, favourable conservation as defined in Articles 1(e) and 1(i) of the Habitats Directive the conservation objectives for an individual site are intended to express what is considered to be that site's appropriate contribution to achieving FCS.

The conservation status of a natural habitat is the sum of the influences acting on it and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species. The conservation status of a natural habitat will be taken as favourable when:

- its natural range and areas it covers within that range are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable.

The conservation status of a species is the sum of the influences acting on the species that may affect the long-term distribution and abundance of its populations. The conservation status will be taken as 'favourable' when:

- population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis."

List of Abbreviations

AA – Appropriate Assessment
AD – Anaerobic Digestion
AMP – Asset Management Plan
BAS – Biosolids Assurance Scheme
CFE – Campaign for the Farmed Environment
CJEU –Court of Justice for the European Union
CSF – Catchment Sensitive Farming
CSMG – Common Standards Monitoring Guidance
CSO – Combined Storm Overflow
DCWW – Dwr Cymru Welsh Water
DWPP – Diffuse Water Pollution Plan
EA – Environment Agency
FCS – Favourable Condition Status
HCILG – Herefordshire Construction Industry Lobby Group
HRA – Habitats Risk Assessment
JNCC – Joint Nature Conservation Committee
LPA – Local Planning Authority
NE – Natural England
NFU – National Farmers Union
NMP – Nutrient Management Plan
NRW – Natural Resources Wales
PTP – Private Treatment Plant
RBD – River Basin District
RBMP – River Basin Management Plan
RephoKus – Re-focusing phosphate use in the UK food system
RPA – Rural Payments Agency
RSuDS – Rural Sustainable Drainage Systems
SAC – Special Area of Conservation
SAGIS – Source Apportionment Geographical Information System
SNCO – Special Nature Conservation Order
SOAF – Storm Overflow Assessment Framework
SPA – Special Protection Area
SRP – Soluble Reactive Phosphorus
SSAFO – Silage, Slurry and Agricultural Fuel Oil Regulations
SSSI – Site of Special Scientific Interest
STW – Sewage Treatment Works
SuDS – Sustainable Drainage Systems
TAG – Technical Advisory Group
WB – Water Body
WFD – Water Framework Directive
WPZ – Water Protection Zone
WUF – Wye and Usk Foundation
WwTW – Wastewater Treatment Works