

# **Carmarthenshire County Council Nutrient Neutrality Interim Action Plan**

**Technical Report**

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# Carmarthenshire County Council – Interim Action Plan

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Document Ref. 10053521-ARC-XX-XX-RP-CW-0002-P2-Carmarthenshire County Council Nutrient Neutrality Interim Action Plan

Date MARCH 2023

## Version Control

Version	Date	Author	Checker	Reviewer	Approver	Changes
P1	10/11/2022	EBP	JL	RG	MG	
P2	09/03/2023	EBP	JL	RG	MG	Addressing Client comments and incorporating DCWW Source Apportionment Data

This report dated 09 March 2023 has been prepared for Carmarthenshire County Council (the “Client”) in accordance with the terms and conditions of appointment dated 19 May 2022 (the “Appointment”) between the Client and **Arcadis Consulting (UK) Ltd** (“Arcadis”) for the purposes specified in the Appointment. For avoidance of doubt, no other person(s) may use or rely upon this report or its contents, and Arcadis accepts no responsibility for any such use or reliance thereon by any other third party.

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# 1 Introduction

In January 2021, Natural Resources Wales (NRW) published evidence<sup>1</sup> following a review of tighter standards set by the Joint Nature Conservation Committee (JNCC), which showed that over 60% of riverine Special Areas of Conservation (SAC) waterbodies fail against revised phosphorus standards.

As a result of these failures, NRW has subsequently issued planning advice<sup>2</sup> to avoid further deterioration in environmental capacity where new developments have the potential to affect phosphorus sensitive riverine SACs. These actions are required to demonstrate the compliance with the Conservation of Habitats and Species Regulations 2017, as amended (Habs Regs). Therefore, this NRW 'advice' relates to all riverine SACs whose drainage catchments extend into Carmarthenshire, namely, the Afon Teifi, Afon Tywi, Afon Cleddau, River Wye and River Usk.

Carmarthenshire County Council (CCC), as the Local Planning Authority (LPA) is required to have regard to this advice given by NRW when making planning decisions on individual developments and Local Development Plans (LDPs). As a result, the new advice passed from NRW with respect to phosphorus within Welsh Riverine SACs effectively paused the progression of CCC's revised Local Development Plan (rLDP) to its adoption stage.

Arcadis Consulting UK Ltd (Arcadis) have been commissioned by CCC to provide specialist support to progress the preparation of the rLDP. Specifically, Arcadis has been tasked with developing an Interim Action Plan (IAP) for the rLDP which will make clear recommendations as to the way ahead, providing a clear indication of how the rLDP can be brought forward to adoption in line with NRW's advice.

As of February 2023, there is still some uncertainty surrounding several key elements of the baseline conditions within the affected catchments in Carmarthenshire and the key information required to develop the proposed mitigation measures. These are discussed in more detail throughout this report; however, it is important to note that given these uncertainties, any action plan put forward must be pragmatic and adaptable.

This document sets out the proposed IAP for the delivery of phosphorus mitigation within Carmarthenshire as the rLDP is brought forward for adoption. It should be seen at this stage as a "living document", i.e., a document that will be updated regularly as uncertainties are removed and understanding is improved.

The document will make clear the potential routes available to CCC to mitigate any negative impacts on the conservation objectives of the relevant SACs resulting from their rLDP appropriately to demonstrate the compliance with Habitats Regulations, whilst ensuring that there is flexibility within the plans to adjust the IAP should things change; this is of particular relevance to the Dwr Cymru Welsh Water (DCWW) and NRW discharge permitting position for the impacted Wastewater Treatment Works (WWTWs).

The CCC administrative boundary contains numerous SACs, including the Afon Tywi and Afon Teifi, that are under pressure from current high levels of phosphorus. The potential addition of wastewater and/or changes in land-use which would result from the rLDP would further exacerbate the current issues regarding phosphorus loading. If a Habitats Regulation Assessment (HRA) finds potential significant effects on a SACs (i.e., following any risk avoidance measures as the first principle) because of excessive phosphorus inputs, then additional mitigating actions must be taken to achieve 'nutrient neutrality' in terms of phosphorus impacts.

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<sup>1</sup> Natural Resources Wales (January 2021) [Tighter phosphate targets change our view of the state of Welsh rivers](#)

<sup>2</sup> Natural Resources Wales [Advice to planning authorities for planning applications affecting phosphorus sensitive river Special Areas of Conservation](#).

## 1.1 Afon Tywi

The Afon Tywi is a medium-sized river in south-west Wales with a total length of around 120km that is particularly important for its migratory fish populations. Its source is located on the lower slopes of the Cambrian Mountains, Crug Gynan. The catchment area is largely rural, with the majority of the upland areas dominated by sheep farming and coniferous forestry. In the middle and lower reaches of the catchment, it mainly consists of dairy/livestock farming. The completion of the Llyn Brianne reservoir in the early 1970s, has resulted in 75km of the Tywi being regulated under low flows to aid in the support of public water supply. The Afon Tywi is currently passing under the Water Framework Directive (WFD) Regulations, despite some concerns over the level of phosphorus within the river.

375.83ha of the Afon Tywi, as seen in Figure 1-1 is a designated SAC. One of the primary reasons for this classification is because of the large spawning population of Twaite shad *Alosa fallax*. Spawning sites are found throughout the lower reaches of the river, with most spawning occurring downstream of Llandeilo. Currently, the water quality of the Afon Tywi is considered adequate to maintaining this vulnerable species. Another primary reason for the SAC classification is the presence of otter *Lutra lutra*. There are few known breeding sites; however, this species has been seen numerous times throughout the river and the water quality is generally considered to be 'good'. Other species present in the Afon Tywi, that are qualifying factors for the SAC classification, but are not a reason for site selection, include Sea lamprey *Petromyzon marinus*, Brook lamprey *Lampetra planeri*, River lamprey *Lampetra fluviatilis*, Allis shad *Alosa alosa* and Bullhead *Cottus gobio*<sup>3</sup>.

NRWs review of Welsh Riverine SACs, shows the Tywi to pass comfortably against its phosphorus targets<sup>4</sup>. Only the mid and lower parts of the Tywi are designated as a SAC, divided over three large waterbodies. The uppermost waterbody overlaps the SAC boundary only at its extreme lower end. The lower/middle waterbodies, for which data is available, comfortably pass their phosphate targets, but data quantity/quality were inadequate to fully assess compliance at the uppermost waterbody.

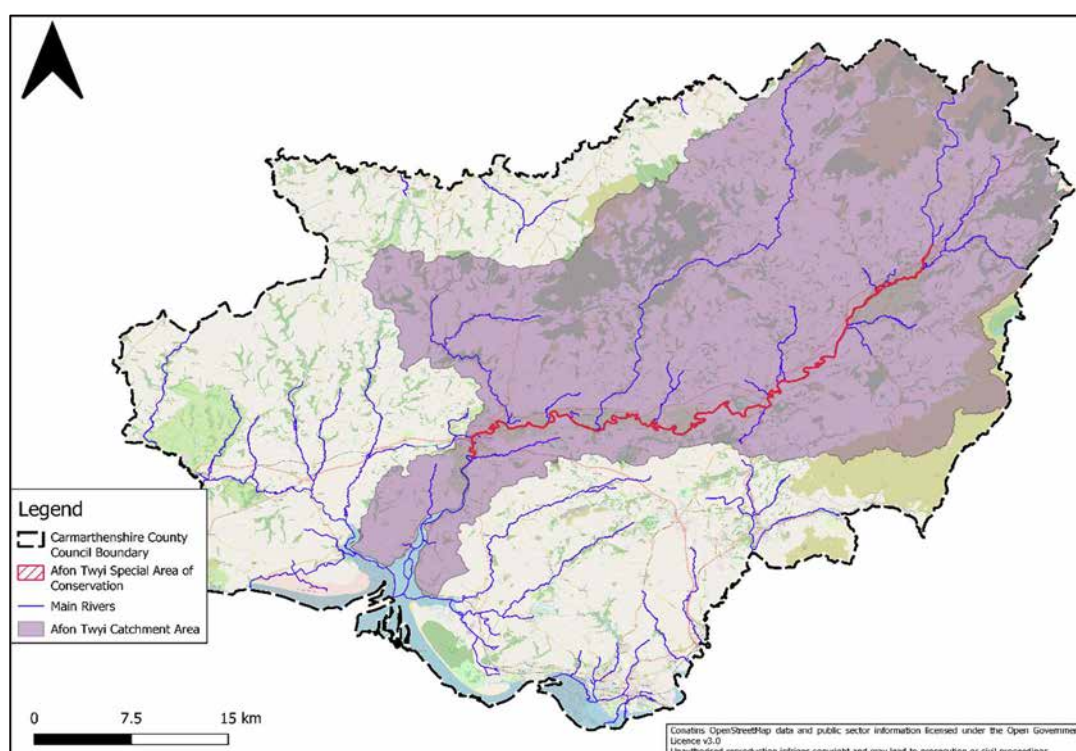


Figure 1-1: Afon Tywi Catchment

<sup>3</sup> Afon Tywi/ River Tywi - Special Areas of Conservation ([jncc.gov.uk](http://jncc.gov.uk))

<sup>4</sup> Hatton-Ellis TW, Jones TG. 2021. *Compliance Assessment of Welsh River SACs against Phosphorus Targets*. NRW Evidence Report No: 489, 96pp, Natural Resources Wales, Bangor.

## 1.2 Afon Teifi

The Afon Teifi is a medium-sized river, which has a total length of approximately 120km with a catchment area estimated to be just over 1,000km<sup>2</sup>. It is sourced from one of the several lakes known collectively as the Teifi Pools, Llyn Teifi. After meandering through upland pastures, a number of small tributaries join Afon Teifi in the rural lowlands, before it finally flows out into Cardigan Bay. The Teifi is currently failing under the WFD Regulations, due to the high phosphorus levels. Under WFD Cycle 3, the overall status of the Afon Teifi is shown as “moderate”.

Within the Afon Teifi, as seen in Figure 1-2, 691.07ha is classified as a SAC. A primary reason for this is due to the unique habitats seen throughout the river. The Teifi is largely mesotrophic with some sections in the upper reaches being oligotrophic. It represents a great example of a sub-type 3 river with Water-crowfoot *Ranunculus* vegetation. Due to the oligo-mesotrophic base-poor rocks, the in-stream vegetation is dominated by water-crowfoot *Ranunculus penicillatus* ssp. *penicillatus*, Water-starworts *Callitriche hamulate* and *C. obtusangula* and the aquatic moss *Fontinalis squamosa*.

The Afon Teifi also flows through Cors Caron, which is a large area of 7110 Active raised bog, which is a SAC in its own right. As a result of the unique habitats and water quality found within the Teifi, the types of species found in the river are also unique. Species that give further reason for the SAC classification include brook lamprey *Lampetra planeri*, River lamprey *Lampetra fluviatilis*, salmon *Salmo salar*, bullhead *Cottus gobio*, otter *Lutra lutra* and Floating water-plantain *Luronium natans*<sup>5</sup>.

According the NRW Compliance Assessment Report of Welsh Riverine SACs<sup>4</sup>, the Afon Teifi is shown to have widespread failures against phosphorus targets across the lower Teifi catchment within Carmarthenshire, though these are noted to be low in magnitude.

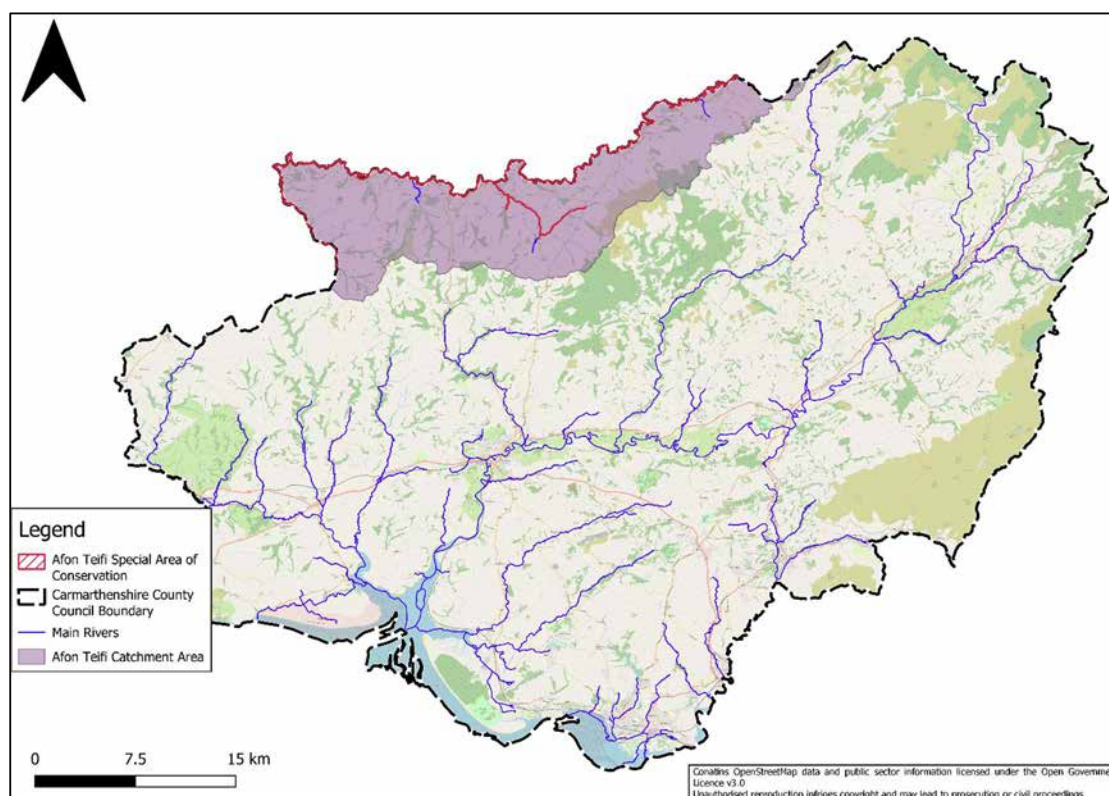


Figure 1-2: Afon Teifi Catchment

<sup>5</sup> Afon Teifi/ River Teifi - Special Areas of Conservation ([jncc.gov.uk](http://jncc.gov.uk))



## 1.3 Afon Cleddau, Afon Wye & River Usk

The Afon Wye is located to the north of the Carmarthenshire boarder, while the Afon Cleddau is found to the southwest and the River Usk to the east within the Brecon Beacons National Park (BBNP). As per the Nutrient Budget Calculator Guidance from CCC and Ricardo<sup>6</sup>, only developments which are within a catchment that drains to an affected SAC or discharge to a WwTW which discharges to a SAC need to be included in the nutrient budget calculations. As shown in **Appendix A Figure A1**, all the proposed housing applications and associated WwTWs in the rLDP either drain to the Afon Tywi or Afon Teifi. Therefore, the Afon Cleddau, Afon Wye and River Usk are not impacted by the housing allocations in this assessment.

## 1.4 Nutrient Neutrality in Carmarthenshire

Over 60% of riverine SACs in Wales fail to meet their new targets for phosphorus. Of the two SACs in this assessment, only the Afon Teifi is failing to meet the new targets. 50% of the waterbodies in the Afon Teifi catchment passed the WFD targets. With the exception of the Groes waterbody, the upper part of the Afon Teifi is passing its phosphorus targets, with the lower waterbodies generally failing as the river flows through Carmarthenshire (Figure 1-3)<sup>7</sup>.

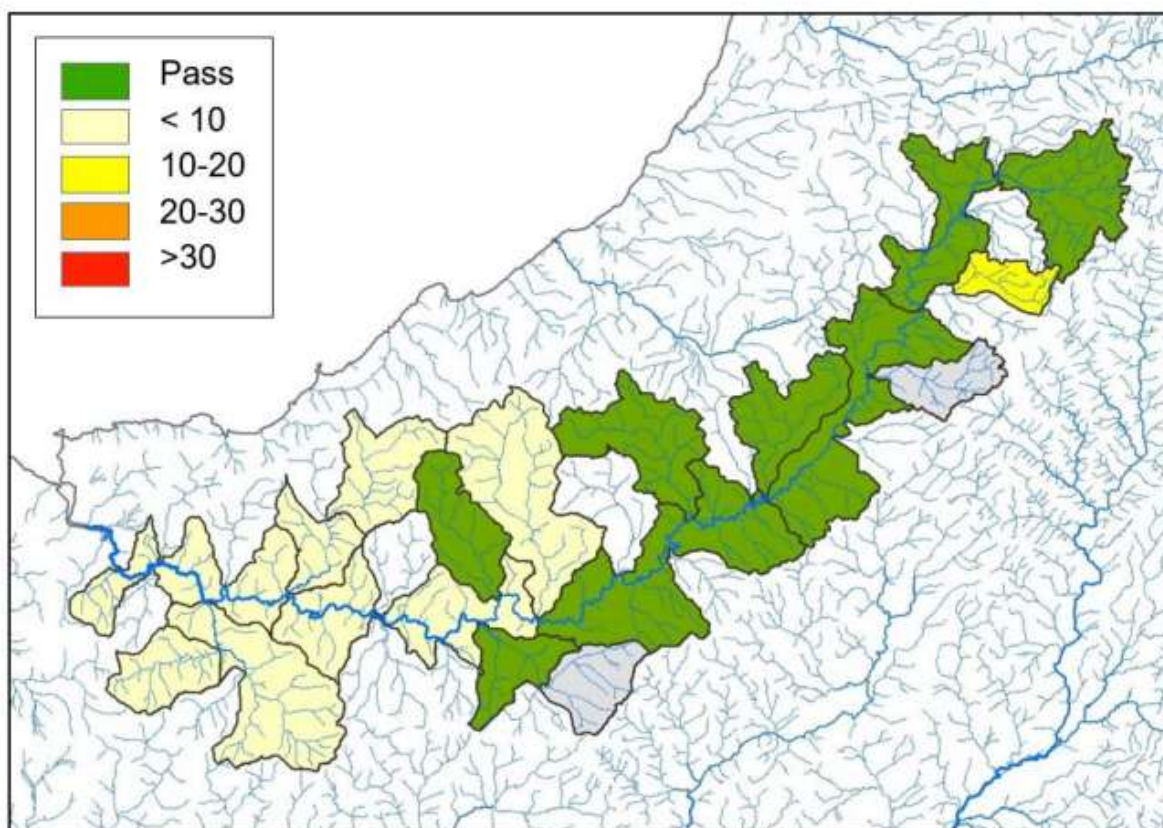


Figure 1-3 Map of phosphorus compliance for Afon Teifi SAC.

**Note:** Water bodies shaded green pass their target. Other colours fail their target with different colours representing the magnitude of failures in  $\mu\text{g l}^{-1}$ , expressed as the larger of annual means and growing season means. Greyed out water bodies could not be assessed due to lack of data.

<sup>6</sup> Nutrient Budget Calculator Guidance: A guide on how to calculate a phosphorus budget for a development

<sup>7</sup> Hatton-Ellis TW, Jones TG. 2021. Compliance Assessment of Welsh River SACs against Phosphorus Targets. NRW Evidence Report No: 489, 96pp, Natural Resources Wales, Bangor.

Conversely, there are currently no known phosphorus failures in the Afon Tywi (Figure 1-4). Despite this, it is important to consider the effects of increased phosphorus generated from the proposed site allocations, particularly in the upper waterbodies which have not been assessed due to poor quality data.

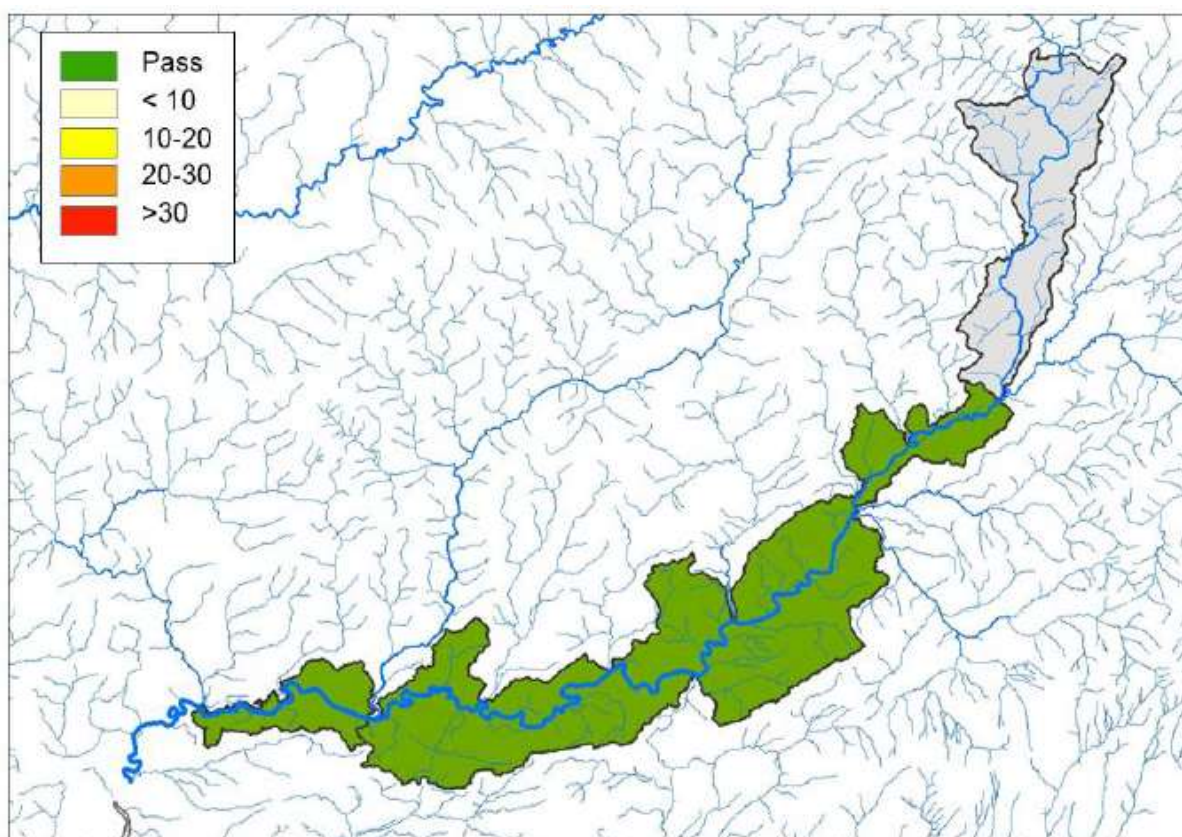


Figure 1-4 Map of phosphorus compliance for Afon Tywi SAC.

Water bodies shaded green pass their target. Other colours fail the target with different colours representing the magnitude of failures in  $\mu\text{g l}^{-1}$ , expressed as the larger of annual means and growing season means. Greyed out water bodies could not be assessed due to lack of data.

In November 2022, NRW provided an update to phosphorus targets for waterbodies in SAC rivers in Wales<sup>8</sup>. The update reviewed the waterbodies “in scope” for SAC targets, made changes to the phosphorus targets of some waterbodies, and reassessed them for compliance. The update has no new implications for the Afon Tywi and Afon Teifi SACs that will contradict the information in Figure 1-3 and Figure 1-4, based on the previously published report in 2021.

As per NRW advice to planning authorities’ guidance<sup>9</sup>; for SAC catchments failing to meet phosphorus targets, it is possible that new developments can be authorised if it can be demonstrated they will not lead to further deterioration of water quality in the SAC water bodies failing to meet water quality targets and will not undermine the ability for the SAC to meet its conservation objectives or introduces additional P within the SAC that could trigger a failure.

<sup>8</sup> NRW (November 2022) Update to phosphorus targets for water bodies in Special Area of Conservation (SAC) rivers in Wales <https://naturalresources.wales/evidence-and-data/research-and-reports/water-reports/update-to-phosphorus-targets-for-water-bodies-in-special-area-of-conservation-sac-rivers-in-wales/?lang=en>

<sup>9</sup> NRW (2021) Advice to planning authorities for planning applications affecting phosphorus sensitive river Special Areas of Conservation. <https://naturalresources.wales/guidance-and-advice/business-sectors/planning-and-development/our-role-in-planning-and-development/advice-to-planning-authorities-for-planning-applications-affecting-phosphorus-sensitive-river-special-areas-of-conservation/?lang=en>



For example, this can be achieved if extra measures associated with a given development area can achieve nutrient neutrality, such that new development does not lead to a net increase in phosphorus entering the impacted SAC river environment. Within SAC catchments that currently meet the specified phosphorus targets, it is possible for new developments to be authorised if it can be robustly demonstrated they will not lead to an adverse effect on site integrity (i.e., will not undermine the ability for the SAC to meet its conservation objectives).

To assess nutrient neutrality, it is required to first consider whether a development will cause additional nutrient inputs to a SAC. In the context of Carmarthenshire, it is only Total Phosphorus (TP) being considered. This requires calculation of the amount of extra phosphorus a new development will create, otherwise known as a TP budget (See Figure 1-5).

The nutrient budget calculations are completed as per the following four key stages:

- **Stage 1** - Calculate the increase in TP loading that comes from a development's wastewater.
- **Stage 2** - Calculate the pre-existing TP load from current land use at the development site.
- **Stage 3** - Calculate the future TP load from land use at the site post-development.
- **Stage 4** - Calculate the net change in TP loading from the development to the SAC with the addition of a 20% precautionary buffer; this is hereby referred to as the TP budget.



Figure 1-5 Diagram showing the overall equation used to calculate the TP budget.

## 1.5 Aims & Objectives

The principal aim of this report is to set out a realistic and adaptable action plan for catchment scale management of phosphorus within the Afon Teifi and Afon Tywi such that the Carmarthenshire rLDP can demonstrate compliance with relevant NRW guidance on phosphorus sensitive SACs.

Given several elements of uncertainty surrounding the baseline conditions within the Afon Teifi and Afon Tywi, an IAP is proposed at this stage, which will be built upon as details are confirmed.

The key objectives of this IAP are:

- Avoid new development in the impacted SACs in the first place where this is the most appropriate action;
- Produce an estimated TP budget for the rLDP (using best available data);
- Identify the key uncertainties that could impact the final TP budget;
- Outline the potential mitigation solutions available to CCC to offset the TP budget;
- Indicate the scale of mitigation required for the solutions deemed most practical / effective while recognising the key uncertainties; and
- Outline next steps to deliver these solutions and requirements for further work, promoting a phased approach for delivery.

## 2 Revised Local Development Plan

The emerging LDP is a land-use plan that sets out the planning requirements for achieving sustainable development in Carmarthenshire County over the period 2018-2033. The Plan identifies where and how much new developments will take place, as well as which areas need to be protected for their environmental qualities.

Arcadis have been involved in delivering the IAP and HRA addendum to support Key Stage 4 – Second Deposit rLDP for the CCC LDP (2018-2033), which has now been published for consultation on 17 February 2023<sup>10</sup>. Following this consultation, the rLDP and HRA addendum may be revised for Key Stage 5 - Submission of the LDP to Welsh Government (WG) for Examination.

The current indicative timeline for this, can be seen in Table 2-1, but this will require further review in tandem with development of the IAP. It is envisaged that mitigation measures to reduce phosphorus will be completed in phases, whereby some allocation sites will be prioritised, based on the recommendations of this IAP. This IAP is a live document that will continue to evolve with stakeholder liaison and emerging evidence as to the efficiencies of Nature-based Solutions (NbS) for phosphorus mitigation.

The relevant Legislation and Planning context can be found in **Appendix B**.

Table 2-1 – Indicative timetable for Key Stages (KS) of the rLDP<sup>11</sup>

Stage in Plan Preparation	Regulation Number	Timescale
<b>Definitive</b>		
KS 1 – Delivery Agreement (DA)	5-10	Initial DA – Feb 2018 to Jul 2018 First Revised DA – publication following WG approval, Nov 2020 Second Revised DA – publication following WG approval, Aug 2022
KS 2 – Pre-Deposit: Preparation & Participation	14	Feb 2018 – Feb 2020
KS 3 – Pre-Deposit: Public Consultation	15,16, 16A	May 2018 – May 2019
KS 4 – First Deposit Revised LDP	17-21	Jan 2019 – Jan 2021
KS 4 – Second Deposit Revised LDP	17-21	Mar 2022 – Jul 2023
<b>Indicative</b>		
KS 5- Submission of LDP to WG for Examination	22	Aug 2023
KS 6 – Independent Examination	23	Aug 2023 – Jun 2024
KS 7 – Publication of Inspector's Report	24	Aug 2024
KS 8 – Adoption	25, 25A	Oct – Nov 2024
KS 9 – Monitoring and Review	37	Continued following adoption

<sup>10</sup> Carmarthenshire County Council. February 2023. Second Deposit Revised Local Development Plan. Available at: [https://www.carmarthenshire.gov.wales/home/council-services/planning/local-development-plan-2018-2033/second-deposit-revised-local-development-plan/#.Y\\_3i8XbP02w](https://www.carmarthenshire.gov.wales/home/council-services/planning/local-development-plan-2018-2033/second-deposit-revised-local-development-plan/#.Y_3i8XbP02w)

<sup>11</sup> Revised Carmarthenshire Local Development Plan 2018 – 2033. Revised Delivery Agreement. Available at: [revised-da-2022-final.pdf \(gov.wales\)](#)

### 3 Total Phosphorus Budget

In August 2022, Arcadis produced a draft Nutrient Neutrality Assessment<sup>12</sup> for the rLDP based on the previous (First Deposit rLDP) site allocations. This indicated that the TP budget that should be mitigated was **677.28 kg TP/year**.

Since this calculation was carried out, Arcadis has consulted with CCC, DCWW and NRW on several matters that materially impact the TP budget. This section will set out changes that have taken place since August 2022 and show their relative impacts on the TP budget required to be mitigated for the Second Deposit rLDP.

#### 3.1 rLDP Site Allocations Review

During regular consultation with CCC to support Key Stage 4 – Second Deposit rLDP for the CCC LDP (2018-2033) preparation evidence base, Arcadis was informed that council planning officers had reviewed each individual site within the rLDP with a view to “screen out” sites which were deemed unlikely to come to fruition under the rLDP. The council provided Arcadis with a refined number of sites to be taken forward.

Table 3-1 and Table 3-2 show the proposed remaining site allocations in the Afon Tywi and Afon Teifi respectively, including the TP budget to be mitigated as per the nutrient budget calculations reported in August 2022. Further details on the August 2022 Nutrient Budget Calculations and associated key assumptions can also be found in **Appendix C**.

For the Afon Tywi (Table 3-1), the number of site allocations reduced from 14 sites (175 dwellings) down to 6 sites (102 dwellings). For the Afon Teifi (Table 3-2), the number of site allocations reduced from 28 sites (417 dwellings) down to 15 sites (189 dwellings).

*Table 3-1 Allocated Sites in the Afon Tywi following CCC Review (Using a Default TP limit of 8mg/l)*

Afon Tywi					
Site Reference	No. of Dwellings	Settlement	Area (ha)	WwTW	Nutrient Budget (TP kg)
SeC15/h2	8	Llandovery	1.18	Llandovery	9.50
SeC16/h1	27	Llandeilo	1.67	Ffairfach	27.79
SeC17/h1	16	Llangadog	0.54	Llangadog	17.04
SeC17/h2	8	Llangadog	0.4	Llangadog	8.14
SuV17/h1	35	Nantgaredig	1.51	Nantgaredig (Pontargothi)	38.16
SuV51/h1	8	Cwm Ifor	0.49	Cwm Ifor	9.14
<b>Total</b>	<b>102</b>			<b>Total</b>	<b>109.77</b>

<sup>12</sup> Carmarthenshire County Council: Nutrient Neutrality Assessment, August 2022, Arcadis

Table 3-2 Allocated Sites in the Afon Teifi following CCC Review (Using a Default TP limit of 8mg/l)

Afon Teifi					
Site Reference	No. of Dwellings	Settlement	Area (ha)	WwTW	Nutrient Budget (TP kg)
SeC12/h1	17	Pencader	0.61	Adpar	22.24
SeC12/h3	20	New Inn	0.72	Adpar	26.52
SeC13/h1	10	Llanybydder	0.42	Llanybydder	11.23
SeC14/h1	20	Llanllwni	0.35	Pencader	20.94
SeC14/h2	24	Pontweli	0.98	Pencader	25.73
SuV33/h1	5	Capel Iwan	0.82	Drefach/Felindre	5.97
SuV35/h1	6	Pencader	0.76	Drefach/Felindre	13.06
SuV36/h1	6	Cwmann	0.5	No public sewerage	8.20
SuV36/h2	16	Llanllwni	0.7	No public sewerage	20.77
SuV37/h2	20	Llangeler	0.4	Lampeter	24.70
SuV37/h3	10	Newcastle Emlyn	1.34	Lampeter	12.18
SuV38/h1	6	Cwmann	0.9	Capel Iwan	7.64
SuV39/h1	7	Waungilwen	0.7	Llanfihangel-ar-arth	7.52
SuV41/h2	14	Llanfihangel-ar-Arth	0.52	Llandysul	19.32
SuV43/h1	8	Newcastle Emlyn	0.96	Llandysul	10.27
<b>Total</b>	<b>189</b>	<b>Total</b>			<b>236.28</b>

As illustrated in Figure 3-1, the impact of reducing the number of site developments within the rLDP has decreased the Nutrient Budget for the Afon Tywi by 43% (191.17 TP kg/yr to 109.77 TP kg/yr) and the Nutrient Budget for the Afon Teifi by 49% (486.11 TP kg/yr to 236.28 TP kg/yr).

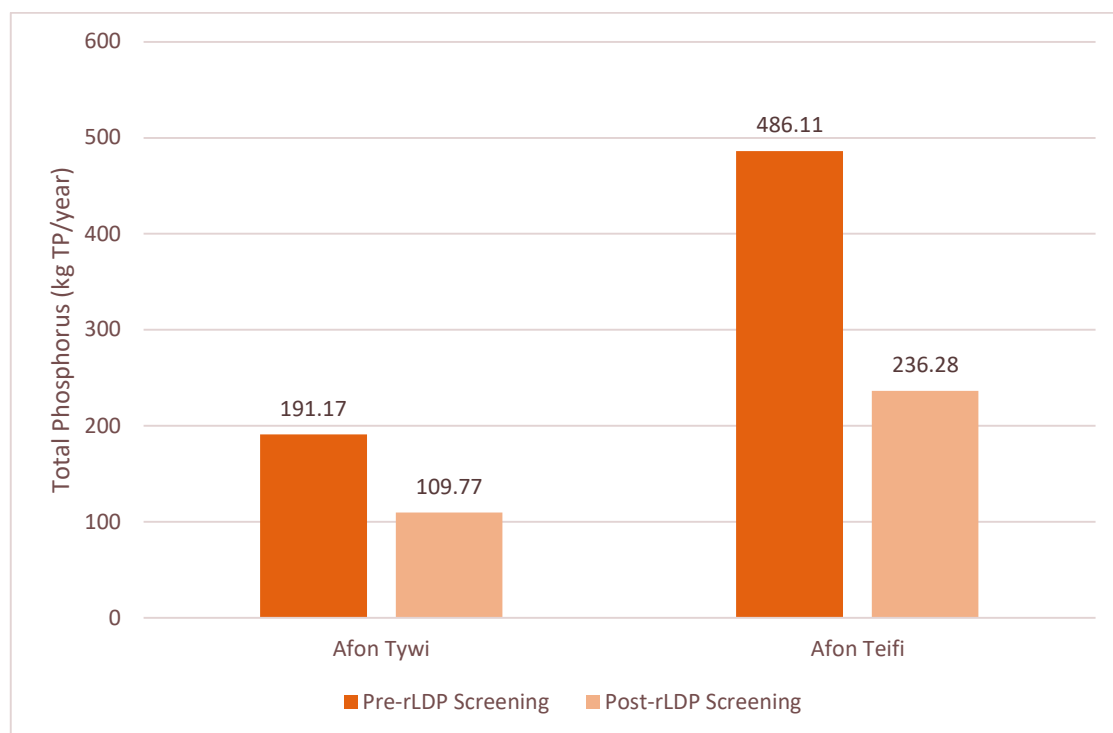


Figure 3-1 TP Budget load per year in each SAC before and after the rLDP screening (Using a Default TP limit of 8mg/l)

## 3.2 WwTW Current Performance & Permitting Situation

The TP Budget load calculations (as shown in Table 3-1 and Table 3-2) were made using the default 8mg/l TP limit for all the existing DCWW WwTWs in Ricardo's nutrient budget calculator. Ricardo and CCC assumed this value in the absence of applicable TP permitting values for these WwTWs with the aim of being precautionary, as part of demonstrating compliance with the Habitat Regulations.

Initial consultation with DCWW was undertaken by Arcadis in July 2022 to clarify the current TP limit consents position and any performance data available for each of the relevant WwTWs. The current P performance (Table 3-3) showed that each of the WwTWs in the assessment were performing well below the assumed 8 mg/l TP limit.

Table 3-3 WwTW current P performance

WwTW	2021 (mg/l)	2022 (mg/l)
Nantgaredig (Pontargothi)	1.2	1.3
Adpar	4.8	1.7
Llanybydder	2	2.2
Pencader	1.6	1.5
Drefach/Felindre	1.6	1.4
Pentrecwrt	3.5	3.1
Lampeter	2.9	1.5
Capel Iwan	2.7	2.1
Llandysul	2.2	2.7
Llandovery	2.6	3.2
Ffairfach	3	3
Llangadog	1.9	2.4

Talley, Cwrt Henry and Llanfihangel-ar-arth WwTW are not shown in Table 3-3 as DCWW did not have any performance data available

Based on the current performance above, further consultation with DCWW (who are currently conducting Source Apportionment Graphical Information System (SAGIS) modelling in the affected SAC catchments throughout Wales) was undertaken to understand the adopted approach. The data collected and modelling by DCWW will identify sources of pollution their loading distribution along the SAC rivers i.e., diffuse or point source pollution. An appreciation of pollution source loading distribution will help determine potential remediation strategies to be employed. DCWW have issued the final SAGIS Non-Technical Calibration Report for the Afon Teifi<sup>13</sup>, but the Afon Tywi SAGIS modelling is expected to be completed later this year (2023)<sup>14</sup>.

DCWW have clarified with Arcadis that the SAGIS model is calibrated using actual effluent concentration, for sites where DCWW have been sampling for phosphorus or using an assumed 5 mg/l limit in the absence of sampling data. Once the SAGIS model is calibrated, the full permitted load scenario is also carried out. For this scenario, effluent concentrations are set at their actual TP limit, but for all WwTWs without a defined TP limit, a 5 mg/l backstop limit will be assumed.

None of the WwTW's looked at in this Arcadis assessment currently have a defined TP limit in their permit. Furthermore, consultation with NRW and DCWW confirmed that using the backstop 5 mg/l value, rather than the default 8 mg/l value as presented in the CCC Nutrient Budget Calculator, is an appropriate assumption with which to prepare this IAP (**Appendix E**).

<sup>13</sup> DCWW (February 2023) Updating the SAGIS Afon Teifi Model 2023. Available at: <https://corporate.dwrcymru.com/-/media/Project/Files/Page-Documents/Our-Services/Wastewater/SAC-Rivers/SAGIS-Reports/English/Updating-the-SAGIS-Afon-Teifi-Model-2023-v6.ashx>

<sup>14</sup> Carmarthenshire County Council (February 2022) Revised Carmarthenshire Local Development Plan 2018-2033. Appendix 1 Position Paper – Phosphates.

Similarly, NRW have also suggested that there may be some variation around the backstop limit on a site-by-site basis (less than 5 mg/l not greater), which would further reduce the nutrient budget to be mitigated. Section 3.2.1 below provides further details justifying the adopted precautionary approach in this IAP, based on the latest information released by DCWW in February 2023.

The SAGIS modelling for the Afon Teifi has been subjected to an assurance process with NRW. As this IAP is a live document, the results and conclusions should be updated once the latest SAGIS modelling results and technical notes are approved and published for the Afon Tywi. It is also anticipated that a “Review of Permit” exercise across each river (supported by an HRA) will be concluded by NRW later this year (2023), along with the SAGIS modelling of the Afon Tywi. This IAP will be updated accordingly to reflect the outcomes of these future reports.

### 3.2.1 DCWW SAC phosphorus permit programme

At the time of publishing this IAP, DCWW have recently released key documents<sup>15</sup> relating to their SAGIS modelling and planned phosphorus reduction investment strategy under the emerging programme. This will support collaborative efforts with their key stakeholders to restore the SACs to favourable conservation status whilst supporting the economic development of Wales. The expected completion of this programme is the end of 2032, delivered over multiple 5 yearly Asset Management Plans (AMP) investment periods that will require prior agreement with OFWAT.

SAGIS modelling has been used to identify where DCWW must remove additional phosphorus in order to meet their ‘fair share’ of the improvements needed. DCWW’s programme states that all WwTW discharging over 20m<sup>3</sup>/day to a SAC or discharging to a non-designated waterbody draining to a SAC (i.e., where there is no TP limit currently in place), will meet a backstop phosphorus permit limit of 5 mg/l by the end of the investment programme<sup>16</sup>. Investment will be prioritised to tackle the largest phosphorus contributing sites first, with smaller sites later in the programme.

It should be noted that all WwTWs assessed in this IAP qualify under these conditions i.e., will meet a backstop permit of 5 mg/l. However, at six WwTW locations within the Afon Teifi SAC, implementation of a tighter TP limit has already been confirmed, as described below.

Under the current AMP period (AMP7), investment has already been allocated to improve the removal of phosphorus from two WwTWs assessed by this IAP (Lampeter and Llanybydder). As per the DCWW Phosphorus Programme List<sup>17</sup>, the proposed P permit for these two WwTWs is 2.5 and 0.5 mg/l respectively. As these are under the current AMP7 programme (2020-2025), these P permit limits have been used instead of the default 8mg/l or ‘backstop’ 5mg/l P permit limits.

Four WwTWs in the Teifi SAC catchment have been allocated tighter P permits (Capel Iwan: 1.8 mg/l, Pencader: 3.5 mg/l, Tregaron: 2.0 mg/l, and Pontrhydfendigaid: 1.8 mg/l). However, Tregaron and Pontrhydfendigaid only receive flows from the adjacent Ceredigion County Council. These P limits are future AMP 8/9 upgrades and are still to be formally confirmed with NRW and OFWAT. Therefore, default and backstop limits of 8 mg/l and 5 mg/l have been assumed as part of this IAP analysis.

## 3.3 Updated TP Budget Estimate

As described in Section 3.2.1, all WwTWs in this assessment discharge over 20m<sup>3</sup>/day without a P permit and will therefore be at least subject to a backstop P limit of 5 mg/l by the end of DCWW’s planned investment programme (2032). However, as a precautionary approach, the default 8 mg/l P permit calculations are provided as there is no guarantee when the tighter limit will come into force.

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<sup>15</sup> DCWW (February 2023) Understanding the sources of phosphorus in our rivers <https://www.dwrcymru.com/en/our-services/wastewater/river-water-quality/sac-rivers>

<sup>16</sup> DCWW (February 2023) Phosphorus Programme Cover Letter. <https://corporate.dwrcymru.com/-/media/Project/Files/Page-Documents/Our-Services/Wastewater/SAC-Rivers/Cover-Letter/English/Programme-Cover-Letter-Feb23-ENGLISH.ashx>

<sup>17</sup> DCWW (February 2023) Phosphorus Programme List. [https://www.dwrcymru.com/-/media/Project/Files/Page-Documents/Our-Services/Wastewater/SACRivers/PhosphorusProgrammesList/English/DCWW\\_SAC\\_P\\_prog\\_Feb2023v9.ashx](https://www.dwrcymru.com/-/media/Project/Files/Page-Documents/Our-Services/Wastewater/SACRivers/PhosphorusProgrammesList/English/DCWW_SAC_P_prog_Feb2023v9.ashx)

Section 3.3.1 and Section 3.3.2 provided the nutrient budget calculations for each site allocation in the Afon Tywi and Afon Teifi SAC using the default 8 mg/l and backstop 5 mg/l P permits. Following the methodology set out in Figure 1-5, the results below show that Stage 1 (the TP loading that comes from a developments wastewater) is the main contributor to the overall Stage 4 Nutrient Budget, compared to the loading difference in the Stage 2 (current land use TP load) and Stage 3 (post-development TP load) calculations.

A number of key assumptions were made in the August Technical Note (see Appendix C), which are still applicable to the nutrient budget summary presented in Table 3-4 to Table 3-7.

### 3.3.1 Default 8mg/l P limit

As seen in Table 3-4, the default value produced high totals of phosphorus in both the Afon Tywi and Afon Teifi (109.77 kg TP/yr and 196.24 kg TP/yr respectively).

Table 3-4 Latest Nutrient Budget Summary in the Afon Tywi using the default 8mg/l P limit.

Afon Tywi				
Site Ref	Stage 1 8 mg/l Limit	Stage 2 (kg TP/year)	Stage 3 (kg TP/year)	Stage 4* (kg TP/year)
SeC15/h2	6.45	1.62	3.09	9.50
SeC16/h1	21.77	2.99	4.37	27.79
SeC17/h1	12.90	0.26	1.55	17.04
SeC17/h2	6.45	0.71	1.05	8.14
SuV17/h1	28.23	0.37	3.95	38.16
SuV51/h1	6.45	0.12	1.29	9.14
<b>Total</b>	<b>82.26</b>	<b>Total Nutrient Budget</b>		<b>109.77</b>

\*Includes a 20% precautionary buffer, as per Ricardo Nutrient Budget Calculator to address uncertainties.

Table 3-5 Latest Nutrient Budget Summary in the Afon Teifi using the default 8mg/l P limit

Afon Teifi				
Site Ref	Stage 1 8 mg/l Limit	Stage 2 (kg TP/year)	Stage 3 (kg TP/year)	Stage 4* (kg TP/year)
SeC12/h1	16.62	0.16	2.07	22.24
SeC12/h3	19.56	0.28	2.82	26.52
SeC13/h1**	2.52	0.01	1.31	4.58
SeC14/h1	16.13	0.50	1.82	20.94
SeC14/h2	19.36	0.19	2.28	25.73
SuV33/h1	4.03	0.11	1.05	5.97
SuV35/h1	4.84	0.45	6.50	13.06
SuV36/h1	5.87	0.09	1.05	8.20
SuV36/h2	15.65	0.18	1.84	20.77
SuV37/h2**	1.01	1.32	2.34	2.44
SuV37/h3**	0.5	0.93	1.30	1.05
SuV38/h1	4.84	0.42	1.94	7.64
SuV39/h1	5.65	0.90	1.52	7.52
SuV41/h2	11.29	0.50	5.31	19.32
SuV43/h1	6.45	0.07	2.18	10.27
<b>Total</b>	<b>134.31</b>	<b>Total Nutrient Budget</b>		<b>196.24</b>

\*Includes a 20% precautionary buffer, as per Ricardo Nutrient Budget Calculator to address any uncertainties.

\*\* As discussed in Section 3.2.1, these development discharge to Lampeter and Llanybydder WwTW. New P permits will be implemented at these WwTW locations as part of the current AMP7 programme and therefore these tighter TP limits have been used in the nutrient budget calculations.



### 3.3.2 Backstop 5mg/l P limit

The 5 mg/l backstop P limit shows an overall decrease in TP in the Afon Tywi by 34% (109.77 kg TP/yr to 72.75 kg TP/yr) as well as in the Afon Teifi by 34% (196.24 kg TP/yr to 130.03 kg TP/yr). Section 3.5 gives a breakdown of the estimated revised TP budget for all the remaining rLDP sites within each impacted SAC.

Table 3-6 Latest Nutrient Budget Summary in the Afon Tywi using the backstop 5mg/l P limit.

Afon Tywi				
Site Ref	Stage 1	Stage 2	Stage 3	Stage 4 Nutrient Budget*
	5 mg/l Limit	(kg TP/year)	(kg TP/year)	(kg TP/year)
SeC15/h2	4.03	1.62	3.09	6.60
SeC16/h1	13.61	2.99	4.37	17.99
SeC17/h1	8.06	0.26	1.55	11.23
SeC17/h2	4.03	0.71	1.05	5.24
SuV17/h1	17.64	0.37	3.95	25.46
SuV51/h1	4.03	0.12	1.29	6.24
<b>Total</b>	<b>51.41</b>	<b>Total Nutrient Budget</b>		<b>72.75</b>

\*Includes a 20% precautionary buffer, as per Ricardo Nutrient Budget Calculator to address uncertainties.

Table 3-7 Latest Nutrient Budget Summary in the Afon Teifi using the backstop 5mg/l P limit.

Afon Teifi				
Site Ref	Stage 1	Stage 2	Stage 3	Stage 4 Nutrient Budget*
	5 mg/l Limit	(kg TP/year)	(kg TP/year)	(kg TP/year)
SeC12/h1	8.57	0.16	2.07	12.57
SeC12/h3	10.08	0.28	2.82	15.15
SeC13/h1**	2.52	0.01	1.31	4.58
SeC14/h1	10.08	0.50	1.82	13.68
SeC14/h2	12.10	0.19	2.28	17.02
SuV33/h1	2.52	0.11	1.05	4.15
SuV35/h1	3.02	0.45	6.50	10.88
SuV36/h1	3.02	0.09	1.05	4.78
SuV36/h2	8.06	0.18	1.84	11.67
SuV37/h2**	1.01	1.32	2.34	2.44
SuV37/h3**	0.50	0.93	1.30	1.05
SuV38/h1	3.02	0.42	1.94	5.46
SuV39/h1	3.53	0.90	1.52	4.98
SuV41/h2	7.06	0.50	5.31	14.24
SuV43/h1	4.03	0.07	2.18	7.37
<b>Total</b>	<b>79.14</b>	<b>Total Nutrient Budget</b>		<b>130.03</b>

\*Includes a 20% precautionary buffer, as per Ricardo Nutrient Budget Calculator to address uncertainties.

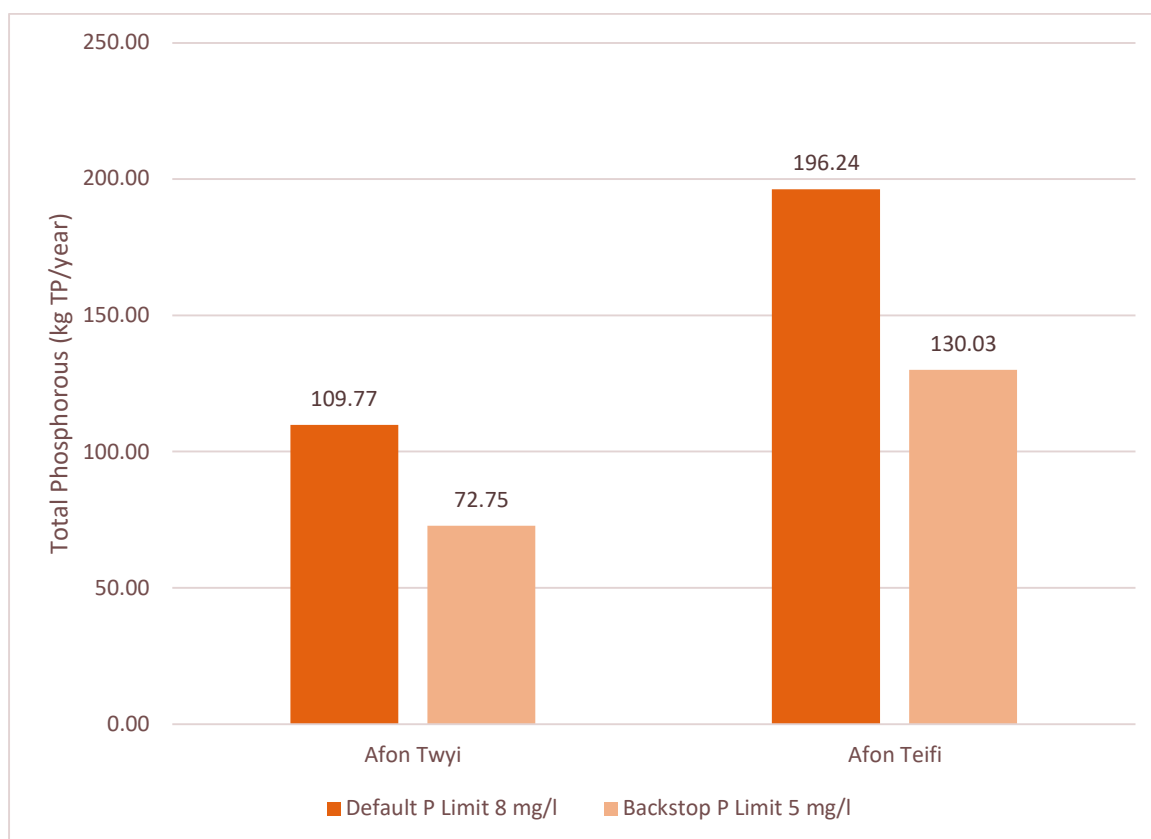
\*\* As discussed in Section 3.2.1, these development discharge to Lampeter and Llanybydder WwTW. New P permits will be implemented at these WwTW locations as part of the current AMP7 programme and therefore these tighter TP limits have been used in the nutrient budget calculations.



### 3.4 Summary

As discussed in Section 3.2, Arcadis have consulted both NRW and DCWW around the use of 5 mg/l as the proposed backstop TP limit and 8 mg/l as the current default TP value that is shown in the Ricardo Nutrient Budget Calculator for the impacted WwTWs.

Figure 3-2 below shows the nutrient budgets for both the default 8 mg/l P limit and 5 mg/l P limit for the Afon Teifi and Afon Tywi. As a precautionary approach to inform this IAP, subsequent sections consider both scenarios and outline the approach taken to screening of potential high level mitigation opportunities to address the nutrient budgets associated with both the default and backstop WwTW TP limits. Also, as discussed in Section 3.2.1, Lampeter and Llanybydder WwTWs are included in DCWW's current investment programme (AMP7 – 2020 to 2025) and therefore their proposed tighter P permits (2.5 mg/l and 0.5 mg/l respectively) have been used in this IAP nutrient budget analysis.



*Figure 3-2 Nutrient Budget TP Load per year to mitigate under different WwTW performance scenarios*

An illustration of the combined nutrient budgets from the proposed Carmarthenshire rLDP site allocations at each WwTW can be seen in **Appendix A Figure A2** whilst Section 5 and Section 6 provide additional details related to each WwTW location and associated mitigation wetland area requirements.

As highlighted throughout in this report, it should be noted that this is an 'Interim' Action Plan and will be reviewed and updated as new information emerges.

## 4 Outline Solutions Screening

### 4.1 Sources of Pollution

The increase in wastewater and/or the change in land-use due to a new development, will result in an additional nutrient load. This can create an 'impact pathway' that will exacerbate the existing nutrient loading issues already seen in Carmarthenshire's SAC's. Examples of multiple impact pathways can be seen in Figure 4-1. The impact pathway for nutrients as a result of new developments will result in a HRA finding 'Likely Significant Effects' on the SAC's because of the increase in nutrient load. The two significant nutrients that are output from new developments are nitrogen (N) and phosphorus (P). All SACs within Carmarthenshire are under pressure from levels of phosphorus<sup>18</sup>.

It is important to understand the sources of pollution, both the existing sources and the proposed new sources, created by the proposed site allocations in order to implement mitigation. Mitigation should, where possible, be implemented at the source. Using the Nutrient Budget loads, which can be categorised based on each WWTW or location, combined with the results of the Source Apportionment modelling when they are available. Hotspots and key contributors can be identified across the catchment, which allows for more targeted solutions to be implemented.

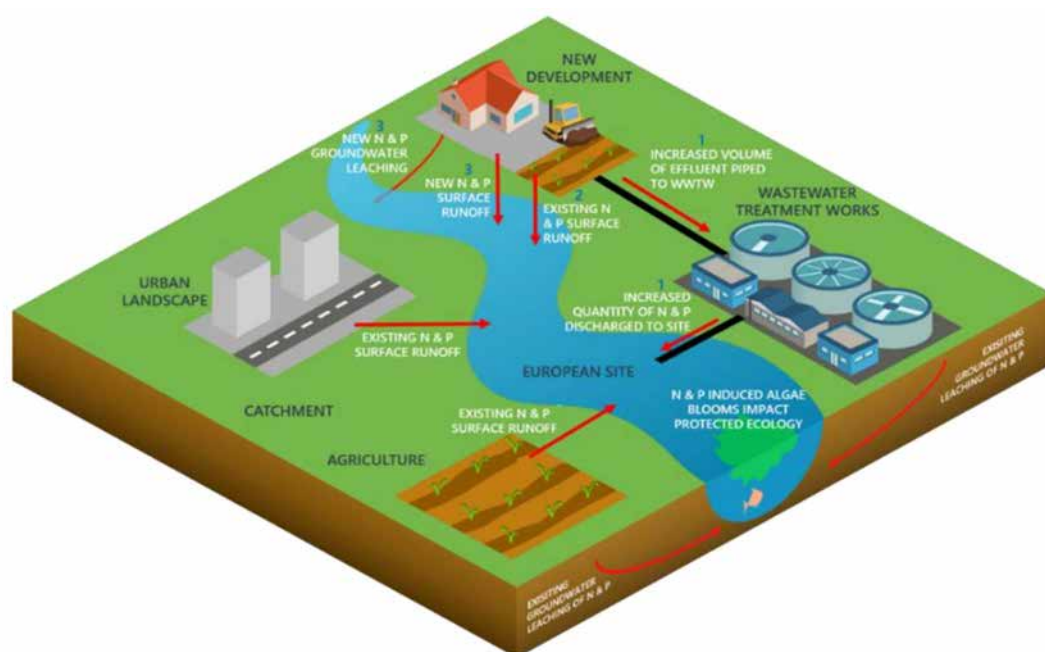


Figure 4-1 Diagram showing potential nutrient impact pathways<sup>11</sup>

The primary sources of excess phosphorus in waterbodies are:

- **Agriculture:** phosphorus in animal manure and chemical fertilisers are necessary to grow crops. However, when these nutrients are not fully utilised by plants, they can be lost from the farm fields and negatively impact air and downstream water quality. This varies according to agriculture type, with more 'intensive' systems like dairy, potatoes, wheat being generally considered to be higher contributors, and more extensive systems like beef, sheep being less phosphorus consuming, and therefore lower contributors. The Teifi valley is mainly rural with agriculture and forestry accounting for the majority of land usage. Large dairy units predominate in the lower reaches of the Teifi, with

<sup>18</sup> Nutrient Budget Calculator Guidance - A guide on how to calculate a phosphorus budget for a development

mixed dairy and livestock rearing present in the middle reaches. In the upper area, the poorer soil conditions restrict agriculture to livestock rearing on rough grazing and improved pastures.

- **Wastewater:** Phosphorus is removed from sewage via either chemical or biological methods. Chemical precipitation occurs when phosphorus is forced to react with iron, aluminium, or calcium, to form solid precipitates that can be collected. Either the chemical precipitate (sludge) or the phosphorus-enriched bacteria can then be scooped out of the sewage treatment plant as 'biosolids'. WwTW are responsible for treating large quantities of waste, and these systems do not always operate properly or remove enough nitrogen and phosphorus before discharging to waterways.
- **Stormwater:** Sources of phosphorus in urban runoff include plant and leaf litter, soil particles, pet waste, road salt, fertilizer, and atmospheric deposition of particles. Lawns and roads account for the greatest loading. Increased surface water runoff then carries phosphorus and other pollutants into local waterways.

As per the latest Phosphorus Source Apportionment Summary on the Afon Teifi, model results suggest that approximately 45kg of phosphorus is discharged from the catchment on a daily basis<sup>19</sup>. It was also found that the predominant source of P in the Afon Teifi is WwTW; 66% of the average daily load (kg/d). Rural land use only contributes 30% of the daily P load, storm overflows (intermittents) contribute 3% and a further 1% from other sources such as septic tanks and urban run-off. This confirms that P load in the Afon Teifi is largely driven by WwTW discharge. Figure 4-2 and **Appendix F** give an overview of the source apportionment loads for the Afon Teifi riverine SAC catchment.

Note that the modelling process/QA for the Tywi is not yet complete and there may be some variation around the backstop limit on a site-by-site basis (less than 5 mg/l, not greater).

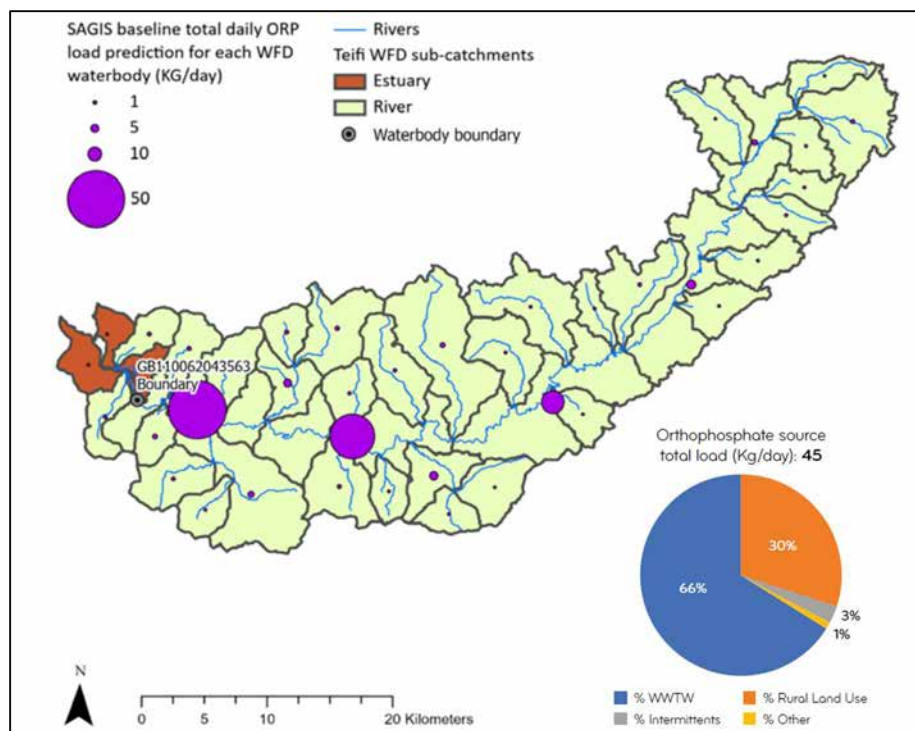


Figure 4-2 Phosphorus apportionment by source<sup>19</sup>

Note: The source apportionment represents that of the boundary of the furthest downstream WFD waterbody in the Afon Teifi catchment (GB110062043563). Load prediction points are plotted at the centre of each WFD waterbody. The "Other" category is comprised of estimated contribution from diffuse sources of urban, industry and septic tanks.

<sup>19</sup> Phosphorus Source Apportionment Summary: Updating the SAGIS River Teifi Model (December 2022)

## 4.2 Potential Solutions

The Nutrient Mitigation Options Technical Review provided by Ricardo<sup>20</sup> offers a shortlist of options for nutrient mitigation, which have been deemed appropriate potential solutions for Carmarthenshire. These options are:

- Private sewerage drainage fields
- Wetlands
- Sustainable drainage systems (SuDS)
- Buffer strips
- Agricultural land use change
- River channel re-naturalisation
- Terrestrial sediment Traps
- Drainage ditch blocking
- Engineered logjams

For each of the options, consideration must be given to the practical upkeep and monitoring required for its long-term maintenance. As well as this, the various factors which may affect the efficacy of each solution must be considered when deciding on the mitigation option which will maximise potential P removal, in any given location.

Proposals for any scheme put forward should give detail on;

- Design objectives
- Feasibility assessment
- Design overview
- Detailed design of the solution
- Implementation of the solution
- Monitoring strategy
- Management and maintenance

A review of the literature undertaken by Arcadis suggests that phosphate removal using appropriately designed SuDS, constructed wetlands and Integrated Buffer Zones (IBZs), are less effective than for other nutrients. P removal performance can vary significantly at a specific location depending on how optimal conditions are, but also can vary significantly subject to the chosen method and location.

A list of case studies is presented below:

- **Folini** in 2015<sup>21</sup> tested the removal capacity of SuDS in the Salmons Brook Catchment in Enfield and found that the average removal of P was 15.2%, with a peak reduction of 64.1%.
- **Lucke** et al in 2014<sup>22</sup> tested four different field swales and demonstrated a reduction in measured P levels of between 20% and 23% between the inlet and the outlet. SuDS performance depends upon optimum design and maintenance;
- **Bratieres** et al in 2018<sup>23</sup> demonstrated an 85% P removal under optimal conditions using SuDS that occupied at least 2% of the catchment area with a vegetated sandy loam filter media.
- **Penn** et al 2017<sup>24</sup> undertook a review of 45 P removal studies and found that statistically significant effectiveness ranged from 21% to 74% with calcium rich sorption materials proving the most effective.
- **Land** et al in 2016<sup>25</sup> undertook a large-scale review, screening 5853 unique records, appraising 93 articles, and extracting data from 203 constructed wetlands. TP is highly dependent on the loading rate as well as the area covered. Median removal rates for P were 1.2 g m<sup>-2</sup> year<sup>-1</sup>, removal efficiency for TP was significantly correlated with inlet P concentration, and median TP removal efficiency was 46%.

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<sup>20</sup> Carmarthenshire County Council (2022) Nutrient Mitigation Options Technical Review. RICARDO.

<sup>21</sup> <https://www.thames21.org.uk/wp-content/uploads/2017/01/Monitoring-of-Sustainable-Drainage-Systems-in-the-Salmons-Brook-Catchment....pdf>

<sup>22</sup> <https://www.mdpi.com/2073-4441/6/7/1887>

<sup>23</sup> <https://www.sciencedirect.com/science/article/abs/pii/S0043135408002534>

<sup>24</sup> <https://www.mdpi.com/2073-4441/9/8/583>

<sup>25</sup> <https://environmentalevidencejournal.biomedcentral.com/articles/10.1186/s13750-016-0060-0>

- **Davis** et al in 2006<sup>26</sup> This work provides an in-depth analysis on removal of nutrients from a synthetic stormwater runoff by bioretention. Results have indicated good removal of phosphorus (70 to 85%).
- **Ballard** et al in 2015<sup>27</sup> states P removal for bioretention systems designed to FAWB guidelines (after FAWB, 2009) can achieve > 80%.
- **Hoffman** et al in 2009<sup>28</sup> assessed how the different flow paths in the riparian buffer influence P retention mechanisms theoretically and from empirical evidence. The results revealed median TP retention rates for woody vegetation of 67%.

The above highlights that there is currently limited information to accurately quantify the P reduction amounts due to the limited monitoring data at these case studies although it clearly shows that there are % reduction values for a range of intervention measures.

The Ricardo report includes a GIS exercise outlining where mitigation can be targeted within Carmarthenshire. Four WwTW have been identified that are likely to contribute a high P load to Carmarthenshire's SAC rivers. It is recommended that a catchment-wide mitigation strategy should initially target these WwTW due to the potential reductions that a well-designed treatment wetland could provide and thus ability for these sites to provide a predictable quantity of strategic mitigation that could unblock development in Carmarthenshire.

## 4.3 On-site / Off-site mitigation

As part of the IAP, each of the proposed housing allocation planning applications were reviewed in order to identify and shortlist any potential onsite mitigation measures. As shown in Table 3-1 and Table 3-2, all of the sites are relatively small (<2 ha) and the area available for onsite mitigation opportunities are therefore limited.

Onsite solutions, such as Sustainable Drainage Systems (SuDS) could be designed to manage surface water runoff and provide nutrient mitigation, as discussed further in Section 7.1 and shown in **Appendix D**. However, one current limitation is that there is relatively limited largescale long-term monitoring to accurately quantify their P reduction values – for example, in terms of kg/ha/year or g/ha/year as per the wetlands.

As discussed further in Section 7, CIRIA recently published guidance “Report C808F - Using SuDS to reduce phosphorus in surface water runoff” in December 2022 in close consultation with key stakeholders, such as Natural England and The Rivers Trust. NRW is currently reviewing the applicability of this CIRIA guidance for the purpose of using in Wales. Therefore, the findings of this guide can also be incorporated into the future iterations of IAP to present alternative options to CCC and developers to mitigate the estimated latest TP budgets in Section 3.2.

The IAP aims to demonstrate that the potential measures to avoid adverse effects to the integrity of the SAC because of planned growth are ‘achievable in practice’. Therefore, Section 5 and 6 outline the main offsite solutions which could be explored to demonstrate nutrient neutrality. However, alternative additional options like SuDS, tree planting and integrated buffer strips have been explored in Section 7.

<sup>26</sup> <https://onlinelibrary.wiley.com/doi/abs/10.2175/106143005X94376>

<sup>27</sup> <https://www.ciria.org/ItemDetail?iProductCode=C753&Category=BOOK&WebsiteKey=3f18c87a-d62b-4eca-8ef4-9b09309c1c91>

<sup>28</sup> <https://access.onlinelibrary.wiley.com/doi/epdf/10.2134/jeq2008.0087>

## 4.4 Approach

Table 4-1 shows the recommended hierarchy of main solutions which should be used to mitigate the additional P loading that will be generated by new developments in Carmarthenshire within the Afon Tywi and Afon Teifi SAC drainage catchments. As highlighted above, P removal state for SuDS should be reviewed once NRW have concluded their review on the recently published CIRIA document (Report C808F) as some SuDS can perform well if they are designed and maintained correctly.

*Table 4-1: Hierarchy of Solutions*

Mitigation Option	P Removal	Costs	Scale	Feasibility
Enhanced WwTW	High	High	Medium	Medium
Constructed Wetlands	Medium – High	Medium – High	Medium	Medium
Land Management	Low	Low	Low	Low
SuDS	Medium - Low	Low	Low	Medium
Tree Planting	Low	Low	Medium	Medium
Integrated Buffer Zones	Medium	Low	Medium	Medium

The Interventions Measures Matrix in **Appendix D** also outlines further potential mitigation measures with regard to their feasibility and effectiveness as solutions for P removal. A number of interventions are highlighted as having ‘high’ effectiveness, however out of these only two options have both ‘high’ feasibility as well. These are farming source control and surface water separation. The feasibility of a solution is determined by feasibility to put in place, with consideration to likely cost as well as capacity.



## 5 Enhanced WwTWs

A small quantity of phosphorus is naturally removed through WwTWs with solids settlement and biological treatment processes. However, this is not enough to remove the quantities required to meet phosphorus limits. To achieve this, many techniques have been developed to remove phosphorus through the treatment process. In some cases where existing phosphorus permits are being tightened or new permits are introduced, a combination of techniques may be required. These consist of: -

- **Chemical Precipitation** – where metal salts are used to precipitate the phosphate component through flocculation and settlement. The use of rare elements to remove phosphorus has also shown to be effective at P removal as rare earths form a strong crystalline ionic bond with phosphates, unlike the chemical approach of iron- and aluminium-based coagulants, which do not bind to phosphorus as efficiently<sup>29</sup>
- **Physical separation** – where filtration is used to remove the suspended solids phosphorus component. One example of this is electrocoagulation which destabilizes and aggregates contaminant particles, ions such as heavy metals, and colloids, using an electrical charge to hold them in solution.
- **Enhanced biological phosphorus removal** – where an anaerobic phase positioned upstream of an activated sludge process encourages growth of phosphorus accumulating microorganisms to take up phosphorus in the downstream aerated stage.
- **Algae treatment** – where algae is used to naturally consume the phosphorus as a nutrient. This is a relatively new technology. This solution is already being used by South West Water.<sup>30</sup>
- **Reedbeds** – where there have been developments in phosphorus adsorbing media being used as the base for the reedbed.
- **Constructed wetlands** – where high retention times encourage settlement and natural uptake of phosphorus.

### 5.1 Collaboration on Phosphorus Reduction Schemes

Following DCWW's 'Source Apportionment' modelling to identify the main phosphate sources on each section of the five failing SAC rivers in Wales, DCWW have produced their indicative Phosphorus Reduction Programme, detailing WwTWs likely to require a new phosphorus permit limit, to address DCWW's regulatory compliance needs. Each WwTW has been allocated a 'collaboration category', based on the existing permit limit and future planned investment.

Importantly, DCWW published these collaboration opportunities in February 2023 with the relevant existing Nutrient Management Boards (NMBs) ahead of the NRW led Review of Permit (RoP) exercise, and this information is now available online for their stakeholders<sup>15</sup>. Therefore, the categories are subject to change. However, the upfront preliminary desktop screening aims to provide a starting point for focused and well directed Constructed Treatment Wetland (CTW) feasibility studies. These categories are summarised in Table 5-1.

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<sup>29</sup> Phosphorus Removal from Wastewater. Reduced Sludge from Wastewater (1019neowatertreatment.com)

<sup>30</sup> South West Water to use I-Phyc's algae-based treatment to sustainably remove Phosphorus and micro-pollutants from sewage

Table 5-1 DCWW WwTW Collaboration Categories

Category	Qualifying Criteria	Impact on Collaboration
A	<p>DCWW has an existing TP limit of <math>\leq 4\text{mg/l}</math>.</p> <p>DCWW will have a TP limit of <math>\leq 4\text{mg/l}</math> in future AMPs.</p> <p>The current or future flows expect to increase the population equivalent the treatment WwTW serves over the suitable flows for a wetland to accommodate.</p> <p>The WwTW receives trade effluent that contains certain substances that is likely to harm a wetlands habitat, or make the normal treatment process a wetland can provide, inefficient.</p>	<p>No further TP via CTW is possible.</p> <p>No collaboration opportunities are available at this site for further TP reduction.</p> <p>No Proformas or collaboration requests can be processed for these WwTW.</p>
B1	<p>DCWW has an existing TP limit <math>&gt; 4.1\text{mg/l}</math></p> <p>DCWW will have a TP limit of <math>&gt; 4.1\text{mg}</math> in future AMPs</p> <p>DCWW's future AMP TP limit will require investment*</p>	<p>There is potential for further TP reduction.</p> <p>Collaboration opportunity is available at these WwTW.</p> <p>This collaboration may involve a jointly owned CTW (different cells owned by different organisations but part of the same interconnected wetlands).</p> <p>Both parties garner a reportable TP reduction from the CTW.</p> <p>Category B WwTW are subject to change. The categorisation is based on current sample data. Sites may transition to a category D site, as our understanding of the site's performance increases during route course analysis.</p> <p>The impact of this change in category (from B to D) will mean the wetlands transitions from being a jointly owned and funded CTW, to a 3rd party solely owned and funded CTW.</p>
B2	<p>DCWW has a future AMP water quality investment need (within certain limits), that is non-Phosphorus related**</p> <p>DCWW's future AMP driver, has the potential to be addressed by a CTW (based on known flows and WwTW dynamics among additional variables)</p>	<p>CTW is anticipated to form part of/all the solution required to address DCWW's water quality driver.</p> <p>CTW solution could also be designed to reduce TP</p> <p>There is a need for a multi-scope feasibility to be agreed in the inception meeting to understand if the CTW can address both organisation's needs.</p> <p>This collaboration may involve a jointly owned CTW (different cells owned by different organisations, with clear compliance demarcation, but part of the same interconnected wetlands).</p> <p>DCWW garners it's required water quality parameter reduction, partner organisation garners TP reduction from the same CTW.</p>
C	<p>DCWW has AMP8 driver that is non- Phosphorus related.</p> <p>DCWW expects to have a conventional solution to address the water quality improvement (determined by the % reduction required or the route course analysis).</p>	<p>Further TP reduction is available following DCWW's future AMP investment. Though both organisations require separate solutions.</p> <p>The impact of this, and the difference between a Category C WwTW and a Category D WwTW, is that the future flow and water quality parameters are what the feasibility should be based upon. Not the current parameters.</p>
D	<p>Based on current regulation and policies, DCWW has no anticipated future investment need (now or future AMPs) due to the sites current performance, % of growth anticipated, flows and/or location of the WwTW in the catchment.</p>	<p>Partners can progress feasibility, using current parameters, provided by the WwTW Asset Information Pack</p> <p>DCWW supports with effluent transfer only, full TP reduction provided by the CTW is the reportable benefit of the third party.</p>

\*As opposed to a WwTW that requires a TP limit, but the site is already meeting the new permit limit or will do so by the regulatory deadline.

\*\*For example, ammonia reduction target, or another water quality parameter



Further discussion with DCWW may be needed to establish if any collaboration opportunities are available at the Category A WwTW locations. For example, where suitable wetland sites are present, and there are other stakeholder and/or DCWW drivers to promote such nature-based solutions. This is because current research shows that it is still possible to remove phosphorus when the influent concentration strength is < 4mg/l TP (the threshold currently being used by DCWW). However, this will require further modelling using *P-K-C\** and *K-C\** analytical methods to determine suitable wetland sizes to ensure the desired treatment performance. It is also important to recognise that wetlands can provide multiple benefits, including other water quality treatment benefits, not just phosphorus.

Table 5-2 below shows the proposed P permit and current collaboration category for those WwTWs that will receive flows from Carmarthenshire rLDP site allocations.

Currently, there are four WwTWs in Collaboration Category A that receive flows from Carmarthenshire rLDP site allocations. This means that, at present, no DCWW collaboration opportunities are available at these locations. As discussed in Section 3.2.1, Lampeter and Llanybydder are included in DCWW's current investment programme, which are classed as Collaboration Category A based on their new proposed AMP7 P permits. Capel Iwan and Pencader are also in Collaboration Category A, with tighter P permits proposed, however, these improvements are planned in future AMP8/9 cycles.

It should be noted that there are two more Collaboration Category A WwTWs (namely, Tregaron and Pontrhydfendigaid) within the Afon Teifi SAC, due to their tighter P permits under future AMP8/9 cycles, but they will only receive flows from the adjacent Ceredigion County Council area.

*Table 5-2 Summary of DCWW Phosphorus Reduction Scheme by WwTW for Carmarthenshire rLDP*

WWTW	Proposed P permit (Approximators)	DWF m <sup>3</sup> /day	Above 20 m <sup>3</sup>	Collaboration Category
Capel Iwan	1.8	82	Y	Category A
Pencader	3.5	439	Y	Category A
Drefach/Velindre	5	943	Y	Category B1
Pentrecwrt	5	56	Y	Category B1
Llanfihangel-ar-arth	5	56.3	Y	Category B1
Llanybydder	2.5	1019	Y	Category A
Lampeter	0.5	1201	Y	Category A
Adpar	5	535	Y	Category B1
Llandysul	5	689	Y	Category B1
Cwm Ifor	5	92.5	Y	Category B1
Ffairfach	5	847	Y	Category B1
Llandovery	5	705	Y	Category B1
Llangadog	5	427	Y	Category B1
Pontargothi	5	171	Y	Category B1

## 5.2 DCWW Permitting

As discussed in Section 3.2, DCWW have undertaken source apportionment modelling on four rivers, all of which are designated SACs, and all are currently failing to achieve their water quality targets. The preliminary findings, outlined in the summary reports, show that under current conditions, approximately 45kg of phosphorus is discharged from the catchment on a daily basis. Effluent from sewage treatment works accounts for 66% of the average daily load (kg/d) with rural land use contributing 30%, storm overflows (intermittents) contributing 3% and a further 1% from other sources, including septic tanks and urban run-off.

Based on these preliminary results, it is clear that WwTWs are the largest contributor to phosphorus in the Afon Teifi SAC. Also, as shown in

Table 3-5 (with the default 8mg/l P limit) and Table 3-7 (with the backstop 5mg/l P limit), the TP load at Stage 1 (from the WwTW) accounts for between 60-70% of the Nutrient Budget in the Afon Teifi SAC.

### 5.2.1 TP limits and Nutrient Budgets

Figure 5-1 below compares the estimated Stage 4 Nutrient Budgets for the default P limit and backstop P limit at each WwTW location for the Afon Tywi and Afon Teifi, respectively. This shows the TP budget breakdown for the default 5 mg/l P limit and the backstop 8 mg/l P limit. This includes a 20% precautionary buffer, as per Ricardo Nutrient Budget Calculator to address any uncertainties in current assumptions. As outlined in Section 3.1, 5 mg/l is the assumed 'backstop' permit limit to prevent deterioration of the SACs. All WwTWs in this assessment will be required to meet this backstop limit by the end of DCWWs phosphorus permit programme (2032).

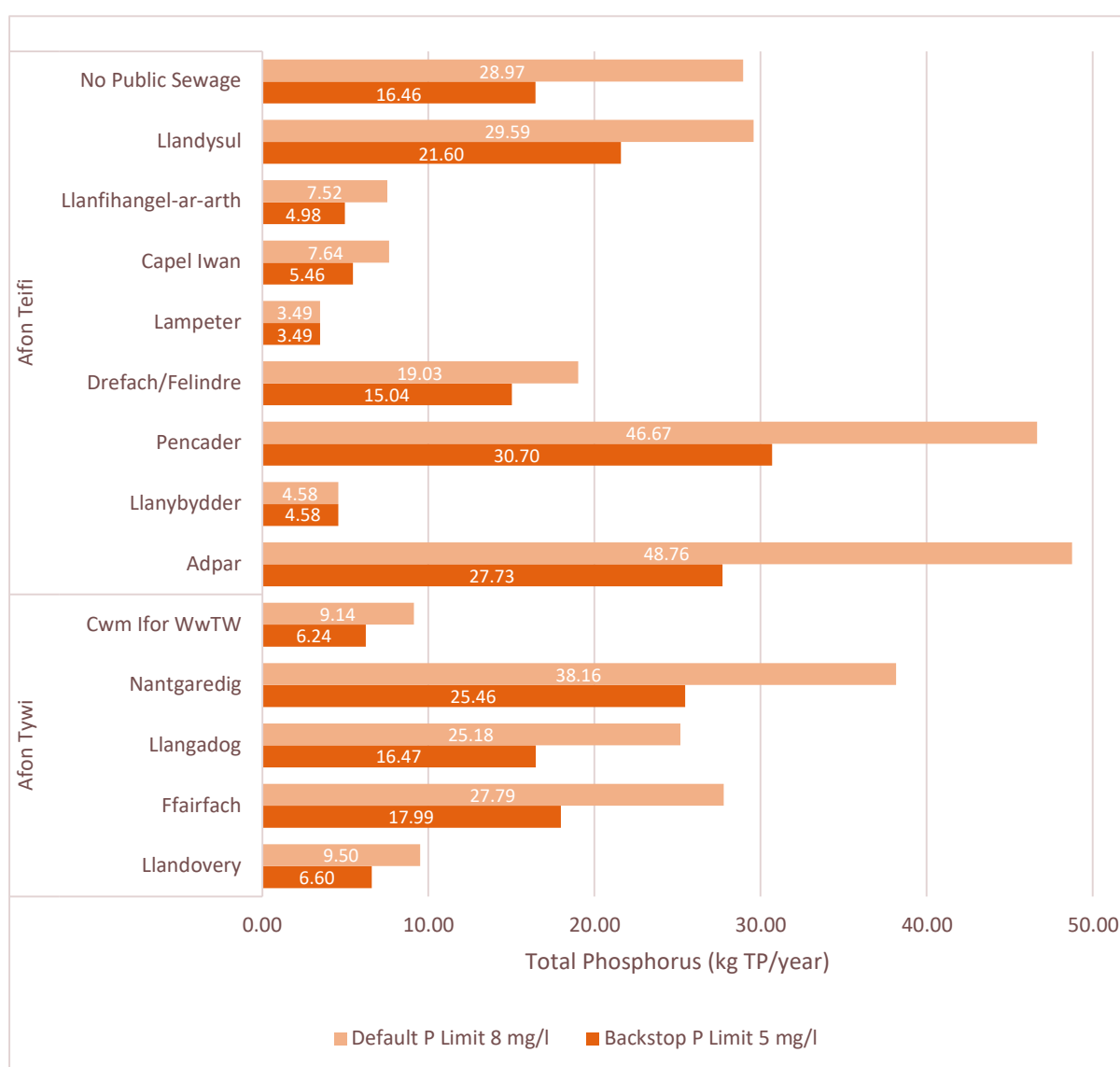


Figure 5-1 Impact of the P limit scenarios on the Nutrient Budget Load\*

\*Lampeter and Llanybydder are using their proposed AMP7 P permits (0.5 and 2.5 respectively) so that backstop and default limits are not applicable at these two WwTW locations.

## 6 Constructed Wetlands

Constructed wetlands are densely vegetated waterbodies that use natural processes to provide treatment of surface water runoff and WwTW final effluent. They remove fine sediments, metals and particulates, and dissolved nutrients. They can consistently provide the largest P removal capacity of the nature-based solutions and the greatest biodiversity benefits. Constructed wetlands designed for nutrient mitigation are distinguished from other wetlands in that they receive a well-defined source of water and are managed to improve the quality of water through creating and maintaining appropriate water depths and flows.

### 6.1 Wetland Requirements

Figure 6-1 below shows the indicative wetland area requirements (based on Nutrient Budgets for each WwTW), which includes an additional 25% buffer to account for the required earth reprofiling and bunds to deliver the effective treatment area required. This shows the wetland area breakdown the default 5 mg/l P limit and the backstop 8 mg/l P limit area for each WwTW location.

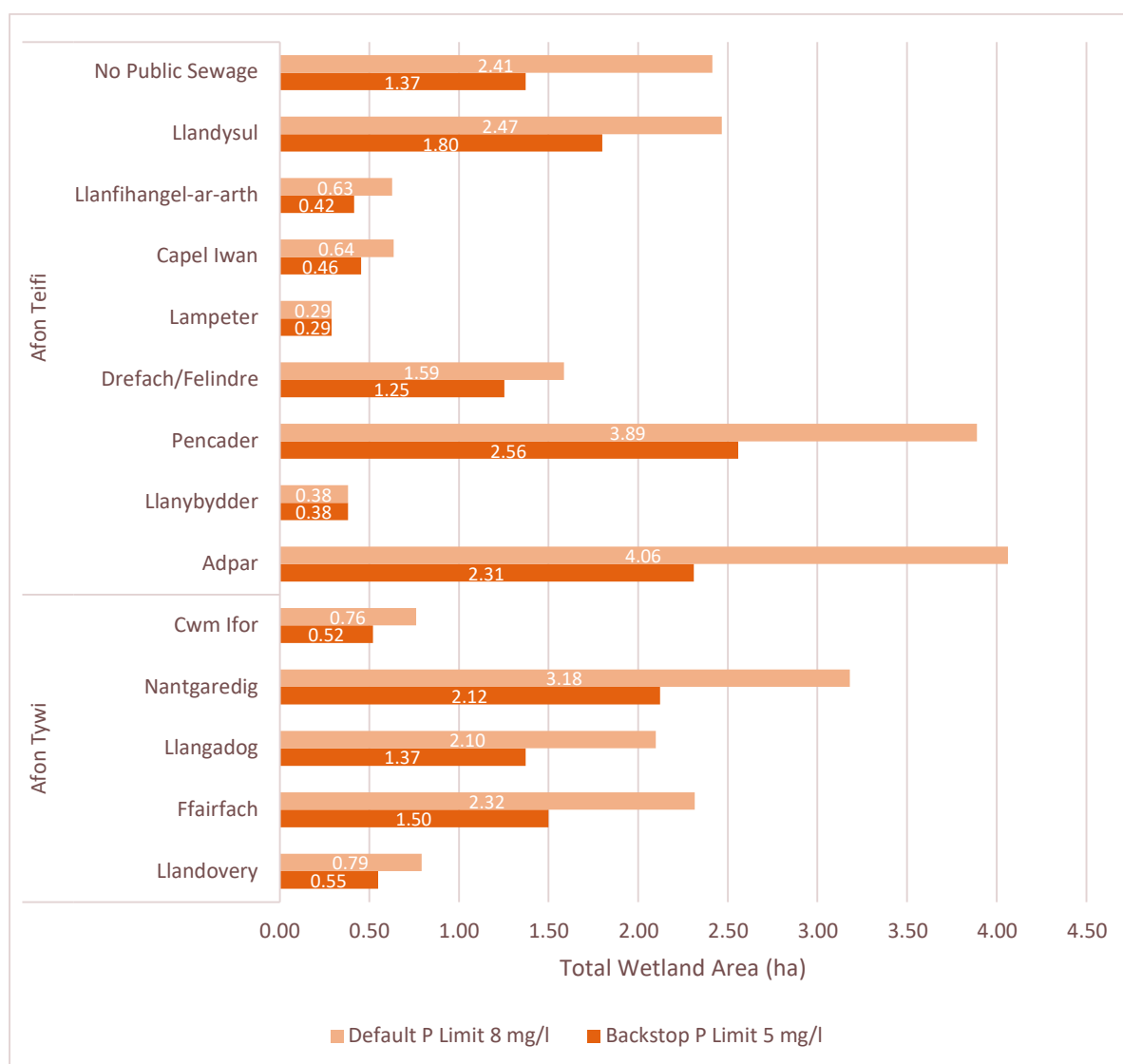


Figure 6-1 Indicative Wetland area requirements, per WwTW, to offset the Nutrient Budget Load.

As outlined before, there is limited information to accurately quantify the effective P reduction for the various mitigation options due to limited monitoring data that is applicable for specific site conditions. However, the average P removal rates from constructed wetlands can be considered as 1.2 g m<sup>-2</sup> year<sup>-1</sup>. Whilst this is acceptable to use for the current initial feasibility stage, alternative, more accurate design approaches should be used to calculate the wetland treatment areas and perform their hydraulic design during the next stage when the wetland locations and their site conditions are better known.

Figure 6-2 below shows the indicative wetland requirements based on Nutrient Budgets for the Afon Tywi and Afon Teifi, as shown in Figure 5-1. The effective area (as shown in Figure 6-2) is the area required to mitigate for the Nutrient Budget. However, an additional 25% buffer is needed to the effective area to account for the required earth reprofiling and bunds. Therefore, the total wetland area requirement is the summation of the effective treatment area and 25% buffer, as illustrated below for each impacted SAC.

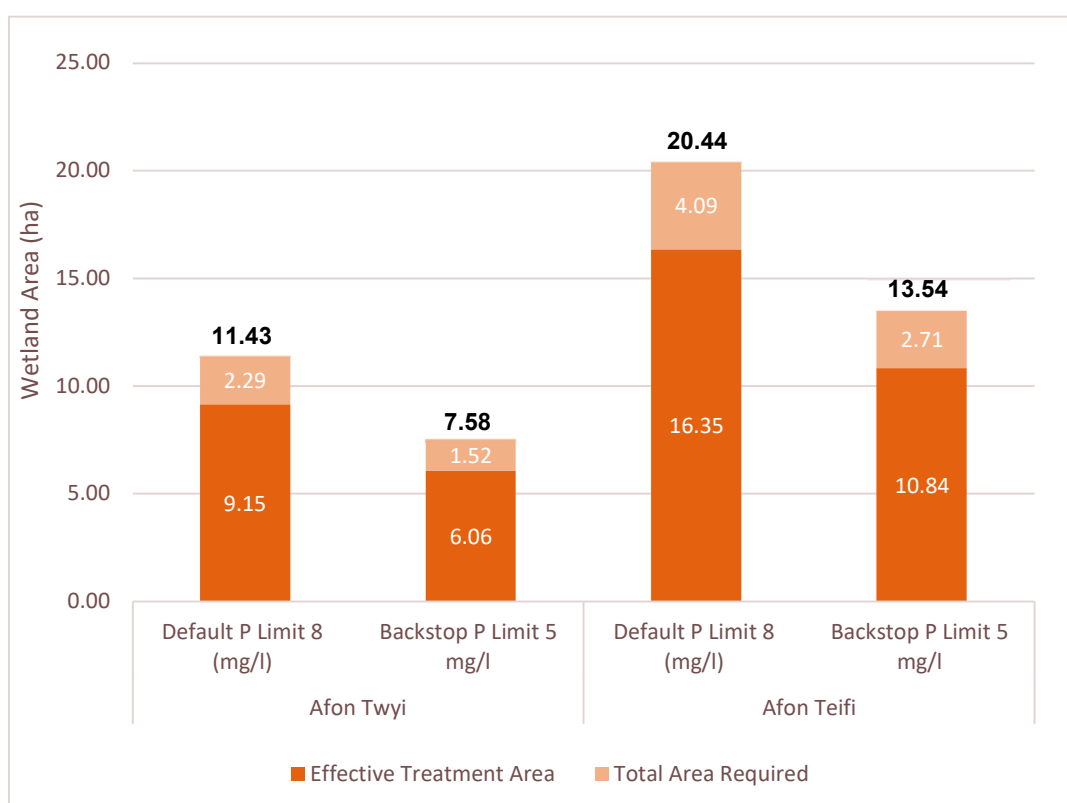


Figure 6-2 Indicative Wetland area requirements, per SAC, to offset the Nutrient Budget Load, including a 25% buffer to account for wetland bunding to deliver the effective treatment area required.

The above shows that to meet Nutrient Neutrality the following wetland treatment areas are required:

- The default TP permit of 8 mg/l requires a total of 31.88 ha of wetland area. That is 11.44 ha (9.15 ha effective treatment area) on the Afon Tywi and 20.44 ha (16.35 effective treatment area) on the Afon Teifi; or
- The backstop limit of 5 mg/l requires a total of 21.13 ha. That is 7.58 ha (6.06ha effective treatment area) on the Afon Tywi and 13.55 ha (10.84 effective treatment area) on the Afon Teifi.

However, these values are only indicative and as the rLDP progresses, a more robust approach, such as the *P-K-C\** model would be required to refine the calculations and develop design and costing of these wetlands.

## 6.2 Challenges

### 6.2.1 Technical Feasibility

Designing, constructing and maintaining constructed wetlands is a complex process. In addition to characterising the source, volume, quality and variability of the inflow to a wetland, there are a myriad of other considerations to be taken into account including soil, topography, flood risk, archaeology, seasonal and long-term maintenance requirements. A high-level feasibility study has been carried out across the Afon Tywi and Afon Teifi catchments to identify the most suitable locations for constructed wetlands. As per the Constructed Wetlands Hub wetland design process<sup>31</sup>, there are several factors which need to be considered (Table 6-1).

To meet the objectives of the Habitat Regulations, a wetland scheme must provide effective mitigation for nutrient loads to avoid any adverse effects on SACs. As the Action Plan develops and wetland schemes are brought online to mitigate nutrient impacts, it is recommended that the design process and methodologies (*P-K-C\** approach, *K-C\** approach or Regression equations) described in the Natural England and Rivers Trust wetland framework guidance<sup>32</sup> are used.

One of the main challenges, is that there is a lack of council owned land along the Afon Teifi which could be used for constructing wetlands and therefore all the potential mitigation is situated in non-council owned land. Also, there are no council owned land opportunities near to the existing WwTWs on the River Tywi either. Therefore, consultation would be required with the relevant landowners before these options are taken further.

Table 6-1 Wetland feasibility assessment criteria

Factor	Commentary
Land Ownership	Opportunities on council owned land have been explored first as they reduce costs and risks associated with land purchase and reduce / simplify stakeholder engagement.
Land Use	Where council owned land has been identified, the existing / proposed land use has been given consideration. On privately owned land, where generally agricultural / vacant land has been considered, the agricultural land classification (ALC) system <sup>33</sup> has been used with a preference to avoid grades 1 - 3a (good quality) and move towards grades 3b – 5 (Poorer quality).
Soils	It is favourable to site wetlands in impermeable soils to avoid infiltration of the nutrients absorbed into ground, providing a potential pathway to water supply. Where this is not possible, an impermeable layer (lining) may be required to prevent infiltration – this has the impact of increasing costs. Soils have been identified and characterised using Soilscales <sup>34</sup> .
Geology & Hydrogeology	Where an aquifer is present, this can provide upward discharge of groundwater into the wetland, compromising the treatment efficiency. There is also risk of leakage from the wetland, which could enter local groundwater and pollute watercourses/water supply. Solid and drift geological maps have been reviewed to determine potential areas for the proposed wetlands, favouring classification Secondary B, where layers of low permeability are generally found and therefore store / discharge limited amounts of groundwater.
Flood Risk	For a wetland to be effective, the volume and flow rates must be carefully controlled – if flooding is frequent, this is not possible and overall effectiveness reduces.

<sup>31</sup> Constructed Wetlands Hub. <https://storymaps.arcgis.com/collections/6543a2f8de0348f683187ff268a79687?item=3>

<sup>32</sup> Natural England (2022) Framework Approach for Responding to Wetland Mitigation Proposals. The Rivers Trust and Constructed Wetland Association

<sup>33</sup> Guide to assessing development proposals on agricultural land (2021)

<sup>34</sup> Soilscales, available: <https://www.landis.org.uk/>

Factor	Commentary
	As such, it is generally favourable to locate wetlands in Flood Zone 1 (Land having a less than 1 in 1,000 annual probability of flooding). Creating a wetland within Flood Zone 2 or 3 (Land having a greater than 1 in 1000 annual probability of flooding) may be possible in some situations, although not currently recommended as best practice for the purpose of nutrient mitigation because of potential remobilisation risk of captured phosphates back into the river as well as increased maintenance needs due to siltation during times of river flood inundation. If they are to be considered for nutrient mitigation then additional design, planning, safety redundancy, maintenance and monitoring will be essential to demonstrate satisfactory performance throughout the design life.
Hydrology & Drainage	<p>Wetlands should be sited downstream of WwTW's and intensive agriculture so that the concentration of nutrients entering the wetland is high, and therefore the load removal is high. If the inlet nutrient concentrations are low, then it is unlikely that the wetlands will remove the required load of nutrient sufficiently to achieve nutrient neutrality.</p> <p>Furthermore, suitable 'Online' wetland locations i.e., where the wetland is connected to a 'natural' water source in and out without environmental damage, are likely to represent a more feasible and cheaper solution although they are more vulnerable to flood risk and siltation. 'Offline' wetlands, may require additional hard engineering to create diversions, which would require permitting and more complex stakeholder engagement.</p>
Topography	Wetlands require earthworks and balancing the amount of cut and fill will minimise the cost of the design. The need for deep excavations should be avoided as these could cause health and safety issues and slope stability problems. LiDAR and topographical mapping have been reviewed to determine the potential area each of the proposed wetlands could occupy. All of the wetlands are sited on flat, low-lying land in or adjacent to the floodplain to minimise the need for deep excavation.
Groundwater	<p>If a wetland is receiving a source of water that has higher contaminant levels than are generally prevalent in the surrounding environment (e.g., discharge from a WwTWs) it is important to be sure that the water from the wetland does not harm groundwater resources.</p> <p>All groundwater is a potential future resource for drinking water. Groundwater nitrate vulnerable zones (NVZs) identify areas where groundwater is vulnerable to nitrate pollution and should be protected from elevated levels of nitrate leaching either directly via leakage from a wetland or via leaching from the soil during the construction process.</p>
Protected Sites & Species	<p>If the location is in, or near, a protected site, and could impact the conservation objectives of the site, a permit will be required from NRW.</p> <p>If protected species are present at or near the site and could be impacted by the project, a consent will be required from NRW.</p>
Archaeology	<p>Archaeological remains and landscape features may need to be protected so that they are not lost. The best way to minimise the risk that archaeological remains will delay construction and increase costs is to identify the issue early on and plan for it.</p> <p>Scheduled monuments have additional protection and should not be impacted by development.</p> <p>Peat soils will also preserve environmental records in situ and should be protected.</p> <p>The heritage value of the site and its landscape can be important. The feasibility of the wetland design needs to consider how to accommodate landscape and heritage issues.</p>

## 6.2.2 Cost feasibility

As part of the wetland area requirements above, some preliminary costings have been prepared based on Environment Agency Guidance document<sup>35</sup> and variety of other published information sources. The capital costs below (Table 6-2) are based on the wetland areas required, as shown in Figure 6-2, rather than the total wetland area potentially feasible. This is to show the minimum cost required to meet nutrient neutrality. However, this excludes upfront land purchase and detailed operation and maintenance (O & M) costs of the wetland for its design life.

The wetland capital costs below are based on the £30/m<sup>3</sup> upper bound value for constructed wetlands, based on the Environment Agency Report –SC080039/R9 (Cost estimation for SUDS – summary of evidence, dated March 2015). However, this unit cost rate was first verified with a variety of alternative latest information sources for benchmarking to a likely precautionary level based on the constructed wetlands in the UK and overseas for stormwater and wastewater treatment wetlands.

It was then decided to use £30/m<sup>3</sup> as a precautionary estimate at the current feasibility stage and the capital costs shown below currently assumes an average wetland excavation depth of 1m. This may however currently exclude some notable cost items such as land acquisition, stakeholder engagement, permitting, lining to protect groundwater pollution, monitoring and project administration associated with delivering nutrient removal wetlands. Therefore, further work is required to confirm these costs as the detailed wetland proposals are produced.

Table 6-2 Indicative Wetland capital costs based on the Nutrient Load for the 8 mg/l and 5 mg/l Permit

	Default P Limit 8 (mg/l)		Backstop P Limit 5 (mg/l)	
	Wetland (ha)	Indicative Cost	Wetland (ha)	Indicative Cost
Afon Tywi	11.43	£3,430,000	7.58	£2,273,000
Afon Teifi	20.44	£6,132,000	13.54	£4,064,000
<b>Total</b>	<b>31.88</b>	<b>£9,562,000</b>	<b>21.12</b>	<b>£6,337,000</b>

Environment Agency Report–SC080039/R9 also recommends £0.1 / m<sup>2</sup> of wetland surface area for estimating ongoing annual maintenance costs, and a further annual maintenance of £200-250/yr for first 5 years (declining to £80 - £100/yr after 3 years) should also be allowed. However, higher maintenance costs than this will be generally expected to account for additional maintenance, sampling and monitoring requirements associated with these nutrient mitigation wetlands. This means approximately £20k - £35k annual total maintenance costs are expected with the above wetlands depending on the WwTW TP limits being used for sizing.

## 6.3 Current Opportunities

A key driver for locating potential constructed wetlands sites, is the ability to easily receive discharges from the existing or proposed WwTW plants, including the proximity to both WwTWs and receiving watercourses. However as highlighted before, availability of suitable land and dealing with landownership considerations are also key.

Based on the currently available information to Arcadis at this IAP initial feasibility screening scope, the location of the preliminary wetland opportunities have been illustrated in **Appendix A Figure A3** for the Afon Tywi and **Appendix A Figure A4** for the Afon Teifi. Currently, these figures only point to

<sup>35</sup> Environment Agency (2015) Cost estimation for SUDS - summary of evidence. Report –SC080039/R9

a broad area of opportunity rather than outline the specific area for the wetland as these areas are only based on a high-level and desk-based opportunity and constraints mapping exercise.

These include two wetland opportunities amongst land owned by CCC near to the Afon Tywi, but a key disadvantage of them is that they are located some distance away from the existing WwTWs. Therefore, the main source of phosphorus loading for these wetlands is likely to be from upstream fluctuating river flows that include phosphorus from both WwTW Dry Weather Flows (DWFs) and agricultural runoff.

One of these sites (CW02), can be created just south of the Afon Tywi, the other is just south of this site, south of a tributary of the Afon Tywi. Different challenges are present depending on which side of the river the wetland is situated. Therefore, this site has been split into two options (Location A and Location B). As the IAP progresses and DCWW information regarding collaboration opportunities and permitting positions within the Tywi is released, alternative options for wetland sites could be explored focussing on locations adjacent to.

Seven potential wetland locations have been suggested along the Afon Teifi within the CCC boundary, but more suitable locations may also be available in the neighbouring Ceredigion County Council boundary and need further investigation during the next stage of this IAP preparation. Specificities regarding the current wetland sites can be seen in Table 6-3 and Table 6-4 for Afon Tywi and Afon Teifi respectively.

*Table 6-3 Afon Tywi Constructed Wetland Opportunities*

Ref	Area (ha)	Land-owner	ALC	Flood Zone	Soil Type	Indicative P removal (TP Kg/yr)	Indicative Capital Cost
Tywi CW01	8	C	3b	Flood Zone 1	Slowly Permeable	96	£ 2,400,000
Tywi CW02 – Location A	7	C	3a	Flood Zone 2/3	Freely Draining	84	£ 2,100,000
Tywi CW02 – Location B			3b	Flood Zone 1			
<b>Total</b>	<b>15</b>					<b>180</b>	<b>£ 4,500,000</b>

C= Council Owned land; ALC= Agricultural Land Classification; Total Area = Effective Treatment Area (11.25ha) plus 25% of this area required earth reprofiling and bunds which is > 9.15ha requirement with default 8mg/l TP limit; Total Costs based on the £30/m<sup>3</sup> upper bound value for constructed wetlands, based on the Environment Agency Report –SC080039/R9<sup>35</sup>

*Table 6-4 Afon Teifi Constructed Wetland Opportunities*

Ref	Area (ha)	Land-owner	ALC	Flood Zone	Soil Type	Indicative P removal (TP Kg/yr)	Indicative Capital Cost
Teifi CW01	5	P	3a	Flood Zone 2/3	Freely Draining	60	£ 1,500,000
Teifi CW02	6	P	3b	Flood Zone 2/3	Slowly Permeable	72	£ 1,800,000
Teifi CW03	2.5	P	3a/3b/4	Flood Zone 2/3	Freely Draining	30	£750,000



Ref	Area (ha)	Land-owner	ALC	Flood Zone	Soil Type	Indicative P removal (TP Kg/yr)	Indicative Capital Cost
Teifi CW04	3	P	5	Flood Zone 1	Slowly Permeable	36	£900,000
Teifi CW05	6	P	3b	Flood Zone 1	Freely Draining	72	£1,800,000
Teifi CW06	2	P	3a/5 *grade 3a seems unlikely	Flood Zone 1	Slowly Permeable	24	£ 600,000
Teifi CW07	12	P	5	Flood Zone 1	Slowly Permeable	144	£ 3,600,000
<b>Total</b>	<b>36.5</b>					<b>438</b>	<b>£ 10,950,000</b>

P= Privately Owned land; ALC= Agricultural Land Classification; Total Area = Effective Treatment Area (27.4ha) plus 25% of this area required earth reprofiling and bunds which is > 16.35ha requirement with default 8mg/l TP limit; Total Costs based on the £30/m<sup>3</sup> upper bound value for constructed wetlands, based on the Environment Agency Report –SC080039/R9<sup>35</sup>

## 6.4 Next Steps

**Appendix A Figure A3 and A4** show potential preliminary example locations for illustrative purposes only at this early stage of IAP. These preliminary wetland locations will need further investigation to confirm their suitability and deliverability. Similarly, there would be suitable alternative areas near to the existing WwTWs, which are yet to be identified in consultation with CCC, DCWW, NRW and relevant landowners.

The currently shown illustrative locations would aim to satisfy the maximum wetland requirements associated with the 8 mg/l P permit limit to deliver the residential growth in CCC rLDP (2018-2033) within the impacted Afon Teifi and Afon Tywi SAC catchment. This includes a 20% precautionary buffer when estimating the TP budget, which accounts for the current uncertainties associated with the assumptions used, including the median wetland performance efficacy value used for sizing. A further 25% buffer is added to the estimated effective wetland treatment area to account for the required earth reprofiling and bunds.

In summary, all these preliminary wetland locations shown in these figures would be subject further appraisal to determine their technical feasibility, viability, deliverability, and longevity, including maintenance, ownerships, and replacement (if applicable) through further work during the next stages of this IAP. As highlighted in Section 5.0, DCWW are planning to undertake a programme of phosphorus reduction measures under the next AMP cycles, which may include interventions at some of the WwTWs in Afon Teifi and Afon Tywi SACs to meet their own statutory obligations, and therefore continuing engagement with DCWW and NRW would be essential alongside the ongoing RoP process to maximise potential collaboration opportunities.

## 7 Secondary Measures

In the hierarchy of wastewater treatment solutions, enhanced WwTW are preferred (Table 4-1), which should be considered in conjunction with Nature-Based Solutions (NbS) where necessary. However, where wastewater treatment and/or sufficient headroom capacity for total P is not available, the council and developers have the option of waiting for additional capacity to be delivered via future AMP programmes or alternatively to fund the works themselves.

The following section discuss some alternative, smaller scale solutions which CCC, DCWW and developers could invest in across the catchment to reduce the requirements on the large mitigation solutions like wetlands and WwTW improvements.

### 7.1 SuDS

There is a growing acceptance that we need a more sustainable approach to managing surface water. SuDS mimic natural drainage processes to reduce the effect on the quality and quantity of runoff from developments and provide amenity and biodiversity benefits. SuDS can also deliver additional environmental benefits. In addition to SuDS, IBZs which are strips of habitat surrounding agricultural fields or adjacent to watercourses, can support drainage and protect watercourses.

SuDS components differentiate from traditional drainage by providing water quality improvements by reducing sediment and contaminants from runoff either through settlement or biological breakdown of pollutants. This can improve the quality of downstream waterbodies such as streams, rivers, lakes, bathing or shellfish waters.

Sustainable drainage includes a variety of components, each having different approaches to managing flows, volumes, water quality and providing amenity and biodiversity benefits. There are a variety of SuDS components, and there is often some overlap. Components that materially contribute to the improvement of water quality are:

- **Source control** – a key method of source control includes permeable paving which can attenuate flow and enhance water quality. Green roofs can help provide interception storage which can handle and treat some of the more frequent but smaller, polluting rainfall events (at least 5mm, if not 10mm). Their purpose is to manage rainfall close to where it falls, not allowing it to become a problem elsewhere.
- **Swales and conveyance channels** – these carry surface water runoff using vegetated channels across the site and can be used to manage floodwater. Swales may need to be lined appropriately in certain situations to avoid pollutants entering into undesired zones (e.g. contaminated land, areas with high groundwater table and source protection zones);
- **Filtration** – Filtration and removing sediment or other particles from surface water runoff is one of the main treatment methods for sustainable drainage, filter strips including street trees and bioretention areas include vegetation that traps silt to remove pollutants and reduce runoff downstream. Bioretention areas are shallow depressions that are aimed at managing and treating runoff from frequent rainfall events;
- **Infiltration** – Infiltration components are used to capture surface water runoff and allow it to infiltrate (soak) and filter through to the subsoil layer, before returning it to the water table below. These include rain gardens which are relatively small depressions in the ground that can act as infiltration points for roof water and other ‘clean’ surface water;
- **Retention & detention** – Provide storage, through the retention of surface water runoff, or attenuation through the detention of surface water runoff. Retention is primarily provided on the surface through ponds, however, there should be upstream components or treatment stages

before surface water is conveyed to ponds. Detention is often useful in attenuating the peak flow from a rainfall event, but it also allows filtering and sedimentation to take place, which contributes to water quality improvement.

Schedule 3 of the Flood and Water Management Act 2010 for Wales<sup>36</sup>, which came into effect 7<sup>th</sup> January 2019, outlines the mandatory SuDS standards and requirements developers need to meet before gaining approval from the SuDS Approving Body (SAB). Early consideration of the potential multiple benefits and opportunities<sup>37</sup> will help deliver cost effective SuDS schemes with the best results.

CIRIA recently published guidance “Report C808F - Using SuDS to reduce phosphorus in surface water runoff” in December 2022 in close consultation with key stakeholders, such as Natural England and The Rivers Trust. NRW is currently reviewing the applicability of this CIRIA guidance for the purpose of using in Wales. Therefore, the findings of this guide can also be incorporated into the future iterations of IAP to present alternative options to CCC and developers to mitigate the estimated latest TP budgets in Section 3.2.

## 7.2 Tree Planting

Carefully planned and managed woodland created alongside watercourses can reduce the risk of soil erosion, pollution and nutrient run-off from neighbouring fields and in urban areas, run-off from roads and buildings. Tree roots strengthen stream banks and woodland plants trap the sources of diffuse pollution before they reach the watercourse.

As per the CCC Nutrient Budget calculator, the average phosphorus leachate rates from semi-natural native woodland planting, as well as grass set aside and neutral grass can be considered as 0.02 kg/ha/yr<sup>38</sup>. This means that including woodland planting and greenspaces in proposed developments or converting agricultural land to woodland would reduce the total nutrient load to mitigate as well as provide some mitigation of its own.

The NRW Welsh Information for Nature-based Solutions (WINS)<sup>39</sup> has produced a dataset showing opportunities for woodland planting across Wales. These maps can be used to start discussions on the best way to realise Welsh Government’s ambition for new woodland creation to achieve 2,000 hectares of new woodland per annum from 2020, rising to 4,000 hectares per annum as rapidly as possible. The dataset showed that South West Wales could provide ~6000 ha of woodland, with over half being located within Carmarthenshire.

This target is mostly aimed at meeting climate change mitigation requirements, however as woodlands provide a wide range of other ecosystem services, other policy aims will be secured through the creation of new woodland.

## 7.3 Integrated Buffer Zones

Integrated Buffer Zones (IBZs) are different-sized areas or strips of permanent vegetation that minimize soil erosion by reducing surface runoff. They can also trap and degrade a portion of runoff adsorbed to sediments or dissolved in water; they can be used along with other best management practices to protect water quality. IBZs are an effective and cost-efficient best management practice that can be used to improve water quality. Habitats within these IBZs used for water control and water

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<sup>36</sup> Schedule 3 of the Flood and Water Management Act 2010. [sub-Id11776-em-w.pdf \(senedd.cymru\)](#)

<sup>37</sup> [Benefits of SuDS \(susdrain.org\)](#)

<sup>38</sup> DEFRA (2006) Updating the Estimate of the Sources of P in UK Waters - WT0701CSF. [Science Search \(defra.gov.uk\)](#)

<sup>39</sup> NRW. Welsh Information for Nature-based Solutions' (WINS) <https://smnr.nrw.hub.arcgis.com/apps/036c04ccb85948d2abe7312de75ad318/explore>

quality improvement, include woodland, grassland and wetlands that may provide a physical barrier to prevent water contamination and prevent degradation of soil, reducing soil erosion, minimise the movement of soil sediment and nutrient loading to surface and groundwater, moderating water temperatures. Other benefits include biodiversity benefits which in turn can minimise pathogens, maximise pest predators and maximise conditions for metabolization of pollutants.

Integrated Buffer Zones or Vegetated Filter Strips have been found to be effective in removing phosphorus from agricultural runoff. A study by Zreig et al 2003<sup>40</sup> found that filter length/width had the highest and most significant effect on P removal while inflow rate, vegetation type, and density of vegetative coverage had secondary influences. The P trapping efficiencies of the 2-, 5-, 10-, and 15-m-long filters were 32, 54, 67, and 79%, respectively. While short filters (5 m) are quite effective for removal of sediment, they are not very effective for P removal. For sediment trapping, increasing filter length beyond 15 m is not at all effective in increasing sediment removal but it is expected to further increase P removal. These findings were largely confirmed by the EA evidence base for 3D buffer strips<sup>41</sup> in association with the Forestry Commission. There are of course other environmental benefits such as greater passive cooling and carbon sequestration associated with woodland IBZs.

Nutrient loss risk modelling and mapping in Pembrokeshire, Ceredigion and Carmarthenshire<sup>42</sup> provides spatial information regarding preventative and mitigative action on nutrient loss and nutrient enrichment throughout the counties. In Carmarthenshire, a number of opportunities for buffer strips have been identified downstream of areas with high nutrient loss rates. Along the Afon Tywi, over 10km of buffer strips have been identified, with 6km along the Afon Teifi, these are shown in **Appendix A Figure A5 and Figure A6**, respectively.

## 7.4 Next Steps

An overview for opportunities to reduce nutrient enrichment in waterbodies across the Afon Tywi and Afon Teifi can be seen in **Appendix A Figure A5 and Figure A6**, respectively.

Once the final source apportionment modelling results and technical reports are published, this data could be used in combination with the opportunities for creating buffer strips to mitigate nutrient loss data, along with the opportunities for tree planting and riparian planting data published on the WINS website<sup>39</sup> to undertake some P removal modelling. This would focus on areas where rural land use is the largest contributor of P to the catchment and would assess the impact of converting P intensive activities, like general cropping, to trees or buffer strips, which have significantly low leachate rates for P. By undertaking this modelling in line with the source apportionment data, targeted mitigation can be implemented at these hotspots in order to maximise their effectiveness.

Once NRW have confirmed the applicability of the recently published CIRIA guidance “Report C808F - Using SuDS to reduce phosphorus in surface water runoff” for the purpose of using in Wales, the findings of this guide can also be incorporated into the future iterations of IAP to present alternative or supplementary options to mitigate the estimated latest TP budgets (Section 3.2).

Finally, a key factor for accepting any of these secondary measures for the purpose of delivering nutrient neutrality is the ability to ensure their long-term maintenance over the lifetime of the proposed rLDP site allocations. Otherwise, they may be only considered as potential interim measures or Category 2 measures that are described in Section 8.

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<sup>40</sup> Abu-Zreig, M., Rudra, R.P., Whiteley, H.R., Lalonde, M.N. and Kaushik, N.K., 2003. Phosphorus removal in vegetated filter strips. *Journal of environmental quality*, 32(2), pp.613-619.

<sup>41</sup> Environment Agency (2020) 3D buffer strips: designed to deliver more for the environment.

<https://www.gov.uk/government/publications/3d-buffer-strips-designed-to-deliver-more-for-the-environment>

<sup>42</sup> Environment Systems Ltd (April 2022) Modelling and Mapping Nutrient Loss Risk in Pembrokeshire, Ceredigion and Carmarthenshire.

## 8 Category 2 Measures

Interventions directly aimed at delivering nutrient neutrality for the projected Site Allocations for the rLDP are termed Category 1 interventions or measures, which will include a combination of enhanced WwTWs, constructed wetlands and secondary measures described in the previous chapters. However, these Category 1 measures outlined in the IAP will operate alongside other initiatives, which while not directly designed to deliver nutrient neutrality, are concerned with delivering ecological improvements and enhancements to Carmarthenshire and the SAC waterbodies. Many of these initiatives, termed Category 2 measures, such as buffer strips, conversion of agricultural habitat, fencing of riparian areas, could have a direct and/or indirect impact on the reduction of phosphorus levels in the relevant SACs and support the overarching aims of this IAP.

Category 2 measures are aimed at the delivery of wider reductions in P to meet NRW Phosphorus targets for the SAC. For example, a constructed wetland can be specifically designed to enhance tertiary treatment at a WwTW or a particular SuDS scheme encouraging source control can remove P from new developments prior to entering a watercourse thus reducing the overall P loading, or interventions can be strategically located to reduce P from wider existing problem areas. The responsibility for identifying and securing the delivery of Category 2 measures, rests with several parties who can secure funding, along with their statutory duties to meet their targets.

By understanding, supporting and strategically collaborating with the relevant partners and groups focused on conserving and enhancing the natural environment there is potential not only to reduce overall phosphate pressure but to deliver an environmental net gain. Therefore, the approach to achieving nutrient neutrality should not be undertaken in isolation. Any Nature-Based Solutions (NbS) currently being delivered or planned by others will also have a positive impact on restoring favourable conditions in these SACs as they will help reduce nutrient pollution. More effort is needed on monitoring the P removal efficacy of the various interventions and ongoing projects and to maximise opportunities to enhance the wider benefits of current work to support achieving favourable conditions in the SAC and other waterbodies. In some situations, the additional enhancements delivered as part of this IAPs measures may be even considered as suitable interim measures towards achieving nutrient neutrality, but further discussion with NRW, CCC and key stakeholders will be required to clarify this.

In particular, the Carmarthenshire Nature Partnership<sup>43</sup>, set up in 1998, focuses on ecological resilience with a vision to restore and create better connected networks of habitats within the county. They work with a number of partners, including NRW, Wildfowl and Wetland Trust (WWT) and West Wales River Trust (WWRT) to deliver outcomes that help to conserve and enhance our natural environment and often deliver multiple benefits that improve the well-being of the people.

It is envisaged that these opportunities will be guided by an overarching Nutrient Management Board (NMB). The role of the NMB would be supported by a Stakeholder Group and Technical Officers to ensure that these opportunities are directed towards those strategic opportunity areas presented within this evolving IAP and to support and manage implementation. Using the information presented within this document, the finalised Action Plan (AP) would be developed so that it would set out specific actions, numbers and sizes of interventions proposed and dates for implementation, in order to achieve P mitigation within Carmarthenshire.

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<sup>43</sup> Carmarthenshire Nature Partnership.

<https://www.biodiversitywales.org.uk/Carmarthenshire#:~:text=The%20Carmarthenshire%20Nature%20Recovery%20Action,by%20a%20range%20of%20participants.>

**Appendix G** provides greater detail as to the existing collaborators, projects, funding and opportunities that can be applied to the Afon Tywi and Afon Teifi SACs and present the potential risks to delivery and mitigation measures.

## 8.1 Next Steps

Once the final source apportionment modelling results and technical reports are published, this data could be used in combination with the opportunities for creating additional Category 2 measures such as, buffer strips to mitigate nutrient loss data, along with the opportunities for tree planting and riparian planting data published on the WINS website<sup>39</sup> to undertake some P removal modelling.

This would focus on areas where rural land use is the largest contributor of P to the catchment and would assess the impact of converting P intensive activities, like general cropping, to trees or buffer strips, which have significantly low leachate rates for P. By undertaking this modelling in line with the source apportionment data, targeted mitigation can be implemented at these hotspots in order to maximise their effectiveness.

These Category 2 measures will deliver wider reductions in P to meet NRW Phosphorus targets for the SAC and re-establishing favourable conditions. An overview of these opportunities to reduce nutrient enrichment in waterbodies across the Afon Tywi and Afon Teifi can be seen in **Appendix A Figure A5 and Figure A6**, respectively.

## 9 HRA Compliance

### 9.1 Introduction

For the original LDP HRA submitted in November 2019<sup>44</sup> the following SACs were scoped in for further screening with regards to water quality:

- Afon Teifi
- Afon Tywi
- Cleddau Rivers
- Cardigan Bay
- Carmarthen Bay and Estuaries
- Cernydd Carmei
- Pembrokeshire Marine

However, these assessments, with regards to water quality, were pending further information from NRW.

Under Regulation 63 of the Habitats Regulations, NRW are responsible for ensuring that potential effects from treated wastewater on European Designated sites are considered as part of a Review of all existing Consents (RoC). Under the RoC, discharge consents and water abstraction licences are required to have been considered to ensure that there were no detrimental impacts on the conservation interests in designated sites as a result of these consents.

In the original HRA it was determined that *“The final HRA of the LDP deposit plan will need to seek clarification from both NRW and DCWW over the potential capacity within the current post RoC discharge consent limits for further growth. Where allocations can be accommodated within the post-RoC discharge consent limits, it can be considered that there will be no likely significant effects on European Designated sites. If the allocated development might exceed available permitted capacity, then a new or modified permit is likely to be required at the wastewater treatment works in question to provide for the increased demand, and the HRA would need to consider whether it would be feasible for such additional capacity to be provided without any adverse effects on the integrity of any European Sites.”*

However, there are two issues with reliance on the above approach. Firstly, not all consents include TP limits. Secondly, in January 2021, NRW published evidence following a review of tighter water quality standards set by the Joint Nature Conservation Committee (JNCC). NRW undertook a Phosphorus compliance exercise for SACs<sup>45</sup>. Phosphorus concentration data were extracted from the NRW water quality database for a three-year period from January 2017 to December 2019 for all sample points within water bodies in the nine SACs designated for one or more river features. These were:

- Afon Eden – Cors Goch Trawsfynydd
- Afon Gwyrfai a Llyn Cwellyn
- Afon Teifi
- Afon Tywi
- Afonydd Cleddau
- Meirionnydd Oakwoods and Bat Sites (the Afon Glaslyn)
- River Dee & Bala Lake

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<sup>44</sup> Habitats Regulations Assessment (HRA) of the Deposit LDP (November 2019) [Habitat Regulations Assessment.pdf \(gov.wales\)](#)

<sup>45</sup> [compliance-assessment-of-welsh-sacs-against-phosphorus-targets-final-v10.pdf \(cyfoethnaturiol.cymru\)](#)



- River Usk
- River Wye

This review showed that over 60% of riverine SAC waterbodies were failing against revised phosphorus standards. As a result of these failures, NRW issued planning advice to avoid further deterioration in environmental capacity. This 'advice' relates to all Riverine SACs whose catchments extend into Carmarthenshire, namely, the Afon Teifi, Afon Tywi, Afon Cleddau, River Usk and River Wye and requires a rescreening of site allocations with regards to phosphorus.

Of these five waterbodies, only two were screened in as having the potential to be impacted by the Carmarthenshire LDP site allocations. They are the Afon Teifi and Afon Tywi. Out of these two SAC waterbodies, only the Afon Teifi is currently failing to meet the new targets. Its failures are mostly in the "low" category, which is less than 10ug/l in exceedance of their targets, which largely range from 20 to 30 ug/l P.

According to the NRW review of Welsh Riverine SACs, the Tywi is shown to pass comfortably against its Phosphorus targets. However, there is a requirement to consider the effects of the increased amount of phosphorus generated from the proposed site allocations on both SAC waterbodies.

## 9.2 Potentially Affected SACs

### 9.2.1 Afon Teifi

The Afon Teifi in west Wales is a large river flowing over hard rock, with some spectacular gorges in the lower section. It is mainly mesotrophic but also has oligotrophic sections in the upper reaches and represents an outstanding example of a sub-type 3 river with water-crowfoot *Ranunculus* vegetation in western Britain. It is designated as a SAC for the following features:

- Annex I habitats that are a primary reason for selection of this site 3260 Water courses of plain to montane levels with the *Ranunculus fluitantis* and *Callitriche-Batrachion* vegetation
- Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site 3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoetes-Nanojuncetea*
- Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site 3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoetes-Nanojuncetea*
- Annex II species that are a primary reason for selection of this site
  - 1096 Brook lamprey *Lampetra planeri* The Teifi is a predominantly mesotrophic river in west Wales supporting a large population of brook lamprey *Lampetra planeri*. A mixture of habitat and substrate types provides the combination of spawning gravels adjacent to silt beds that are favoured by this and other lamprey species. A large number of tributaries have been included in the SAC; these are thought to be important for lampreys in the Teifi because the main channel is prone to severe floods that may result in washout of smaller ammocoetes.
  - 1099 River lamprey *Lampetra fluviatilis* The Teifi is a large catchment of high conservation value in west Wales. It contains a healthy population of river lamprey *Lampetra fluviatilis*. The semi-natural channel containing a mixture of substrates and in-stream features provides excellent habitat for juvenile lampreys.
  - 1106 Atlantic salmon *Salmo salar* The Teifi is a medium-sized mesotrophic river system in west Wales. In 1999 the salmon *Salmo salar* rod catch in the Teifi was the third largest in Wales, and the system has not experienced the steep decline in stock numbers seen in many other rivers in the area. This is likely to reflect the high quality of the catchment,

with a semi-natural channel largely unaffected by poor water quality or artificial barriers to migration. However, in common with many other Welsh rivers, acidification in the upper reaches is a cause for concern. In common with many other rivers in west Wales, grilse are the main stock component. There is a small traditional coracle fishery that exploits the salmon and sea trout *Salmo trutta trutta*.

- 1163 Bullhead *Cottus gobio* The Teifi represents bullhead *Cottus gobio* in west Wales. Water quality is generally good, and the diversity of semi-natural habitat and predominance of stony substrates provides excellent bullhead habitat throughout much of the catchment. Environment Agency electrofishing data shows this species to be widespread throughout the system. Bullheads show marked differences in growth and longevity between upland and lowland streams, and the Teifi includes sections representing both types of habitat.
- 1355 Otter *Lutra lutra* The Teifi in west Wales holds otter *Lutra lutra* throughout much of its catchment. The river has suitable resting and breeding sites along its length. Evidence from surveys and sightings suggest the tidal reach is being increasingly used by otters.
- 1831 Floating water-plantain *Luronium natans* The Teifi is a mixed habitat supporting floating water-plantain *Luronium natans* at the western margins of its range in the UK. This species has been recorded in the nutrient-poor standing waters of the Teifi pools in the headwaters of the river. It has also been recorded in a moderately nutrient-rich stretch of the river immediately downstream of Cors Caron.
- Annex II species present as a qualifying feature, but not a primary reason for site selection
  - 1095 Sea lamprey *Petromyzon marinus*

## 9.2.2 Afon Tywi

The Afon Tywi is one of the longest rivers flowing entirely within Wales. Its total length is 120 km. It weaves its way from its source in the Cambrian Mountains above Llyn Brianne reservoir to the sea at Carmarthen Bay. It has been designated for the following features:

- Annex II species that are a primary reason for selection of this site:
  - 1103 Twaite shad *Alosa fallax* A large spawning population of twaite shad *Alosa fallax* occurs in the Tywi, south Wales, and is considered to be self-sustaining. Spawning sites occur throughout the lower reaches of the river between Carmarthen and Llangadog, with most spawning occurring downstream of Llandeilo. Water quality and quantity are considered adequate to maintain this internationally vulnerable species, and there are no impassable obstructions along the migration route, though one weir at Manorafon may be an obstacle during low flow conditions. The presence of Llyn Brianne reservoir at the headwaters provides the potential to manipulate river flows to aid shad migration.
  - 1355 Otter *Lutra lutra* The Afon Tywi is one of the best rivers in Wales for otters *Lutra lutra*. There are abundant signs of otters and they are regularly seen on the river. The water quality is generally good and there is an ample supply of food. There are suitable lying-up areas along the river bank, but there few known breeding sites on the main river, although cubs have been seen.
- Annex II species present as a qualifying feature, but not a primary reason for site selection:
  - 1095 Sea lamprey *Petromyzon marinus*
  - 1096 Brook lamprey *Lampetra planeri*
  - 1099 River lamprey *Lampetra fluviatilis*
  - 1102 Allis shad *Alosa alosa*
  - 1163 Bullhead *Cottus gobio*

## 9.3 Avoidance Measures

As per NRW advice to planning authorities guidance<sup>46</sup>, for SAC catchments failing to meet phosphorus targets, new developments can be authorised if it can be demonstrated that they will not lead to further deterioration of water quality in the SAC waterbodies failing to meet water quality targets and will not undermine the ability for the SAC to meet its conservation objectives.

The Teifi is particularly vulnerable to changes in water quality due to the requirements of its vegetation features, with Phosphate levels being mentioned in the management plan as having an influence on vegetation health<sup>47</sup>. Maintenance of appropriate Phosphate levels is likely to require catchment wide measures to control diffuse pollution from agriculture as one of the main sources of phosphates. However, the DCWW SAGIS modelling results show that under the current conditions, wastewater accounts for 66% of the average daily P load with rural land use contributing 30%<sup>19</sup>.

Therefore, the additional input from new overnight accommodation within the LPD would increase the exceedances for the Afon Teifi and potentially cause exceedances in the Afon Tywi. To determine the magnitude of the additional P, nutrient budgets were calculated.

### 9.3.1 Screening Allocation Sites

As there are no TP limits within current WwTW discharge permits, for this nutrient budgeting, a discharge level of 8mg/l of TP was assumed for initial calculations, as per the published Ricardo's Nutrient Budget Calculator by CCC. Following initial nutrient budgeting calculations (presented in Section 3) for the Afon Tywi (Table 3-1), the number of site allocations were reduced from 14 sites (175 dwellings) down to 6 sites (102 dwellings). For the Afon Teifi, the number of site allocations reduced from 28 sites (417 dwellings) down to 15 sites (189 dwellings). The impact of the reduction of these allocation removals is presented in Figure 3-1.

As explained in Section 3, the initial precautionary 8mg/l TP default limit for existing WwTW discharge was lowered to a 5mg/l TP backstop limit, in line with the current performance and latest Arcadis discussions with NRW and DCWW along with the recent release of DCWW's preliminary phosphorus reduction programme. TP nutrient budgets (in kg per year) were therefore predicted for both the 8mg/l and 5mg/l limits for the newly reduced site allocations (Figure 3-2). The default 8 mg/l P permit nutrient budget calculations are still provided as there is no guarantee when the tighter permit limit will come into force, as discussed in Section 3.3.

### 9.3.2 Screening Policies

The main policies that have a direct impact upon phosphates are Policy CCH4: Water Quality and Protection of Water Resources, and Policy INF5: Rural Allocations outside Public Sewerage System Catchments (Table 9-1). Policy CCH4 was amended to alter its name and to provide greater clarity of the wording of the policy in regard to National Site Network Sites. It was therefore screened in within the Draft Phosphate Assessment Appendix to the rLDP HRA Addendum<sup>48</sup>, however to this wording and name change has a minor impact upon phosphates. INF5 has also been screened in however the exact wording behind the policy is to be reviewed and confirmed. It was concluded in the Draft Phosphate Assessment Appendix to the rLDP HRA Addendum that the policy changes will have no adverse effect for this HRA addendum and that there will be enough potential land to create wetlands

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<sup>46</sup> Natural Resources Wales / Advice to planning authorities for planning applications affecting phosphorus sensitive river Special Areas of Conservation

<sup>47</sup> 2012 08 07 Afon Teifi River Teifi SAC management plan \_ Eng \_ (naturalresources.wales)

<sup>48</sup> Draft Phosphate Assessment Appendix to the rLDP HRA Addendum (February 2023)

for offsetting the additional P from the developments. The policy screening process is discussed in further detail in the Draft Phosphate Assessment Appendix to the rLDP HRA Addendum.

*Table 9-1 Policies screened in that directly impact phosphates*

rLDP Policies	Description	Reason
CCH4: Water Quality and Protection of Water Resources	<p>Amend Policy wording to:</p> <p>“Development proposals must make efficient use of water resources and, where appropriate, contribute towards improvements in water quality. Proposals will be permitted where they do not have an adverse effect upon water resources, water quality, fisheries, nature conservation, public access, or water related recreation use in the County.</p> <p>“Where appropriate, SuDS must be implemented with approval required through the Sustainable Drainage Approval Body (SAB).</p> <p>Proposals will be supported if they promote the safeguarding of watercourses through ecological buffer zones or corridors, protecting aspects such as riparian habitats and species, water quality, and providing for flood plain capacity.”</p> <p>“Development will only be permitted if it can be demonstrated that there is no adverse effect on the integrity of phosphorus sensitive riverine SACs. In the hydrological catchment area designated for riverine SACs, development creating wastewater discharges will be required to demonstrate there is no increase in phosphorus levels in the SAC. This can be achieved through implementation of mitigation measures and associated supplementary planning guidance. Where evidence demonstrates that adverse effects on the integrity of river SAC can be avoided or offset using mitigation, these must be agreed with the Council on a case-by-case basis, in consultation with NRW.”</p>	<p>In the interests of clarity and emerging response in relation to NRW’s phosphate guidance.</p>
INF5: Rural Allocations outside Public Sewerage System Catchments	<p>New policy to be inserted for rural allocations which fall outside the catchment of the public sewerage system.</p> <p>The new policy would seek to assure that the allocation in its entirety utilises one private system as proliferation of private plants can cause environmental problems.</p> <p>New policy – “Proposals for the delivery of sites of 5 or more dwellings in settlements where there is no connection to the public sewer will be supported where they are served by a single private system. Such proposals will be permitted where it does not</p>	<p>Seeking a new policy for rural allocations which fall outside the catchment of the public sewerage system we would advise that your Authority consider the allocation in its entirety utilising one private system as proliferation of private plants can cause environmental problems. This is a topic area that needs to be accounted for in the</p>

rLDP Policies	Description	Reason
	<p>have a detrimental effect on the natural environment, surrounding uses or local amenity.”</p> <p>And supporting text – “There is concern that the proliferation of private sewers is having a detrimental impact on the environment. This policy aims to discourage a development from having individual private sewers and instead encourage utilisation of a shared private sewerage system.”</p>	written statement given the dynamics of the county.

Moreover, there are additional policies that do not have a direct impact upon phosphate levels, however, may still highlight potential sources of P which should be considered (Table 9-2). Since these policies do not directly impact phosphate levels like the policies mentioned in Table 9-1, the **Category 1 measures** that are implemented may be able to account for these as potential sources of P. This is a result of Category 1 measures allowing for compliance with the Habitats Regulations and avoiding the adverse effects from the developments arising from the rLDP allocations. Further detail about the policies below and the screening process can be found in HRA Addendum Report: Deposit rLDP 2018–2033.

*Table 9-2 Policies that may highlight potential sources of P but may be addressed by Category 1 measures.*

rLDP Policies	HRA implications
SG1: Regeneration and Mixed-Use Sites	In accordance with Section F.6.2.3. of the HRA Handbook, the relevant drivers of change provided by these policies were found to be more appropriately assessed through the specific allocations respective to each SAC catchment.
HOM1: Housing Allocations	
HOM3: Homes in Rural Villages	Whilst these policies do not propose allocations for development themselves, they collectively set out the requirements (and, in some instances, support) for planning applications which the ensuing development could be a potential source of P throughout the County.
HOM4: Homes in Non-Defined Rural Settlements	
HOM5: Conversion or Subdivision of Existing Dwellings	
HOM6: Specialist Housing	
HOM7: Renovation of Derelict or Abandoned Dwellings	
HOM8: Residential Caravans	
HOM9: Ancillary Residential Development	
GTP1: Gypsy and Traveller Accommodation	
VE2: Holiday Accommodation	

VE3: Touring Caravan, Camping and Non-Permanent Alternative Camping Accommodation	
VE4: Static Caravan and Chalet Sites and Permanent Alternative Camping Accommodation	
RD1: Replacement Dwellings in the Open Countryside	
RD2: Conversion and Re-Use of Rural Buildings for Residential	
RD3: Farm Diversification	
RD5: Equestrian Facilities	
WM2: Landfill Proposals	

In the already failing Afon Teifi and vulnerable Afon Tywi, and with regards to NRW advice on screening out policies that will not have a significant impact on phosphorus loading, it would not be possible for development provided for within the plan that added wastewater to the system to conclude no adverse effect to the integrity of the two SACs. Following the screening assessments in the Draft Phosphate Assessment Appendix to the rLDP HRA Addendum, it was concluded that the screened in policies (Table 9-1) should be subject to the preparation of information for an Appropriate Assessment under the Habitats Regulations. A combination of the NbS and the WwTW improvements (Category 1 measures) will be used to demonstrate avoidance of impacts to the SACs. Category 2 measures will also be sought via collaboration and presented within the evolution of the IAP to be managed via a Nutrient Management Board.

### 9.3.3 Implementation and Delivery

#### 9.3.3.1 The need for developer contributions

A Developer Contributor Scheme (DCS) is an important aspect of the IAP in demonstrating how mitigation required to facilitate LDP growth can be calculated and secured by planning.

The DCS has not been produced yet, but it will be required prior to plan adoption. For the benefit of the LDP examination and Habitats Regulations, this section will demonstrate how the DCS could work in practice and demonstrate that the mechanisms (LDP policy and planning tools – planning obligations) are already in place, and much of the technical work for the DCS has been completed.

The DCS provides a strategic approach to mitigation that facilitates the delivery of new development within the catchment (bespoke solutions are supported, see below). It will be the mechanism by which measures required to facilitate LDP growth, Category 1 mitigation measures, are delivered by the LDP<sup>49</sup> (note the responsibility for Category 2 mitigation does not fall on development but on a range of stakeholders see Section 8 and Appendix G).

<sup>49</sup> Note, that developers are not obliged to use the DCS, but may choose their own solution.

The DCS will be relevant to all residential development which leads to a net increase in phosphorus load being discharged into the Afon Teifi and Afon Tywi SACs. It will essentially set a charge on development for mitigation required to address the additional phosphorus load, will contain the detailed mitigation costs, mitigation calculations and phosphorus budget and will then explain the principles by which obligation charges will be calculated and apportioned to development. Contributions will be apportioned in a fair, equitable and consistent manner on the basis of the phosphorus load associated with each development proposal.

## 9.4 Next Steps

For the HRA addendum to provide certainty for the LDP, the following parameters around the avoidance measures should be considered in addition to the considerations in Section 9:

- Consultation with NRW to confirm the impact pathways and the avoidance measures approach;
- Confirm the rLDP Site Allocation phasing and align with the required wetlands and other Category 1 opportunities;
- Screening of in combination effects from other Local Plans that may affect the Afon Teifi and Tywi SACs;
- Phasing of wetland creation across the catchment to be established once the Site Allocations and nutrient budgeting have been confirmed for Ceredigion and Pembrokeshire to account for in combination effects on the Afon Teifi and Afon Tywi SACs;
- Clear delivery milestones against which progress can be clearly monitored;
- How contributions from development could be collected;
- Update of data on NbS efficiencies and management;
- Discussion with DCWW and CCC (including Ceredigion and Pembrokeshire Councils if needed) regarding the management of the constructed wetlands and any other Category 1 measures;
- Effective running of the Nutrient Management Board incorporating stakeholders, existing projects and potential funding to direct and monitor the avoidance measures across the catchment area to provide confidence in delivery regarding potential in combination effects;
- 1st phase of mitigation measures to be agreed by Nutrient Management Board, CCC and Arcadis;
- 1st development window to be agreed i.e., which Site Allocations can be released by the mitigation identified;
- 2nd / 3rd phase mitigation measures to iteratively coincide with 2nd / 3rd phase Development Windows and consequent updates to the AP;
- Consultation on the restoration of monitoring points to confirm avoidance measures successes; and
- Matters arising from further consultation.



## 10 Implementation and Delivery

This section sets out an initial plan to implement and deliver the mitigation measures set out in this document such that development within the rLDP can be delivered alongside the necessary reductions in phosphorus. It is important to note that further work is required to implement these measures and several actions will be recommended within this section to set up a framework for delivery. This IAP is a live document based on current best understanding of the situation within Carmarthenshire. As further details are confirmed, this document will be updated and so too might the actions required to implement and deliver the phosphorus mitigation measures required.

### 10.1 Developer Contribution Scheme

A potential mechanism that could help to deliver the mitigation required to facilitate the rLDP is a Developer Contribution Scheme (DCS). A DCS would be applicable to all residential development predicted to lead to a net increase in phosphorus load discharged to either the Afon Teifi or Afon Tywi SACs.

A developer contribution is made by a landowner or developer to ensure that, where planning permission is granted for new development, any impact on the environment is in accordance with appropriate regulatory obligation and the infrastructure necessary to support the development is provided. By securing these contributions, planning authorities can help to improve the quality and sustainability of individual development schemes and their acceptability to local communities.

A DCS would provide a strategic approach to mitigation that facilitates the delivery of new development within the catchments. Under a DCS, phosphorus mitigation costs are matched proportionally to each development based on the additional phosphorus generated. A DCS would need to be developed alongside rLDP adoption with supplementary guidance if appropriate.

It is recommended that a DCS is prepared with key stakeholders, as one of the measures within the Afon Teifi and Afon Tywi SACs and should be delivered alongside other wider measures within the remit of the recently appointed NMB. It is understood that the current NMB's remit extends beyond the Teifi and Tywi SACs, and indeed beyond Carmarthenshire, and so the DCS could be extended in its remit to cover additional SACs and development beyond the rLDP. However, for the purpose of this document, we will focus on how the DCS would benefit delivery of the rLDP alone.

It is recommended that any DCS is prepared as a "living" document, i.e., one that evolves iteratively as the evidence base changes. As discussed throughout this report, several uncertainties exist with respect to the Nutrient Budget calculated for the rLDP, not least of which is the current permitting position within the Teifi and Tywi catchments. As a result, the final quantum of phosphorus mitigation required, and therefore the costs associated with this, are likely to change, and so too therefore must the developer contributions calculated as part of a DCS.

Further to the above, it is important to recognise that a DCS is not the only means of securing funding for mitigation. As set out in the Intervention Measures Matrix in Appendix D, there are multiple funding streams available for phosphorus mitigation within the catchments, particularly when considering the multiple benefits afforded by certain nature-based solutions, such as constructed wetlands. Appendix D demonstrates measures for Flintshire, which is an illustrative concept but not appropriate for Carmarthenshire at this stage. Here, the DCS must again be flexible to ensure that as funding is secured by other means, the costs apportioned to development are appropriately adjusted.

Finally, the DCS should be not seen as the only option available to developers when bringing sites forward through the rLDP. When making an application, a developer could ask the authority to assess their application separately from the DCS. The council would therefore remain open to considering any bespoke mitigation proposals brought forward on a case-by-case basis. Consequently, the DCS

would not be publicly consulted on, instead it would represent an agreed way forward, but not the only option available to developers in securing the phosphorus mitigation required for their development.

An alternative option to enable developers to make a financial contribution to P reduction is through setting up a phosphate credit scheme. Where a separate offsite council led P mitigation scheme is constructed, developers can make a financial contribution by purchasing credits from the associated council scheme to offset any additional P loading from their development. Such phosphate credit schemes have been utilised in Somerset and also in Herefordshire where the Council priced credits at £14,000 (+VAT) per kilogram of offset required per year to meet neutrality in the River Lugg SAC<sup>50</sup>.

### 10.1.1 Roles and Responsibilities

The responsibility for the DCS would lie with the LPA. NRW would be consulted in preparing the DCS in their role as an appropriate nature conservation body advising on Habitats regulations. Advice from NRW should be sought on specific technical aspects of the DCS e.g., developing guidance around calculating phosphorus savings from mitigation measures.

### 10.1.2 Policy Drivers

The 2<sup>nd</sup> Deposit rLDP (2018-2033) went to public consultation in February 2023. Strategic policy “SP9: Infrastructure” will be a key policy driver. This overarching strategic policy supports the principals of planning obligations in considering the need for development proposals to demonstrate that there is sufficient capacity in the existing infrastructure to deliver and support the proposed development. Where this cannot be achieved, the proposals will need to demonstrate that suitable arrangements are in place to provide the infrastructure capacity considered necessary to deliver and support the development.

Within this policy, utility services are given specific mention, as well as biodiversity and environmental protection. Under these elements, phosphorus mitigation could be considered and a DCS could provide the mechanism for developers to assess their level of contribution needed towards specific mitigation measures.

Strategic Policy “SP12: Placemaking, Sustainability Places” also offers a useful mechanism to ensure developments contribute positively to nutrient management within the Teifi and Tywi SACs. Within this policy, protection of or enhancement of biodiversity is required. This would necessitate developments to consider the additional phosphorus generated by their development and deliver measures to mitigate accordingly. Furthermore, this would ensure developers consider on-site mitigation measures such as SuDS as standard.

On SuDS, further understanding is required as to their likely contribution to phosphorus reduction. This should be considered in line with new guidance (see Section 7.1) and in the event that more certainty is placed on the potential for SuDS to remove phosphorus and this is accepted by NRW, a developer could put forward plans for on-site mitigation that reduces their requirement for off-site mitigation. As discussed previously, any DCS put forward must be flexible to these proposals such that costs are proportional and offer developers options to bring forward their own mitigation to safeguard the natural environment.

Strategic Policy “CCH4: Water Quality and Protection of Water Resources” also places requirement on development that are in line with this IAP for phosphorus mitigation. This places importance on the HRA with respect to the impacts of the rLDP on European protected sites (Afon Teifi and Afon Tywi SACs). The current HRA is due to be updated following the publication of NRW’s Advice to planning authorities for applications affecting phosphorus sensitive riverine SACs. This will make clear the need to consider the additional phosphorus generated by residential development and subsequently will be a suitable policy to secure the mitigation required to support the development of the rLDP.

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<sup>50</sup> Herefordshire Council (June 2022) Phosphate Credits FAQs. [Phosphate Credit FAQs \(herefordshire.gov.uk\)](https://www.herefordshire.gov.uk/phosphate-credits-faqs)

In this regard, the policy mechanisms to ensure delivery of the appropriate phosphorus mitigation required already exist and are clear in their remit. Updates to the HRA would secure this and planning obligations will then be actionable. A DCS would then act as a mechanism by which developers would bring forward their sites whilst contributing towards the necessary mitigation.

### 10.1.3 Planning Obligations

Developer contributions are normally secured through a “planning obligation”. This is a legal commitment by the developer to secure a contribution (in cash or in kind) to address community, infrastructure or environmental improvement needs associated with development. It may be a bilateral agreement between the LPA and the developer, or simply a unilateral undertaking by the developer to provide the same. These are a proper and recognised part of the planning system and are normally entered into under Section 106 of the Town and Country Planning Act 1990 (as amended).

Planning obligations can be used to secure benefits on the development site itself or on other suitable sites close to the proposed development (as long as they are directly related to the development). Developers may be requested to make a payment of money to the relevant LPA, to be spent on agreed benefits or for the maintenance of them.

Historically, planning obligations have tended to be used to secure infrastructure improvements only from a limited number of sites. However, in respect of the impacts on the Afon Tywi and Afon Teifi, the DCS provides a strategic approach to offsetting the negative effects of development and includes a mechanism for gaining contributions from all new development which connects to mains drainage, and non-mains development where it is considered to be appropriate.

Developer contributions can reasonably be secured in respect of:

- Actual implementation of measures (i.e., costs to actually do the work);
- Staff resource to oversee and co-ordinate implementation;
- Compensation to landowners where measures involve a change of use;
- The long-term (in perpetuity) maintenance and management of mitigation; and
- Monitoring the effectiveness of mitigation measures.

In principle, planning obligations could be used to fund improvements of WwTWs, particularly if development came forward before planned upgrades to WwTWs, however, there is much uncertainty as to the likely permit levels to be in place (and therefore the potential improvements planned) at the WwTW within Carmarthenshire. Further discussions are needed with the statutory water undertaker, DCWW and NRW as regulator before any commitment was made to this effect.

Regulation 123 of the Community Infrastructure Levy (CIL) Regulation prevents the imposition of planning obligations for “infrastructure”, if five or more separate planning obligations which provide for the funding or provision of that type of infrastructure have been entered into on or after 6<sup>th</sup> April 2010. However, the measures to be funded through the Developer Contribution Scheme are “environmental protection measures” and fall outside the definition of infrastructure (S 216 (1) Planning Act 2008) so are not subject to pooling restrictions.

### 10.1.4 Grampian Condition

Grampian Conditions provide a means by which mitigation can be secured. A Grampian Condition prohibits development authorised by the planning permission or other aspects linked to the planning permission (in the case of residential use, occupation of the development) until a specified action has been taken (in this case the provision of an avoidance and mitigation package). Such conditions should not be used where there are no prospects at all of the action in question being performed within the time-limit imposed by the permission, which is not envisaged in this case.

### 10.1.5 Development Affected

In principle any development adding phosphorus load to the Afon Tywi and Afon Teifi SAC will require mitigation e.g., tourism, agricultural development and overnight accommodation, however it would not be appropriate for the DCS to provide for every circumstance. In the context of IAP, the DCS will initially focus on the strategic issue for the rLDP examination, enabling residential development. In time it may be appropriate to expand the DCS to cover other types of non-strategic development responding to local circumstances and pressures. In the meantime, non-residential development will be treated on a case-by-case basis at the planning application stage, and the DCS may provide a solution to such development depending on the specific circumstances of each case.

Consequently, the DCS will provide mitigation for development that would lead to an increase in phosphorus entering the SAC river environment. This is likely to consist mainly of residential development connecting to public or private sewers discharging into the catchment of the Afon Tywi and Afon Teifi SAC where treatment works currently do not have the facility to remove additional phosphorus and/or planned investment to upgrade treatment works to remove phosphorus from effluent are not aligned with timing of development need.

Development where connection to the mains network is not a viable option will continue to be addressed on a case by case basis and follow NRW guidance on such matters; the DCS may provide a solution to such development depending on the specific circumstances of each case.

### 10.1.6 Developer Contributions and Wastewater Treatment Works Environmental Permits

The DCS will be available for all residential development in Carmarthenshire regardless of which WwTWs serves the development, the phosphorus budget (Section 2) accounts for the spatial distribution of growth and the various treatment works permits.

As discussed in Section 3.2, there are currently no phosphorus permits in place within Carmarthenshire and therefore assumptions have been made with regards to the likely permitting position. These permits are due to be reviewed between DCWW and NRW and this process will start in Spring 2023 for the Afon Teifi and Autumn 2023 for the Afon Tywi. In the event that the phosphorus limit conditions are tightened, the amount of mitigation from development can be reduced and so the DCS would need to be updated.

## How could planning obligations be calculated?

### Step 1: Phosphorus Budget

Carmarthenshire's Nutrient Neutrality IAP will inform developers of the budget allocations for individual developments within the rLDP (Table 3-4 and Table 3-5 for the default 8mg/l P limit and Table 3-6 and Table 3-7 for the backstop 5mg/l P limit).

### Step 2: Identify Mitigation

Based on the budget from Step 1, this Action Plan also sets out potential mitigation measures available that can be delivered in the plan period. The Council can draw from these options to provide a package of detailed mitigation measures for delivery via a DCS.

The package of selection mitigation measures will provide the level of phosphorus reduction required to facilitate the development brought forward. The measures in the DCS will be fully costed to include all reasonable costs associated with the works as per the discussion in this section. It will be for the DCS to expand on the range of cost associated with the mitigation measures.

The DCS would determine the total cost of delivery of the mitigation as £/kg phosphorus mitigated or similar.

### Step 3: Apportion Mitigation Costs to Developer

The DCS will need to determine a suitable mechanism of apportioning the total cost of the mitigation works to the developer. Several examples in England are available, and an appropriate review of the potential options should be undertaken in development of the DCS to find a suitable arrangement for Carmarthenshire.

Simply put, the costs will be apportioned to the developer in an equitable way such that the costs are proportional to the phosphorus generated from the development.

### Monitoring and Phasing

It will be necessary to manage and monitor phosphorus budgets during the course of the LDP to ensure sufficient mitigation is still available. For many reasons additional phosphorus budgeting could be required e.g., permissions are allocated a budget, but permissions are not commenced/completed, housing delivery exceeds LDP delivery schedule or more information is known about the effectiveness of mitigation measures. Monitoring will give advance notice if there is a need to release additional mitigation measures in an updated DCS. It might be appropriate to manage mitigation in development 'windows' matching the LDP delivery schedule, this is a matter to be determined in preparing a DCS.

For the DCS to mitigate the negative effects of development, it is important that the reduction measures are implemented in a timely manner which reflects the rate at which development comes forward. In the case of larger scale development, phased payment can be negotiated with the LPA on a case-by-case basis as appropriate.

Note, the delivery of mitigation could constrain the timely delivery of development, however, there are short term options. While these may not be sustainable solutions, they could provide a stopgap solution subject to ensuring the longer-term solutions are delivered and are effective.

Planning obligation funding will be pooled to deliver any of the mitigations within the DCS range of measures. The LPA will allocate funding to the measures in order to ensure sites can be delivered in phase with the occupation of the proposals.

## 10.2 Additional Sources of Funding

It is important to note that any DCS developed to aid delivery of this action plan must consider additional sources of funding available and reduce developer contributions where necessary. The Intervention Measures Matrix in **Appendix D** identifies potential sources of funding available for each intervention. **Appendix D** demonstrates measures for Flintshire, which is an illustrative concept but not appropriate for Carmarthenshire at this stage. The key funding streams that should be considered are set out below:

- **Natural Resources Wales**
  - **Welsh Government Grant In Aid**; this funding is available to deliver measures in Sites of Special Scientific Interest (SSSI) and SAC in order to move the designated species and habitats closer to 'favourable' status. In 2021, this funding was an annual Biodiversity & Ecosystem Fund and from 2022 will become a 'multiyear' fund.
  - **Welsh Government Strategic Allocated Funding**; provides funding for a five-year plan for the improvement of fish and fish habitat in Wales. This fund is known to be being used in other Welsh catchments to undertake catchment measures which reduce nutrient input to watercourses.
  - **European Sustainable Fisheries Funding**; this is available for annual ad-hoc bids for specific projects and includes catchment measures to reduce nutrient input to watercourses.

- **Welsh Government Water Quality Capital Fund**; this is used to fund improvements in water quality such as reducing nutrients for Water Framework Directive (WFD) targets and in 2021, £1.8m was available for such work.
- Dwr Cymru / Welsh Water
  - In July 2022, DCWW announced plans to improve their WwTWs across Wales in line with their Phosphorus Permitting Programming, declaring a spend of £100m on improving river water quality, £60m of which will be for removing phosphorus from WwTW on SAC rivers such as the Teifi (Lampeter and Llanybydder).
  - DCWW receive funding via their customer bills through a five-year program called an Asset Management Plan (AMP). This multi-million-pound funding includes improvements to sewage treatment works and storm overflows resulting in a reduced amount of phosphorus entering the watercourses. The drivers for this can include WFD and Habitats Directive (SAC) targets.
  - DCWW have made available the Environment Fund which aims to provide financial support to projects that will benefit and enhance biodiversity at or near DCWW sites. DCWW are also enabling third party funded wetlands whereby effluent at DCWW sewage treatment works is directed to a wetland to garner additional polishing for P removal. Note – this is currently in England only.
- Welsh Government
  - Welsh Government are providing funding to support the work of nutrient management boards, with up to £415k being made available in 2022-23 and additional provision in 2023-24 and 2024-25; in addition to £40m of funding over the next three years to address water quality problems across Wales.
  - Welsh Government continues to provide multi million pounds of funding to farmers in Wales to deliver positive environmental outcomes, including reducing nutrients entering watercourses. Funding is also provided to Farming Connect who provide advice and guidance to farmers on reducing nutrient run-off.
  - Welsh Government fund the NRW Dairy Project across Wales which employs officers to visit dairy farms to give advice and guidance on ways of minimising agricultural pollution.
  - Welsh Government provide funding for a Nature Network Fund and this has provided NRW resource in other SAC catchments to carry out investigations and visits to reduce nutrient inputs into the watercourses
- Ofwat PR24
  - The 2024 Price Review (PR24) is in the process of being created by Ofwat, with their final decisions being announced in December 2024<sup>51</sup>. This will set the levels of service and bills from water and sewerage companies for 2025 to 2030.
  - Some of the key themes that Ofwat aims to address in the PR24 include both an increased focus on the long-term impacts and to deliver greater environmental and social value. Ofwat emphasised the use of NbS in accounting for these aims in addition to how they can help the Welsh and UK governments to achieve net zero emissions by 2050.
  - For instance, they highlight funding services that are the ‘best whole life’ solution that considers the long-term beyond the 2020-2025 period, rather than funding the cheapest option.
  - Ofwat also highlighted the opportunity to gain funding outside of the Price Review where reputational pressures are strong and where improvements do not require funding beyond that provided by DCWW base cost allowance.

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<sup>51</sup> PR24 and beyond: Creating tomorrow, Together (May 2021) <https://www.ofwat.gov.uk/wp-content/uploads/2021/05/PR24-and-Beyond-Creating-tomorrow-together.pdf>



- Ofwat are keen to develop the previous PR19 approach for funding capital maintenance and maintaining asset health at PR24. For the PR19, Resilience was a key theme and £13 billion of funding was provided by Ofwat in this area for companies to maintain base services and for enhancements where they were well evidenced. Considering the NbS approaches proposed in this IAP and their potential long-term benefits, the PR24 provides the opportunity to gain significant additional funding for the Category 2 measures to further support P reduction in the wider catchment.

It is recommended that the Nutrient Management Board explores these additional sources of funding at an early stage and looks to begin applications for funding as more detailed plans emerge for the mitigation opportunities outlined in this report.

## 10.3 Pathway to achieve targets

There are various mechanisms for implementing the identified phosphorus reduction opportunities ranging from:

- Providing advice on funding sources, best practice, and effective solutions;
- Promoting co-delivery mechanisms to maximise wider opportunities and benefits through collaboration and building stakeholder trust and confidence; and
- Exercising regulatory tools that are within the power of Ofwat, NRW, the LPAs and the Welsh Government.

As discussed in Section 2, phasing of the rLDP, delivery of the developments within it and other factors outside of the council's remit will play a pivotal role in implementing the actions outlined in this report. To ensure that developments are brought forward in sync with the phosphorus mitigation required to release them, strategic milestones are required. These milestones will be of central importance to the rLDP strategic policies outlined in Appendix B, offering certainty that developments are only brought forward when the infrastructure required to mitigate their environmental impacts is in place.

This IAP is a live document, and in any version, the proposed milestones reflect the level of detail available at the time. In particular, it is important to note that at this initial stage, feasibility screening only has been carried out for the mitigation options outlined in Section 5, 6 and 7. As this IAP develops, and elements of uncertainty are removed, these screening opportunities will be confirmed and progressed into detailed designs and so too will the understanding of their relative impact on the Nutrient Budget calculated for the rLDP. Integral to this is the publication of the phosphorus source apportionment technical outputs for both the Teifi and the Tywi, which will then confirm the new permitting requirements for DCWW's existing WwTWs later in 2023 or 2024. Another key consideration is the evolution of DCWW's recently published preliminary phosphorus reduction investment programme and maximising the available collaboration opportunities to CCC for implementing constructed wetland opportunities near to the existing WwTWs.

One way to manage this process is to agree 'Development Windows'. Development Windows would be defined on the basis of a timetable for delivering specified mitigation measures and the phosphorus reductions which will be secured. These will be mapped against the delivery of specific sites as per the rLDP to ensure that occupation of development occurs in-sync with the delivery of necessary mitigation measures.

As the funding for DCWW's planned phosphorus reduction programme has been approved by Ofwat in 2024 there will be more certainty on the locations, scale and timing of the additional phosphorus reduction measures that should also be implemented by CCC and stakeholders to protect and improve the impacted SACs. However, this IAP has identified a range of potential Category 1 and Category 2 measures to achieve this, based on the best practice guidance on achieving nutrient



neutrality. They also provide redundancy contingency buffer and flexibility to address any current uncertainties, and the IAP details mitigation requirements against an 8 mg/l default TP limit (assuming no WwTW upgrades/P permits) and DCWW's 5 mg/l new backstop TP limit.

Section 5.1 indicated that except at four WwTW locations (namely Lampeter, Llanybydder, Capel Iwan and Pencader), which are currently termed as Collaboration Category A by DCWW, there is clear opportunity for CCC to implement wetlands at all other nine WwTW locations assessed by this IAP.

As highlighted before, if suitable land can be found at Lampeter, Chapel Iwan and Pencader WwTWs, further discussion with DCWW is recommended because current research shows that wetlands can still efficiently remove phosphorus when the influent concentration strength is < 4mg/l, which is the precautionary TP threshold currently used by DCWW when defining Collaboration Category A wetlands amongst other factors such as existing trade flows.

Table 10-1 below outlines indicative milestones in line with current Arcadis understanding. It is recommended that this be reviewed with the council at a workshop to populate and confirm these milestones and outline means of ensuring they are kept to.

*Table 10-1: Indicative milestones*

Milestone	Commentary	Completion Date
Interim Action Plan Workshop	Meeting between CCC and Arcadis to discuss content of draft IAP report, outline current options for phosphorus mitigation and agree next steps to ensure that mitigation is in place in-sync with the development proposals outlined in the rLDP.	Dec 2022
Interim Action Plan Publication	Publish the IAP whilst recognising the new DCWW information released in February 2023 on the Teifi SAC SAGIS modelling and preliminary phosphorus reduction investment programme.	March 2023
Draft DCS	Assumes that the council are in agreement that a DCS is a required mechanism to at least part-fund mitigation proposed within this IAP.	July 2023
1 <sup>st</sup> Update to Interim Action Plan	Following publication of DCWW's source apportionment technical paper and data for the Teifi, and conclusion of NRW/DCWW permitting discussions for the Teifi, an update to the IAP will be triggered. This will confirm changes to the nutrient budget within the catchment and look to prioritise catchment interventions depending on technical detail of the DCWW source apportionment study.  Further technical studies and liaison with landowners, NRW and DCWW may also take place to progress potential offsite wetland solutions and onsite SuDS solutions.	Aug 2023
Agree/quantify 1 <sup>st</sup> phase mitigation measures	In line with the 1 <sup>st</sup> update of the Action Plan, it is recommended that a first phase of mitigation measures are identified within the Teifi and Tywi catchments. Selection should take a risk-based approach owing to the uncertainties in either catchment. It is recommended that a sufficient number of mitigation measures are selected to secure development due to come forward first under the rLDP and the deliverability of the proposed solutions. Measures selected in this first phase will set out a plan for delivering outline and detailed design with more certainty gained	Oct 2023

Milestone	Commentary	Completion Date
	on the efficacy of the solutions. The IAP can be updated according to account for this increased understanding.	
Agree 1 <sup>st</sup> development window	Having quantified the reductions from the first phase of mitigation measures, it will be possible to define the first 'Development window' to phase the release of development accordingly.	Dec 2023
2 <sup>nd</sup> Update to the interim Action Plan	Following publication of DCWW's source apportionment study for the Tywi, and conclusion of NRW/DCWW permitting discussion for the Tywi, a 2 <sup>nd</sup> update to the IAP will be delivered. This will finalise understanding of the Nutrient Budgets for the Teifi and Tywi SACs according to the latest P permits. Catchment mitigation can be further prioritised / developed according to the detail of the source apportionment study.	April 2024
Deliver 1 <sup>st</sup> phase mitigation measures	<p>Delivery of the 1<sup>st</sup> phase mitigation measures will need to have commenced before the first development window starts to be delivered and occupied (i.e., before flows connect to a WwTW).</p> <p>Release of further development within the first Development Window will be dependent on sufficient measures to neutralise additional phosphorus being operational and effective. N.B. commenced means that <u>at least</u> one measure is operational and effective.</p>	Dec 2024
Iteratively agree 2 <sup>nd</sup> / 3 <sup>rd</sup> Phase Mitigation measures	In line with updates to the Action Plan, 2 <sup>nd</sup> / 3 <sup>rd</sup> phase mitigation measures can be identified and developed through outline and detailed design as per the 1 <sup>st</sup> phase.	Dec 2025
Iteratively agree 2 <sup>nd</sup> / 3 <sup>rd</sup> Development Window	In line the 2 <sup>nd</sup> / 3 <sup>rd</sup> Phase Mitigation Measures, it will be possible to define 2 <sup>nd</sup> / 3 <sup>rd</sup> Development Windows to phase release of development accordingly.	<p>2<sup>nd</sup> Window - March 2025</p> <p>2<sup>nd</sup> Window - March 2026</p>
Iteratively Delivery 2 <sup>nd</sup> / 3 <sup>rd</sup> Phase of Mitigation	As per delivery of the 1 <sup>st</sup> phase mitigation measures, this will ensure that mitigation is delivered as development is delivered and occupied.	<p>2<sup>nd</sup> Phase – Dec 2026</p> <p>3<sup>rd</sup> Phase – Dec 2028</p>

## 10.4 Managing Uncertainty & Monitoring

Strategic approaches to phosphorus mitigation to facilitate LDPs at a strategic level is fraught with uncertainties. Furthermore, due to the nature of the available measures, the complexities of working within a dynamic riverine ecosystem, estimates of phosphorus reductions are based on the best available information and expert judgement.

While phosphorus reduction values for each measure will be estimated by relevant experts, a degree of uncertainty is still unavoidable. If the DCS is to ensure effective mitigation and compliance with the Habitats Regulations these uncertainties can be addressed in the following ways:

- Firstly, the relevant experts and officers taking a precautionary approach to the estimated reductions that will be associated with each measure, such that achieving a greater reduction than anticipated is more likely than achieving less.
- Secondly, whilst being reasonable, the estimates of phosphorus load from new development remain precautionary in light of recent monitoring data of actual effluent quality.
- Thirdly, where feasible, ongoing monitoring of measures to best assess the actual reductions achieved upon implementation is an integral part of this action plan, together with monitoring of the final effluent to calculate the actual P load associated with the additional flow. This action plan is a live document; the milestones include actual improvements to water quality from mitigation, any evidence which identifies a failure in the mitigation measures to achieve the planned phosphorus reduction from development can inform later revisions to the strategy to provide additional measures.

It is recommended that plans are put in place to manage ongoing uncertainty, and a catchment-scale monitoring solution is developed between the relevant stakeholders by the Nutrient Management Board to ensure the long-term health of the riverine SACs in Carmarthenshire.

# 11 Summary

Arcadis have been commissioned by CCC to provide specialist support to progress the preparation of their rLDP. This report has been prepared to outline an IAP to deliver phosphorus mitigation with Carmarthenshire's two impacted riverine SACs such that new development can be brought forward under the rLDP without damaging the downstream sensitive water environment.

At the time of writing, several uncertainties exist with respect to the baseline conditions within the affected catchments in Carmarthenshire. As such, an IAP has been developed, intended to act as a living document that can be updated as and when further detail and understanding develops. This document sets out a pragmatic and adaptable plan to deliver phosphorus mitigation with Carmarthenshire, and central to its success will be further collaboration between Arcadis, CCC, the Nutrient Management Board, NRW and DCWW in updating the plan.

Analysis set out in this document has confirmed the scale of the challenge in achieving nutrient neutrality in Carmarthenshire. As outlined in Section 3, a TP Budget has been calculated for the most recent rLDP deposit plan. This has allowed for a review of the current rLDP development sites, which saw an overall reduction in allocation sites under the rLDP (from 42 to 21 sites) within the drainage catchments of Afon Teifi and Tywi SACs. It has also allowed for a change in the currently used basic assumption in the Ricardo Nutrient Budget calculator around the TP limits of the impacted existing WwTW discharges in Carmarthenshire (See Section 3.2).

As explained in Section 0, the default 8mg/l P limit and the backstop 5mg/l P limit have been used for all WwTW with the exception of two sites: Lampeter and Llanybydder. These two sites, as per the DCWW Phosphorus Programme List<sup>52</sup>, have a proposed P permit in the current AMP7 period (2020-2025) of 0.5mg/l and 2.5mg/l respectively. Based on best available information at the time of writing, the rLDP must therefore mitigate for a total annual phosphorus load of **306 TP kg/year and 203 TP kg/year** for the default 8mg/l and the backstop 5mg/l P limits respectively.

Whilst the TP Budget calculated and reported above is noted as being subject to change, this IAP must be pragmatic and adaptable. As such, opportunities to mitigate this budget have been explored based on the current understanding. Solutions explored have included:

- Enhanced WwTWs
- Constructed Wetlands
- Land Management
- SuDS
- Tree Planting
- Integrated Buffer Zones

Enhanced WwTWs can offer the most significant opportunity to mitigate additional phosphorus resulting from the rLDP. DCWW's current phosphorus reduction investment programme and screening of collaboration categories (Section 5.1) means that collaboration is possible for further P removal, based on current WwTW performance and DCWW's future investment needs.

Further to the above, tighter permits could still be applied over and above the proposed backstop TP limit at these WwTWs. In fact, there may be significant benefit to this in areas currently failing phosphorus targets such as areas of the lower Teifi. In these areas, if tighter TP Permits were achieved in line with negotiations between NRW and DCWW, new development could be phased appropriately to ensure that investment and delivery of enhanced WwTWs were in-sync with

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<sup>52</sup> DCWW (February 2023) Phosphorus Programme List. [https://www.dwrcymru.com/-/media/Project/Files/Page-Documents/Our-Services/Wastewater/SAC-Rivers/Phosphorus-Programmes-List/English/DCWW\\_SAC\\_P\\_prog\\_Feb2023v9.ashx](https://www.dwrcymru.com/-/media/Project/Files/Page-Documents/Our-Services/Wastewater/SAC-Rivers/Phosphorus-Programmes-List/English/DCWW_SAC_P_prog_Feb2023v9.ashx)

development delivered / occupied as part of the rLDP. This needs to be kept under review as details emerge and will likely play a significant part in reducing the overall nutrient budget needing to be mitigated to deliver the rLDP.

As discussed above, the scale of the potential enhancements to WwTWs is unknown at the current time of writing. As such, alternative mitigation measures have been investigated. Constructed wetlands offer a significant opportunity to reduce phosphorus within Carmarthenshire's riverine SACs and are considered as one of the better understood mitigation measures currently available. Circa 50 ha of wetland have been identified as potentially feasible within this IAP (37 ha in the Teifi and 15 ha in the Tywi catchments). These wetlands are estimated to remove a total of **618 TP kg/year** i.e., more than 200% of the current TP budget if all wetlands were delivered.

Not all these solutions need to be delivered and the actual quantum delivered will also be dependent on the outcomes of the NRW/DCWW permitting position as well as any planned upgrades to the impacted WwTWs. As such, a mechanism is required to bring forward constructed wetlands in a pragmatic manner that allows for this dynamic situation. This is set out in Section 9 which advocates for the development of a DCS and project milestones that are flexible to the emerging details and allow for measures to be developed and delivered in phases such that development and mitigation are aligned.

Further to constructed wetlands, several other mitigation measures have been outlined in Section 4. These measures should be given consideration in delivering appropriate mitigation within Carmarthenshire's riverine SACs. However, there are uncertainties regarding their efficacy which may require monitoring to confirm. Opportunities to bring these solutions forward should be considered in line with more definitive interventions, such as constructed wetlands, as a buffer / precautionary additional mitigation measure. Delivered in line with an appropriate monitoring plan, these measures could be quantified in the medium-long term such that subsequent nutrient management budgets for the remaining rLDP sites are reduced. This should be developed in line with the milestones set out in Section 9.

The mitigation measures set out above show that several opportunities to mitigate the required phosphorus resulting from the rLDP are available. Whilst uncertainties remain, this IAP has outlined a phased and holistic approach to implementation and delivery that is adaptable to changing circumstance. Key to this is the phasing of mitigation measures and development. As outlined in Section 9, mitigation can be brought forward taking a risk-based approach and in parallel with proposed development.

The development of a DCS or phosphate credit mechanism, together with exploration of additional funding sources should provide a mechanism by which mitigation can be delivered. As per Section 9.3, mitigation measures can be iteratively brought forward in line with updates to the interim action plan and delivery / occupation of development in the rLDP. This will ensure that mitigation is brought forward to outline / detailed design at appropriate points in the delivery of the rLDP. These measures can then be quantified in terms of their phosphorus reduction and the TP Budget for the rLDP can be updated accordingly within this document.

## 11.1 Next Steps and Priorities

The following next steps are recommended to be taken; priority items are listed first.

- Update the Habitats Regulations Assessment appendix to the addendum with the additional consultation information including the new AMP 7 TP permits and DCWW NbS collaboration information.
- Update Ricardo Nutrient Budget Calculator to reflect the reduced TP limits adopted in this IAP report (to reflect proposed backstop TP permit) as well as the need to include Lampeter and Adpar WwTWs (with AMP7 TP permits) as the proposed rLDP are likely to connect to these WwTWs although they are located outside Carmarthenshire's boundary.
- Develop a DCS such that a mechanism is in place to fund mitigation measures should urgent action be required to release early development sites.
- Nutrient Management Board to explore opportunities for additional funding for mitigation measures outlined in this report; Arcadis can support a triage exercise to select most appropriate measures for funding.
- Arcadis to update IAP following publication of source apportionment work on the Teifi SAC and subsequent confirmation of the DCWW/NRW permitting position whilst taking into consideration further technical studies, surveys and engagement with the impacted landowners and stakeholders being undertaken.
- 1<sup>st</sup> Phase of mitigation measures to be agreed by Nutrient Management Board, CCC and Arcadis
- 1<sup>st</sup> Development window to be agreed i.e., which sites can be released by the mitigation identified.
- 2<sup>nd</sup> update to the IAP will seek to account for the 1<sup>st</sup> phase of mitigation measures and the expected release of source apportionment study for the Tywi and subsequent confirmation of the DCWW/NRW permitting position.
- 2<sup>nd</sup> / 3<sup>rd</sup> Phase mitigation measures to iteratively coincide with 2<sup>nd</sup> / 3<sup>rd</sup> phase Development Windows and consequent updates to the IAP.

Table 11-1 below provides a timeline of key publications and events including the projected number of housing units per annum from the rLDP. Subject to the outcome of the HRA consultation response and update, permitting positions and subsequent IAP review, it is recommended that development windows are established in order to bring forward development and mitigation measures.

Table 11-1 A timeline of key publications and events

Key stakeholders / items	Year											
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
<b>rLDP # of housing units to be constructed per annum: Teifi</b>				48	27	36	38	30	17	12	0	0
<b>rLDP # of housing units to be constructed per annum: Tywi</b>				21	14	56	54	27	2	5	3	2
<b>DCWW</b>		Phosphorus Source Apportionment Technical Reports and Draft Phosphorus Reduction Investment Programme  PR24 Submission for Ofwat approval	Ofwat approval to PR24 Submission  Final Phosphorus Reduction Investment Programme	Asset Management Plan 8 (AMP8) commences								
<b>NRW</b>		Commencement of Review of Consents  Publication of NRW wetland design policy/ review outcome of CIRIA SuDS Report C808F	Completion of Review of Consents									
<b>CCC and Arcadis rLDP HRA - Habitats Risk Assessment</b>	Review of current HRA	Completion of draft and final rLDP HRA										
<b>CIRIA SUDS</b>	Publication of Report C808F - Using SuDS to reduce phosphorus in surface water runoff											
<b>Interim Action Plan</b>		Publication of IAP, followed by 1 <sup>st</sup> iteration	Publication of 2 <sup>nd</sup> IAP iteration									
<b>Development windows</b>		Agree 1 <sup>st</sup> window.		Agree 2 <sup>nd</sup> window.	Agree 3 <sup>rd</sup> window.							
<b>Mitigation Measures</b>		Agree 1 <sup>st</sup> Phase	Deliver 1 <sup>st</sup> Phase	Agree 2 <sup>nd</sup> Phase	Deliver 2 <sup>nd</sup> Phase	Agree 3 <sup>rd</sup> Phase	Deliver 3 <sup>rd</sup> Phase					



# Appendix A

## Report Figures

Appendix A Figure A1: Overview of SACS and Phosphorus Sensitive Catchments

Appendix A Figure A2: TP Nutrient Budget based on a 5mg/l backstop and an 8mg/l default at each WwTW

Appendix A Figure A3: Tywi Wetland Mitigation

Appendix A Figure A4: Teifi Wetland Mitigation

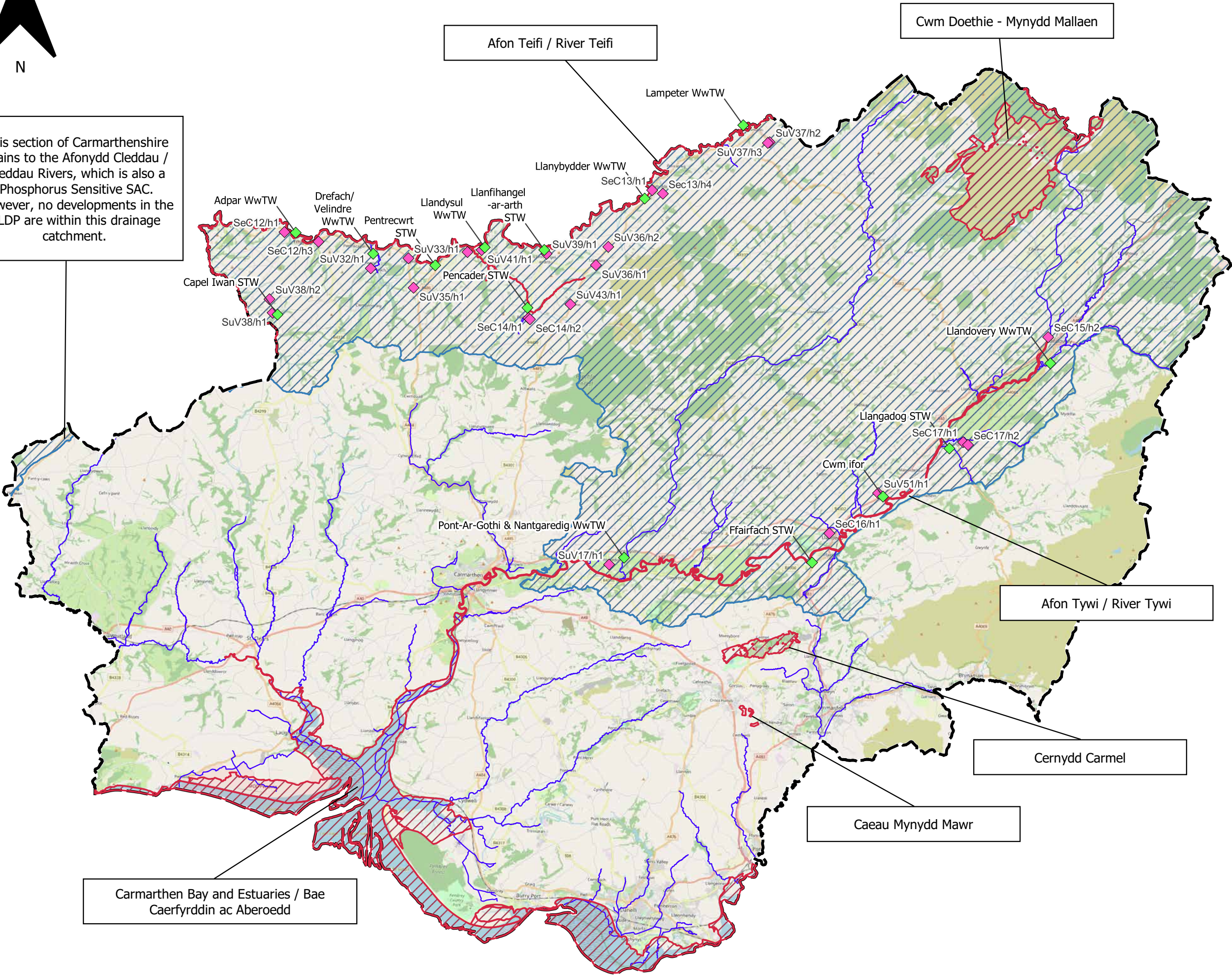
Appendix A Figure A5: Tywi Secondary Options Mitigation

Appendix A Figure A6: Teifi Secondary Options Mitigation





This section of Carmarthenshire drains to the Afonydd Cleddau / Cleddau Rivers, which is also a Phosphorus Sensitive SAC. However, no developments in the rLDP are within this drainage catchment.



## Legend

- Revised LDP Site Allocations
- WwTW Locations
- Main Rivers
- Special Areas of Conservation
- Drainage Catchment to Phosphorous Sensitive SACs
- Carmarthenshire County Council Boundary

## Notes

This map only shows the relevant layers within the Carmarthenshire County Boundary. A number of Phosphorus Sensitive SACs, including the Afon Gwy / River Wye and Afonydd Cleddau / Cleddau Rivers are outside the council boundary.

The Drainage catchment to phosphrous sensitive SACs layer and a reduced number of Site Allocation locations were provided to Arcadis by CCC after a review of the rLDP. This figure and the Nutrient Budget Assessment only covers site allocations within the Phosphorus Sensitive catchment layer.

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## Carmarthenshire County Council Nutrient Neutrality Budget Calculations

## Appendix A Figure A1 - Overview of Special Areas of Conservation and Phosphorus Sensitive catchments in Carmarthenshire

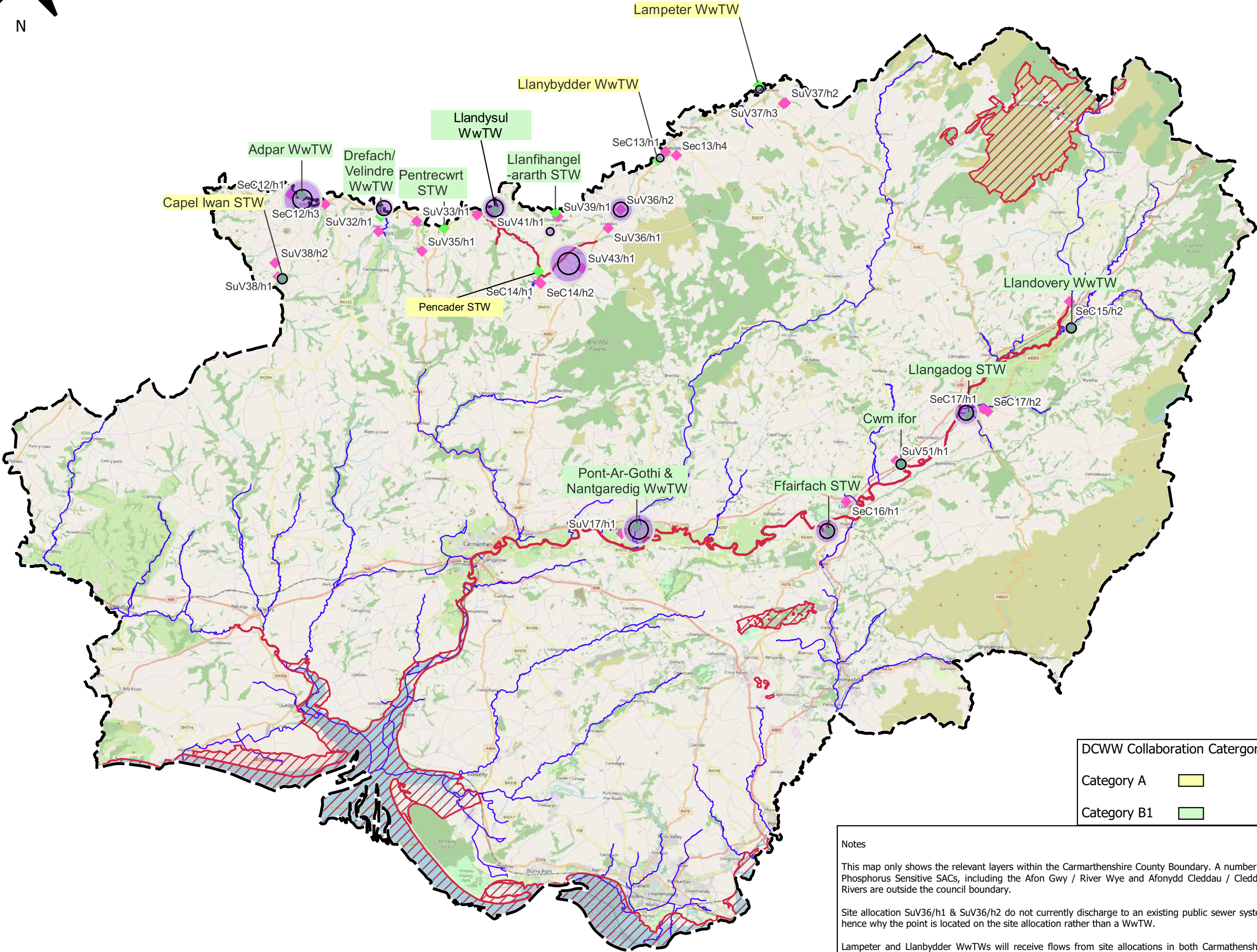
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Legend

- Revised LDP Site Allocations
- WwTW Locations
- Main Rivers
- Special Areas of Convnservation
- Carmarthenshire County County Council Boundary

TP Nutrient Budget

5 mg/l Backstop (kg TP/year)	8 mg/l Default (kg TP/year)
0 - 5	0 - 5
5 - 10	5 - 10
10 - 15	10 - 15
15 - 20	15 - 20
20 - 25	20 - 25
25 - 30	25 - 30
30 - 35	30 - 35
	35 - 40
	40 - 45
	45 - 50

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Nutrient Neutrality Budget Calculations

Appendix A Figure A2 - TP Nutrient  
Budget based on a 5mg/l backstop and a  
8mg/l default at each WwTW

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DCWW Collaboration Category

- Category A
- Category B1

Notes

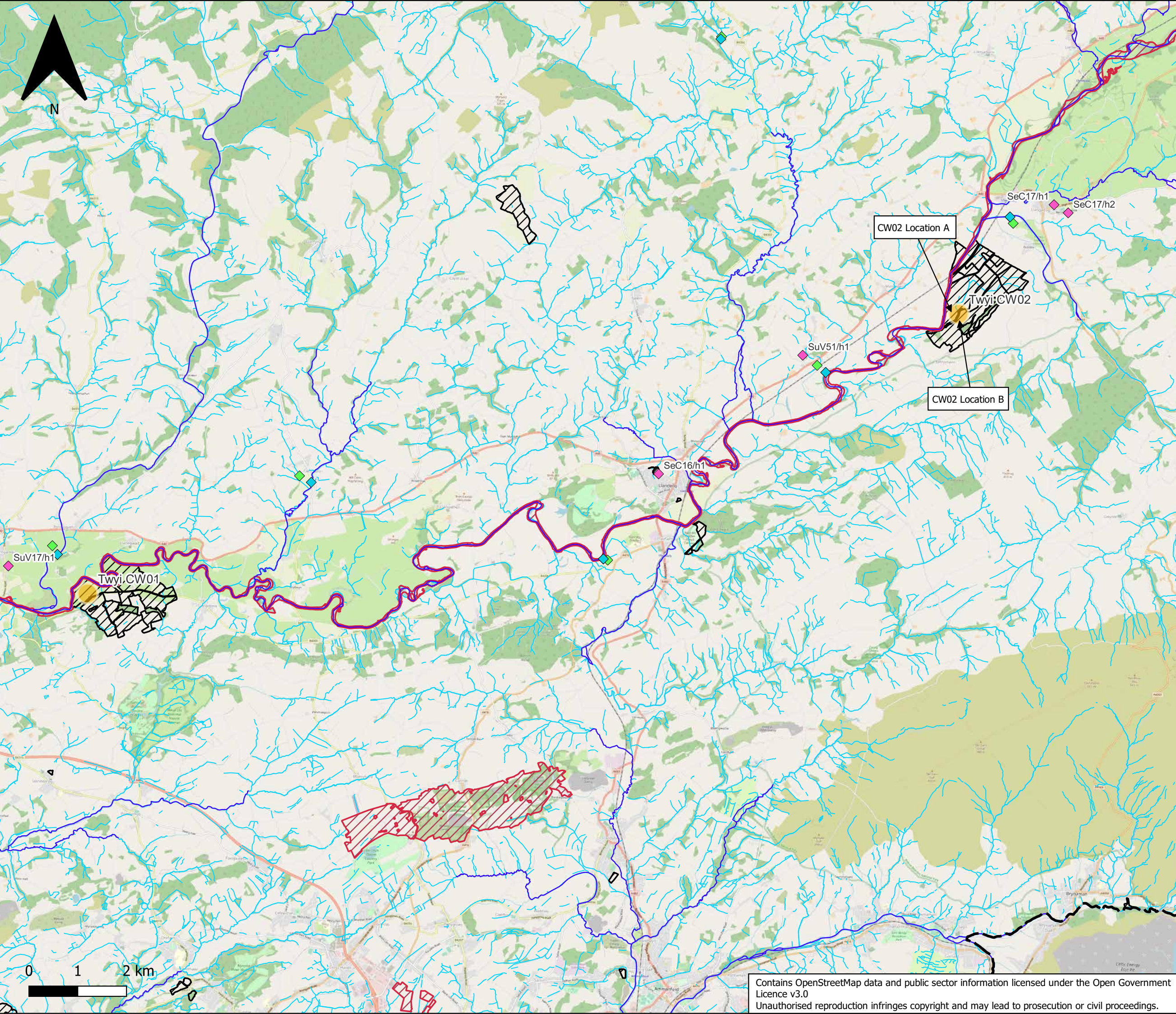
This map only shows the relevant layers within the Carmarthenshire County Boundary. A number of Phosphorus Sensitive SACs, including the Afon Gwy / River Wye and Afonydd Cleddau / Cleddau Rivers are outside the council boundary.

Site allocation SuV36/h1 & SuV36/h2 do not currently discharge to an existing public sewer system hence why the point is located on the site allocation rather than a WwTW.

Lampeter and Llanbydder WwTWs will receive flows from site allocations in both Carmarthenshire and Ceredigion, but this figure only shows details for Carmarthenshire site allocations.

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Legend

Carmarthenshire Council

- Wetland Opportunities
- Revised LDP Site Allocations
- WwTW Locations
- WwTW Discharge Locations
- Main Rivers
- Watercourses
- Special Areas of Conservation
- Carmarthenshire County Council Owned Land
- Carmarthenshire County Council Boundary

Notes

This map only shows the relevant layers within the Carmarthenshire County Boundary. A number of Phosphorus Sensitive SACs, including the Afon Gwy / River Wye and Afonydd Cleddau / Cleddau Rivers are outside the council boundary.

The potential opportunity locations that are shown on this map are for illustrative purposes only and will need further investigation to confirm their suitability and deliverability. There may be alternative areas that are still to be identified

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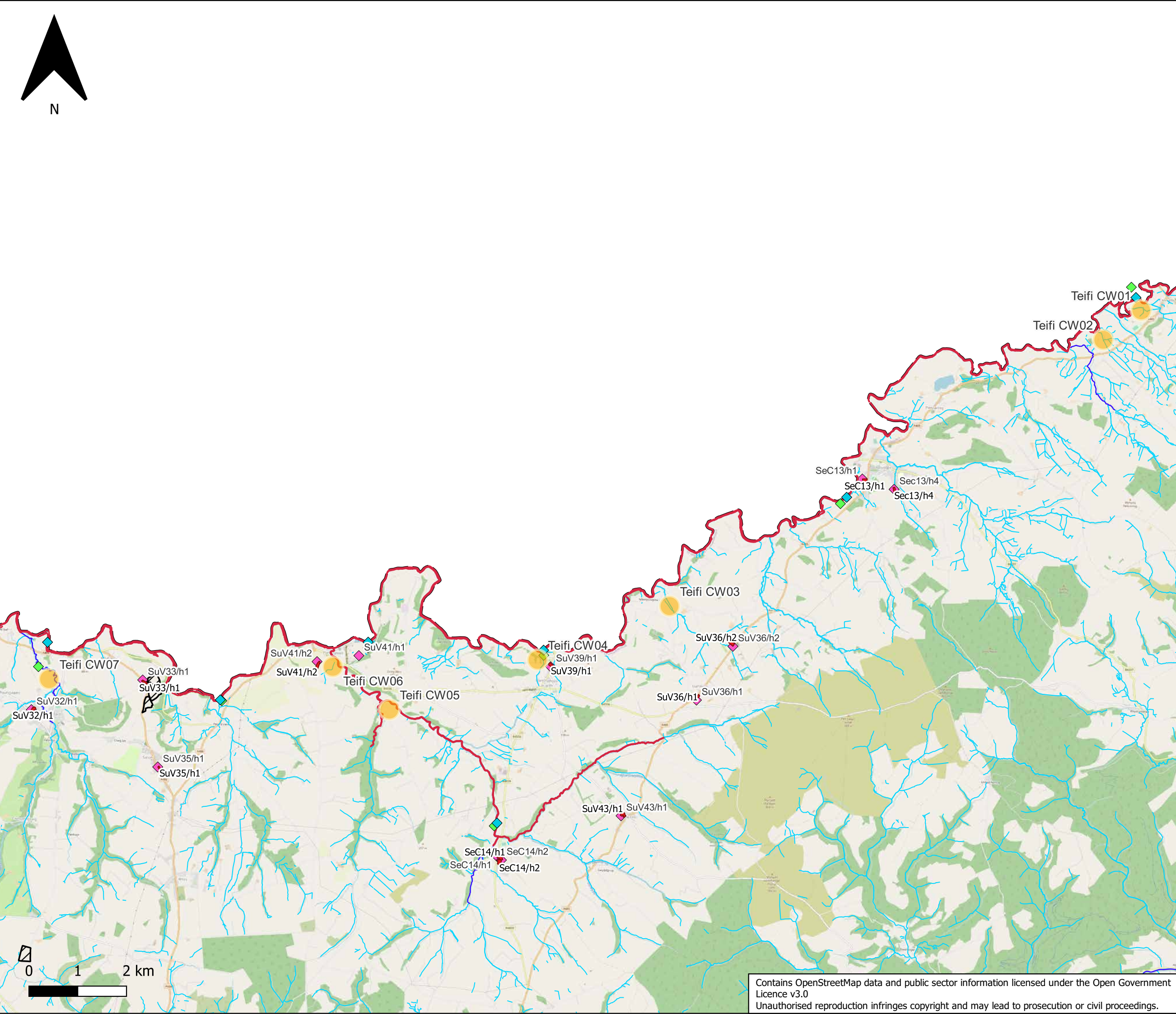


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Nutrient Neutrality Budget Calculations

Appendix A Figure A3: Tywi Wetland Mitigation

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Legend

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- Wetland Opportunities
- Revised LDP Site Allocations
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- WwTW Discharge Locations
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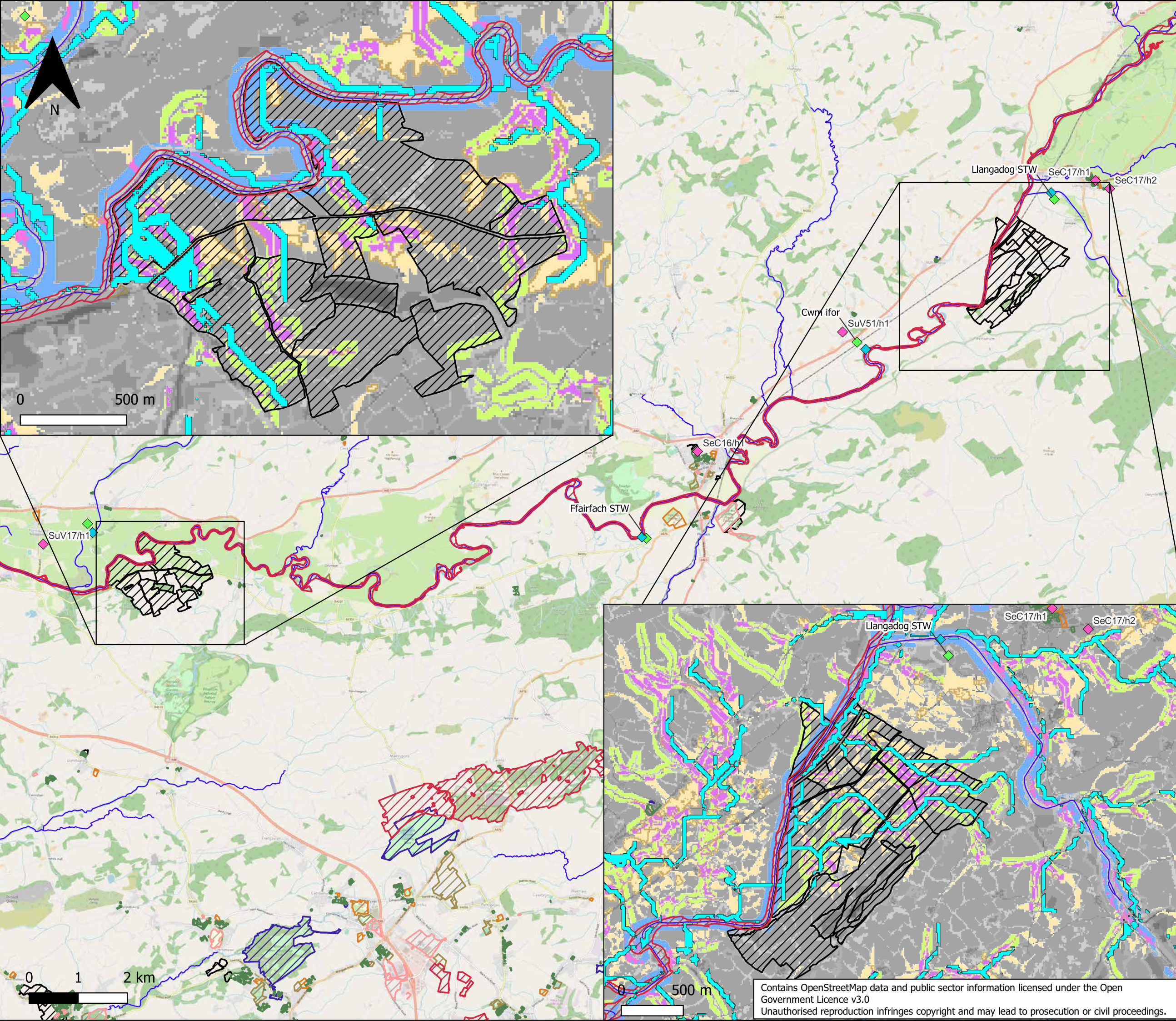


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Nutrient Neutrality Budget Calculations

Appendix A Figure A4: Teifi Wetland Mitigation

Scale	Original Size	Datum	Grid
1:70000	A3	mAOD	OSGB 27700





## Legend

- Revised LDP Site Allocations
  - WwTW Locations
  - WwTW Discharge Locations
- WwTW Discharge Location
- Main Rivers
  - Special Areas of Conservation
  - Carmarthenshire County Council Owned Land
  - Carmarthenshire County Council Boundary
- Opportunities To Reduce Nutrient Enrichment
- Opportunity for Channel Belts
  - Opportunity for Habitat Restoration
  - Opportunity for Hedgerow Planting
  - Opportunity for Riparian Planting
  - Opportunity for Buffer Strips

## Notes

This map only shows the relevant layers within the Carmarthenshire County Boundary. A number of Phosphorus Sensitive SACs, including the Afon Gwy / River Wye and Afonydd Cleddau / Cleddau Rivers are outside the council boundary.

The potential opportunity locations that are shown on this map are for illustrative purposes only and will need further investigation to confirm their suitability and deliverability. There may be alternative areas that are still to be identified

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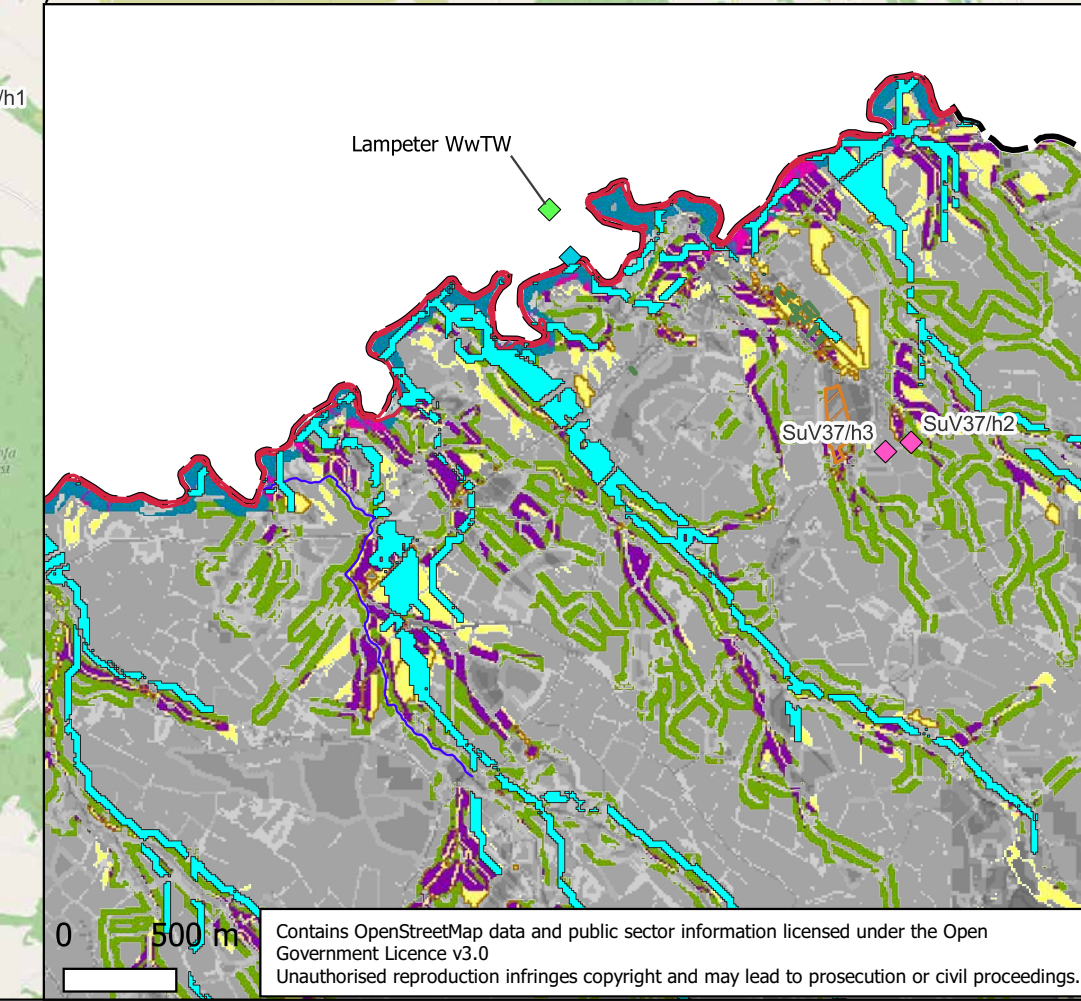
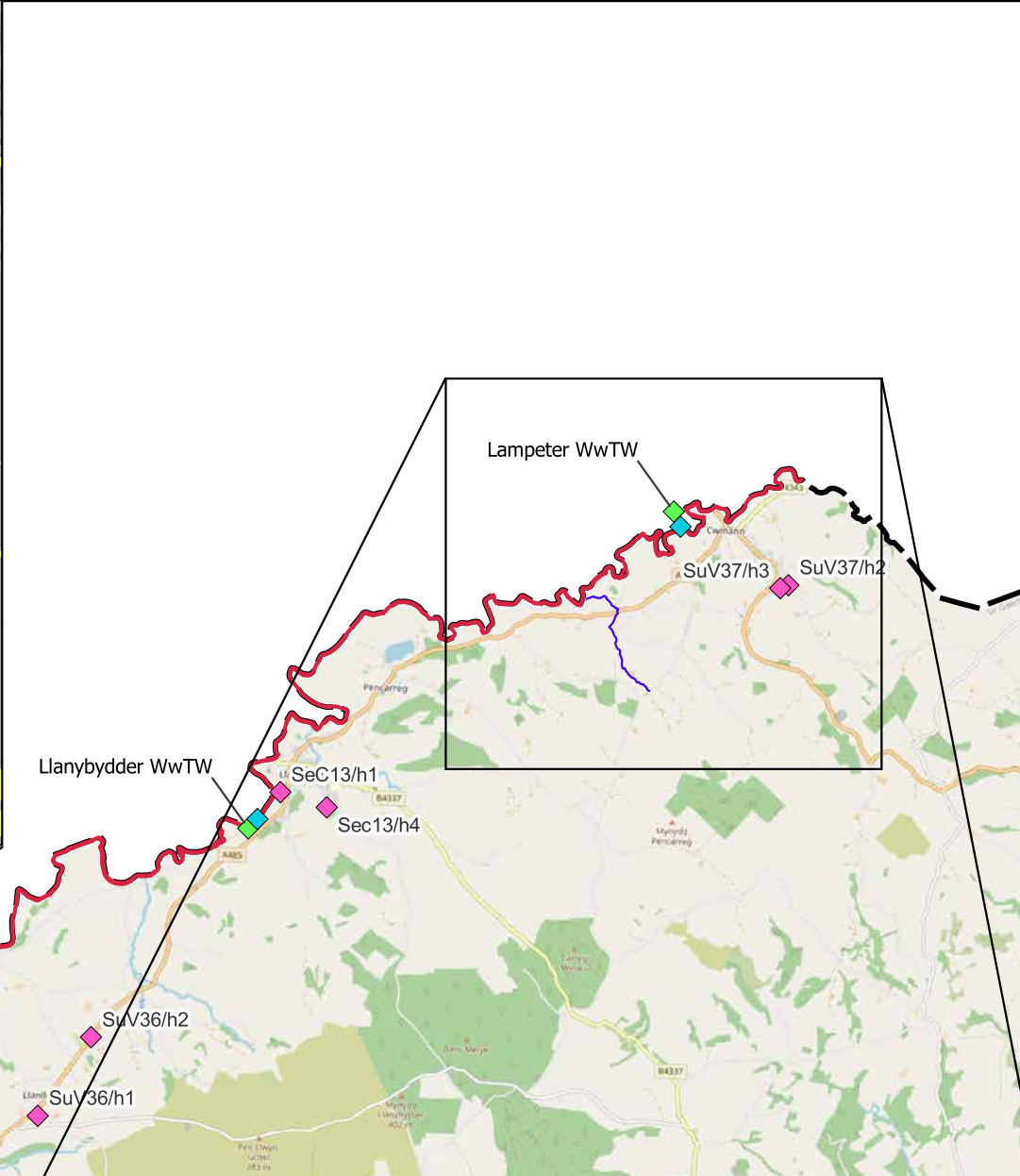
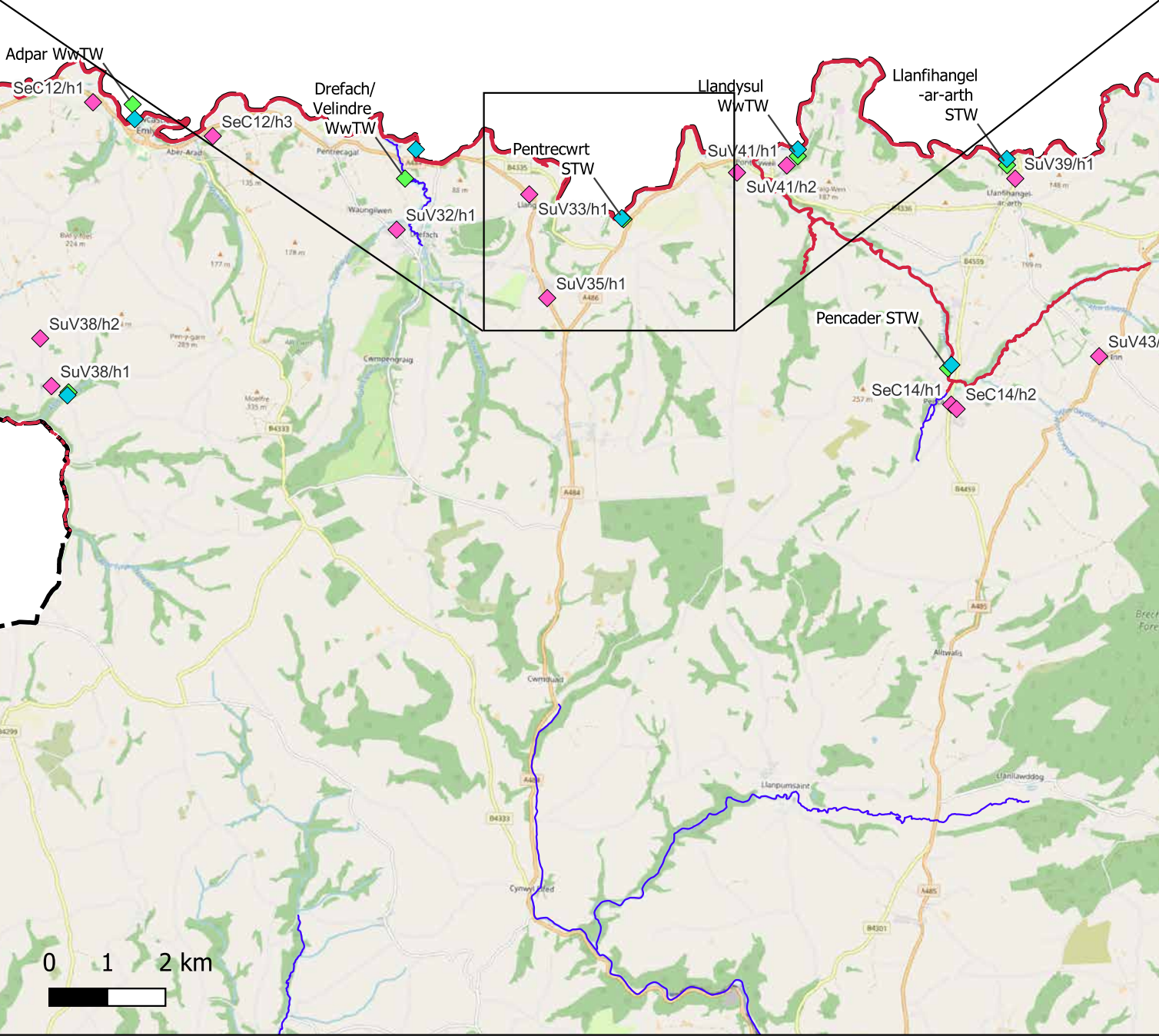
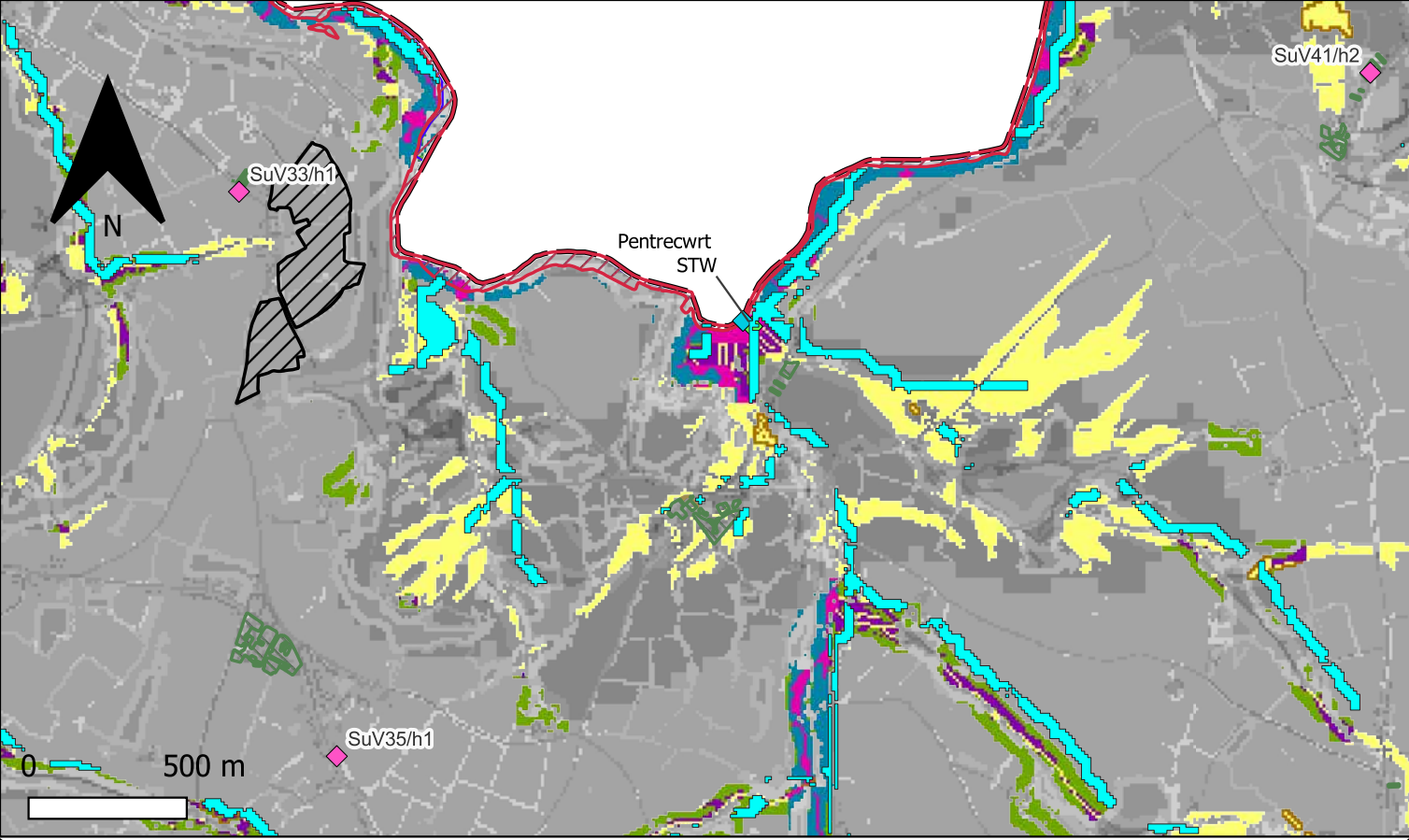
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Appendix A Figure A5: Afon Tywi  
Secondary Options Mitigation  
Opportunities

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# Legend

- Revised LDP Site Allocations
- WwTW Locations
- WwTW Discharge Location
- Main Rivers
- Special Areas of Conservation
- Carmarthenshire County Council Owned Land
- Carmarthenshire County Council Boundary

## Opportunities To Reduce Nutrient Enrichment

- Opportunity for Channel Belts with moderate priority
- Opportunity for Habitat Restoration or Channel Belts with moderate priority
- Opportunity for Habitat Restoration or Riparian Planting with moderate priority
- Opportunity for Habitat Restoration with moderate priority
- Opportunity for Riparian Planting with moderate priority
- Opportunity for Buffer Strips

### Notes

This map only shows the relevant layers within the Carmarthenshire County Boundary. A number of Phosphorus Sensitive SACs, including the Afon Gwy / River Wye and Afonydd Cleddau / Cleddau Rivers are outside the council boundary.

The potential opportunity locations that are shown on this map are for illustrative purposes only and will need further investigation to confirm their suitability and deliverability. There may be alternative areas that are still to be identified.

Areas were prioritised according to the number of downstream waterbodies with known issues with nutrient inputs; areas feeding into multiple at-risk waterbodies were ranked a higher priority than areas feeding into a single waterbody.

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Appendix A Figure A6: Afon Teifi  
Secondary Options Mitigation  
Opportunities

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# Appendix B

## Legislative and Planning Context

### Legislative Context

The following are the key pieces of national legislation that may affect the implementation of phosphate mitigation measures:

- Environment (Wales) Act 2016
- Well-being of Future Generations (Wales) Act 2015
- The Flood and Water Management Act 2010
- The Water Resources (Control of Agricultural Pollution) (Wales) Regulations 2021
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017
- Agriculture (Wales) Bill

#### **Environment (Wales) Act 2016<sup>53</sup>:**

The duty for public authorities in the exercise of functions in relation to sustainable management of natural resources – enables Wales’ resources to be managed in a more proactive, sustainable and joined-up way. This included the provision for Sustainable management of natural resources (SMNR) and is defined in the Environment Act as: *“using natural resources in a way and at a rate that maintains and enhances the resilience of ecosystems and the benefits they provide. In doing so, meeting the needs of present generations of people without compromising the ability of future generations to meet their needs, and contributing to the achievement of the well-being goals in the Well-being of Future Generations Act.”* Innovative Nature based Solutions comply with their Natural Resources Policy under Section 9 of the Environment (Wales) Act 2016.

#### **Well-being of Future Generations (Wales) Act 2015<sup>54</sup>:**

In this Act “sustainable development” means the process of improving the economic, social, environmental and cultural well-being of Wales by taking action, in accordance with the sustainable development principle, aimed at achieving the well-being goals. The seven well-being goals (‘the goals’) show the kind of Wales we want to see. Together they provide a shared vision for the public bodies listed in the Act to work towards. The most relevant to this context are A resilient Wales:

- biodiversity and soil - Maintain and enhance the natural environment through managing land appropriately to create healthy functioning ecosystems
- natural green space – support a social resilience and community well-being
- Knowledge of Nature – increased awareness of the importance of a biodiverse natural environment with healthy functioning ecosystems
- Water quality and air quality – support ecological resilience making the environment healthier for wildlife and people
- Using natural resources – be adaptive to a changing environment where there is a need to use resources efficiently

#### **The Flood and Water Management Act 2010<sup>55</sup>:**

Amendments to the Flood and Water Management Act 2010 (Schedule 3), came into effect in Wales on 7 January 2019. A UK Act of Parliament relating to the management of the risk concerning flooding and coastal

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<sup>53</sup> <https://www.legislation.gov.uk/anaw/2016/3/contents/enacted>

<sup>54</sup> <https://www.legislation.gov.uk/anaw/2015/2/contents/enacted>

<sup>55</sup> <https://www.legislation.gov.uk/ukpga/2010/29/contents>

erosion. The Act aims to reduce the flood risk associated with extreme weather, compounded by climate change. It created the role of Lead Local Flood Authority, which is the local government authority responsible for managing flood risk in the local government area. The Act gave new powers to local authorities, the Welsh Ministers and water companies. It requires new developments to include SuDS features that comply with Welsh national standards<sup>56</sup>, which state that:

*‘Developers should demonstrate compliance with these standards in submitting planning applications. For major developments, where a drainage strategy document may be required as part of a local validation requirement, this should demonstrate how these standards have been met in the site design. It should be noted that a number of planning authorities in Wales have adopted guidance on sustainable drainage which should be taken into account in any development proposal’.*

#### **The Water Resources (Control of Agricultural Pollution) (Wales) Regulations 2021<sup>57</sup>:**

This Guidance describes the requirements that farmers and land managers in Wales must follow to comply with the Water Resources (Control of Agricultural Pollution) (Wales) Regulations 2021 – (SI 2021/77, W.20) which came into force on 1 April 2021.

NRW is responsible for enforcing the Regulations. Advice on general nutrient storage and management can be obtained from NRW and the Welsh Government.

The Water Resources (Control of Agricultural Pollution) (Wales) Regulations 2021 have been introduced to reduce losses of pollutants from agriculture to the environment by setting rules for certain farming practices. The Regulations also set standards for silage making, storage of silage effluent and for slurry storage.

#### **The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017<sup>58</sup>:**

This regulation imposes duties on the Secretary of State, Welsh Ministers, the Environment Agency (EA) and NRW to carry out certain functions so as to ensure compliance with the EU directives, in particular when deciding whether to grant, vary or revoke certain permits and licences which affect water quality.

Part 2 of the regulations requires the identification of river basin districts, and a number of other assessments to be carried out by the EA and NRW to characterise and classify the status of water bodies in those districts and assess the economic aspects of water use. River basin management plans must be established for each river basin district. In Part 3, which makes provision for certain protected areas, the identification of bodies of water from which drinking water is abstracted is required, and specific measures are specified that must be included in a programme of measures to protect the quality of the water.

#### **Agriculture (Wales) Bill<sup>59</sup>:**

The Agricultural Bill would be strategic in scope, setting a support framework which can accommodate the development of agriculture and forestry within Wales for the next fifteen to twenty years.

The Bill's policy framework is a response to the legislative framework established by the Well-being of Future Generations (Wales) Act 2015 and the Environment (Wales) Act 2016. It will create a new system of farm payments that “rewards farmers for their response to the climate and nature emergencies” and supports them to produce food sustainably. This is in the form of a proposed Sustainable Farming Scheme that reward farmers appropriately for the production of additional non-market goods (improved soils, clean air, clean water, improved habitat condition, actions to reduce global warming) at levels above those set by regulation through the management of land in a sustainable way. It will also provide advice and support for farmers and farm businesses. As described in the Agriculture Wales Bill White Paper.

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<sup>56</sup> <https://gov.wales/sites/default/files/publications/2019-06/statutory-national-standards-for-sustainable-drainage-systems.pdf>

<sup>57</sup> <https://gov.wales/sites/default/files/publications/2021-03/water-resources-control-of-agricultural-pollution-wales-regulations-2021-guidance-for-farmers-and-landmanagers.pdf>

<sup>58</sup> <https://www.legislation.gov.uk/ukxi/2017/407/part/1/made>

<sup>59</sup> <https://gov.wales/agriculture-wales-bill>

## **Key organisations and parties relevant to the delivery of phosphate mitigation measures:**

### **Local Planning Authority:**

LPAs are 'competent authorities' under the Habitats Regulations<sup>60</sup> and must 'have regard' to the requirements of the Birds and Habitats Directives in exercising any of their functions. LPAs are responsible for ensuring that their decision making is compliant with the requirements of the Habitats Regulations. Part 7 of the Town and Country Planning Act 1990 gives LPAs a range of enforcement powers to address breaches of planning control. A breach of planning control is defined in section 171A of the Town and Country Planning Act 1990 as<sup>61</sup>:

- the carrying out of development without the required planning permission; or
- failing to comply with any condition or limitation subject to which planning permission has been granted.

Any contravention of the limitations on, or conditions belonging to, permitted development rights, under the Town and Country Planning (General Permitted Development) (Wales) Order 2014<sup>62</sup>, constitutes a breach of planning control against which enforcement action may be taken.

There are a number of responsibilities which LPA's could use to support the delivery of phosphate mitigation:

- The Town and Country Planning Process and Building Control functions help deliver the requirements of the WFD through careful considerations and consultation around developments, and by avoiding or minimising the adverse effects of any environmental risks on present or future land use<sup>63</sup>.

Following the implementation of the Flood and Water Management Act 2010 (FWMA), councils in Wales, as the Lead Local Flood Authorities (LLFAs) are responsible for the management of flood risk from surface water, groundwater and ordinary watercourse. Under the Land Drainage Act, LLFAs also lead on ordinary watercourse consenting and enforcement. LPA's should follow the advice note on the WFD to minimise the impacts on the water environment<sup>64</sup>.

Local Authorities have a major role to play in promoting water environment benefits through environmental health and pollution control functions.

As significant land and property owners, local authorities play an important role in protecting and improving the water environment. Local Authority and NRW operational teams should work together to discuss and identify potential opportunities to design and maintain drainage schemes on Local Authority sites and land to provide valuable flood management, water quality, ecological and amenity benefits.

Local Planning Authorities statutory function as the Sustainable Drainage Approving Body (SAB)<sup>65</sup> should ensure that drainage proposals for all new developments are designed and built in accordance with the national standards for sustainable drainage, as published by Welsh Ministers.

### **Natural Resources Wales<sup>66</sup>:**

NRW is the Appropriate Nature Conservation Body (ANCB) for Wales and their functions include the management of Wales's forests and woodlands, pollution control, waste regulation, the management of water resources, flood and coastal risk management, fisheries, navigation and safeguarding of protected sites and species. NRW are the "competent authority" responsible for the implementation of the Water Framework Directive. In relation to the Habitats Regulations the "competent authority" is the decision maker under the HRA requirements and can include local authorities, harbour authorities, and other public bodies. They

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<sup>60</sup> Habitats regulations assessments: protecting a European site - GOV.UK ([www.gov.uk](http://www.gov.uk))

<sup>61</sup> Town and Country Planning Act 1990 ([legislation.gov.uk](http://legislation.gov.uk))

<sup>62</sup> <https://www.legislation.gov.uk/wsi/2014/592/contents/made>

<sup>63</sup> <https://naturalresources.wales/media/684784/20171122-final-signed-revised-wfd-advice-note-for-local-authorities.pdf>

<sup>64</sup> <https://naturalresources.wales/media/2627/wfd-docs-eng.pdf>

<sup>65</sup> <https://gov.wales/sites/default/files/publications/2019-06/statutory-guidance.pdf>

<sup>66</sup> Natural Resources Wales / What we do

determine whether or not an appropriate assessment is required, whether proposals would have an adverse effect and, if necessary, whether or not derogation tests are met. It is the competent authority's responsibility to carry out the appropriate assessment and the ANBC (NRW) must be consulted by the competent authority during an appropriate assessment to provide advice and assistance on some decisions. Habitats Regulation 63(4) provides for public consultation at the discretion of the competent authority (it is not a statutory requirement). The "appropriate authority" in Wales under the Habitats Regulations are the Welsh Ministers. Under the HRA requirements, the competent authority must inform the appropriate authority before it consents to a plan or project.

#### **Afonydd Cymru<sup>67</sup>:**

Afonydd Cymru (AC) is the umbrella body that represents the six Rivers Trusts in Wales. They advocate for the Rivers Trust on relevant Welsh Government and NRW working groups championing Wales' thirty-three rivers, and the many lakes and smaller watercourses. Their environment, fish and fisheries and the wide range of diverse species depend on clean water and unspoilt habitats.

#### **Water Utility Companies:**

Water utility companies are a competent authority for their activities under the Habitats Regulations<sup>68</sup> and 'public bodies' under the Regulations which implement the Water Framework Directive. As such they also have a statutory duty to 'have regard' to the requirements of the Birds and Habitats Directives and to the River Basin Management Plan. Under Ofwat's strategy, Ofwat have made it clear that they will take action if a company fails to comply with its obligations and if there is non-compliance<sup>69</sup>. They use a risk-based approach to regulation which enable them to use enforcement tools to deliver outcomes. The action that Ofwat take will depend on the nature, seriousness and impact of any contravention.

DCWW's performance is tightly monitored and regulated by a number of regulators. The roles and responsibilities of DCWW regulators are outlined below:

- The Welsh Government sets the legislative and regulatory framework within which DCWW operate by making regulations and issuing statutory guidance. Welsh Government also publishes statutory guidance setting out the strategic priorities that it expects Ofwat to pursue in its regulation of the water industry in Wales.
- NRW brings together the work of the Countryside Council for Wales, Environment Agency Wales and Forestry Commission Wales, as well as some functions of Welsh Government.
- The Environment Agency monitors and enforces compliance with environmental water quality standards. It also ensures the proper use and management of water resources.

#### **National Farmers Union (NFU):**

NFU Cymru is the leading agricultural organisation for farmers in Wales<sup>70</sup>. NFU represents the farming community with over 47000 members and are the UK's largest representative body for agriculture and horticulture with has local representatives across the country, including water pollution specialists, to communicate messages between the farming industry, and the regulators. Alongside population growth, the agricultural sector will change in the future and the NFU vision is to achieve this development together with environmental improvement.

#### **Farmers (including fish farms and cress farms) and land managers:**

The role of farmers (including those involved in fish farms and cress farm) and land managers in the delivery of the ambition target reductions and the overall achievement of the conservation objectives should not be underestimated. The willingness of farmers and land managers to sign up to the various delivery mechanisms will be crucial to the extent to which reductions can be achieved without the need for further regulatory control.

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<sup>67</sup> [About Afonydd Cymru | Afonydd Cymru](#)

<sup>68</sup> [The Conservation of Habitats and Species Regulations 2017 \(legislation.gov.uk\)](#)

<sup>69</sup> <https://www.ofwat.gov.uk/wp-content/uploads/2015/11/Approach-to-enforcement.pdf>

<sup>70</sup> [About Us – NFU Cymru \(nfu-cymru.org.uk\)](#)

# Planning Context

## Planning and Key Legislation<sup>71</sup>

The Planning and Compulsory Purchase Act 2004 introduced the LDP system to Wales. Local Planning Authorities have a duty to produce an LDP for their area. Any statutory body carrying out a planning function must exercise those functions in accordance with the principles of sustainable development for the purpose of ensuring that the development and use of land contribute to improving the economic, social, environmental and cultural well-being of Wales.

## Future Wales – The National Plan 2040<sup>72</sup>

It is a spatial plan, setting a direction for where Welsh Government and key stakeholders should be investing in infrastructure and development for Wales. Firstly, from an environmental perspective, natural resources should be sustainably managed, and pollution reduced. Secondly, for economic outcomes, development plans should be forward thinking, with a positive attitude towards enabling economic development, investment and innovation. Nature based solutions are one of the potential mitigation measures for water quality, in addressing phosphorus pollution, they could also help deliver this national policy. The policy sees nature-based solutions as part of shaping urban growth and securing biodiversity enhancements.

## Planning Policy Wales (PPW)<sup>73</sup>

PPW contains a framework of National Sustainable Placemaking Outcomes considered to be optimal for development plans and individual developments. The 2 key outcomes are;

*Growing our Economy in a Sustainable Manner and Making best Use of Resources*; Growth needs to be facilitated without compromising the integrity of the Afon Teifi and Afon Tywi and to do so in a long term sustainable, effective, efficient and least onerous manner;

*Maximising Environmental Protection and Limiting Environmental Impact*; Promote resilient biodiversity, reducing environmental risks, helping to ensure the Afon Teifi and Afon Tywi is resilient to the effects of climate change, promoting biodiversity, managing water resources sustainably and reducing overall pollution.

PPW contains national policy for a range of planning topics, the most pertinent now follow:

*Infrastructure* - Development should be located so that it can be well serviced by existing or planned infrastructure. This will involve maximising the use of existing infrastructure or considering how the provision of infrastructure can be effectively co-ordinated to support development plans. These issues were addressed in the preparation of the rLDP, working collaboratively with NRW and DCWW, the spatial strategy focusses development to areas served with WwTW that have phosphorus limits on the Permits and capacity for growth.

*Housing* - Planning authorities are required to identify the housing needs for its communities, identify land to meet the requirement and demonstrate delivery. Iteratively through the rLDP, it must demonstrate that the housing requirement and any associated mitigation can be delivered.

*Environment* – Natural assets must be protected, promoted, conserved and enhanced. Negative environmental impacts should be avoided for the wider public interest. This means acting in the long term to respect environmental limits and operating in an integrated way so that resources and/or assets are not irreversibly damaged or depleted. The polluter pays principle applies where pollution cannot be prevented and applying the precautionary principle ensures cost effective measures to prevent environmental damage.

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<sup>71</sup> Section 38(6) of the Planning and Compulsory Purchase Act 2004

<sup>72</sup> <https://gov.wales/future-wales-national-plan-2040>

<sup>73</sup> <https://gov.wales/planning-policy-wales>

## Appendix C

### Nutrient Neutrality Assessment (August 2022) Technical Note – Nutrient Budget Summary Tables and Key Assumptions

Table B2 Nutrient Budget Assessment Summary in the Afon Teifi SAC

Site Ref	No. of Dwellings	Cluster	WwTW	Stage 1 (kg TP/year)	Stage 2 (kg TP/year)	Stage 3 (kg TP/year)	Stage 4 (kg TP/year)
SeC12/h1	17	4	Adpar	16.62	0.16	2.07	22.24
SeC12/h2	14	4	Adpar	13.69	0.25	0.46	16.68
SeC12/h3	20	4	Adpar	19.56	0.28	2.82	26.52
SeC13/h1	10	4	Llanybydder	8.06	0.01	1.31	11.23
SeC13/h2	30	4	Llanybydder	24.19	4.07	5.05	30.20
SeC13/h3	23	4	Llanybydder	18.55	0.19	2.34	24.83
New Site W39176	9	4	Llanybydder	7.26	0.71	1.20	9.30
SeC14/h1	20	4	Pencader	16.13	0.50	1.82	20.94
SeC14/h2	24	4	Pencader	19.36	0.19	2.28	25.73
SeC14/h3	28	4	Pencader	22.58	0.37	4.54	32.10
SeC14/h4	7	4	Pencader	5.65	0.13	0.82	7.60
SuV31/h1	12	4	Drefach/Velindre	9.68	0.69	1.92	13.08
SuV31/h2	10	4	Drefach/Velindre	8.06	0.70	0.98	10.01
SuV32/h1	6	4	Drefach/Velindre	4.84	1.25	1.83	6.51
SuV33/h1	8	4	Drefach/Velindre	6.45	0.11	1.05	8.87
SuV34/h1	14	4	Pentrecwrt	11.29	1.44	2.02	14.24
SuV35/h1	35	4	Drefach/Velindre	28.23	0.45	6.50	41.13
SuV36/h1	6	4	No public sewerage	5.87	0.09	1.05	8.20
SuV36/h2	10	4	No public sewerage	9.78	0.18	1.84	13.73
SuV37/h1	20	4	Lampeter	19.56	1.47	2.63	24.85
SuV37/h2	20	4	Lampeter	19.56	1.32	2.34	24.70
SuV37/h3	10	4	Lampeter	9.78	0.93	1.30	12.18
SuV38/h1	11	4	Capel Iwan	8.87	0.42	1.94	12.48
SuV38/h2	5	4	Capel Iwan	4.03	0.20	2.14	7.16
SuV39/h1	7	4	Llanfihangel-ar-arth	5.65	0.90	1.52	7.52
SuV41/h1	19	4	Llandysul	15.32	0.44	5.53	24.49
New Site W40639	14	4	Llandysul	11.29	0.50	5.31	19.32
SuV43/h1	8	4	Llandysul	6.45	0.07	2.18	10.27
<b>Total</b>	<b>417</b>						<b>486.11</b>

Table B3 Nutrient Budget Assessment Summary in the Afon Tywi SAC

Site Ref	No. of Dwellings	Cluster	WwTW	Stage 1 (kg TP/year)	Stage 2 (kg TP/year)	Stage 3 (kg TP/year)	Stage 4 (kg TP/year)
SuV15/h1	10	1	Cwrt Henri WwTW	8.06	0.70	1.30	10.40
SuV16/h1	8	1	Nantgaredig (Pontargothi) WwTW	7.82	1.17	1.63	9.94
SuV17/h1	30	1	Nantgaredig (Pontargothi) WwTW	24.19	0.37	3.95	33.33
SuV18/h1	15	1	Nantgaredig (Pontargothi) WwTW	12.10	0.14	1.48	16.13
SeC15/h1	12	5	Llandovery WwTW	9.68	0.17	1.77	13.54
SeC15/h2	8	5	Llandovery WwTW	6.45	1.62	3.09	9.50



Site Ref	No. of Dwellings	Cluster	WwTW	Stage 1 (kg TP/year)	Stage 2 (kg TP/year)	Stage 3 (kg TP/year)	Stage 4 (kg TP/year)
SeC16/h1	27	5	Ffairfach WwTW	21.77	2.99	4.37	27.79
SeC16/h2	5	5	Ffairfach WwTW	4.03	0.11	0.20	4.95
SeC16/h3	5	5	Ffairfach WwTW	4.03	0.24	2.50	7.55
SeC17/h1	16	5	Llangadog WwTW	12.90	0.26	1.55	17.04
SeC17/h2	8	5	Llangadog WwTW	6.45	0.71	1.05	8.14
SuV47/h1	7	5	Talley WwTW	5.65	0.64	1.08	7.30
SuV48/h1	16	5	Cwrt Henri WwTW	12.90	1.67	2.45	16.42
SuV51/h1	8	5	Cwm lfor WwTW	6.45	0.12	1.29	9.14
<b>Total</b>	<b>175.00</b>						<b>191.17</b>

A number of key assumptions reported in the August Technical Note which are still relevant to the IAP are outlined below:

### 1. Wastewater Treatment Work

It should be noted that a number of the WwTW identified already have limited capacity for additional wastewater loads, these include: Adpar, Drefach/Velindre, Lampeter and Capel Iwan. Where capacity is limited, the DCWW's acceptability position will require confirmation.

Further to the above, the Adpar and Lampeter WwTW are slightly outside of the CCC boundary and are therefore not included in the Ricardo Nutrient Budget Calculator. Based on pipe mapping from DCWW, there appear to be rising mains (combined sewer for Lampeter and a foul sewer for Adpar) which are in the direction of the relevant site allocation. In addition, the developments are within the FEH drainage catchments<sup>74</sup> of the respective WwTWs (as identified by CCC). In the absence of these WwTWs from the calculator, Package Treatment Plants (PTP) have been currently assumed. However, it is recommended that further consultation with DCWW be explored to confirm the permitting position for these works; if it is confirmed that these sites could discharge to either of these WwTWs, then they should be added to the Ricardo calculator and the nutrient budget should be updated.

### 2. Existing Land Use

The selection of existing land use is often uncertain and subjective, particularly where a planning application has not been submitted, and satellite imagery is relied upon along with Agricultural Land Classification Grades mapping. The council has provided information on existing land use (e.g., 'greenfield', 'agriculture' etc.), and this alongside any available planning application documents has been the principal source of information. Also, where the type of agricultural use is unspecified which is the case on most occasions (the calculator requires the user to specify if the land is used for crops, cereals or grazing for example), satellite imagery has been used to support a decision. Often this is inconclusive, and so in line with the guidance, the existing land use has been assigned as 'mixed'. Similarly, where CCC have indicated the site is 'vacant/agriculture', the land has been normally allocated as 'mixed' unless planning application documents show otherwise.

In some instances, there is very limited information available i.e., no planning application and the council has indicated the site is just 'vacant'. In these areas, satellite imagery has again been utilised and where sites appeared to be unused or overgrown, the land has been allocated as 'shrub'.

In the majority of cases, the influence of the existing land use on the final phosphate budget is minor. However, where possible, it is recommended that further consultation be undertaken with relevant CCC staff (e.g. ecology teams) and the relevant landowners to confirm reasonable representations of the existing land

<sup>74</sup> UK Centre for Ecology & Hydrology. Flood Estimation Handbook Webservice.



use. In particular, where CCC have indicated 'vacant/agriculture' it is recommended to verify when it was last used for agriculture.

### **3. Proposed Land Use**

All developments have assumed 100% 'residential land use' as the proposed land use. Whilst many of the developments will include gardens and small areas of greenspace, the guidance is clear that the residential land classification includes grass verges, gardens and blue-green SuDS infrastructure. Furthermore, any greenspace which could legitimately be differentiated from residential land, must be >0.1ha in size. Many of the sites are small, and so it is unlikely that greenspace of sufficient size will have been provided. This assumption provides a worst-case scenario for the nutrient budget calculation and is in line with the precautionary principal.

## Appendix D

### Interventions Measures Matrix

Table D.1 Intervention Measures Matrix

Intervention	Description		Advantages	Disadvantages	Feasibility (including cost and capacity)	Effectiveness	Delivery Partners	Other benefits	Potential funding opportunities
Reduction of Agricultural P at source	<ul style="list-style-type: none"><li>Changing farming practices (inc.</li></ul>		<ul style="list-style-type: none"><li>Reduces pressure on traditional WwTW and nature-based solutions and will reduce expenditure on P removal and increase the sustainability of soil</li><li>Associated pre-treated sludge biosolid spreading by DCWW as a single accredited stakeholder</li></ul>	<ul style="list-style-type: none"><li>Many different small stakeholders requiring large changes in historical practices and may be difficult to manage and monitor</li><li>Strategic interface with DCWW potentially helpful as one major stakeholder</li></ul>	Low	High	<ul style="list-style-type: none"><li>Welsh Government</li></ul>	<ul style="list-style-type: none"><li>Increase biodiversity in watercourses, habitats from a reduction in nutrient enrichment and in soil</li></ul>	<ul style="list-style-type: none"><li>Welsh Government</li><li>Food accreditation schemes</li><li>Welsh Government Farm Business Grant</li></ul>
Farming Source Control	<ul style="list-style-type: none"><li>Farm improvement works to prevent P entering watercourses, which can include fencing.</li></ul>		<ul style="list-style-type: none"><li>Easy to do and increases the value of the farm</li><li>Existing grants scheme may benefit from promotion</li></ul>	<ul style="list-style-type: none"><li>Many different small stakeholders may be difficult to manage and monitor and ensure maintained with certainty</li></ul>	High	High	<ul style="list-style-type: none"><li>NRW</li><li>NFU Cymru</li><li>Dwr Cymru Welsh Water</li></ul>	<ul style="list-style-type: none"><li>Increase biodiversity in watercourses, habitats from a reduction in nutrient enrichment and in soil</li></ul>	<ul style="list-style-type: none"><li>Welsh Government Farm Business Grant Scheme post 2024</li><li>Glastir Small Grant Scheme</li></ul>
Surface Water Separation	<ul style="list-style-type: none"><li>Separate surface water drainage inputs to combined sewer flows from both new and existing developments</li></ul>		<ul style="list-style-type: none"><li>Business as usual for new developments (i.e., presumption that all new development should have separate drainage systems)</li><li>Would lead to reduced Combined Sewer Overflow (CSO) discharges into watercourses and reduced WwTW P loading and water pollution and treatment costs</li><li>Similar compensatory surface water removal approach already in place for Carmarthen Bay and Estuaries European Marine site</li></ul>	<ul style="list-style-type: none"><li>Separation of surface drainage from existing combined systems in urban areas can be typically costly</li><li>Limited reduction in phosphorous concentration unless effective SuDS are also incorporated to treat the polluted stormwater</li><li>Opportunities may be generally limited – Category 1 qualification may also depend on whether new development is on a combined system without DCWW fully funded plans otherwise to improve or is paying to retrofit scheme opportunities elsewhere in the catchment where fully funded plans currently don't exist</li><li>Long term Effectiveness can depend on existing operating practices at WwTW</li></ul>	High	High	<ul style="list-style-type: none"><li>Developers</li><li>Carmarthenshire County Council</li><li>Dwr Cymru Welsh Water</li><li>Wales Green Infrastructure Forum</li></ul>	<ul style="list-style-type: none"><li>Efficiency and increased capacity at WwTW</li></ul>	<ul style="list-style-type: none"><li>Developer led for new developments</li><li>Welsh Water/ Ofwat funding for addressing issues with existing CSOs/combined sewer systems</li></ul>
Enhanced Wastewater Treatment Works	<ul style="list-style-type: none"><li>Increased Phosphate stripping capacity</li></ul>		<ul style="list-style-type: none"><li>Increase headroom for new development that is mains connected</li><li>Clear delivery mechanisms with Welsh Water</li><li>Opportunity to explore developer contributions to accelerate delivery</li></ul>	<ul style="list-style-type: none"><li>Requires long term investment and budgeting</li><li>Requires generally a long lead-in time to deliver</li><li>May transfer issues to biosolid spreading, which require extra mitigation control</li></ul>	Medium	High	<ul style="list-style-type: none"><li>Dwr Cymru Welsh Water</li><li>Developers</li><li>NRW</li><li>NFU Cymru</li></ul>	<ul style="list-style-type: none"><li>None</li></ul>	<ul style="list-style-type: none"><li>Developers</li><li>Welsh Water</li><li>Welsh Government</li></ul>
SuDS Source control	<ul style="list-style-type: none"><li>Permeable paving</li></ul>		<ul style="list-style-type: none"><li>Reduce peak flows and enhance water quality treatment</li><li>Dual use of landscape</li><li>Prevents ponding</li><li>Can be used for high density developments</li></ul>	<ul style="list-style-type: none"><li>Not compatible with large sediment loads</li><li>Low traffic volume areas only</li><li>Maintenance to minimise silt clogging</li></ul>	Medium	High	<ul style="list-style-type: none"><li>Developers</li><li>Carmarthenshire County Council</li><li></li></ul>	<ul style="list-style-type: none"><li>None</li></ul>	<ul style="list-style-type: none"><li>Developer led for new developments</li></ul>
	<ul style="list-style-type: none"><li>Green roofs</li></ul>		<ul style="list-style-type: none"><li>Reduce peak flows and enhance water quality treatment</li><li>Reduce storm water overloading in combined systems and CSO spillages</li><li>Mimic predevelopment state of hydraulics and hydrology</li><li>Can be applied in high density developments</li><li>Can be retrofitted (reliant on-site specifics)</li><li>No additional land take</li><li>Can provide a return on investment from energy savings and public use if accessible</li></ul>	<ul style="list-style-type: none"><li>Cost (compared to conventional roof)</li><li>Not appropriate for steep roofs</li><li>Opportunities for retrofitting may be limited by roof structure (strength, pitch etc)</li><li>Maintenance of roof vegetation</li><li>Limited impact on P removal as they mainly receive unpolluted roof drainage</li><li>Any subsequent damage to waterproof membrane likely to be more critical since water is encouraged to remain on the roof</li></ul>	Medium	Medium	<ul style="list-style-type: none"><li>Developers</li><li>Carmarthenshire County Council</li><li>Dwr Cymru Welsh Water</li></ul>	<ul style="list-style-type: none"><li>Biodiversity</li><li>Thermal attenuation</li><li>Climate resilience</li><li>Water efficiency</li><li>Noise attenuation</li><li>Air quality improvements</li><li>Amenity</li><li>Visual</li><li>Increase life span of roofs</li><li>Health and wellbeing if accessible</li></ul>	<ul style="list-style-type: none"><li>Developer led for new developments will help deliver BNG</li><li>Business Improvement Districts for retrofits</li></ul>
Swales	<ul style="list-style-type: none"><li>Shallow, broad and vegetated channels designed to store and/or convey runoff and remove pollutants.</li></ul>		<ul style="list-style-type: none"><li>Easy to incorporate into landscaping</li><li>Good removal of urban pollutants</li><li>Reduces runoff rates and volumes</li><li>Low capital cost</li><li>Maintenance can be incorporated into general landscape management</li><li>Pollution and blockages are visible and easily dealt with</li></ul>	<ul style="list-style-type: none"><li>Not suitable for steep areas or areas with roadside parking</li><li>Limits opportunities to use trees for landscaping</li><li>Risks of blockages in connecting pipe work</li></ul>	Medium	Medium	<ul style="list-style-type: none"><li>Developers</li><li>Carmarthenshire County Council</li><li>Local Highways Agencies</li><li>The Welsh Government</li><li>National Surface Water Management and SuDS Group</li><li>Dwr Cymru Welsh Water</li><li>Wales Green Infrastructure Forum</li></ul>	<ul style="list-style-type: none"><li>Biodiversity</li><li>Amenity</li><li>Visually appealing</li><li>Passive cooling</li></ul>	<ul style="list-style-type: none"><li>Living Streets Cymru</li><li>Active Travel and Safe Routes in Communities (SRiC) schemes</li></ul>
Conveyance channels	<ul style="list-style-type: none"><li>Channels and Rills are open surface water channels with hard edges that can be planted with vegetation</li></ul>		<ul style="list-style-type: none"><li>Effective in water &amp; pollution treatment</li><li>Can act as pre-treatment to remove silt before water is conveyed into further SuDS features</li><li>Easy to construct</li></ul>	<ul style="list-style-type: none"><li>Incorrect planting can cause silt build up</li><li>Need to give careful consideration to crossings</li></ul>	Medium	Medium (design dependant)		<ul style="list-style-type: none"><li>Biodiversity</li><li>Amenity</li><li>Visually appealing</li><li>Passive cooling</li></ul>	<ul style="list-style-type: none"><li>Living Streets Cymru</li><li>Active Travel and Safe Routes in Communities (SRiC) schemes</li></ul>
Filtration	<ul style="list-style-type: none"><li>Filter strips which are gently sloping areas of grass including street trees that water flows over, can include geocellular structures</li></ul>		<ul style="list-style-type: none"><li>Well suited to implementation adjacent to large impervious areas with heavy trafficking</li><li>Encourages evaporation and can promote infiltration and interception</li><li>Easy to construct and low construction cost</li><li>Effective pre-treatment option</li></ul>	<ul style="list-style-type: none"><li>Not suitable for steep sites</li><li>Not suitable for draining hotspot runoff or for locations where risk of groundwater contamination, unless infiltration is prevented</li><li>No significant attenuation or reduction of extreme event flows</li></ul>	Medium	Medium		<ul style="list-style-type: none"><li>Biodiversity</li><li>Amenity</li><li>Visually appealing</li><li>Health and wellbeing</li><li>Can encourage active transport</li></ul>	<ul style="list-style-type: none"><li>Living Streets Cymru</li><li>Active Travel and Safe Routes in Communities (SRiC) schemes</li></ul>

Intervention	Description		Advantages	Disadvantages	Feasibility (including cost and capacity)	Effectiveness	Delivery Partners	Other benefits	Potential funding opportunities
	<ul style="list-style-type: none"> <li>Bioretention shallow landscaped areas with engineered soils, enhanced vegetation and filtration, which can also include trees</li> </ul>		<ul style="list-style-type: none"> <li>Very effective in removing urban pollutants</li> <li>Can reduce volume and rate of runoff</li> <li>Flexible layout to fit into landscape</li> <li>Well-suited for installation in highly impervious areas</li> <li>Good retrofit capability</li> </ul>	<ul style="list-style-type: none"> <li>Requires landscaping and management</li> <li>Susceptible to clogging if surrounding landscape is not managed</li> </ul> <p>Not suitable for areas with steep slope</p>	Medium	High	<ul style="list-style-type: none"> <li>Developers</li> <li>Carmarthenshire County Council</li> <li>Local Highways Agencies</li> <li>The Welsh Government</li> <li>National Surface Water Management and SuDS Group</li> <li>Dwr Cymru Welsh Water</li> <li>Wales Green Infrastructure Forum</li> </ul>	<ul style="list-style-type: none"> <li>Biodiversity</li> <li>Amenity</li> <li>Visually appealing</li> </ul>	<ul style="list-style-type: none"> <li>Developer led for new developments will help deliver BNG</li> <li>Welsh Water</li> </ul>
<b>Infiltration</b>	<ul style="list-style-type: none"> <li>Rain gardens</li> <li>Infiltration trenches and basins</li> <li>Soakaways</li> </ul>		<ul style="list-style-type: none"> <li>Rain gardens – small and easy to retrofit. minimal land take, easy to maintain, flexible layout to fit into landscape, can be installed in impervious areas if designed correctly</li> <li>Can reduce rate of run off and some volume reduction</li> <li></li> </ul>	<ul style="list-style-type: none"> <li>Rain gardens - As they are often small, their impact can be limited</li> <li>Requires landscaping and management</li> <li>Susceptible to clogging if surrounding landscape is not managed</li> </ul> <p>Not suitable for areas with steep slopes or impermeable soils</p>	Medium	Medium		<ul style="list-style-type: none"> <li>Biodiversity</li> <li>Amenity</li> <li>Visually appealing</li> </ul>	<ul style="list-style-type: none"> <li>Developer led for new developments will help deliver BNG</li> </ul>
<b>Retention</b>	<ul style="list-style-type: none"> <li>Retention ponds</li> </ul>		<ul style="list-style-type: none"> <li>Can cater for all storms</li> <li>Good removal capability of urban pollutants</li> <li>Can be used where groundwater is vulnerable, if lined</li> </ul>	<ul style="list-style-type: none"> <li>No reduction in runoff volume</li> <li>Anaerobic conditions can occur without regular inflow</li> <li>Land take may limit use in high density sites</li> <li>May not be suitable for steep sites, due to requirement for high embankments</li> <li>Colonisation by invasive species could increase maintenance</li> <li>Perceived health &amp; safety risks may result in fencing and isolation of the pond</li> </ul>	Medium	High		<ul style="list-style-type: none"> <li>Biodiversity</li> <li>Thermal attenuation</li> <li>Climate resilience</li> <li>Amenity</li> <li>Visually appealing</li> <li>Recreation</li> </ul>	<ul style="list-style-type: none"> <li>Developer led for new developments will help deliver BNG</li> </ul>
<b>Detention</b>	<ul style="list-style-type: none"> <li>Detention basins, shallow vegetated areas which retain water at times</li> </ul>		<ul style="list-style-type: none"> <li>Can cater for a wide range of rainfall events</li> <li>Can be used where groundwater is vulnerable, if lined.</li> <li>Simple to design and construct</li> <li>Potential for dual land use</li> <li>Easy to maintain</li> <li>Safe and visible capture of accidental spillages.</li> </ul>	<ul style="list-style-type: none"> <li>Little reduction in runoff volume</li> <li>Detention depths may be constrained by system inlet and outlet levels</li> </ul>	Medium	Medium		<ul style="list-style-type: none"> <li>Biodiversity</li> <li>Amenity</li> <li>Visually appealing</li> <li>Health and wellbeing can double up as play and recreation areas</li> </ul>	<ul style="list-style-type: none"> <li>Developer led for new developments will help deliver BNG</li> </ul>
<b>Constructed Wetlands</b>	<ul style="list-style-type: none"> <li>Wetland Creation designed and maintained specifically for maximising P reduction from both storm and foul water discharges.</li> <li>Can provide for tertiary treatment after effective primary and secondary foul treatment processes</li> </ul>		<ul style="list-style-type: none"> <li>Good removal capability for pollutants</li> <li>Can trap large volumes of sediments</li> <li>If lined, can be used where groundwater is vulnerable</li> <li>Large wider environmental benefits</li> </ul>	<ul style="list-style-type: none"> <li>Land take is high</li> <li>Requires maintaining sufficient baseflows in dry periods</li> <li>Limited depth range for flow attenuation</li> <li>May release nutrients during non-growing season, which must be mitigated by good design and maintenance</li> <li>Little reduction in runoff volume</li> <li>Less effective for steep sites and will require significant earthworks</li> <li>Colonisation by invasive species could increase maintenance</li> <li>Performance vulnerable to high sediment inflows.</li> <li>P will be bound in sludge which may require disposal and will require extra pre-treatment with solar drying and well managed biosolid spreading to satisfy crop need</li> </ul>	Medium	High	<ul style="list-style-type: none"> <li>Developers</li> <li>Carmarthenshire County Council</li> <li>Welsh Rivers Trust</li> <li>Dwr Cymru Welsh Water</li> <li>NFU Cymru</li> <li>Local Nature Partnership for North East Wales</li> <li>United Utilities</li> </ul>	<ul style="list-style-type: none"> <li>Biodiversity</li> <li>Thermal attenuation</li> <li>Climate resilience</li> <li>Amenity</li> <li>Visually appealing</li> <li>Recreation</li> </ul>	<ul style="list-style-type: none"> <li>Developer led for new developments will help deliver BNG</li> <li>Welsh Water</li> <li>Welsh Government</li> <li>Heritage Lottery Fund</li> </ul>
<b>Integrated Buffer Zones and/or Tree Planting</b>	<ul style="list-style-type: none"> <li>Grassland including floodplain grassland</li> <li>Beetle banks</li> <li>Woodland</li> <li>Hedgerows</li> </ul>		<ul style="list-style-type: none"> <li>Good capability for capture of pollutants</li> <li>Large wider environmental benefits</li> </ul>	<ul style="list-style-type: none"> <li>Reduced productive area under agriculture may release nutrients during non-growing season</li> </ul>	Medium	High	<ul style="list-style-type: none"> <li>Developers</li> <li>Carmarthenshire County Council</li> <li>Welsh Rivers Trust</li> <li>Dwr Cymru Welsh Water</li> <li>NFU Cymru</li> <li>Cities for Trees</li> <li>Local Nature Partnership Carmarthenshire</li> <li>United Utilities</li> <li>Salmon and Trout Conservation'</li> </ul>	<ul style="list-style-type: none"> <li>Biodiversity</li> <li>Climate resilience</li> <li>Air quality</li> <li>Health and Wellbeing</li> <li>Educational</li> <li>Pest control</li> <li>Biodiversity</li> <li>Noise attenuation</li> <li>Air quality</li> <li>Amenity</li> <li>Visual</li> <li>Health and wellbeing</li> </ul>	<ul style="list-style-type: none"> <li>Developer led for new developments will help deliver BNG</li> <li>Section 106</li> <li>Welsh Water</li> <li>Welsh Government</li> <li>Glastir Small Grant Scheme</li> <li>Heritage Lottery Fund</li> <li>Woodlands for Wales</li> <li>Wales and West Utilities</li> <li>British Gas</li> </ul>
<b>Private Sewerage Drainage Fields</b>	<ul style="list-style-type: none"> <li>Network of discharge pipes from Septic Tank or Package Treatment Plant laid in trenches under the ground surface so that effluent can be discharged to the ground</li> <li>Effluent percolates through soil.</li> </ul>		<ul style="list-style-type: none"> <li>Likely to be less costly than a wetland system with less maintenance for same P removal performance.</li> <li>Can be delivered up to medium spatial scale (&lt;100 units / &lt;2.0 ha)</li> </ul>	<ul style="list-style-type: none"> <li>Longevity of scheme anticipated to be low (10-20 years). Increased usage of the drainage field with time can result in the soils or filter materials sorption capacity being reached.</li> <li>Fields where ground water flood risk is high or water table is within 2.0 m of ground surface are unsuitable.</li> <li>Provides no additional environmental benefits</li> </ul>	Medium	High	<ul style="list-style-type: none"> <li>Developers</li> <li>Dwr Cymru Welsh Water</li> <li>NFU Cymru</li> <li>Carmarthenshire County Council</li> </ul>	<ul style="list-style-type: none"> <li>Efficiency and increased capacity at WwTW</li> </ul>	<ul style="list-style-type: none"> <li>Developer led for new developments</li> <li>Dwr Cymru Welsh Water</li> </ul>

Intervention	Description		Advantages	Disadvantages	Feasibility (including cost and capacity)	Effectiveness	Delivery Partners	Other benefits	Potential funding opportunities
	Sediment bound P is immobilised and soluble P is bound to soils and sediments								
<b>River Channel Re-naturalisation</b>	<ul style="list-style-type: none"> <li>Re-meandering</li> <li>Creating berms</li> <li>Pool-riffle systems</li> <li>Riparian planting</li> <li>Reconnecting channel to floodplain</li> </ul>		<ul style="list-style-type: none"> <li>Good capability for capture of pollutants</li> <li>Large wider environmental benefits</li> </ul>	<ul style="list-style-type: none"> <li>Currently no industry standard regarding the design of larger scale river and floodplain re-naturalisation schemes to support the achievement of nutrient removal</li> <li>Baseline and longer-term monitoring will be required prior to and following the implementation of a scheme in order to determine how much P the scheme is removing</li> <li>P sorption to sediments is primary process of nutrient removal however process is reversible with desorption occurring if P concentration of water drops below a threshold. Threshold is dynamic as the sorption capacity of sediments changes over time.</li> </ul>	Medium	Medium (variable – dependant on design)	<ul style="list-style-type: none"> <li>Carmarthenshire County Council</li> <li>NRW</li> <li>Welsh Rivers Trust</li> <li>Salmon and Trout Conservation'</li> <li>Land owners / land managers</li> </ul>	<ul style="list-style-type: none"> <li>Natural Flood Management</li> <li>Biodiversity</li> <li>Amenity</li> <li>Carbon sequestration</li> <li>Additional pollutant removal</li> <li>Health and well being</li> <li>Air quality</li> <li>Climate resilience</li> </ul>	<ul style="list-style-type: none"> <li>NRW</li> <li>Welsh Government</li> <li>Heritage Lottery Fund</li> </ul>
<b>Drainage Ditch Blocking</b>	<ul style="list-style-type: none"> <li>Placing of barriers across ditches to slow flow, increase residence times and prevent downstream transport of sediments.</li> </ul>		<ul style="list-style-type: none"> <li>Easy to construct</li> <li>Low construction cost</li> <li>Low maintenance</li> </ul>	<ul style="list-style-type: none"> <li>Low predictability / certainty of success, and low removal performance</li> <li>Lack of UK based evidence for effectiveness; baseline and long term monitoring is recommended pre-and post implementation</li> <li>May result in localised flooding during heavy rainfall events.</li> </ul>	Medium	Low	<ul style="list-style-type: none"> <li>Land owners / land managers</li> <li>NRW</li> <li>Carmarthenshire County Council</li> <li>NFU Cymru</li> </ul>	<ul style="list-style-type: none"> <li>Natural Flood Management</li> <li>Biodiversity enhancement</li> <li>Additional pollutant removal</li> </ul>	<ul style="list-style-type: none"> <li>NRW</li> <li>Welsh Government</li> <li>Heritage Lottery Fund</li> <li>Welsh Government Farm Business Grant</li> </ul>
<b>Engineered log jams</b>	<ul style="list-style-type: none"> <li>Leaky dams made of woody debris constructed to mimic beaver dams and slow flows and re-naturalise river reaches.</li> </ul>		<ul style="list-style-type: none"> <li>P removal achieved through sedimentation, chemicals sorption and biomass assimilation.</li> <li>Well-designed schemes will require little maintenance and could last up to 50 years or more.</li> <li>Could serve up to 100 units</li> </ul>	<ul style="list-style-type: none"> <li>Risk being washed away in flood events – best suited to small watercourses &lt; 2 m wide</li> <li>Lack of research for engineered logjams / beaver dams to confirm potential nutrient removal estimates; monitoring will be required pre/post scheme introduction to determine effectiveness.</li> <li>Potential for increased localised flooding</li> </ul>	Medium	Medium	<ul style="list-style-type: none"> <li>Carmarthenshire County Council</li> <li>NRW</li> <li>Welsh Rivers Trust</li> <li>Salmon and Trout Conservation'</li> <li>Land owners / land managers</li> </ul>	<ul style="list-style-type: none"> <li>Natural Flood Management</li> <li>Biodiversity enhancement</li> <li>Carbon sequestration</li> <li>Additional pollutant removal</li> </ul>	<ul style="list-style-type: none"> <li>NRW</li> <li>Welsh Government</li> <li>Heritage Lottery Fund</li> <li>Welsh Government Farm Business Grant</li> </ul>
<b>Terrestrial Sediment Traps</b>	<ul style="list-style-type: none"> <li>Barriers made of geotextiles or other permeable materials that allow water through but trap sediment.</li> <li>Temporary detention ponds</li> </ul>		<ul style="list-style-type: none"> <li>Combats diffuse pollution downstream of areas at greater risk of soil erosion / sediment mobilisation i.e. steep slopes, exposed soils, arable farmland</li> <li>Potential lifespan up to 50 years</li> <li>Can be constructed cheaply and can be temporary or permanent</li> <li>Can be used in conjunction with detention basins</li> </ul>	<ul style="list-style-type: none"> <li>Can become blocked and sediment accumulation will affect storage capacity and performance upstream over time.</li> <li>Rural sediment traps / detention ponds require less maintenance than urban but will require visual monitoring to assess sediment accumulation rates (unless intended to be buried though this will not provide Nutrient Neutrality in perpetuity).</li> </ul>	Medium	Low	<ul style="list-style-type: none"> <li>Land owners / land managers</li> <li>Carmarthenshire County Council</li> <li>NFU Cymru</li> </ul>	<ul style="list-style-type: none"> <li>Additional pollutant removal</li> </ul>	<ul style="list-style-type: none"> <li>Welsh Government Farm Business Grant</li> </ul>

## Appendix E

### DCWW and NRW Consultation

**Subject:** FW: Request for Information

**Sensitivity:** Confidential

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**From:** Environmental Information Requests <[EnvironmentalInformationRequests@dwrcymru.com](mailto:EnvironmentalInformationRequests@dwrcymru.com)>

**Sent:** 25 October 2022 14:26

**To:** Gunasekara, Renuka <[renuka.gunasekara@arcadis.com](mailto:renuka.gunasekara@arcadis.com)>

**Subject:** Request for Information

**Sensitivity:** Confidential

Our Reference: EIR/1284/2022

Dear Sirs,

### **Request for Information**

We write further to your request for information dated 27<sup>th</sup> of September 2022, which we have been considering under the Environmental Information Regulations 2004.

Please find below your questions alongside our responses:

**1. Can DCWW confirm the amendment clarified compliance conditions for Dry Weather Flow (including the requirement for MCERT flow monitoring) for these impacted WwTWs?**

The amendment involved the deletion of all current conditions specifying numeric limit for Dry Weather Flow, the rate of discharge, the volume of the discharge and flow measurement and substitution with the following conditions:

- (1) The Dry Weather Flow of the discharge shall not exceed [x] cubic metres per day. The consented Dry Weather Flow limit is set at the Consent Holder's planned annual 80%-exceeded flow.  
  
Note For [x] in each consent, insert the numeric Dry Weather Flow limit for that discharge as shown in the current consent.
- (2) In determining compliance with this consent, the measured Dry Weather Flow is that total daily volume that is exceeded by 90% of the recorded measured total daily volume values in any period of 12 months.
- (3) The numeric value of the measured Dry Weather Flow shall not exceed the numeric value of the consented Dry Weather Flow limit.

If the measured Dry Weather Flow exceeds the consented Dry Weather Flow limit, then the Consent Holder shall as soon as is practicable investigate the reasons for the exceedance. The Consent Holder shall report the reasons for the exceedance to the Environment Agency and the steps that it proposes to take to restore compliance. An exceedance of the Dry Weather Flow limit shall not be recorded as a failure if the Consent Holder takes appropriate steps to restore compliance.

If the measured Dry Weather Flow exceeds the consented Dry Weather limit because of unusual rainfall during a 12-month period, then it will not be recorded as a failure of the Dry Weather Flow limit. For the purposes of this condition, unusual rainfall shall mean rainfall that causes significantly higher sewage flows during the three-month period that normally records the lowest flows.

For unusual rainfall to be considered, the Consent Holder shall notify the Agency and provide supporting evidence as part of the normal specified data returns.



- (4) A continuous flow measurement and recording system that complies with the MCERTS Flow Monitoring Scheme, shall be provided and operated to record the total daily volume of sewage through the treatment works.

The flow system shall also measure and record either the instantaneous flow at least every 15 minutes or the 15-minute averaged flow every 15 minutes. The Consent Holder shall provide and operate an on-site visual display from which the Environment Agency can readily obtain the instantaneous or 15-minute averaged flow readings.

The Consent Holder shall hold records of the total daily volume and the 15-minute flow readings.

- (5) As soon as reasonably practicable after installation of the flow system and before the expiry of any certificate issues, the Consent Holder shall employ an independent expert to certify that the flow system complies with the MCERTS Flow Monitoring scheme.

The Consent Holder shall immediately on issue provide a copy of the MCERTS certificate to the Environment Agency and shall provide a copy of the independent expert's report to the Environment Agency on request.

The Consent Holder shall ensure that the flow system is always subject to a current MCERTS certificate.

- 2. I have noted that the current DWF at Pentrecwrt WwTW has also exceeded the consented flow (by 20.33 m<sup>3</sup>/day). Are you in the process of resolving Pentrecwrt WwTW with NRW? What is the expected timescale for having a resolution to all three impacted WwTWs (Pont-ar gothi & Nantgaredig WwTW, Pencader WwTW and Pentrecwrt WwTW) and will this include accommodating the extra DWF from the currently proposed Carmarthenshire rLDP growth as well? Are you expecting any significant WwTW process treatment capacity issues related to these three WwTWs or other WwTWs in our original list (reference EIR/1172/2022) to accommodate Carmarthenshire rLDP?**

Please see below the response for the three exceedances highlighted. All works to resolve these exceedances should be delivered by 31<sup>st</sup> December 2023.

Please note, the below works aim to restore the flow rate to a state where they achieve the current DWF permit limit. The resolutions may provide some headroom within the permit but the extent of this isn't currently quantified:

- a. Pentrecwrt has been reported to Natural Resources Wales (NRW) as a DWF compliance exceedance from 2019 onwards. Programme progress updates are provided through relevant regulatory meetings. Root cause investigation work was completed and confirmed groundwater infiltration was entering the sewerage network resulting in increased treated total daily volume. A scheme to resolve this is provisionally scheduled to be delivered during 2022 to complete network rehabilitation work to remove this groundwater ingress and resolve the compliance risk. The target removal is ~0.4 litres per second infiltration to restore compliance.
- b. Nantgaredig was reported to NRW as an exceedance for the 2017 calendar year. Root cause investigations completed have confirmed river ingress into the sewerage network upstream of the treatment works. Budget is assigned to resolve this during 2023. Due to the location of the inflow, the scheme will require extensive over-pumping and temporary works to enable rehabilitation works to be completed. The target removal is between 0.8 and 3.9 l/s to achieve permit compliance (2020/2021 measured Q80 differ considerably).
- c. Pencader was reported to NRW as an exceedance for 2021. Investigation into reason for non-compliance confirmed that recirculation flow from the final tanks were being double counted through the MCERTS monitor. To resolve this there are plans to install an additional flow meter on the return pipework to deduct this flow from the total daily volume measurement. This work will be delivered during 2023. The 2020 measured Q90 was 412 m<sup>3</sup>/d. This figure would leave 0.2 l/s headroom in the current permit.

All 3 STW have adequate biological capacity to accommodate the extra organic loading from the proposed developments and meet the current sanitary permit limits. The extra flow will not affect the works as they will continue to operate within their current permit flow limits until such time that the DWF or FPF are reviewed and if

this happens it will drive investment through a quality scheme that will upgrade the works accordingly. This is why they were approved at LDP stage.

**3. Can you confirm that none of the WwTWs (reference EIR/1172/2022) currently have an effective Total Phosphorus limit in their permit? What is the current timeline for SAGIS model calibration and determining the full permitted load scenario for all the impacted WwTWs in our Carmarthenshire catchment?**

None of the three assets (Pont-ar gothi & Nantgaredig WwTW, Pencader WwTW and Pentrecwrt WwTW) have a Total Phosphorus limit in their permit.

DCWW has prepared the SAGIS modelling which has been submitted to NRW for the failing SAC rivers. The modelling exercises are now going through an assurance process with NRW, and it is DCWW understanding that this will then be followed by a "Review of Permit" exercise across each river, that will conclude in spring next year.

We hope that this response is clear. Should you have any questions, you can contact us at [EnvironmentalInformationRequests@dwrcymru.com](mailto:EnvironmentalInformationRequests@dwrcymru.com).

If you are dissatisfied with the handling of your request, you have the right to ask for an internal review. Internal review requests should be submitted within 40 working days of the date of receipt of this response and should be addressed to Company Secretary, Dŵr Cymru Welsh Water Linea, Fortran Road, St. Mellons, Cardiff, Wales, CF3 0LT.

If you are not content with the outcome of the internal review, you have the right to apply directly to the Information Commissioner for a decision.

Yours faithfully

**Dŵr Cymru Welsh Water**

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Dŵr Cymru Welsh Water is firmly committed to water conservation and promoting water efficiency. Please log on to our website [www.dwrcymru.com/waterefficiency](http://www.dwrcymru.com/waterefficiency) to find out how you can become water wise. Mae Dwr Cymru Welsh Water wedi ymrwymo i warchod adnoddau dwr a hyrwyddo defnydd dwr effeithiol. Mae cyngor i' ch helpu i ddefnyddio dwr yn ddoeth yn [www.dwrcymru.com/waterefficiency](http://www.dwrcymru.com/waterefficiency)

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## Blount-Powell, Elliot

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**From:** Environmental Information Requests  
<EnvironmentalInformationRequests@dwrcymru.com>  
**Sent:** 23 September 2022 10:32  
**To:** Blount-Powell, Elliot  
**Cc:** Lloyd, Jon; Gunasekara, Renuka; gpearce-taylor  
**Subject:** RE: Carmarthenshire Phosphate Study - Data Request

**Follow Up Flag:** Follow up  
**Flag Status:** Flagged

Our Reference: EIR/1263/2022

Dear Blount-Powell

### Request for information

We write further to your request for information dated 5<sup>th</sup> September 2022, which we have been considering under the Environmental Information Regulations 2004.

We have set below your questions followed by our response. For reference we have removed question 4 regarding the GIS Maps as our colleague has already provided you with this information.

- 1) For the information provided by DCWW on the WwTW, in the Consent Dry Weather Flow column, there is an asterisk against some of the values without explanation, what does it mean?

The values with an asterisk against them had a Modification to their permits applied in 2010 by the regulator (which was the Environment Agency at that time) relating to Dry Weather Flow conditions. The amendment clarified compliance conditions for Dry Weather Flow including the requirement for MCERT flow monitoring.

- 2) In this same table, the Pont-ar gothi & Nantgaredig and Pencader WwTW are listed as discharging above their consented DWF, is this correct?

Nantgaredig and Pencader are both ongoing DWF exceedances that have been reported to NRW and we are in the process of resolving. Both are due to river ingress/network infiltration.

- 3) As part of our calculations, we are using Ricardo's Carmarthenshire Nutrient Budget Calculator. This calculator suggests that all WwTWs within Carmarthenshire have a P permit of 8 mg TP/litre, however, information provided by DCWW would suggest that current performance (inc. the last 12 months) is often lower. Can we confirm the current permitting position with DCWW as this has significant bearing on the nutrient budget calculations?

The SAGIS model is calibrated using actual effluent concentration for sites where we have been sampling for phosphorus and 5 mg/l in the absence of data.

Once the model is calibrated, the full permitted load scenario is carried out. For this scenario, effluent concentrations are set at their actual permit limit. In the absence of permit limit, 5 mg/l is assumed.

- 5) The WwTWs Lampeter and Adpar are outside of Carmarthenshire CC boundary, but happen to be the nearest WwTWs for several sites within the LDP. Please can you confirm if in theory it is possible to make a connection to these WwTW's? We can provide site specifics if required. As per item 3, can you also confirm the Permitting position for these two WwTW.

Both Adpar WwTW and Lampeter WWTWs are on the northern Ceredigion side of the Afon Teifi. However, in both instances the WwTW catchment/public sewerage network extends to the southern Carmarthenshire side of the river, serving the settlements of Newcastle Emlyn and Cwmann respectively. As such, there are no issues in theory in providing a public sewerage network connection to any proposed allocated sites within the Carmarthenshire settlements of Newcastle Emlyn and Cwmann.

Regarding the Permitting positions, both works have an effective permit but neither have a Total Phosphorus limit in their permit. Therefore, although we have provided performance data for P, regulatory sampling or reporting P is not currently a requirement of the permit.

We hope that this response is clear. Should you have any questions, please contact us by email at [EnvironmentalInformationRequests@dwr-cymru.com](mailto:EnvironmentalInformationRequests@dwr-cymru.com)

If you are dissatisfied with the handling of your request, you have the right to ask for an internal review. Internal review requests should be submitted within 40 working days of the date of receipt of this response and should be addressed to Company Secretary, Dwr Cymru Welsh Water Linea, Fortran Road, St. Mellons, Cardiff, Wales, CF3 0LT.

If you are not content with the outcome of the internal review, you have the right to apply directly to the Information Commissioner for a decision.

Yours faithfully

**Dŵr Cymru Welsh Water**

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**From:** Blount-Powell, Elliot <elliot.blountpowell@arcadis.com>

**Sent:** 05 September 2022 17:26

**To:** Environmental Information Requests <EnvironmentalInformationRequests@dwrcymru.com>

**Cc:** Lloyd, Jon <Jon.Lloyd@arcadis.com>; Gunasekara, Renuka <renuka.gunasekara@arcadis.com>; gpearce-taylor <gpearce-taylor@cararthenshire.gov.uk>

**Subject:** Carmarthenshire Phosphate Study - Data Request

\*\*\*\*\* External Mail \*\*\*\*\*

Dear DCWW,

We have been commissioned by Carmarthenshire County Council (CCC) to undertake a review of their HRA and feed into the consolidated LDP that CCC planners are currently working on. Part of this work involves the calculation of Phosphorus budgets for the catchments and identifying mitigation opportunities which will eventually feed into Nutrient Management Plans.

We understand that DCWW recently responded to an information request (reference **EIR/1172/2022**) which is attached for reference. We have several follow up queries which we would appreciate DCWWs assistance with, noted below:

- 1) For the information provided by DCWW on the WwTW, in the Consent Dry Weather Flow column, there is an asterisk against some of the values without explanation, what does it mean?
- 2) In this same table, the Pont-ar gothi & Nantgaredig and Pencader WwTW are listed as discharging above their consented DWF, is this correct?
- 3) As part of our calculations, we are using Ricardo's Carmarthenshire Nutrient Budget Calculator. This calculator suggests that all WwTWs within Carmarthenshire have a P permit of 8 mg TP/litre, however, information provided by DCWW would suggest that current performance (inc. the last 12 months) is often lower. Can we confirm the current permitting position with DCWW as this has significant bearing on the nutrient budget calculations?
- 4) GIS layers showing drainage catchment boundaries were requested as part of the EIR/1172/2022 request but instead we received PDF figures showing the WwTW site boundaries. Could we please receive this following information in GIS format (.shp files)
  - a. DCWW owned land assets
  - b. DCWW WwTW info – e.g. locations, final discharge points, drainage catchment boundaries
- 5) The WwTWs Lampeter and Adpar are outside of Carmarthenshire CC boundary, but happen to be the nearest WwTWs for several sites within the LDP. Please can you confirm if in theory it is possible to make a connection to these WwTW's? We can provide site specifics if required. As per item 3, can you also confirm the Permitting position for these two WwTW.

Thanks,  
Elliot

**Elliot Blount-Powell** BSc (Hons), GradCIWEM  
Assistant Engineer, Flood Risk and Hydrology  
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Blount-Powell, Elliot

To: Blount-Powell, Elliot  
Subject: RE: Carmarthenshire Phosphate Study - Data Request

From: Blount-Powell, Elliot <elliott.blountpowell@arcadis.com>  
Sent: 10 November 2022 10:49  
To: Blount-Powell, Elliot <elliott.blountpowell@arcadis.com>  
Subject: RE: Carmarthenshire Phosphate Study - Data Request

From: Environmental Information Requests <[EnvironmentalInformationRequests@dwrcymru.com](mailto:EnvironmentalInformationRequests@dwrcymru.com)>  
Sent: 11 July 2022 08:51  
To: Gail Pearce-Taylor <[GPearce-Taylor@carmarthenshire.gov.uk](mailto:GPearce-Taylor@carmarthenshire.gov.uk)>  
Cc: Ryan Norman <[Ryan.Norman@dwrcymru.com](mailto:Ryan.Norman@dwrcymru.com)>  
Subject: Carmarthenshire Phosphate Study - Data Request

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**Rhybudd:** E-bost allanol yw hwn ac nid oedd yn tarddu o'r Cyngor. Byddwch yn ofalus wrth glicio dolenni neu atodiadau agoriadol. Pan fyddwch yn ansicr, defnyddiwch y botwm 'Report Message'.

Our Reference: EIR/1172/2022

Dear Ms Pearce-Taylor,

Request for information

We write further to your request for information dated 10<sup>th</sup> June 2022, which we have been considering under the Environmental Information Regulations 2004.

Please find attached 16 copies of the GIS layers as requested. The land that is owned by DCWW is hatched in red.

We have also completed the table provided below:

WwTW	Asset ID	WwTW NGR Coordinate	Served Population Equivalent	Final Discharge Point NGR	Receiving Watercourse Name	Current Consent – P Permit limit (mg/l)	Planned AMP 7/8 P Permit Limit (if applicable/known)	Consented Dry Weather Flow (m3/day)	Current Dry Weather Flow (Q90 m3/day) – 2021 (1/1/21 to 31/12/21)	Current P performance - last 12 months (mg/l)	Current P performance - 2022 (mg/l)
Cwrt Henri	50597	SN5541522823	155.0	SN5565022700	Afon Dulas	N/A	None	40.4	18.8676	No Data	No Data
Pont-ar gothi & Nantgaredig	50716	SN5034321422	597.5	SN5044621217	Afon Cothi	N/A	None	171*	511.3368	1.2	1.3
Adpar	50533	SN3046441042	1799.3	SN3049640814	Afon Teifi	N/A	None	535*	465.0354	4.8	1.7
Llanybydder Llanybyther	50692	SN5165043154	1750.7	SN5172443265	River Teifi	N/A	None	1019*	706.2633	2.0	2.2
Pencader	50736	SN4449236504	1135.9	SN4630037000	Glwydeth	N/A	None	439*	506.9806263	1.6	1.5
Drefach/Felindre	50604	SN3516139758	2042.0	SN3533640291	Afon Teifi	N/A	None	N/A	806.2839	1.6	1.4
Pentrecwrt	50741	SN6323002791	301.3	SN3888039110	Afon Teifi	N/A	None	56*	76.32504	3.5	3.1



Lampeter	50647	SN3890539094	3669.3	SN5763047340	River Teifi	N/A	None	1201*	1149.696	2.9	1.5
Capel Iwan	50563	SN5756547557	192.8	SN2930036100	Afon Mamog	N/A	None	82*	24.44346	2.7	2.1
Llanfihangel-ar-arth	50664	SN2935736125	241.3	SN4520038900	Trib of Afon Twelly	N/A	None	N/A	20.1996	No Data	No Data
Llandysul	50660	SN4551439993	1534.3	SN4191040290	River Teifi	N/A	None	689*	326.484	2.2	2.7
Llandovery	50659	SN4193640183	1942.1	SN7613033180	Afon Bran	N/A	None	705*	499.1121	2.6	3.2
Ffairfach	50613	SN7616833144	2840.6	SN6164121126	River Towy	N/A	None	847	545.4027	3.0	3.0
Llangadog	50667	SN6174421109	1243.9	SN6989028140	River Sawdde	N/A	None	427*	229.0032	1.9	2.4
Talley	50787	SN7004228005	232.9	SN6405031782	Nant Ddu	N/A	None	128*	63.02142	No Data	No Data
Cwrt Henri	50597	SN6407231835	155.0	SN5565022700	Afon Dulas	N/A	None	40.4	18.8676	No Data	No Data

We hope that this response is clear. Should you have any questions, please contact us by email at [EnvironmentalInformationRequests@dwrcymru.com](mailto:EnvironmentalInformationRequests@dwrcymru.com)

If you are dissatisfied with the handling of your request, you have the right to ask for an internal review. Internal review requests should be submitted within 40 working days of the date of receipt of this response and should be addressed to Company Secretary, Dwr Cymru Welsh Water Linea, Fortran Road, St. Mellons, Cardiff, Wales, CF3 0LT.

If you are not content with the outcome of the internal review, you have the right to apply directly to the Information Commissioner for a decision.

Yours faithfully

Dŵr Cymru Welsh Water

**From:** Gail Pearce-Taylor <[GPearce-Taylor@carmarthenshire.gov.uk](mailto:GPearce-Taylor@carmarthenshire.gov.uk)>  
**Sent:** 10 June 2022 15:43  
**To:** Owain George <[Owain.George@dwrcymru.com](mailto:Owain.George@dwrcymru.com)>; Ryan Norman <[Ryan.Norman@dwrcymru.com](mailto:Ryan.Norman@dwrcymru.com)>  
**Cc:** Ian R Llewelyn <[IRLlewelyn@carmarthenshire.gov.uk](mailto:IRLlewelyn@carmarthenshire.gov.uk)>  
**Subject:** FW: Carmarthenshire Phosphate Study - Data Request

\*\*\*\*\* External Mail \*\*\*\*\*

Hello both,

Hope that you're well.

We have engaged consultants to undertake a review of our HRA, and feed into the consolidated LDP that our planners are currently working on. As part of this work they will be calculating phosphorus budgets for the catchments and identifying mitigation opportunities. This work will of course also feed into Nutrient Management Plans.

As part of the work, they have requested the following information.

Would you be able to provide DCWW datasets and information please?

GIS Layers for the following:

- DCWW owned land assets
- DCWW WwTW info – e.g. locations, final discharge points, drainage catchment boundaries

WwTW	Asset ID	WwTW NGR Coordinate	Served Population Equivalent	Final Discharge Point NGR	Receiving Watercourse Name	Current Consent – P Permit limit (mg/l)	<i>Planned AMP 7/8 P Permit Limit (if applicable/known)</i>	Consented Dry Weather Flow (m3/day)	Current Dry Weather Flow (Q90 m3/day) – 2021 (1/1/21 to 31/12/21)	Current P performance - last 12 months (mg/l)	Current P performance - 2022 (mg/l)
Cwrt Henri											
Nantgaredig											
Adpar											
Llanybydder											
Pencader											
Drefach/Felindre											
Pentrecwrt											
Lampeter											
Capel Iwan											
Llanfihangel-ar- arth											
Llandysul											
Pencader											
Llandovery											
Ffairfach											
Llangadog											
Talley											
Cwrt Henri											
Cwm Ifor											
Ffairfach											

Many thanks,

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\*\*\*\*\*

## Blount-Powell, Elliot

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**From:** Carpenter, Gideon <Gideon.Carpenter@cyfoethnaturiolcymru.gov.uk>  
**Sent:** 20 October 2022 11:29  
**To:** Blount-Powell, Elliot  
**Cc:** SAC Rivers Enquiries / Ymholiadau Afonydd ACA  
**Subject:** RE: Carmarthenshire Phosphate Study - Data Request (NRW)

Good morning Elliot

It's fine to contact me direct. We also have a SAC Rivers project email address which is [SACriversenquiries@cyfoethnaturiolcymru.gov.uk](mailto:SACriversenquiries@cyfoethnaturiolcymru.gov.uk). I would advise sending/copying any email enquiry to this inbox as other members of staff will have access to it if I am not available.

Regarding your enquiry it is good to hear about the work you are undertaking for Carmarthenshire. You are correct in your understanding that a 5 mg/l TP has been used as a default/backstop P limit for WWTWs in the current SAGIS modelling. The 'backstop' P limit has been used for those sites where chemical dosing or other works improvements to reduce P in effluent are either not present or unlikely to be included in the next AMP cycle – these being the smaller works. Many works currently have no P limit conditioned on the permit and the permit review is likely to lead to this backstop limit being included.

It is an appropriate assumption to use the 5 mg/l value where P stripping improvements are not planned or likely to be planned. Note that the modelling process/QA for the Tywi and Teifi is not yet complete and there may be some variation around the backstop limit on a site by site basis (less than 5 mg/l not greater). Of course until the modelling is complete we won't know for sure so your assumption remains valid but having scope to make amendments will be useful.

Kind regards

Gideon

---

**From:** Blount-Powell, Elliot <elliot.blountpowell@arcadis.com>  
**Sent:** 19 October 2022 18:25  
**To:** Carpenter, Gideon <Gideon.Carpenter@cyfoethnaturiolcymru.gov.uk>  
**Subject:** FW: Carmarthenshire Phosphate Study - Data Request (NRW)

Hi Gideon,

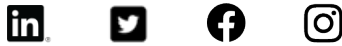
Hope you are well.

Gail Pearce Taylor from Carmarthenshire County Council passed on your contact details. Please see the email below for context.

We sent this email to the general NRW information team a while ago but as you are someone who is involved in providing NRW advice to planning authorities for phosphorus sensitive SAC, are you able to provide any thoughts or feedback on the approach below?

Many thanks,  
Elliot

**Elliot Blount-Powell** BSc (Hons), GradCIWEM  
Assistant Engineer, Flood Risk and Hydrology  
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**From:** Blount-Powell, Elliot

**Sent:** 05 October 2022 17:07

**To:** [accesstoinformationteam@naturalresourceswales.gov.uk](mailto:accesstoinformationteam@naturalresourceswales.gov.uk)

**Cc:** Lloyd, Jon <[Jon.Lloyd@arcadis.com](mailto:Jon.Lloyd@arcadis.com)>; Gunasekara, Renuka <[renuka.gunasekara@arcadis.com](mailto:renuka.gunasekara@arcadis.com)>

**Subject:** Carmarthenshire Phosphate Study - Data Request (NRW)

Dear NRW,

Arcadis has been commissioned by Carmarthenshire County Council (CCC) to prepare an interim nutrient management action plan. The action plan is intended to demonstrate how the council can bring forward sites within their revised Local Development Plan (rLDP) whilst securing nutrient neutrality.

At the present stage, Arcadis has undertaken nutrient budget calculations for the development sites within the two SACs impacted by nutrient neutrality (Afon Twyi and Afon Teifi), thus confirming the scale of Phosphorus mitigation required. To calculate these budgets, we have used the CCC / RICARDO Nutrient Budget Calculator and supporting guidance. During the development of these calculations, it was noted that all the Wastewater Treatment Works (WwTW) within Carmarthenshire have been assigned a P permit level of 8 mg/l. Further consultation on this has revealed that the value of 8 mg/l has been used in the absence of a P permit and selected at a higher than typical value in line with the precautionary principal. We have consulted DCWW on this issue and note that permits are due to be revisited between NRW and DCWW in the coming months, following review and agreement of the source apportionment studies. However, it was also established during this consultation that a) existing 12-month performance at the WwTW is comfortably below the 8 mg/l assumption (and always below 5 mg/l), and b) that in the source apportionment studies, DCWW have assumed a P Permit value of 5 mg/l.

As such, we have advised CCC that their calculator should be revisited for the purposes of developing the interim action plan. We have suggested that assuming a P Permit of 5 mg/l would be suitable in this instance, and whilst it would need to be kept under review as the Permit positions are agreed between NRW and DCWW, is likely to represent a worst-case scenario for most WwTW in the catchment.

As we have alluded to, we are producing an interim action plan at this stage, owing to the fact that issues such as the permitting position within Carmarthenshire remains to be confirmed. We will be outlining mitigation opportunities within the catchment in the coming weeks and working iteratively as details emerge / are confirmed. We hope to share these plans with NRW as they develop and receive comments and feedback in due course. At this stage, we wanted to highlight our current position, and the assumptions we are currently working to. We would welcome at this stage any initial thoughts from NRW.

Many thanks,

Elliot

**Elliot Blount-Powell** BSc (Hons), GradCIWEM  
Assistant Engineer, Flood Risk and Hydrology  
2 Glass Wharf, Temple Quay, Bristol | BS2 0FR | United Kingdom  
M +44 (0)7341 034498



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## Appendix F

### Afon Teifi Phosphorus Loading Overview



Legend

NRW Phosphorus Compliance Assesment

Pass

< 10

10-20

Could Not Be Assessed

Other

Areas Not Covered By NRW Phosphorus Compliance Assessment

Main River

Urban Area

Legend

Load (kg/day)

0 - 1

1 - 5

5 - 10

10 - 100

Sewage Treatment Works

Rural Land Use

Storm Overflows

Other

The map displays the Afon Teifi catchment area, divided into sub-catchments. Each sub-catchment is color-coded based on its phosphorus load assessment: green for 'Pass', yellow for '< 10', orange for '10-20', and grey for 'Could Not Be Assessed'. Pie charts are placed at various points along the river, representing the relative contribution of different phosphorus sources: blue for Sewage Treatment Works (STW), orange for Rural Land Use, grey for Storm Overflows, and yellow for Other. The map also shows urban areas in grey and main rivers in blue. A scale bar indicates 10 Kilometers. A north arrow is located in the bottom left corner.

Afon Teifi

Phosphorus Load Overview

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Teifi Total Load (kg/day)

3%

1%

30%

66%

% STW

% Rural Land Use

% Storm Overflows

% Other



## Appendix G

### Category 2 Measures – Strategic Collaboration Opportunities

#### Welsh Government

The Welsh Government also have numerous schemes and guidance to reduce the level of nutrients at source including considerable guidance on SuDS design<sup>75</sup>. These measures have considerable potential to reduce impacts at source. The Welsh Government would likely be a key NMB member there are significant opportunities to strategically direct this funding towards P reductions across the Dee.

Welsh Government has dedicated £1.5 million to help farmers improve water quality and £11.5m of capital funding will be used to directly support farm businesses to improve nutrient management infrastructure<sup>76</sup>.

- **Sustainable Farming Scheme (2025)**<sup>77</sup> - Development of scheme is ongoing. Payments are expected to be made for sustainable farming practices. Potential payment options will be presented in the consultation on the final Scheme in 2023.
- **The Farm Business Grant (FBG)**<sup>78</sup> – Yard Coverings, is a Capital grant scheme available to farmers in Wales. In 2021 the minimum application was for £1000 the maximum of £12,000. For 2023 the application window opens 26 June until 4 August 2023. The aims of the scheme are:
  - To support improvements in on-farm nutrient management
  - To improve existing on-farm infrastructure through the separation of rain/clean water from dirty water, animal slurry, animal manure or silage effluent
  - To support separation of rainwater and slurry from existing livestock feeding areas, livestock gathering areas, manure storage areas, slurry stores and silage stores.
- **The Sustainable Production Grant**<sup>79</sup> - The grant scheme (£12,000 – £50,000) offers 40% funding for covered slurry storage and management equipment.
- **The Woodland Investment Grant (TWIG)**<sup>80</sup> Scheme is open to applications from landowners and those with full management control of land. The scheme provides grants to enhance and expand existing woodlands and create new woodlands in accordance with the UK Forestry Standard, which have the potential to become part of the National Forest in the future. This means woodlands that are well-managed, accessible to people and give local communities the opportunity to get involved.
  - The grant provides 100% funding.
  - The maximum grant award per application is up to £250,000 and the minimum is £10,000.
  - The capital budget for the latest window is £2.5 million, plus revenue budget of £250k.

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<sup>75</sup> <https://gov.wales/sites/default/files/publications/2019-06/statutory-guidance.pdf>

<sup>76</sup> <https://gov.wales/nearly-ps10m-help-improve-water-quality-wales>

<sup>77</sup> Sustainable Farming Scheme: outline proposals for 2025 | GOV.WALES [Accessed 05/01/23]

<sup>78</sup> Farm Business Grant | Sub-topic | GOV.WALES

<sup>79</sup> <https://gov.wales/sustainable-production-grant>

<sup>80</sup> <https://gov.wales/national-forest-wales-woodland-investment-grant-rules-booklet-html>

As the maximum water quality benefits are derived from woodland buffers over 15m this scheme has significant potential to deliver highly functioning Integrated Buffer Zones.

The Welsh government has allocated over £5m to a series of projects across 2020-2021, working with partner organisations to improve water quality across Wales, including:

- **Nature Recovery Action Plan** (£1.115m) – NRW will work with partners including Afonydd Cymru on measures for salmon and trout in Welsh waterways to restore fish habitat and improve breeding distribution;
- **Glastir Small Grant Scheme** (£1.5m) – match funding for a specific grant focusing on improving water quality farms within our strategic catchment area have a good chance of being selected for tree, shrub and hedge planting and pond creation<sup>81</sup>; while the current application window is closed this has been a very successful grant and it is likely that this will reopen or be replaced by another Sustainable Farming Scheme grant.
- **Natural Flood Management Programme** (£1m) – contribution to a dedicated scheme at catchment level combined with water quality improvement measures, to achieve both reduction in flood risk and improving water quality;
- **Research & Development (R&D) Projects** (£1m) – the project will develop effective innovative solutions to minimise the long-term impact of metal mine water discharges, improve the ecological status of Welsh rivers and support a healthy farming industry. This includes innovative projects such as Coleg Sir Gar's Gelli Aur Sustainable Farming Centre (See Box G.1). Similar, opportunities for undertaking new R&D projects (e.g. monitoring the efficacy of P reduction measures or identifying innovative Category 1 and Category 2 delivery approaches) could also be explored.

#### **Box G.1: Gelli Aur Sustainable Farming Centre**

The Gelli Aur Sustainable Farming Centre aims to become a knowledge centre for the farming community, developing alternative systems for water and slurry management suitable for on farm use. The project will be led by Coleg Sir Gar in collaboration with NRW, Welsh Water, AHDB, Farming Connect, the farming unions and Power & Water, a Swansea based company specialising in electrochemical-based water treatments. This new project will innovatively reduce farm waste and help safeguard the environment and address the agricultural industry's impact on the environment by developing a dewatering and purification system to manage slurry on farms. With the intensification of the dairy industry, slurry management is becoming an increasing issue for farmers and the environment.

The project will apply innovative and proven concept technology to reduce air and water pollution to reduce the overall volume of slurry by up to 80%. A de-watering and purification system is used to filter slurry, transforming the water to a suitable quality for recycling or discharging to a clean watercourse. The system will also utilise nutrients from the slurry to produce good quality fertiliser. The aim is to significantly reduce the risk of air and water pollution at the same time as maximising the recycling nutrient value. This development process will considerably reduce storage of slurry on farms as well as handling costs. Efficiently extracting nutrients from manures could save on the cost of commercial fertilisers and reduce serious environmental impact. <http://www.slurryprojectwales.co.uk/index.php/en/>

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<sup>81</sup> <https://gov.wales/sites/default/files/publications/2020-08/glastir-small-grants-water-maps-showing-likelihood-of-selection.pdf>

The Welsh government has developed detailed guidance for farmers and land managers<sup>82</sup> to support the implementation of the requirements of The Water Resources (Control of Agricultural Pollution) (Wales) Regulations 2021 which have been introduced to reduce losses of pollutants from agriculture to the environment by setting rules for certain farming practices. While they are targeted at nitrogen, the Regulations also set standards for silage making, storage of silage effluent and for slurry storage systems which will have a regulatory effect on P. It has a staged roll out from 2021 to 2024 that could significantly reduce P at source.

- Requirements from 1 April 2021:
  - Storage of silage;
  - Notifying NRW of the construction of any new substantially enlarged or reconstructed silo or slurry storage system;
  - Controlling the spreading of nitrogen fertiliser at high-risk times and high risk areas;
  - Incorporating organic manures into bare soil or stubble; and
  - Closed periods for spreading manufactured nitrogen fertiliser.
- Requirements from 1 January 2023:
  - Risk Maps;
  - Storage of organic manure;
  - Temporary field sites;
  - The individual hectare limit for the spreading of organic manure;
  - Import/Export of manure;
  - Nutrient Management Planning (NMP) and recording; and
  - Nutrient applications restricted to crop limits.
- Requirements from 30 April 2023:
  - Holding nitrogen limit 'the 170 limit'
- Requirements from 1 August 2024
  - Closed periods for spreading nitrogen fertiliser (includes slurry and other organic manures);
  - Storage capacity for Slurry; and
  - The storage period.

## Local Planning Authorities

As previously highlighted in Section 7.1, the opportunistic retrofitting SuDS nibbling approach in urban and peri-urban areas can reduce flooding and pollution and deliver a wider positive impact. Therefore, a SuDS opportunity area plan in each LPA area, which identifies potential suitable locations would increase the uptake for nature-based solutions. There are also opportunities to combine the wetland and Integrated Buffer Zones encompassing nature-based solutions, with delivery of Biodiversity Net Gain via the following LPA led schemes. There are a suite of guidance and strategies from the LPAs that would contribute:

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<sup>82</sup> [https://www.gov.wales/sites/default/files/publications/2023-01/water-resources-control-of-agricultural-pollution-wales-regulations-2021-guidance-for-farmers-and-landmanagers\\_0.pdf](https://www.gov.wales/sites/default/files/publications/2023-01/water-resources-control-of-agricultural-pollution-wales-regulations-2021-guidance-for-farmers-and-landmanagers_0.pdf)

- **Carmarthenshire Nature Partnership<sup>83</sup>** involves organisations including the Council, government, and non-government wildlife bodies, wildlife charities and voluntary groups. focuses on action that seeks to maintain and enhance biodiversity within Carmarthenshire either through the management of land, or action to help specific species.
- **Carmarthenshire Revised Local Development Plan (LDP) 2018 - 2033: Green Infrastructure assessment (2020)<sup>84</sup>** supports the emerging LDP and provides an assessment of the green infrastructure across Carmarthenshire.
- **Carmarthenshire pre application SuDS planning advice<sup>85</sup>** outlines the requirements provided by Welsh Government for the sole purpose of submitting information to the SuDS Approving Body (SAB) in accordance with the legislation detailed in the planning advice document and other relevant items of primary and subordinate legislation.
- **The North Wales Flood Risk Management Group (NWFRMG) North Wales SuDS Guide (2021).** The guide provides a comprehensive single source of reference for developers, designers, planners, and prospective owners by clearly setting out the expectations, requirements and processes involved with SuDS approval and adoption across the North Wales region.
- **Carmarthenshire Fisherman's Federation (CFF)<sup>86</sup>** represents the interests of angling clubs and fishery owners of Carmarthenshire. They piloted a scheme in 2018 called 'Adopt a Tributary', which then commenced in 2019. This community-led project is ongoing and aims to protect the tributaries of the Afon Tywi in Carmarthenshire.

## NRW

NRW has a suite of projects and plans and works in partnership to deliver P reductions across the Afon Teifi and Afon Tywi SACs. Examples include:

- **Taclo'r Tywi Initiative<sup>87</sup>** aims to engage with all interested parties and through this partnership approach have a practical plan for the future management of the Afon Tywi. The initiative aims to promote:
  - Better water quality
  - Better biodiversity
  - Less non-native invasive plant species such as Himalayan Balsam
  - Natural flood management
  - More support for farmers and agriculture
  - Better protection for local wildlife
  - Lower rates of soil erosion
  - Increased fish numbers
  - More efficient nutrient management systems
- **Four Rivers for LIFE<sup>88</sup>** is a large-scale river restoration project to improve the condition of four major rivers in Wales: Teifi, Cleddau, Tywi and Usk. The project will use long term nature-based solutions to improve the ecological quality of the four rivers such as, improving accessibility for migratory fish, improving habitat structure and function, and improving water quality. The European

<sup>83</sup> [Carmarthenshire Nature Partnership \(gov.wales\)](#) [Accessed 05/01/23]

<sup>84</sup> [green-infrastructure-assessment-jan-2020.pdf \(gov.wales\)](#) [Accessed 05/01/23]

<sup>85</sup> [Sustainable Drainage Approval Body \(SAB\) \(gov.wales\)](#) [Accessed 05/01/23]

<sup>86</sup> [Carmarthenshire Fishermen's Federation | Facebook](#) [Accessed 05/01/23]

<sup>87</sup> [Natural Resources Wales / Taclo'r Tywi - About the project](#) [Accessed 05/01/23]

<sup>88</sup> [Natural Resources Wales / Four Rivers for LIFE](#) [Accessed 05/01/23]

Union has committed to restore 25,000km of rivers by 2030, in total this project will improve 776km of river, thereby contributing 2% of this total.

- Working with partner organisations, farmers, landowners, local communities and contractors the project targets that would support phosphate removal include their aims to:
  - Revise the core management plans for the 4 SAC rivers to ensure a sustainable future for Natura 2000 habitats and species;
  - Manage riparian and catchment land use to reduce nutrients, plastic and sediment entering the 4 rivers, thereby improving the quality of at least 160 km of river, benefiting all target habitats and species;
  - Re-naturalise rivers and restore natural processes – boulder, woody material and gravel re-introduction. Re-meandering, and floodplain reconnection along 5km of river and restoration of freshwater and wetland habitats on 136 hectares of floodplain.
  - Planting 50,000 native trees (supplied by the Woodland Trust) along river banks to create habitat, increase shading and establish buffer strips with 100km of fencing, with associated water quality and bank stability benefits.
  - Improve land management practices – reducing nutrients and sediment inputs from agricultural land by working with farmers and landowners to promote best practice farming techniques with the aim of engaging 350 farms.
  - Habitat improvement over 15km for the critically endangered Freshwater Pearl Mussel that are highly sensitive to water quality.
- **Salmon and sea trout plan of action for Wales 2020:** areas for action is an NRW led plan to improve salmonid populations, the following elements support improvements in water quality:
  - Tackling Physical habitat constraints in the freshwater environment via Fish Habitat Restoration Plans
  - Safeguarding water quality and quantity

**NRW Water Quality Improvement Projects (£802,000)** – NRW will work with partners on 15 smaller scale projects to tackle areas affected by increased levels of pollutants, such as phosphorus and improve marine biodiversity; and

NRW are also working with a large number of groups and forums that work directly for improved water quality:

- **Wales Land Management Forum** agriculture sub group is tasked with undertaking root cause analysis to achieve a common understanding of the causes of agricultural pollution and the ways in which these are currently addressed through the investigation, agreement, reporting and delivery on potential solutions, taking an integrated approach, working across organisations. Their main areas of focus are:
  - A robust regulatory regime
  - Developing a voluntary, farmer-led approach to nutrient management
  - Ensuring better advice and guidance is provided and can be taken up by farmers
  - Improving the range of investment opportunities
  - Identifying and promoting innovation

- **Wales Water Management Forum** purpose is to provide an opportunity for membership organisations to share evidence and explore opportunities for working together collaboratively towards the sustainable management of water in Wales.
- **Wales Fisheries Forum** represents a range of stakeholders with an interest in the freshwater and diadromous fisheries resources of Wales and the work of NRW and others to maintain, improve and develop migratory and freshwater fisheries in Wales.
- **National Surface Water Management and SuDS Group Members**<sup>89</sup> objectives are:
  - To provide a source of expertise in the field of surface water management;
  - Encourage collaborative working and identify where benefits can be maximised;
  - To ensure that environmental protection and eco-systems services are at the heart of delivery;
  - To support LLFAs in the implementation of SuDS and in the development of Flood Risk Management Plans;
  - Provide advice and signpost stakeholders to support the development of the relevant skills and expertise to manage surface water and construct SuDS;
  - To provide advice and expertise to Welsh Government when requested in order to support the development of emerging policy;
  - To develop a resource base for stakeholders and the public to inform them of best practice in relation to managing surface water and the use of SuDS;
  - To encourage the reuse of water where possible; and
  - To promote a better understanding of SuDS and Water Sensitive Urban Design, including the social, economic and environmental benefits that can be derived.
- Key documents

There are a number of key documents that capture key stakeholders and measures surrounding improvement on the Afon Tywi and Afon Teifi:

- Conservation Objectives for the SAC<sup>90</sup>;
- Teifi and North Ceredigion Management Catchment<sup>91</sup>
- The updated Compliance Assessment of Welsh SACs against Phosphorus targets<sup>92</sup>

## Rivers Trust of Wales (Welsh Rivers Trust) Afonydd Cymru

The Rivers Trust of Wales, Afonydd Cymru<sup>93</sup>, formed in 2008 as an umbrella organisation to represent member Rivers Trusts across Wales, they represent the regional Rivers Trusts with NRW and Welsh Government and they champion Wales' thirty-three rivers, and the many lakes and smaller watercourses. Their aims are to:

- Restore all Welsh rivers to good ecological status

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<sup>89</sup> <https://www.sudswales.com/about/working-group-members/>

<sup>90</sup> CONSERVATION OBJECTIVES FOR N2K SITES ([afonyddcymru.org](http://afonyddcymru.org))

<sup>91</sup> Teifi and North Ceredigion Management Catchment ([naturalresources.wales](http://naturalresources.wales))

<sup>92</sup> [compliance-assessment-of-welsh-sacs-against-phosphorus-targets-final-v10.pdf](https://www.naturalresources.wales/compliance-assessment-of-welsh-sacs-against-phosphorus-targets-final-v10.pdf) ([cyfoethnaturiol.cymru](http://cyfoethnaturiol.cymru))

<sup>93</sup> <http://afonyddcymru.org/>

- Build an expanded and more effective Rivers Trust movement in Wales with a long-term, sustainable funding base
- Eliminate the current high levels of water pollution
- Influence relevant legislation, policy and practice and challenge to protect and enhance Wales' freshwater environment
- Gain greater public awareness of rivers and the work of the Rivers Trust movement

They have a number of projects working with partners and directly with farmers across a number of catchments in West Wales:

- **River Restoration Project** running a nationwide Fisheries Habitat Restoration Project. Working with NRW, regional Rivers Trusts, and dedicated volunteers to carry out surveys of certain river catchments. An extensive report is generated from each catchment survey, including analysis of existing data, which highlight all fisheries habitat improvement opportunities:
  - Barriers to migration / Habitat fragmentation (weirs, trash dams, perched culverts),
  - Riparian management opportunities (fencing, tree planting, soil management, invasive weeds, erosion, stock access / poaching, rubbish, revetment), etc.

This information feeds into a GIS database and a document detailing the key survey results and proposals for restoration. The generated reports, GIS data and collected survey information are informing future fisheries habitat restoration works nationwide and will be valuable for opportunity mapping and success monitoring.

They have a nutrient and soil management project that has skills, lessons learned and partnerships that could be applied to Carmarthenshire, this is the:

- **AC DC: The Nutrient and Soil Management Project**, West Wales which seeks to improve water quality by offering advice and financial support to farmers. This joint project with Welsh Water and has been modelled on the successful work by the farm team of the Wye and Usk Foundation, bringing together pragmatic and cost-effective actions to achieve improvements to water quality. Farm advisers visit farms and aim to advise on workable solutions and possibly offer grant funding (subject to availability) and support for any of the following:
  - fencing and alternative water for stock - to improve stock management & reduce the risk of stock exposure to waterborne diseases by improving the bank stability & water quality.
  - manage run off from yards - how to reduce the risk of yard run off via drainage improvements including manure, slurry and pesticide management.
  - run off risk maps - assess organic matter, soil structure and nutrient levels, helping to maintain good sward health & reduce waterlogging.

## The West Wales Rivers Trust<sup>94</sup>

The West Wales Rivers Trust was formed in 2017 with the aim of restoring and safeguarding the rivers, lakes and wetlands of Pembrokeshire, Carmarthenshire and Ceredigion. The objectives of the Trust are to:

- Promote awareness of environmental issues and best practice
- Promote recreational enjoyment of rivers, lakes and wetlands
- Undertake research and development to help restore damaged habitats

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<sup>94</sup> [West Wales Rivers Trust | Restoring the Wildlife Habitats of Rivers, Lakes & Wetlands](#) [Accessed 05/01/23]



### Box G.2: Case Study: West Wales Water Quality Improvement Project 2019

The West Wales Water Quality Improvement Project aimed to addressing diffuse pollution from agriculture into the North Western Cleddau and the Ceri Brook, by creating a working methodology to tackle this. This was a partnership project between Afonydd Cymru and DCWW. The start-up and delivery were co-ordinated by the Wye & Usk Foundation (WUF), West Wales Rivers Trust (WWRT) have provided local knowledge and additional funding has been provided by NRW to support capital works. The project worked with farmers and landowners to identify priority areas and create recommendations for improvement. The three central aims of this project were as follows:

- Establish an advisory function within Wales to engage land managers;
- Reduce losses of slurry, manure and sediment which are currently impacting on water body status;
- Reduce the impact of diffuse pollution and costs in DCWW assets including a reduction in faecal coliforms and suspended solids.

This ACDC project was the first example of a River Trust 1:1 advisory project in West Wales. Farmer engagement was extremely positive as noted by the feedback provided from the farmers about the knowledge and practical ability of Catchment Advisors. Where appropriate, grant support was offered to remedy issues having a direct impact on water quality. Additional investment was signposted to WG Small Grant Scheme and WG Sustainable Production Grant. The project will have removed 4.6 tonnes of Phosphate annually. The cost for the grant for this was £23,280 with the farmers themselves contributing an equal amount. Despite the initial concerns from farmers about the costs of investment in large scale storage and infrastructure, the owners saw benefits to their farms and water quality by making these changes.

## Delivery Risks and Mitigation

As has been presented there is an enormous amount of funding, guidance, delivery partners, existing projects and plans that affect the Afon Teifi and Afon Tywi. The key is to engage the appropriate parties and direct them towards the most effective interventions. The Case Study in Box G.3 overleaf presents the potential difficulties in implementing strategic approaches and recommends policies to address them. Table G-1 below also presents the key risks to delivery and suggested mitigation for the required wider P reductions.

Table G-1 Delivery Risk Summaries and Mitigation

Risk	Mitigation
Too many stakeholders	<ul style="list-style-type: none"><li>• NMB will facilitate and co-ordinate delivery of measures across multiple stakeholders with clear roles and responsibilities, actions, targets and monitoring within the finalised Action Plan.</li></ul>
Lack of evidence re P removal capacity of nature-based solutions	<ul style="list-style-type: none"><li>• Monitoring of each feature is unlikely to be practical, a number of selected interventions could be monitored and consolidated monitoring of failing stretches of watercourses should be undertaken. As a live document there should be a continued review of efficiencies of nature-based solutions and the IAP should be reviewed and updated, as required.</li><li>• Collaboration with additional delivery partners is likely to be required, for example, universities and colleges, laboratories etc. to collate, analyse, assess and report to effectiveness of nature-based solutions at P removal.</li></ul>

Risk	Mitigation
Lack of funding and opportunity uptake from landowners	<ul style="list-style-type: none"> <li>Where appropriate and relevant to NMB members, they could prepare an opportunity pack directed at their stakeholders which pulls together the available funding, support and guidance and directs stakeholder to the technical support that can help with funding applications and delivery advice.</li> </ul>
Failure to implement and maintain	<ul style="list-style-type: none"> <li>Bespoke delivery and management plans will be required for the implementation and maintenance of the finalised Action Plan to ensure that all appropriate parties are consulted so that a bottom up and top-down approach can be delivered, promoting engagement and ownership at all levels. Maintenance of different interventions could be via LPAs, farmers, DCWW or Wildlife Trusts etc. Legally binding maintenance plans would be drawn and monitoring of schemes will be undertaken, as part of the IAP and wider NMB actions. Release of development will be conditional on milestones within detailed Action Plan being met.</li> </ul>

### **Box G.3: A participatory approach for comparing stakeholders' evaluation of P loss mitigation options in a high ecological status river catchment Micha et al 2018**

Fifteen P mitigation options were shortlisted based on agronomic and environmental data from a case-study agricultural catchment and presented to a group of experts and farmers. Results showed significant disparities between perceived effectiveness by farmers and expert groups.

The measures ranked as 1st by each group and by FARMSOPER are:

- **Experts: Avoid fertilizer application in high risk areas**
- **Farmers: Reduce effects of poaching around drinking points/gateways**
- **FARMSOPER: Loosen compacted soils**

Overall, farmers and FARMSOPER agreed on the most and least effective measures, with disparities appearing only for 4 measures (NMP, fertilizer injection, avoid fertilizer application in high risk areas and moving drinking troughs regularly). FARMSOPER did not consider these options as effective as the fertilizers rates were already low, while farmers did not find injection and moving drinking troughs effective probably because of lack of understanding of their P transfer mitigation mechanism (based on interviews with farmers). Experts identified effectiveness at catchment scale, whilst farmers identified field scale effectiveness. In summary, four main policy recommendations arise from the discussion in this study:

- **Design bottom-up participatory tools that accommodate farmers' social and cultural norms;**
- **Approach farmers to seek their participation in policy design rather than expect them to engage in voluntary schemes;**
- **Reinforce links between researchers and advisors to provide the latter with more powerful knowledge transfer tools; and**
- **Enhance the direct interaction between researchers and farmers to achieve two-way exchange of opinions.**

## Effectiveness Testing

The effectiveness of P reduction through the use of woodland planting, habitat restoration, and fencing has been recently investigated by Arcadis in the context of the River Dee SAC in north Wales and could be employed for Carmarthenshire as well.

Defra-developed and supported FARMSCOPER model<sup>95</sup> (FARM Scale Optimisation of Pollutant Emission Reductions) was used to undertake a preliminary assessment of the P reduction extent of some Category 2 measures, as explained in Box G.4 and Box G.5 below. It is acknowledged that there are general limitations of applying FARMSCOPER model in assessing the typical losses of phosphate from different farm types encountered within catchments and to model the reductions in losses due to intervention measures. However, this gives an initial indication and starting point to assess some Category 2 measures.

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<sup>95</sup> <https://adas.co.uk/services/farmscoper/>

#### Box G.4: Woodland planting, habitat restoration and fencing - adjacent to Buckley WwTW

This preliminary assessment investigates the effectiveness of incorporating new woodland planting and habitat restoration areas within Flintshire County Council owned land, adjoining to existing Buckley WwTW. Wat's Dyke also runs through an area of farmland and woodland to the southeast of Buckley WwTW.



Existing site: Overall site area is 15.68ha within Flintshire County Council ownership (pink hatched area), which contains 1.89ha of existing woodland and 13.79ha of unconstrained arable farmland (assumed 95% winter and spring barley with 5% rotational grassland). Flintshire County Council's owned land is shown by the area hatched in pink.

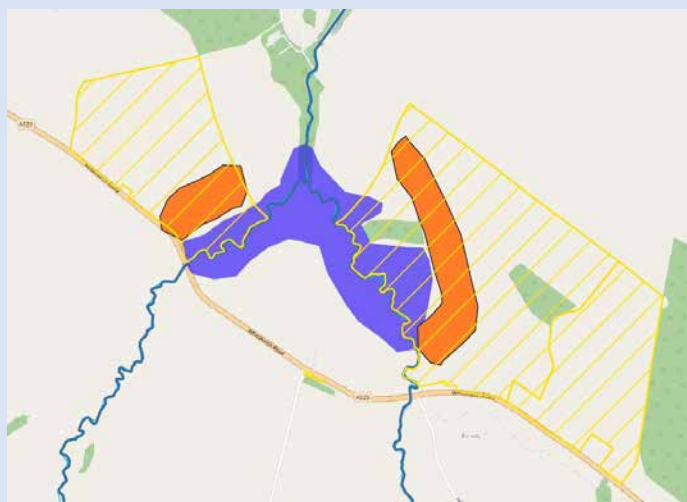
Proposed measures: New onsite woodland planting area of 6.69ha (green), onsite habitat restoration area of 0.56ha (purple) and fencing off the southern portion of the site (orange) between Wat's Dyke and the unnamed watercourse. Proposed measures were assumed to deliver wider benefits (as a Category 2 measure) in this test, but they can be treated as Category 1 measures instead to facilitate the LDP as there are completely within Council's land.

The estimated annual rainfall is between 900 and 1200mm. The FARMSCOPER model was first tested to determine the individual effectiveness of proposed woodland planting, habitat restoration and fencing. This showed that woodland planting, habitat restoration and fencing can reduce the annual P load by 17% (from 11.25kg to 9.33kg), 4.4% (from 11.25kg to 10.76kg), and 2.8% (from 11.25kg to 10.93kg) respectively. The fencing test assumed that only 20% of the site was deemed to be fenced off from the watercourses on site, which would stop any livestock South of Wat's Dyke from accessing the dyke or the unnamed watercourse on the southern boundary of the site. This was because it was considered that animals could still access the watercourse (Wat's Dyke) to the north of the fencing area. The model was then run with all three intervention measures in place simultaneously, which showed that they can reduce the annual P load by 20.2% (from 11.25kg to 8.97kg).

The responsibility for delivery and maintenance of the above measures (whether Category 1 or Category 2) would be by Flintshire County Council, however there is potential for DCWW adoption. There is also opportunity for riparian planting (yellow) outside the Flintshire County Council owned land along the unnamed watercourse, but this measure was not modelled in this test. Since this is outside the Council owned land it should be treated as a Category 2 measure, and the delivery and maintenance responsibility would be discussed in liaison with the current landowners and the delivery potential partners discussed in this strategy. The Woodland Investment Grant, Natural Flood Management programme, or one of the other funding opportunities presented etc. (see para 4.518) could provide potential funding sources to implement these measures. These would be investigated further at scheme feasibility stage.

### Box G.5: Riparian planting integrated buffer zone – Whitchurch Road at Pandy

This case study investigates effectiveness of incorporating new riparian planting as an integrated buffer zone between the proposed wetland area and existing farmland that borders the Emral Brook and an unnamed tributary.



**Existing site:** Overall site area is 61.19ha, which contains 1.31ha of existing woodland and 59.88ha of unconstrained arable farmland (assumed 90% winter and spring barley with 10% rotational grassland). Wrexham County Borough Council's owned land is shown by the area hatched in yellow.

**Proposed measures:** New onsite riparian planting area of 8.42ha (orange) in Wrexham County Borough Council's owned land (hatched in yellow) that will be located outside the wetland opportunity area of 17.1ha (blue).

**Estimated annual rainfall:** Between 900 and 1200mm.

The FARMSCOPER model was tested to determine the effectiveness of riparian planting opportunity area within the Wrexham County Borough Council's owned land. It was assumed that 85% of the site will be intercepted by the riparian planning buffer strips as the remaining 15% of the site will directly drain to the existing watercourses via the wetland opportunity areas. This test showed that riparian planting can reduce the annual P load by 22.1% (from 32.49kg to 25.3kg).

Proposed riparian planting were assumed to deliver wider benefits (as a Category 2 measure) in this test, but they can also be designed as a Category 1 measure to facilitate the LDP as they are completely within Council's land.

The wetland area is not included in FARMSCOPER model in this test as the wetland P removal efficiency has already been discussed in the previous sections and is largely agreed upon. The wetland area is partially within the Council's owned land, which also means P removal benefits derived from this area could be delivered to avoid impacts from new development and reduce P loading burdens for water quality treatment (as a Category 1 measure). This example is presented here for illustration purposes to demonstrate how Category 1 and Category 2 benefits can be potentially drawn through a combined scheme facilitated by Council's landownership. The lead delivery partner for such a combined scheme would be the Councils, with potential for co delivery and adoption by DCWW alternatively to accelerate the process it may be that the Councils' retain ownership including the maintenance responsibility for in perpetuity through suitable legal agreements. Funding could be sought from a range of potential sources, to be presented within the feasibility of any such scheme.

## Summary of Category 2 Opportunities and Effectiveness

Section 4.2 indicated that the Median removal rates for P for wetlands is  $1.2 \text{ g m}^{-2} \text{ year}^{-1}$  with a removal efficiency of 46%. Preliminary analysis demonstrated that other nature based potential Category 2 interventions that involve habitat restorations, tree planting and riparian buffer strips that have a mean P removal efficiency of up to 67%, but further testing across the catchment scale will be required to confirm this.

Reduction of Agricultural P at source and Farming Source Control should also provide high P removal rates although their delivery and long-term maintenance are currently uncertain. There are many funding sources and guidance to support targeted activities.

While locational information on existing works and negotiations are generally subject to confidentiality agreements, bottom-up stakeholder involvement combined with the top-down approach re strategies such as this and subsequent modelling will maximise these opportunities and monitor their effectiveness to support ongoing P removal in the long-term.

