Cyfoeth Naturiol Cymru
Natural Resources Wales

CORE MANAGEMENT PLAN INCLUDING CONSERVATION OBJECTIVES

FOR

Afon Gwyrfai a Llyn Cwellyn Special Area of Conservation

Cyfoeth Naturiol Cymru
Natural Resources Wales

Noddir gan
Lywodraeth Cymru
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Welsh Government

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Version 2	September 2022	Revision of water quality targets for river features, updated formatting, clarification of the relationship between Conservation Objectives and Performance Indicators. Updated Conservation Objectives and Performance Indicators for Feature 1.	Euros Jones
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Preface

This document provides the main elements of Natural Resources Wales' management plan for the site(s) named. It sets out what needs to be achieved on the site(s), and advice on the action required. This document is made available through Natural Resources Wales' web site and may be revised in response to changing circumstances or new information. This is a technical document that supplements summary information on the Natural Resources Wales' web site.

One of the key functions of this document is to provide Natural Resources Wales' statement of the Conservation Objectives for the relevant Special Area of Conservation (SAC) and Special Protection Area (SPA) site(s). This is required to implement the changes through the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 in addition to the existing Conservation of Habitats and Species Regulations 2017. As a matter of Welsh Government Policy, the provisions of those regulations are also to be applied to Ramsar sites in Wales.

Vision for the site

This is a descriptive overview of what needs to be achieved for conservation on the site. It brings together and summarises the Conservation Objectives (part 4) into a single, integrated statement about the site.

The purpose of the designation of SAC and SPA sites is to help secure the maintenance or restoration of habitats and species to favourable conservation status for the foreseeable future. Given that we foresee a changing climate, despite the uncertainty of the nature, degree and timing of those changes, we must address the need to ensure the resilience of each site to that changing environment. This will be achieved in the first instance by ensuring favourable condition of the important features, since a healthy feature is likely to be more resilient to the effects of climate change than one which is already stressed. Secondly, consideration must be given to those structures, functions and processes which maintain or boost the resilience of ecosystems to climate stress, including the avoidance, reduction or mitigation of other stress factors such as invasive species, nutrient enrichment, habitat and population fragmentation.

This site forms part of a wider network, and is ecologically connected with its surroundings and with other designated sites in the region. Although the focus of this document is on the individual site, the conservation objectives and management requirements need to be considered in the wider context. A connected network of sites is more robust than sites in isolation, and more resilient to pressures such as climate change.

Our vision for the Afon Gwyrfai a Llyn Cwellyn SAC is to maintain, or where necessary restore the river and lake to high ecological status, including its largely unmodified and undisturbed physical character, so that all of its special features are able to sustain themselves in the long-term as part of a naturally functioning

ecosystem. The natural processes of erosion and deposition will be allowed to operate without undue interference and the physical river habitat will maintain connectivity as the foundation for this ecosystem. The quality and quantity of water, including natural flow variability, and the quality of adjacent habitats, are maintained or restored to a level necessary to maintain the features in favourable condition for the foreseeable future. In places where natural processes may affect urban infrastructure, artificial control measures may be required.

The aquatic plant communities that characterise parts of the river and lake are not only attractive but also give a good indication of the overall quality of the environment. They contain the variety and abundance of species expected for these water bodies of low nutrient status, in conditions of suitably clean water and bed substrate combined with a relatively stable flow regime, and are an outstanding example of a low-nutrient river and lake system. Locally, there are patches of white-flowered water-crowfoots. In the more shaded reaches, aquatic plants may be scarce, consisting mainly of mosses and liverworts.

The largely unmodified lake will continue to support characteristic plants and fish that are special to this area, including the rare Arctic charr, one of only three natural populations in North Wales. Atlantic salmon, which swim up river to spawn and go through their juvenile stages in the river, are present in numbers that reflect a healthy and sustainable population supported by well-distributed good quality habitat. These migratory fish are able to complete their migrations and life cycles largely unhindered by artificial barriers such as weirs, pollution, or depleted flows.

The abundance of prey and widespread availability of undisturbed resting and breeding sites, allows an otter population to thrive. They are found along the entire length of the river and its main tributaries.

The presence of the Afon Gwyrfai a Llyn Cwellyn SAC and its special wildlife enhances the economic and social values of the area, by providing a high quality environment for local people and visitors. The river catchment’s functions of controlling flooding and supplying clean water are recognised and promoted through appropriate land management. The river is a focus for education to promote increased understanding of its biodiversity and the essential life support functions of its ecosystems.

Site description

Area and Designations Covered by this Plan

Grid reference(s): 53 04 59N 04 10 15W / SH547 561

Unitary authority(ies): Gwynedd

Area (hectares): 114.29

Designations covered: Afon Gwyrfai a Llyn Cwellyn SAC

Afon Gwyrfai a Llyn Cwellyn SSSI

Y Foryd SSSI

The plan in its present form does not specifically address SSSI features.

The most downstream, tidal unit of the SAC is underpinned by a unit of the Foryd SSSI. The remainder of the SAC is underpinned by Afon Gwyrfai a Llyn Cwellyn SSSI.

Maps showing the management units referred to in this plan are on NRW's website and can also be viewed on Welsh Government' interactive website Map Data Cymru.

Outline Description

This site comprises the Afon Gwyrfai and Llyn Cwellyn. The Gwyrfai flows out of Llyn y Gader near Rhyd Ddu and passes through Llyn Cwellyn on its way to the sea at Y Foryd, Caernarfon Bay. It also includes a tributary of the Gwyrfai, the Afon Treweunydd, and the small lake it flows from on the slopes of Snowdon. Sporadically throughout its course, the SAC is abutted by semi-natural wetland riparian habitat much of which is within the SSSI.

Llyn Cwellyn has long been recognised for its conservation importance and is an excellent example of a deep (maximum depth of 37m, average depth of 23m) oligotrophic lake formed during the last Ice Age. Its nutrient–poor waters support a range of typical macrophytes, and one of the best populations of floating water plantain in the UK.

The whole of the Gwyrfai river system is of outstanding ecological quality. The river is particularly noted for its salmon population, for which it is considered to be one of the best supporting rivers in the United Kingdom. It is also notable for its otter population which occur here in good numbers because of the relative naturalness of its riparian habitats and the abundance of undisturbed dense cover. In addition to the lake, the

river supports a discrete community of floating water plantain, and water-crowfoot *Ranunculus spp*, with other associated vegetation including bryophyte assemblages occurring in various sectors of the river.

Outline of Past and Current Management

The relatively low nutrient status of the river and the very clear lake water, reflects the fact that precipitation falls onto a steep sided rock catchment of less than 50km^2. With just 21km of river, water is transported quickly into the glacially deepened Llyn Cwellyn and onto the sea via the Afon Gwyrfai. Under natural conditions the accumulation of nutrients and pollutants are thus unlikely to build up. The main sources of pollution or nutrient enrichment are therefore likely to be anthropogenic in origin, and it is these factors that will need to be managed in the future, to maintain and enhance the scientific features of interest in the SAC.

The upper Gwyrfai flows through Rhyd Ddu and thence into Llyn Cwellyn. From the lake the Afon Gwyrfai passes through the settlements of Betws Garmon, Waenfawr, Bontnewydd and into the Foryd estuary. Associated with this route is a local infrastructure of roads, narrow gauge railway, bridges, revetments and some buildings adjacent to the course of the river. The area is relatively sparsely populated, so pollution of waters and interference with the natural course of the river are not expected to be of major concern. Much of the lake and river are bounded by natural or semi natural habitat. This comprises of broadleaved woodland, marshy grassland and mire, with semi improved land in the lower sections of the river.

A small dam which was completed in 1979, holds back the waters of Llyn Cwellyn, from which water abstraction is permitted. Dŵr Cymru can abstract up to 6.5 million m^3 of water per annum over 60 days in any year at a maximum rate of 20,400 m^3 per day and at 300 l per second. The barrier is not thought to obstruct migration routes of migratory fish species.

Historically, anthropogenic influence upon the upper catchment mainly relates to the occurrence of several disused slate quarries, some afforestation, water abstraction from the partially impounded Llyn Cwellyn, low intensity fishing of the lake and river and relatively low intensity tourism. Reference to county series maps indicates that the upper catchment, above Llyn Cwellyn, was dotted with both active and disused slate quarries in the mid to late 19th century. These are unlikely to have affected water quality, but may have encouraged changes to runoff patterns and river form. Plantation forestry during the same period was limited to areas above Llyn y Gader, thus forested areas above Cwellyn are a relatively new influence upon the landscape. The bulk of Beddgelert Forest, above Llyn Cwellyn and extending along the upper Gwyrfai to Rhyd Ddu was mostly planted between 1943 and 1947, the Glanrafon slate quarry alongside the Afon Treweunydd has since been closed.

The extent of the wooded areas in the lower catchment between Waenfawr and Bontnewydd has remained relatively consistent. Extensive beds of aquatic macrophytes occur from below the lake as far downstream as Bontnewydd.

Diatom analysis suggests that Llyn Cwellyn has suffered from progressive but moderate acidification since the 1860s, with a decline of around 0.8 pH units. From the 1980s to 1995 subtle changes in diatom composition suggest a slight reversal, thought to be caused by a drop in sulphur deposition within the catchment.

Nutrient enrichment and sedimentation from harvesting conifer plantations above the lake could lead to changes in the plant and invertebrate communities which are characteristic of oligotrophic lakes, and an increase of non-target fish species at the detriment of typical species, including the rare fish Arctic Charr.

Similarly, agricultural runoff from fertilisers or lime on nearby fields could have a similar detrimental effect upon the macrophyte vegetation of the Afon Gwyrfai. A large area of riparian habitat is designated as SSSI and maintained alongside the river and will normally provide some buffering. The most likely mechanism for any eutrophication to happen is via seepage into the ditches which ultimately enter the river.

Whilst not seen as a problem currently, woodland should not become so dense that it heavily shades stretches of river or upland streams, especially those which support good macrophyte communities or are important for feeding fish. This needs to be balanced with the requirement to provide good cover for otter throughout the catchment.

Ecological surveys have identified invasive plant species along river banks, with both Japanese Knotweed, *Fallopia japonica,* and Himalayan balsam, *Impatiens glandulifera,* known to be present.

Management Units

The area covered by this plan has been divided into management units to enable practical communication about features, objectives, and management. This will also allow us to differentiate between the different designations where necessary. In this plan the management units have been based on distinctive sections of the river and lake, which can be expected to have characteristic ecological features.

Maps showing the management units referred to in this plan can be viewed on Welsh Government' interactive website Map Data Cymru.

The following table confirms the relationships between the management units and the designations covered:

NRW Internal reference	SAC Management Unit	SSSI	Waterbody IDs within unit
1	1674	Afon Gwyrfai a Llyn Cwellyn	N/A Afon Treweunydd which is not a WFD waterbody.
2	1675	Afon Gwyrfai a Llyn Cwellyn	GB110065054191
3	1676	Afon Gwyrfai a Llyn Cwellyn	GB31034002 (Lake)
4	1677	Afon Gwyrfai a Llyn Cwellyn	GB110065054190
5	1678	Afon Gwyrfai a Llyn Cwellyn	GB110065054190
6	1679	Afon Gwyrfai a Llyn Cwellyn	GB110065054190
7	1680	Afon Gwyrfai a Llyn Cwellyn	GB110065054190
8	1681	Afon Gwyrfai a Llyn Cwellyn	GB110065054190
9	1682	Y Foryd	GB521006501200 (Transitional)

The Features

Confirmation of Features

SAC feature (Annex I habitats and Annex II species)	Primary reason for site selection?	Relationships, nomenclature etc
Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoteo-Nanojuncetea*	Yes	EU Habitat Code: 3130
Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	Yes	EU Habitat Code: 3260
Atlantic salmon *Salmo salar*	Yes	EU Species Code 1106
Floating water-plantain *Luronium natans*	Yes	EU Species Code 1831
European otter *Lutra lutra*	No	EU Species Code 1355

SSSI features are listed in the table below.

Designated Feature	Relationships, nomenclature etc
Open Water, standing oligotrophic	Managed as a SAC feature
Open Water, running	Managed as a SAC feature
Floating water-plantain *Luronium natans*	Managed as a SAC feature
Aquatic plant assemblage	
European otter *Lutra lutra*	Managed as a SAC feature
Artic charr *Salvelinus alpinus*	Managed as a sub-feature of the oligotrophic standing waters SAC feature
Atlantic salmon *Salmo salar*	Managed as a SAC feature
GCR – Mineralogy of Wales	

Features and Management Units

This section sets out the relationship between the designated features and each management unit. This is intended to provide a clear statement about what each unit should be managed for, taking into account the varied needs of the different special features. All features are allocated to one of seven classes in each management unit. These classes are:

Key Features

KH - a 'Key Habitat' in the management unit, i.e. the habitat that is the main driver of management and focus of monitoring effort, perhaps because of the dependence of a key species (see KS below). There will usually only be one Key Habitat in a unit but there can be more, especially with large units.

KS – a 'Key Species' in the management unit, often driving both the selection and management of a Key Habitat.

Geo – an earth science feature that is the main driver of management and focus of monitoring effort in a unit.

Other Features

Sym - habitats, species and earth science features that are of importance in a unit but are not the main drivers of management or focus of monitoring. These features will benefit from management for the key feature(s) identified in the unit. These may be classed as 'Sym' (sympathetic) features because:

(a) they are present in the unit but may be of less conservation importance than the key feature; and/or

(b) they are present in the unit but in small areas/numbers, with the bulk of the feature in other units of the site; and/or

(c) their requirements are broader than and compatible with the management needs of the key feature(s), e.g. a mobile species that uses large parts of the site and surrounding areas: and/or

(d) key features (KH, KS) are closely associated with these features, and the conservation of key features depends on them being managed appropriately.

Nm - an infrequently used category where features are at risk of decline within a unit as a result of meeting the management needs of the key feature(s), i.e. under Negative Management. These cases will usually be compensated for by management elsewhere in the plan, and can be used where minor occurrences of a feature would otherwise lead to apparent conflict with another key feature in a unit.

Mn - Management units that are essential for the management of features elsewhere on a site e.g. livestock over-wintering area included within designation boundaries, buffer zones around water bodies, etc.

x – Features not known to be present in the management unit.

The table(s) below sets out the relationship between the features and management units identified in this plan:

SAC Management Unit	1674	1675	1676	1677	1678	1679	1680	1681	1682
NRW internal reference number	1	2	3	4	5	6	7	8	9
SAC features									
Luronium natans			KS		KS				
Lutra lutra	KS	KS	KS	KS	KS	KS	KS	KS	KS
Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoto-Nanojuncetea*		KH	KH						
Salmo salar	KS	KS	KS	KS	KS	KS	KS	KS	KS
Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation		KH	KH	KH	KH	KH	KH	KH	KH
SSSI features									
Assemblage of Red Data Book and/or Nationally Scarce vascular plants			KS		KS				
Luronium natans			KS		KS				
Lutra lutra	KS	KS	KS	KS	KS	KS	KS	KS	KS
Nitella gracilis	KS		KS						
Running water - Group C rivers-		KH		KH	KH	KH	KH	KH	KH
Salmo salar	KS	KS	KS	KS	KS		KS	KS	KS
Salvelinus alpinus			KS						
Standing water - Oligotrophic-			KH						

Conservation Objectives

Background to Conservation Objectives:

a. Outline of the legal context and purpose of conservation objectives.

Conservation objectives for individual SACs and SPAs are required by the 1992 'Habitats' Directive (92/43/EEC) as implemented through the Conservation of Habitat and Species Regulations 2017 (As amended). The aim of the Habitats Directive is the maintenance, or where appropriate the restoration, of the 'favourable conservation status' (FCS) of habitats and species listed in the Annexes to the Directive (see Box). Therefore FCS provides the overarching framework for defining the conservation objectives for individual SACs.

Although neither the Birds Directive nor the Ramsar Convention refer to FCS, Natural Resources Wales considers that the overall aim of both those legal instruments is sufficiently similar to FCS to make it practical and proportionate to use the same guiding principle when establishing the conservation objectives for SPAs and Ramsar sites, as well as SACs. Therefore the Habitats Directive definition of FCS is considered to provide the overarching framework for conservation objectives for all SACs, SPAs and Ramsar sites in Wales.

Favourable conservation as defined in Articles 1(e) and 1(i) of the Habitats Directive

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

its natural range and areas it covers within that range are stable or increasing, and

the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and

the conservation status of its typical species is favourable.

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

population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and

the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and

there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

The achievement of FCS is not an objective that applies at the level of the individual sites. Rather it is a wider objective to which each individual site contributes. Therefore the conservation objectives for an individual site are intended to express what is considered to be that site's appropriate contribution to achieving FCS. Since SACs are the most important mechanism in the Habitats Directive for achieving FCS, and the sites represent the most important areas for conservation of the Annex I habitat types and Annex II species, the objectives for each individual SAC should seek to ensure that the site makes a substantial contribution which properly reflects its importance in a local, national and European context and the particular reasons why the site was selected for inclusion in the UK National Sites Network of SACs. A similar approach is taken to setting conservation objectives for SPAs and Ramsar sites.

Achieving the conservation objectives of individual sites requires appropriate management and the control of factors which are influencing, or may influence the features.

The conservation objectives have a number of specific roles:

- Communication

The conservation objectives should help convey to stakeholders what are the reasons for the designation and what it is intended to achieve.

- Site planning and management

The conservation objectives guide management of sites, to maintain or restore the designated habitats and species. They provide the basis for identifying what management is required both within the site boundary, and outside it, where achieving the objectives requires action to be taken outside the site.

- River Basin Management Planning

Conservation Objectives for aquatic and water dependent SAC and SPA features are also used as the "standards and objectives" referred to in Article 4 (1c) of the Water Framework Directive (WFD) (2000/60/EC). In 2009, Welsh Ministers decided that where SAC and SPA conservation objectives are more stringent than 'Good Ecological Status' (GES) as defined in the WFD, they (and the standards they contain) are the objectives referred to in Article 4(1c) of the WFD.

- Assessing plans and projects

Article 6(3) of the 'Habitats' Directive requires the assessment of proposed plans and projects in view of a site's conservation objectives. Subject to certain exceptions, plans or projects may not proceed unless it is established that they will not adversely affect the integrity of sites. There are similar requirements for the review of existing decisions and consents. Note that the assessment of plans and projects should be made in view of the entirety of the conservation objectives for the site, including the performance indicators.

- Monitoring and reporting

In addition to foregoing purposes, conservation objectives provide the basis for defining the evidence that will be used for assessing the condition of a feature and the status of factors that affect it. That evidence is contained in a sub-set of conservation objectives called 'performance indicators'. The performance indicators are those conservation objectives which are quantifiable and measurable, and which provide the basis for monitoring and reporting. The performance indicators are set out in an Appendix to this document.

The conservation objectives in this document reflect Natural Resources Wales' current information and understanding of the site and its features and their importance in an international context. The conservation objectives are subject to review by Natural Resources Wales in the light of new knowledge.

b. Format of the conservation objectives

Each conservation objective is a composite statement defining a site-specific aspiration for each designated feature. This composite statement contains clauses that correspond to all the elements of FCS, namely:

For habitat features:

- Extent should be stable in the long term, or where appropriate increasing;
- Quality (including in terms of ecological structure and function) should be being maintained, or where appropriate improving;
- Populations of the habitat's typical species must be being maintained or where appropriate increasing;
- Factors affecting the extent and quality of the habitat and its typical species (and thus affecting the habitat's future prospects) should be under appropriate control.

For species features:

- The size of the population should be stable or increasing, allowing for natural variability, and sustainable in the long term;
- The distribution of the population should be being maintained;
- There should be sufficient habitat, of sufficient quality, to support the population in the long term;
- Factors affecting the population or its habitat should be under appropriate control.

The elements above constitute a generic checklist or guide to the elements that should normally be included in the conservation objectives, in order to ensure that the site makes an effective and appropriate contribution to achieving favourable conservation status for the habitats and species for which it is designated.

There is one conservation objective for each designated feature listed above. In some cases, where there are distinct areas or forms of a designated habitat or separate populations of a designated species within a site, the conservation objective is sub-divided into different sections to enable different aspirations to be expressed for different occurrences of the features within the site.

As well as describing the aspirations for the condition of the feature, each conservation objective contains a statement that the factors which significantly affect the feature are under appropriate control.

Conservation Objective for the watercourse:

The ecological status of the watercourse is a major determinant of FCS for all features. The required conservation objective for the watercourse is defined below.

- The capacity of the habitats in the SAC to support each feature at near-natural population levels, as determined by predominantly unmodified ecological and hydromorphological processes and characteristics, should be maintained as far as possible, or restored where necessary.
- The ecological status of the water environment should be sufficient to maintain a stable or increasing population of each feature. This will include elements of water quantity and quality, physical habitat and community composition and structure.
- Flow regime, water quality and physical habitat should be maintained in, or restored as far as possible to, a near-natural state, in order to support the coherence of ecosystem structure and function across the whole area of the SAC.
- All known breeding, spawning and nursery sites of species features should be maintained as suitable habitat as far as possible, except where natural processes cause them to change.
- Flows, water quality, substrate quality and quantity at fish spawning sites and nursery areas will not be depleted by abstraction, discharges, engineering or gravel extraction activities or other impacts to the extent that these sites are damaged or destroyed.
- The river plan-form and profile should be predominantly unmodified. Physical modifications having an adverse effect on the integrity of the SAC, including, but not limited to, revetments on active alluvial river banks using stone, concrete or waste materials, unsustainable extraction of gravel, addition or release of excessive quantities of fine sediment, will be avoided.
- River habitat SSSI features should be in favourable condition.
- Artificial factors impacting on the capability of each species feature to occupy the full extent of its natural range should be modified where necessary to allow passage, e.g. weirs, bridge sills, acoustic barriers.
- Natural factors such as waterfalls, which may limit the natural range of a species feature or dispersal between naturally isolated populations, should not be modified.
- Flows during the normal migration periods of each migratory fish species feature will not be depleted by abstraction to the extent that passage upstream to spawning sites is hindered.
- Water quality targets for the river Gwyrfai follow those in the revised Common Standards Monitoring Guidance for Rives (JNCC 2016). These are detailed in Appendix 2.
- Potential sources of pollution not addressed in the Review of Consents, such as contaminated land, forestry operations and improvement of riparian habitat, will be considered in assessing plans and projects.
- Levels of suspended solids will be agreed by NRW for the Water Framework Directive water bodies in the Afon Gwyrfai a Llyn Cwellyn SAC. Measures

including, but not limited to, the control of suspended sediment generated by agriculture, forestry and engineering works, will be taken to maintain suspended solids below these levels.

Conservation Objective for Feature 1: Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and /or of the *Isoteo-Nanojuncetea* (EU Habitat Code: 3130)

The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Water quality of the lake is within parameters suitable to support the characteristic flora and fauna.
- The lake shows the characteristic vegetation zonation from the shore to deeper water.
- The lake has a macrophyte flora which includes many of the characteristic species including *Littorella uniflora, Lobelia dortmanna, Isoetes lacustris, Luronium natans* and *Subularia aquatica*, together with a diverse range of associates including *Myriophyllum alterniflorum, Callitriche hamulata, Nitella flexilis* and *Potamogeton berchtoldii*.
- *Nitella gracilis* and *Luronium natans* to be present as characteristic plants.
- There will continue to be a healthy population of Arctic charr (*Salvelinus alpinus*) in Llyn Cwellyn.

Conservation Objective for Feature 2: Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (EU Habitat Code: 3260)

The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- The conservation objective for the watercourse as defined above must be met.
- The extent of this feature within its potential range in this SAC should be stable or increasing.
- The extent of the sub-communities that are represented within this feature should be stable or increasing.
- The conservation status of the feature's typical species should be favourable.
- All known, controllable factors, affecting the achievement of these conditions are under control (many factors may be unknown or beyond human control).

Conservation Objective for Feature 3: Atlantic salmon *Salmo salar* (EU Species Code 1106)

The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

FCS component	Supporting information / current knowledge
1. The conservation objective for the watercourse as defined above must be met	
2. The population of the feature in the SAC is stable or increasing over the long term.	See below for current assessments of feature populations. Entrainment in water abstractions directly impacts on population dynamics through reduced recruitment and survival rates. Fish stocking can adversely affect population dynamics through competition, predation, alteration of population genetics and introduction of disease.
3. The natural range of the feature in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future. The natural range is taken to mean those reaches where predominantly suitable habitat for each life stage exists over the long term. Suitable habitat is defined in terms of near-natural hydrological and geomorphological processes and forms e.g. suitable flows to allow upstream migration, depth of water and substrate type at spawning sites, and ecosystem structure and functions. Suitable habitat need not be present throughout the SAC but where present must be secured for the foreseeable future. Natural factors such as waterfalls may limit the natural range of individual species. Existing artificial influences on natural range that cause an adverse effect on site integrity, such as physical barriers to migration, will be assessed.	Details of feature habitat suitability are given in the next section. In general, management for one feature is likely to be sympathetic for the other features present in the river, provided that the components of favourable conservation status for the watercourse given above are secured. For example, the abundance of macrophytes provides cover and sub-habitats for fish species. Salmon migration can be affected by acoustic barriers and by high sediment loads, which can originate from a number of sources including construction works.
4.The Gwyrfai will continue to be a sufficiently large habitat to maintain the feature's population in the SAC on a long-term basis.	

Conservation Objective for Feature 4: Floating water-plantain *Luronium natans* (Code: 1831)

The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- The conservation objective for the watercourse as defined above must be met.
- Llyn Cwellyn will continue to support a peripheral floating water-plantain assemblage, as well as a deeper water assemblage, with a characteristic zonation of vegetation from the shore at two areas of the lake.
- Floating water-plantain will continue to flourish in the Afon Gwyrfai and will continue to occur in every selected section.
- All factors affecting the achievement of these conditions are under control.

Conservation Objective for Feature 5: European otter *Lutra lutra* (EU Species Code: 1355)

The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- The population of otters in the SAC is stable or increasing over the long term and reflects the natural carrying capacity of the habitat within the SAC, as determined by natural levels of prey abundance and associated territorial behaviour.
- The natural range of otters in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future. The natural range is taken to mean those reaches that are potentially suitable to form part of a breeding territory and/or provide routes between breeding territories. The size of breeding territories may vary depending on prey abundance.
- The population size should not be limited by the availability of suitable undisturbed breeding sites. Where these are insufficient they should be created through habitat enhancement and where necessary the provision of artificial holts. No otter breeding site is subject to a level of disturbance that could have an adverse effect on breeding success. Where necessary, potentially harmful levels of disturbance are managed.
- The safe movement and dispersal of individuals around the SAC is facilitated by the provision, where necessary, of suitable riparian habitat, and underpasses, ledges, fencing etc at road bridges and other artificial barriers.
- All factors affecting the achievement of these conditions are under control.

Assessment of status and management requirements

This section provides:

- A summary of the assessment of the status of each feature.
- A summary of the management issues that need to be addressed to maintain or restore each feature.

Status and Management Requirements of Feature 1: Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoteo-Nanojuncetea*

Status of Feature 1

The feature is reported as Unfavourable Recovering. This is due to an historic moderate acidification of Llyn Cwellyn since the 1860s. This trend in acidification may be reverting, but patterns need to be monitored. Some concerns over localised nutrient enrichment, sedimentation and from continued water abstraction, Burgess *et al.* (2006).

Management Requirements of Feature 1

Diatom analysis suggests that Llyn Cwellyn has suffered from progressive moderate acidification since 1860 (0.7 – 0.8pH decline). From core samples, the rate of acidification is thought to have increased in 1940's either as a result of background levels or through forestry operations within the catchment. From the 1980's to 1995 subtle changes in diatom composition suggest a slight reversal, thought to be caused by a drop in sulphur deposition within the catchment. Continued monitoring of biological, chemical and physical aspects of the lake should continue to be undertaken.

Future condition assessments should examine whether *J. bulbosus* and *Sphagnum spp*. continue to increase in abundance as a result of nutrient enrichment and sedimentation or whether they decline in abundance, perhaps as a result of a continuing reversal in the historic acidification trend or a reduction in mineral in-wash.

The extent of sediment in-wash to the lake from grassland improvement (liming) and the felling of trees within the catchment should be monitored.

The Red Data Book and Annex II species, *L. natans* and *N. gracilis* should continue to be monitored to ensure that these rare plants are not lost. *L. natans* was frequent

in Llyn Cwellyn in 2014 (Goldsmith *et al*. 2014) and is abundant in Llyn y Gader. It is routinely detected by macrophyte monitoring (e.g. Goldsmith *et al*. 2016, 2019), though cover tends to be underestimated. *N. gracilis* has been recorded from Llyn Cwellyn and also occurs in Llyn y Gader (Goldsmith *et al*. 2016), together with *Pilularia globulifera* and a high diversity of other oligotrophic lake species.

Arctic charr in Llyn Cwellyn should continue to be monitored.

Llyn Cwellyn is used as a drinking water abstraction point. It is crucial that sudden changes in water level are avoided in addition to the introduction of fish stock. The use of the lake within the SAC for angling is currently relatively limited.

Status and Management Requirements of Feature 2: Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation

Status of Feature 2

Status: Favourable (2007)

Important stands have been identified in management units 2, 4, 5, 6, 7 & 8. In 2007 the feature was monitored against JNCC guidelines in management units 2, 5, 6 & 7. The most recent published vegetation survey was that of Scarlett *et al*. (2003). Surveys were carried out at 5 locations in management units 2, 4, 6, 7, & 8. These were classified into JNCC river groups. The condition of the plant communities was good at all sites. Invasive species *Impatiens glandulifera* was recorded at two of the sites and *Fallopia japonica* at one site.

Management Requirements of Feature 2

Factors that are important to the favourable conservation status of this feature include flow, substrate quality and water quality, which in turn influence species composition and abundance. These factors often interact, producing unfavourable conditions by promoting the growth of a range of algae and other species indicative of eutrophication. Under conditions of prolonged low flows and high nutrient status, epiphytic algae may suppress the growth of aquatic flowering plants. Favourable management for this feature is therefore largely dependent on ensuring that sufficient depth, velocity and duration of flow and sufficiently low phosphate levels are maintained within the natural range of the vegetation.

Water Framework Directive (WFD) monitoring shows that nutrient levels (phosphate and ammonia) in the Gwyrfai river waterbodies are low and currently meet High WFD status. However the water quality monitoring point for waterbody GB110065054190 (encompassing SAC units 4 to 8) is upstream of Llanfaglan sewage treatment works (STW), and therefore the monitoring data does not reflect any potential effects that STW discharge may have on the water quality of the river downstream of the discharge (approximately 1Km of river before it meets the tidal

limit). Therefore additional investigations will be initiated to ascertain potential water quality impacts of the STW discharge on the most downstream stretch of the Gwyrfai.

A favourable flow regime can be defined with reference to naturalised flows (removing the influence of artificial abstractions and discharges from flow records). The Mean Trophic Rate (MTR) scores for all but the downstream management unit were high, being between 74 – 90. This implies that the river is not significantly impacted by phosphate inputs. The slightly lower score on the downstream site suggests only minimal phosphate input, (Scarlett *et al* 2003). Equally, EA monitoring of water quality scored the Afon Gwyrfai as grade 1, which equates to <0.02mg/l phosphate levels.

Invasive non-native plants can have a detrimental impact on this feature. Removal of *Impatiens glandulifera* and *Fallopia japonica* is a priority (Scarlett *et al* 2003, p23).

Status and Management Requirements of Feature 3: Atlantic salmon *Salmo salar*

Status of Feature 3

Status: Unfavourable: Unclassified.

Monitoring of Atlantic salmon in the Afon Gwyrfai and Llyn Cwellyn SAC relies on two methods:

i. Estimation of adult run size from angling catch returns,

ii. Electro-fishing for juveniles in nursery areas.

The current unfavourable status results from a precautionary assessment of feature distribution and abundance, in particular the results of salmon catches and juvenile surveys, and from the presence of adverse factors, in particular flow depletion.

Management requirements of Feature 3

The relatively demanding water quality and spawning substrate quality requirements of this feature mean that reduction in diffuse pollution and siltation impacts is important.

Elevated levels of fines (particles <0.83mm) within spawning substrates can interfere with egg and fry survival. Clean substrate free from excessive siltation should predominate at suitable spawning sites. Spawning habitat is defined as stable coarse substrate without an armoured layer, in the pebble to

cobble size range (16-256 mm) but with the majority being <150 mm. Water depth during the spawning and incubation periods should be 15-75 cm. Fry habitat is indicated by water of <20 cm deep and a gravel/pebble/cobble substrate. Parr habitat is indicated by water 20-40 cm deep and similar substrate. Holding areas are defined

as pools of at least 1.5 m depth, with cover from features such as undercut banks, vegetation, submerged objects and surface turbulence. Coarse woody debris should not be removed from rivers as it plays a significant role in the formation of new gravel beds, and provides cover for fish and a source of food for invertebrates.

The most significant sources of diffuse pollution and siltation are from agriculture, including fertiliser run-off, livestock manure, silage effluent and soil erosion. The most intensively used areas such as heavily trampled gateways and tracks can be especially significant sources of polluting run-off. Preventative measures can include surfacing of tracks and gateways, moving feeding areas, and separating clean and dirty water in farmyards. Farm operations should avoid ploughing land which is vulnerable to soil erosion or leaving such areas without crop cover during the winter.

Among toxic pollutants, sheep dip and silage effluent present a particular threat to aquatic animals in this predominantly rural area. Contamination by synthetic pyrethroid sheep dips, which are extremely toxic to aquatic invertebrates, can deprive fish populations of food over large stretches of river. These impacts can arise if recently dipped sheep are allowed access to a stream or hard standing area, which drains into a watercourse. Pollution from organophosphate sheep dips and silage effluent can be very damaging locally. Pollution from slurry and other agricultural and industrial chemicals, including fuels, can kill all forms of aquatic life. All sheep dips and silage, fuel and chemical storage areas should be sited away from watercourses or bunded to contain leakage. Recently dipped sheep should be kept off stream banks. Used dip should be disposed of strictly in accordance with NRW regulations and guidelines. Statutory and voluntary agencies should work closely with landowners and occupiers to minimise the risk of any pollution incidents and enforce existing regulations.

Measures to control diffuse pollution in the water environment, including ‘Catchment Sensitive Farming’, may be implemented as a result of the Water Framework Directive and, along with existing agri-environment schemes, will help to achieve the conservation objectives for the SAC.

Discharges from sewage treatment works, urban drainage, engineering works such as road improvement schemes, contaminated land, and other domestic and industrial sources can also be significant causes of pollution, and must be managed appropriately. Current consents for discharges entering, or likely to impact upon the site should be monitored, reviewed and altered if necessary.

Overhanging trees provide valuable shade and food sources, whilst tree root systems provide important cover and flow refuges for juveniles. At least 50% high canopy cover to the watercourse/banks should be maintained, where appropriate. Some reaches may naturally have lower tree cover. Cover may also be lower in urban reaches.

Artificial barriers should be made passable. The impact of existing barriers in the Afon Gwyrfai a Llyn Cwellyn should be assessed on a case-by-case basis. Physical modification of barriers is required where depth/velocity/duration of flows is unsuitable to allow passage. Complete or partial natural barriers to potentially suitable spawning areas should not be modified or circumvented.

Entrainment in water abstractions directly impacts on population dynamics through reduced recruitment and survival rates. Intake screens must meet statutory requirements under the Salmon & Freshwater Fisheries Act.

There is currently no stocking of salmon into the Afon Gwyrfai a Llyn Cwellyn. The management objectives for SAC salmon populations are to attain naturally self-sustaining populations. Salmon stocking should not be routinely used as a management measure. Salmon stocking represents a loss of naturalness and, if successful, obscures the underlying causes of poor performance (potentially allowing these risks to perpetuate). It carries various ecological risks, including the loss of natural spawning from brood stock, competition between stocked and naturally produced individuals, disease introduction and genetic alterations to the population. Therefore, there is a presumption against salmon stocking in the Afon Gwyrfai a Llyn Cwellyn SAC.

The presence of artificially high densities of other fish can create unacceptably high levels of predatory and competitive pressure on juvenile salmon and the aim should be to minimise these risks in considering any proposals for stocking. Escapes from fish farms are a form of uncontrolled introduction and should be prevented by effective screening on all intakes and discharges.

Controls on exploitation should include migratory passage to the SAC within territorial waters, including estuarine and coastal net fisheries, as well as exploitation within the SAC from rod fisheries. Net Limitation Orders are used to control the estuarine fishery. Exploitation of salmon by rod fisheries is regulated by NRW licensing and byelaws controlling the fishing season and allowable methods.

Status and Management Requirements of Feature 4: Floating water-plantain *Luronium natans*

Status of Feature 4

The habitat is reported as in favourable condition for extent and abundance of peripheral floating water-plantain (2005 SAC Monitoring Report). This status is conditional upon a deeper water survey being undertaken within the next reporting round (2006-2011) to establish the extent and abundance of underwater population(s) of this plant within Llyn Cwellyn. Revised conservation objectives for the distribution of *Luronium natans* within Llyn Cwellyn can be set based on updated survey information (Goldsmith *et al*. 2014, 2016, 2019). The favourable condition status is also conditional upon the water quality status being maintained as defined in the conservation objectives above.

Management Requirements of Feature 4

Infrastructure or river maintenance works, requiring the intentional movement of substrate is the vicinity of known populations of this plant, to be avoided. No intentional disturbance of existing water plants, other than by natural events.

Buffer zones around riverine and lake areas to reduce nutrient input, especially where *Luronium* is known to occur.

Status and Management Requirements of Feature 5: European otter *Lutra lutra*

Conservation Status of Feature 5

The overall status of the otter populations within the SAC is considered to be unfavourable (Liles, 2006). In terms of extent, European otter are considered to be favourable within the SAC, based on the results of the Otter survey of Wales (Jones, 2004). In terms of the quality of the feature, European otter are considered to be in unfavourable condition.

The number and distribution of actual and/or potential breeding sites are too few and they are insufficiently spread throughout the SAC.

Management Requirements of Feature 5

An increase from 5 to at least 8 potential breeding sites is required. These should be located in lower and upper catchments, recommended sites are GW1, GW12, GW14 (Liles, G. 2006).

Action plan: summary

This section takes the management requirements outlined above a stage further, assessing the specific management interventions required on each management unit. The table below is a summary of the information held in Natural Resources Wales' Actions Database for sites

Actions in Natural Resources Wales' Actions Database

NRW Internal Reference Number	Unique SAC Unit Number	Unit Name	Summary of Conservation Management Issues	Action needed?
1	001674	Afon Treweunydd	Conifer plantation not relevant to this unit	Yes
2	001675	Afon Gwyrfai upstream of lake	Assessment required of the long-term impact of any future replanting of conifers adjacent to unit. Japanese knotweed and rhododendron are present in this unit but treatment is underway	Yes
3	001676	Llyn Cwellyn	Invasive species are being tackled - Himalayan balsam and Japanese knotweed identified from the 2011 survey have been treated and are being checked annually. The Nant Mills weir has been removed to prevent impedance of fish and plans are underway to redesign the Cwellyn dam to allow fish passage.	Yes
4	001677	Llyn Cwellyn to weir at Betws Garmon	Investigate potential to re-instate natural river morphology.	Yes
5	001678	Weir to Bryn Gloch caravan park	Investigate potential to re-instate natural river morphology. Bryn Gloch sewage discharge needs investigating to assess impact on low river flow conditions.	Yes
6	001679	Bryn Gloch caravan site to Waenfawr	A survey was undertaken in 2011 and treatment for Himalayan balsam and Japanese knotweed started. Treatment needs to be continued as necessary over the next few years	Yes
7	001680	Waenfawr to Bontnewydd	Control of Himalayan balsam upstream of this unit has been undertaken since 2012. Before a	Yes

			decision is made on whether or not to instigate control within this unit and further downstream, we need to determine how effective that control has been and if we have the necessary resources to tackle the rest of the river. Ongoing control requires input from landowners and other parties.	
8	001681	Bontnewydd to normal tidal limit	Survey for invasive species completed. Further actions identified under the appropriate SSSI units	Yes
9	001682	Estuary	Review impact of drift netting/seine netting in Menai Strait on salmon population.	Yes

Glossary

This glossary defines some of the terms used in this **Core Management Plan**. Some of the definitions are based on definitions contained in other documents, including legislation and other publications of Natural Resources Wales and the UK nature conservation agencies.

Action	A recognisable and individually described act, undertaking or **project** of any kind, specified in a **Core Management Plan** or **Management Plan**, as being required for protecting, managing or enhancing one or more of the **features** for which a site is designated.
Attribute	A quantifiable and monitorable characteristic of a **feature** that, in combination with other such attributes, describes its **condition**.
Common standards	See **JNCC common standards.**
Condition	A description of the state of a feature in terms of qualities or **attributes** that are relevant in a nature conservation context. For example, the condition of a habitat usually includes its extent and species composition and might also include aspects of its ecological functioning, spatial distribution and so on. The condition of a species population usually includes its total size and might also include its age structure, productivity, relationship to other populations and spatial distribution. Aspects of the habitat(s) on which a species population depends may also be considered as attributes of its condition. Condition is considered favourable when all the conservation objectives are being met.
Conservation management	Acts or undertaking of all kinds, including but not necessarily limited to **actions,** taken with the aim of achieving the **conservation objectives** of a site. Conservation management includes the taking of statutory and non-statutory measures, it can include the acts of any party and it may take place outside site boundaries as well as within sites. Conservation management may also be embedded within other frameworks for land/sea management carried out for purposes other than achieving the conservation objectives.
Conservation objective	The expression of the desired state of a **feature,** expressed as a composite statement defining the **condition** that we wish the feature to be in. Each feature has one conservation objective.

Core Management Plan	A Natural Resources Wales document containing the conservation objectives for a site and a summary of other information contained in a full site **Management Plan**.
Factor	Anything that has influenced, is influencing or may influence the **condition** of a **feature**. Factors can be natural processes, human activities or effects arising from natural process or human activities. They can be positive or negative in terms of their influence on features, and they can arise within a site or from outside the site. Physical, socio-economic or legal constraints on management of the site can also be considered as factors.
Favourable condition	See **condition**.
Favourable conservation status	The Habitats Directive definition of **Favourable Conservation Status** (FCS) is given in full in the Conservation Objectives section.
Feature	The species population, habitat type or other entity for which a site is designated. The ecological or geological interest which justifies the designation of a site and which is the focus of **conservation management.**
Integrity	See **Site integrity.**
JNCC common standards	A set of principles developed jointly by the UK nature conservation agencies to help ensure a consistent approach to monitoring and reporting on the features of sites designated for nature conservation, supported by guidance on identification of attributes and monitoring methodologies.
Key Feature	The habitat or species population within a **management unit** that is the primary focus of management and **monitoring** in that unit.
Management Plan	The full expression of a designated site's legal status, **vision**, **features**, **conservation objectives**, **performance indicators** and management requirements. A complete management plan may not reside in a single document, but may be contained in a number of documents (including in particular **the Core**

	Management Plan) and sets of electronically stored information.
Management Unit	An area within a site, defined according to one or more of a range of criteria, such as topography, location of **features**, tenure, patterns of land/sea use. The key characteristic of management units is to reflect the spatial scale at which site management and **monitoring** can be most effectively organised. They are used as the primary basis for differentiating priorities for conservation management and monitoring in different parts of a site, and for facilitating communication with those responsible for management of different parts of a site.
Monitoring	An intermittent (regular or irregular) series of observations in time, carried out to show the extent of compliance with a formulated standard or degree of deviation from an expected norm. In monitoring of sites designated for habitat and species conservation, the formulated standard is the quantified expression of favourable **condition** based on **attributes**.
Operational limits	The levels or values within which a **factor** is considered to be acceptable in terms of its influence on a **feature**. A factor may have both upper and lower operational limits, or only an upper limit or lower limit. For some factors an upper limit may be zero.
Performance indicators	A subset of the conservation objectives that are quantifiable and measurable. They consist of **attributes** and factors together with their associated target values (or ranges of values) which provide the standard against which information from **monitoring** and other sources is used to determine the degree to which the **conservation objectives** for a **feature** are being met.
Plan or project	**Project:** Any form of construction work, installation, development or other intervention in the environment, the carrying out or continuance of which is subject to a decision by any public body or statutory undertaker.

Plan:	a document prepared or adopted by a public body or statutory undertaker, intended to influence decisions on the carrying out of **projects.** Decisions on plans and projects which affect SAC, SPA and Ramsar sites are subject to specific legal and policy procedures.
Site integrity	This is defined in Welsh Government policy as the coherence of a site's ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it is designated.
Site Management Statement (SMS)	The document containing Natural Resources Wales' views about the management of a site issued as part of the legal notification of an SSSI under section 28(4) of the Wildlife and Countryside Act 1981, as substituted.
Special Feature	See **feature**.
Specified limits	The levels or values for an **attribute** which define the degree to which the attribute can fluctuate without creating cause for concern about the **condition** of the **feature**. The range within the limits corresponds to favourable, the range outside the limits corresponds to unfavourable. Attributes may have lower specified limits, upper specified limits, or both.
Unit	See **management unit.**
Vision Statement	The statement conveying an impression of the whole site in the state that is intended to be the product of its **conservation management.** A 'pen portrait' outlining the **conditions** that should prevail when all the **conservation objectives** are met. A description of the site as it would be when all the **features** are in **favourable condition**.

References

Burgess A, Goldsmith B, Hatton-Ellis TW. 2006. Site Condition Assessments of Welsh SAC and SSSI Standing Water Features. CCW Science Report No. 705. Countryside Council for Wales CCW, Bangor.

Clabburn P, Davies R, Griffiths J. 2017. Summary of the results of hydroacoustic surveys of Llyn Padarn and Llyn Cwellyn, 2016. NRW Report FAT/REP/16. Natural Resources Wales, Cardiff.

Environment Agency 2003. River Habitat Survey in Bristol and Ireland – Field Survey Guidance Manual: 2003. Environment Agency, Bristol.

Goldsmith B, Shilland E, Shilland J, Turner S. 2014. Floating water-plantain *Luronium natans* (L.) Raf.: current distribution and status in Llyn Padarn and Llyn Cwellyn, Wales. NRW Evidence Report No. 73. Natural Resources Wales, Bangor.

Goldsmith B, Turner S, Shilland E, Goodrich, S. 2016. Ecological Surveys of Welsh Lakes 2015. NRW Evidence Report No. 145. p 25. Natural Resources Wales, Bangor.

Goldsmith B, Stewart NF, Hatton-Ellis TW. 2019. Ecological Surveys of Welsh Lakes 2018. NRW Evidence Report No. 343. p113. Natural Resources Wales, Bangor.

Hankin B, Evans CD, Bielby S, Hall J. 2014. Water Framework Directive Acidification risk assessment methodology. NRW Report.

Joint Nature Conservation Committee (JNCC) 2005. Common Standards Monitoring Guidance for Rivers. JNCC, Peterborough.

Joint Nature Conservation Committee 2015. Common Standards Monitoring Guidance for Freshwater Lakes. JNCC, Peterborough.

Joint Nature Conservation Committee 2015b. Common Standards Monitoring Guidance for Freshwater Fauna. Version October 2015. JNCC, Peterborough.

Joint Nature Conservation Committee 2016. Common Standards Monitoring Guidance for Rivers. Version September 2016. JNCC, Peterborough.

Jones T, Jones D. 2004. Otter survey of Wales 2002. Environment Agency, Bristol.

Liles G. 2006. Current & Potential distribution, condition and breeding success of the otter (*Lutra lutra*) in the Afon Gwyrfai and the Dyfi Estuary. CCW Environmental Monitoring Report No. 36.

Natural Resources Wales 2015. River Basin Management Plan Overview Annex Updated December 2015. Available at: https://cdn.cyfoethnaturiol.cymru/media/682220/wales-rbmp-overview-annex.pdf?mode=pad&rnd=131596369400000000

SAC Monitoring Report (2005) for *Luronium natans*.

Scarlett PM, Shirley CLR, Henville P, Hornby DD. Dawson FH. 2003. A Resurvey of the Afon Gwyrfai for aquatic macrophytes. CCW Science Report No. 607.

Southey & Broughton (unpublished) Macrophyte Condition Assessment for the Afon Gwyrfai SAC. CCW Contract Science Report (unpublished).

The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

Water Framework Directive – United Kingdom Technical Advisory Group (WFD-UKTAG) 2008. UK Environmental Standards and Conditions (Phase 1). Available at: http://www.wfduk.org/sites/default/files/Media/Environmental%20standards/Environmental%20standards%20phase%201_Finalv2_010408.pdf

WFD-UKTAG 2013. Updated Recommendations on Phosphorus Standards for Rivers. River Basin Management (2015-2021). Available at: http://www.wfduk.org/sites/default/files/Media/UKTAG%20Phosphorus%20Standards%20for%20Rivers_Final%20130906_0.pdf

WFD-UKTAG 2016. UKTAG Lake Assessment Method. Phosphorus. Lake Phosphorous Standards. Available at: https://wfduk.org/sites/default/files/Media/Environmental%20standards/Lake%20Phosphorus%20UKTAG%20Method%20Statement.pdf

WFD-UKTAG 2020. UKTAG Environmental Standards. Lake Nitrogen. Available at: http://wfduk.org/sites/default/files/Lake%20Nitrogen%20UKTAG%20Method%20Statement%20Sep%202020.pdf

Appendix 1. Performance Indicators

These performance indicators are a sub-set of the conservation objectives and describe the evidence, including in particular evidence to be obtained from monitoring of sites and features, that will be used to inform judgements about whether or not the conservation objectives are being met.

The assessment of plans and projects should be made in view of the entirety of the conservation objectives, including the performance indicators.

Table A1.1 Performance indicators for feature 1, Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoteo-Nanojuncetea* (EU Habitat Code: 3130)

Performance indicators for feature condition		
Attribute	**Attribute rationale and other comments**	**Specified limits**
A1. Extent of Oligotrophic to mesotrophic standing waters	Lower limit is based upon current extent as shown in UKLakes.	*Upper limit:* none *Lower limit:* Lake areas must not be permanently less than the following: Llyn Cwellyn: 90ha. Llyn y Gader: 19ha. See F1 for water level regulation.
A2. Macrophyte Community Composition and Structure.	Based on the CSM attributes for this Feature (JNCC 2015).	**A2.1. Characteristic Species Diversity.** Upper Limit: None Lower Limit: Each lake supports at least seven of the following characteristic species: *Isoetes lacustris*; *I. echinospora*; *Littorella uniflora*; *Lobelia dortmanna*; *Subularia aquatica*; *Luronium natans*; *Elatine hexandra*; *Eleogiton fluitans*; *Myriophyllum alterniflorum*; *Nitella gracilis*;

Performance indicators for feature condition		
		N. flexilis agg; *Pilularia globulifera*; *Sparganium angustifolium*; *Utricularia* spp. **A2.2 Loss of Characteristic Species** Upper Limit: None. Lower Limit: Within any ten year period, all characteristic species previously recorded from the site (see A2.1 above) are recorded in at least one of the lakes on the site. **A2.3 Characteristic Species Cover.** Upper Limit: None. Lower Limit: In each lake, at least 60% of vegetated sample points (wader and boat combined) support one or more characteristic species as listed in A2.1. **A2.4 Filamentous Algae** Upper Limit: No more than 20% of sample points (wader and boat combined) have cover values of 3 for filamentous algae.. Lower Limit: None. **A2.5 Maximum Depth of Plant Colonization** Upper Limit: None. Lower Limit: Llyn Cwellyn: 5m; Llyn y Gader: plants grow throughout the lake.
A3. Species of Interest	Based on the CSM attributes for this Feature (JNCC 2015b). *Salvelinus alpinus* targets are included here as a characteristic feature of H3130.	**A3.1 Arctic charr *Salvelinus alpinus*** A reproducing population of Arctic charr (*Salvelinus alpinus*) should be present in Llyn Cwellyn and meeting the following targets: • Juvenile (0+ and 1+ fish) should comprise at least 60% of the total number of individuals in the population; • At least two other age classes (usually 3+ and 4+) should be detected.

Performance indicators for feature condition		
		A3.2 Pillwort *Pilularia globulifera* A population of pillwort (*Pilularia globulifera*) should be present in Llyn y Gader. **A3.3 Slender stonewort *Nitella gracilis*** A population of slender stonewort (*Nitella gracilis*) should be present in at least one of the lakes.
Performance indicators for factors affecting the feature		
Factor	**Factor rationale and other comments**	**Operational Limits**
F1. Abstraction	There should be no new abstractions where this could affect the feature.	*Upper limit:* abstraction should not exceed limits of any abstraction licence and should not expose macrophyte communities of the shallow water close to the shore.
F2. Recreational activity	Fishing – stocking with native and non-native fish	*Upper limit:* no stocking with non-native fish and any stocking with native species must be strictly controlled
F3. Alien Species	Based on CSM Guidance (JNCC 2015)	No WFD high-impact alien species or *Elodea canadensis* established in either lake.
F4. Thermal Impacts	Both lakes could be substantially affected by temperature changes. This is especially true for Cwellyn where stratification is a key feature of its ecology.	There should be no discharges or other activities that could significantly alter the thermal regime of the lake

Table A1.2 Performance indicators for feature 2, Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (EU Habitat Code: 3260)

Performance indicators for feature condition		
Attribute	**Attribute rationale and other comments**	**Specified limits**
A1. Distribution within catchment	Though surveys have identified this feature at various sample sites, the feature's extent, or the extent of suitable habitat for it, within the protected site has never been mapped.	*Upper limit:* Insufficient information *Lower limit:* Insufficient information May occur in all site units except 3 and 9
A2. Typical species	Should conform to Plant community: species composition and abundance targets in Table 1a of JNCC's *Common Standards Monitoring Guidance for Rivers* (March 2005).	Upper limit: Insufficient information Lower limit: See Table 1a of JNCC's *Common Standards Monitoring Guidance for Rivers* (March 2005).
A3. Plant community Reproduction	For this attribute, the 'Targets', 'Method of assessment', and 'Comments' criteria are as those described in Table 1a of the of JNCC's *Common Standards Monitoring Guidance for Rivers* (March 2005), **except** for the lower limit. In the guidance, the 'minimum value is defined in terms of the "total habitat / macrophyte population that should be left uncut". For the Gwyrfai percentages of total habitat area or total macrophyte population cannot be expressed because the total area covered by the habitat is not known. Therefore	See comments (to the left) for details of when cutting can occur. *Upper limit:* at least 50% of the habitat / macrophyte population should be left uncut for the full duration of the remaining growing season and there should be no further cutting at the same location for at least two further growing seasons.

Performance indicators for feature condition		
	in this SAC, the value expressed applies to a percentage of the width of channel, but only at locations where control measures such as weed cutting are an established practice as agreed by NRW. In all other locations there should be no cutting of feature vegetation.	*Lower limit:* Nil
A4. Bank and riparian zone vegetation	In addition to being integral to SSSI river habitat (plant community) types, it is clear that the various types of semi-natural bank and riparian zone vegetation each contribute to the ecological well being of the site and its features in different ways. Examples include:- · Fallen leaves - these provide of a source of allochthonous vegetative input to the aquatic food web. · Fallen trees and branches – woody debris in the water provides cover for fish and invertebrates, and may generate eddies that aid their movement within the site. · Fringing and emergent vegetation at the waters edge provides cover for juvenile fish and invertebrates · Dense vegetation on river banks provides a buffer between intensively farmed land and the river · Ground layer, dense scrub and woodland vegetation on river banks provide a range of terrestrial habitat for otter. Conversely, dense woodland excludes light from the river and may limit the extent of this feature. In view of these and other known and unknown associated factors, the “mosaic” objective should ensure that all the wide-ranging interactions between bank-side vegetation and the in-river ecosystem can continue to take place.	*Upper limit:* None set *Lower limit:* Bank and riparian zone vegetation should form a semi-natural mosaic. However, where it forms part of a plant community classified as a qualifying SSSI habitat feature, it should remain within its notified classification

Performance indicators for feature condition		
A5. Species indicative of eutrophication	Cover values should not increase significantly from an established baseline. Methods used to establish these values should be as indicated in the JNCC's *Common Standards Monitoring Guidance for Rivers* (March 2005), which rely on the method of Holmes (1983) and a standard check-list of macrophyte species. Taxa typically associated with enrichment are considered negative indicators of favourable condition. The species will vary depending on the River Community Type.	*Upper limit:* The Combined cover values of blanket weed, epiphytic or other algae should not exceed 25% *Lower limit:* none set
A6. Alien / introduced species	In the CSM guidance, the SERCON scoring system for naturalness of aquatic and marginal macrophytes and naturalness of banks and riparian zone, are used to assess this attribute. SERCON protocols have not yet been applied in the Afon Gwyrfai SAC, therefore assessment of this attribute relies on locally defined thresholds and expert judgement. Details to be confirmed	*Upper limit:* No impact on native biota from alien or introduced species. *Lower limit:* None set
Performance indicators for factors affecting the feature		
Factor	**Factor rationale and other comments**	**Operational Limits**
F1. Water quality	Water quality should be compliant with the standards set out in JNCC's Common Standards Monitoring Guidance for Rivers (Current version 2016), provided in Appendix 2.	See Appendix 2.
F2. Flow	Flow regime should be characteristic of the	*Upper limit*: +10% of

Performance indicators for feature condition		
	river.	naturalised flow *Lower limit*: -10% of naturalised flow.
F3. Light levels	This factor is partly addressed above in relation to "Bank and riparian zone vegetation" and "Species indicative of eutrophication". However, light levels reaching this feature vegetation community may be affected by other factors such as buildings, bridges or other structures. The specific ranges and values of light parameters beyond which this feature would be significantly affected is not known and therefore in all cases of doubt, the precautionary principle should apply	*Upper limit:* Insufficient information *Lower limit:* Insufficient information
F4. Changes to substrate	Substrate types vary naturally, depending upon reach type and hydrodynamic regime. At almost any scale there are varieties of channel substrate. Localised accumulations of silt on the inside of bends or in back channels do not necessarily indicate a problem. However, widespread siltation of riverine sediments, caused by high particulate loads and / or reduced scour within the channel, is a major threat to this and other interest features. For river types characterised by extensive *Ranunculus* beds, there should be a predominance of 'clean' gravels, pebbles and cobbles, with relatively low cover by silt- dominated substrates. Maximum fines content should not be too great to prevent establishment of new	*Upper limit:* Insufficient information *Lower limit:* Insufficient information

Performance indicators for feature condition		
	plants. (Fines are defined as particles <0.83 mm in the CSM Guidance 2005). The SSSI and SAC boundaries do not extend to the entire catchment. This and other site features are susceptible to siltation, the source of which may lie outside the site boundary. Sources of silt could include run-off from agricultural land, forestry plantations, and sewage discharges. The only specified target relating to substrate in Table 1a of CSM guidance 2005 applies specifically to siltation. It states “No excessive siltation. Channels should contain characteristic ranges of substrate types for unmodified rivers.” Therefore, in the absence of any more detailed guidance or information, the precautionary principle should apply in any decisions relating to change or detected damaging impact to any substrate affecting this feature.	

Table A1.3 Performance indicators for feature 3: Atlantic salmon *Salmo salar* (EU Species Code 1106)

Performance indicators for feature condition		
Attribute	**Attribute rationale and other comments**	**Specified limits**
A1. Adult run size	As there is no fish counter in the Afon Gwyrfai, adult run size can be calculated using rod catch data.	Total run size at least matching an agreed reference level, including a seasonal pattern of migration characteristic of the river and maintenance of the multi-seawinter component.
A2. Juvenile densities	CSM guidance states: These should not differ significantly from those expected for the river type/reach under conditions of high physical and chemical quality. Assessed using electrofishing data.	Expected densities for each sample site using HABSCORE
Performance indicators for factors affecting the feature		
F1. Water - biological and chemical	Targets included in the CSM Guidance for Rivers 2016 are used. These targets are intended to support a healthy, naturally functioning river ecosystem which protects the whole biological community and individual species to a degree characteristic of the river. All chemical targets and targets relating to macroinvertebrates are applicable.	See Appendix 2 and sections 4.2 and 4.6.2 of the CSM guidance for rivers 2016.
F2. Flow	Targets are set in relation to river/reach type(s)	Targets agreed in the Review of Consents. As a guideline flow should be +/-10%of the naturalised daily flow throughout the year.
F3. Illegal fish poaching	Removal of salmonids	Insufficient data

Performance indicators for feature condition		
F4. Invasive alien species	Japanese knotweed is found growing next to the watercourses and is usually controlled via herbicides. Herbicide handled inappropriately may enter the watercourse and poison fish and invertebrates	Assessment of plans and projects.
F5. Coarse woody debris (CWD)	It is natural to find CWD in watercourses and it assists with maintaining good water quality and can provide refuge areas for young fish	Presumption against CWD removal from the watercourse except on grounds of health and safety. Assessment of plans and projects

Table A1.4 Performance indicators for feature 4: Floating water-plantain *Luronium natans* (Code: 1831)

Performance indicators for feature condition		
Attribute	**Attribute rationale and other comments**	**Specified limits**
A1. Species extent and abundance	Presence of *Luronium natans* recorded as plants that are attached to substrate. Detached fragments (unless obviously detached during monitoring) will not be counted. .	*Upper limit:* None set *Lower limit: Luronium natans* will be present at Site 1 on the periphery of Llyn Cwellyn AND *Luronium natans* will be present within each of Sections 1-6 as identified in the maps in monitoring report (2005). This may be revised following the programmed surveillance. **Site-specific Descriptions** Presence of *Luronium natans*

Performance indicators for feature condition		
A2. Sufficient habitat.	Submerged populations of *L. natans* require substrates comprising of mud or stable fine gravel or silt in depths of clear water up to 3m.	Sufficient good quality habitat should exist to support the expansion of existing populations. Extent of good quality habitat should not be reduced.
Performance indicators for factors affecting the feature		
Factor	**Factor rationale and other comments**	**Operational Limits**
F1. Water quantity (flow):	Refer to performance indicators for feature 2.	Refer to performance indicators for feature 2.
F2. Water quality	Targets included in the CSM Guidance for Rivers 2016 and Lakes 2015 are used.	Refer to Appendix 2 and performance indicators for feature 1.
F3. Dredging	Dredging could directly damage *L. natans* beds.	No dredging likely to affect *L.natans* should where suitable habitat is found.
F4. Competition from other aquatic plant species	*L. natans* cannot compete with other aquatic plant species including algae.	Review to assess if competition is an issue.

Table A1.5 Performance indicators for feature 5: European otter *Lutra lutra*

Performance indicators for feature condition		
Attribute	**Attribute rationale and other comments**	**Specified limits**
A1. Population distribution.	Although Performance Indicators are given it is difficult to assess the condition of the otter population distribution feature because of the relatively small size of the SAC areas compared to the typical home range size of otters. As otters are mobile animals occupying very large home ranges, the condition of the otter feature should be considered at the landscape level.	*Upper limit:* None set. *Lower limit:* Otter signs are found at five of the seven (71%) sites searched within the Gwyrfai.
A2. Breeding activity	Breeding Centres are used to provide an estimate of the number of females breeding in the system. They	*Upper limit:* None set.

Performance indicators for feature condition		
	can only be a “best guess” but are based on our present knowledge of the size of otter home ranges, the juxtaposition of potential breeding sites, and records of breeding activity for the catchment.	*Lower limit:* Breeding Centre: There should be no deterioration in, or loss of, bank side habitats within the assumed breeding centre.
A3. Actual & potential breeding sites.	Within the home range of a single female there may be two or more potential breeding sites. When this is the case, the female may use a different breeding site each year (Liles, 2003). Birth takes place in a Natal Den, either above ground in a small patch of cover (i.e.1m x 1m) such as scrub or a pile of timber, or below ground, for example in a tree root system or a pile of boulders. Females often use a different natal den site each year (Liles, 2003). Although targets are set for the number of Potential Breeding sites within the SAC areas and wider sub catchments, the quality, habitat type, and location of sites is also important. Priority should be given to retaining existing sites. If the number or quality of sites does decline, alternative breeding sites can be created at nearby Habitat Improvement Sites.	*Lower limit:* There should be an increase in the number of mapped potential breeding sites on the Gwyrfai from five to eight. *Upper limit:* None set

Site-specific habitat definitions	
Breeding Centre	A Breeding Centre is an area of the catchment in which otter breeding activity and potential breeding sites have been recorded, and which equates in size (i.e. length of watercourse) to the home range of a female otter (approximately 20km of waterway). A Breeding Centre can be based entirely on one tributary or long stretch of main river, or can incorporate a stretch of main river and one or more tributaries. Because otters are territorial it is assumed that, within a Breeding Centre, only one female will breed at a time.

Site-specific habitat definitions	
Potential Breeding Sites	An area of good quality vegetation for breeding otters usually > 0.5 ha free from flood risk and is within 3km of a good food supply. The risk of flooding at a site is considered to be a problem for breeding if flooding at the site is a regular occurrence (i.e. occurs in most years). Access to a good food supply that is within easy travelling distance for a female is likely to be important so that very young and vulnerable cubs are not left unattended for long periods.
Good quality vegetation for breeding otters	Good quality vegetation for breeding otters includes dense scrub (e.g. bramble, blackthorn and gorse); reed-beds; deciduous woodland with an under-story; young conifer plantations; rhododendron thickets; and wetlands (particularly with areas of *Molinia caerulea*).

Performance indicators for factors affecting the feature		
Factor	**Factor rationale and other comments**	**Operational Limits**
F1. Water quality	Targets included in the CSM Guidance for Rivers 2016 are used.	Refer to Appendix 2 and performance indicators for feature 1.
F2. Water quantity (flow):	Refer to performance indicators for feature 2.	Refer to performance indicators for feature 2.
F3. Food availability & riparian habitat	The availability of food within the catchment is likely to be a major factor influencing both the distribution and breeding success of otters.	*Upper limit:* None set. *Lower limit:* Fish & amphibian biomass should stay within expected fluctuations.
F4. Invasive alien species	See factors affecting Atlantic salmon – feature 3	See factors affecting Atlantic salmon – feature 3
F5. Coarse woody debris (CWD)	Where CWD has accumulated alongside the river bank it can create suitable sites for laying up couches and natal dens.	See factors affecting Atlantic salmon – feature 3.
F6. Illegal fish poaching:	See factors affecting Atlantic salmon – feature 3.	See factors affecting Atlantic salmon – feature 3.
F7. Diffuse & point source pollution	See factors affecting feature 2.	See factors affecting feature 2.

Performance indicators for factors affecting the feature		
F8. Agricultural operations	See factors affecting feature 2.	See factors affecting feature 2.
F9. Forestry operations	See factors affecting feature 2.	See factors affecting feature 2.
F10. River engineering	See factors affecting feature 2.	See factors affecting feature 2.
F11. Recreation	Breeding otters can be sensitive to disturbance by humans and dogs so recreational areas should be sited at a distance from suitable breeding habitat and known breeding dens.	To be determined
F12. Deposition atmospheric pollution	Eutrophication and acidification can have an indirect impact on otter by affecting the food chain.	See factors affecting feature 2.
F13. Climate change	Change in rainfall patterns and increased flooding could affect the otter breeding cycle and success rates if natal dens are flooded and feeding patterns disrupted.	See factors affecting feature 2.

Appendix 2. Water Quality Targets for River Waterbodies

(as revised in Common Standards Monitoring guidance for Rivers, JNCC 2016)

River SACs designated under the Habitats Regulations 2017 (UK Gov, 2017) overlap river water bodies designated under Water Framework Directive Regulations (NRW, 2015; UK Gov, 2015). The water quality standards that apply come from the source legislation – i.e. for the water body the WFD Regulations standards and for a SAC the Habitats Regulations standards. Note that the words targets and standards are used under the various documents that sit under these two Regulations. We have interpreted these to mean the same thing and for this document we will use the term standard unless directly quoting from a specific document. Water quality standards for Special Area of Conservation (SAC) rivers are set via agreement at a UK level and presented in the JNCC Common Standards Monitoring (CSM) guidance (JNCC 2016).

However, having two sets of standards for the same area of river can lead to confusion as to which apply in a given situation. This Appendix sets out the standards for water quality attributes for river water bodies in the Afon Gwyrfai SAC. Where they are more stringent, WFD Regulation 2017 standards are adopted as the CSM standards.

Note that for the transitional (estuarine) waterbody GB521006501200, specific water quality standards are not yet available. Therefore the standard for this waterbody is to achieve WFD Good Ecological Status.

1. Organic pollution

Table A2.1a provides the values for the physio-chemical attributes to be applied across all river types. Standards apply throughout the assessment unit, not just at sparsely distributed monitoring sites.

The standards for DO, BOD and un-ionised ammonia are the same for all river water bodies whereas the standard for total ammonia varies according to river type and previous WFD Regulations classification for ammonia (Table A2.1a). For the 90%ile total ammonia the CSM target is 0.25mg/l. However, if High Status under WFD is being reached for a water body for certain river types then the more stringent WFD standard at 0.2mg/l is applied. This is due to the no deterioration principle. Total ammonia standards for each waterbody are given in Table A2.1b.

Table A2.1a. Organic pollution standards for SAC rivers.

Organic pollution attribute	Unit	Test Statistic	Target
Dissolved Oxygen (DO)	% saturation	10%ile	≥85
Biochemical Oxygen Demand (BOD)	mg l^{-1}	Mean calculated over a 3-year period	≤1.5
Total Ammonia	mg l^{-1}	90%ile	Varies by water body. See Table 2.1b.
95%ile un-ionised ammonia	mg l^{-1}	95%ile	≤0.025

Table A2.1b. Total Ammonia standards for river water bodies in the Afon Gwyrfai SAC.

***** Reason for total ammonia standard: some water bodies that meet WFD high status for ammonia have the WFD high target of 0.2 mg l^{-1}, all other water bodies have the CSM target of 0.25 mg l^{-1}.

Water Body ID	Water Body Name	Total Ammonia (90%ile, mg l^{-1})	Reason for total ammonia standard*
N/A-not a WFD waterbody	Afon Treweunydd	0.25	CSM
GB110065054191	Gwyrfai - upstream of Cwellyn	0.25	CSM
GB110065054190	Gwyrfai - downstream of Cwellyn	0.2	WFD (high)

2. Reactive phosphorus

Phosphorous standards are set according to altitude, alkalinity, and river size, with the tightest targets in low alkalinity, high altitude headwater areas, reflecting natural variation (JNCC 2016). River Habitat Survey (EA, 2003) river flow categories are used to determine river size.

The process also includes an alignment procedure to ensure that standards are never less stringent than the Water Framework Directive (WFD) phosphorus standard for the same water body. If the WFD standard is more stringent than the CSM standard then the WFD standard applies.

Individual phosphorus standards for all waterbodies in the Afon Gwyrfai SAC are given in Table A2.2. As explained previously, the WFD phosphate standard has been applied where it is more stringent than CSM targets.

Table A2.2. Phosphorus standards and typology for river waterbodies in the Afon Gwyrfai SAC. * Phosphorus standard to be applied to annual and growing season means. Standard calculated from annual mean expressed in µg L-1 SRP. ** Reason for phosphorus standard: CSM (near natural/max allowable) are derived from the CSM guidance for Rivers and WFD (good/high) from the relevant Water Framework Directive standard.

Water Body ID	Water Body Name	SAC Manage-ment Unit(s)	Phosphorus standard* (µg l^{-1})	Reason for phosphorus standard**	CSM _Alt type	CSM _Alk type	River size
N/A-not a WFD water-body	Afon Treweunydd	1674	5	CSM (near natural)	high Alt >80m	low Alk <50m gl	Head-water
GB1100650541 91	Gwyrfai - upstream of Cwellyn	1675	5	CSM (near natural)	high Alt >80m	low Alk <50m gl	Head-water
GB1100650541 90	Gwyrfai - downstream of Cwellyn	1677 1678 1679 1680 1681	13	WFD (high)	high Alt >80m	low Alk <50m gl	river

3. Trophic diatom index

The standard should be equivalent to WFD high ecological status using the current version of the diatom classification tool (via light microscopy). This is a tool developed to measure increases in nutrient concentrations through assessing degree of change in floristic composition in benthic diatoms (algae) in streams and rivers.

4. Acidification

This standard only applies to assessment units whose water body type is classified as siliceous or peat. Other types have good buffering ability and so will not be affected by acidification. See tables 4a and 4b for standards for all water bodies in the Afon Gwyrfai SAC.

One of the WFD water bodies in the Gwyrfai is classed at risk of acidification (Hankin *et al*. 2014). However, to comply with CSM guidance, acid targets have been applied for both river water bodies. **Note that monitoring and reporting will only be carried out for water bodies classified as either 'at risk' or 'probably at risk'.** If ANC data is available then water bodies should be assessed against the ANC standard but if ANC data is not available then pH should be used.

Table A2.4a. Acidification targets for SAC rivers.

*Acid Neutralising Capacity; ** Dissolved Organic Carbon

Targets for acidification	Method of assessment
ANC*: Mean ANC for all waters > 80 pH (Clear waters with DOC**<10 mg L-1): mean > 6.54 pH (Humic waters with DOC>10 mg L-1): mean > 5.1	Analysis of water chemistry data from environment agencies. At least 36 samples (3 years of data) are required, which must include winter samples.

Table A2.4b. Acidification targets for river waterbodies in the Afon Gwyrfai SAC.

Water Body ID	Water Body Name	Acidification risk	Acid Neutralising Capacity (ANC)	pH
N/A-not a WFD waterbody	Afon Treweunydd	Probably at risk	>80	>6.54
GB110065054190	Gwyrfai - downstream of Cwellyn	Not at risk	>80	>6.54
GB110065054191	Gwyrfai - upstream of Cwellyn	Probably at risk	>80	>6.54

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