CORE MANAGEMENT PLAN
INCLUDING CONSERVATION OBJECTIVES
FOR
AFON TYWI / RIVER TYWI SAC
(SPECIAL AREA OF CONSERVATION)

Version: 11 (Minor map edit, August 2012)
Date: 15 April 2008
Approved by: Tracey Lovering

A Welsh version of all or part of this document can be made available on request.
PREFACE

This document provides the main elements of CCW’s management plan for the site named. It sets out what needs to be achieved on the site, the results of monitoring and advice on the action required. This document is made available through CCW’s 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 web site.

One of the key functions of this document is to provide CCW’s statement of the Conservation Objectives for the relevant Natura 2000 site. This is required to implement the Conservation (Natural Habitats, &c.) Regulations 1994, as amended (Section 4). As a matter of Welsh Assembly Government Policy, the provisions of those regulations are also to be applied to Ramsar sites in Wales.
1. **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.

Our vision for the Afon Tywi SAC is to maintain or, where necessary, restore the river to high ecological status, including its largely unmodified and undisturbed physical character, so that all of its special features will be able to sustain themselves in the long-term as part of a naturally functioning ecosystem. Allowing the natural processes of erosion and deposition to operate without undue interference and maintaining or restoring connectivity will maintain the physical river habitat, which forms the foundation for this ecosystem. The quality and quantity of water, including natural flow variability, and the quality of adjacent habitats will be maintained or restored to a level necessary to maintain the features in favourable condition for the foreseeable future. In places such as urban environments where natural processes are likely to cause significant damage to the public interest, artificial control measures are likely to be required.

The special fish species found in the river, both residents such as the bullhead and brook lamprey, and migratory species such as shad, river & sea lamprey, will be present in numbers that reflect a healthy and sustainable population supported by well-distributed good quality habitat. The migratory fish will be 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 will allow a large otter population to thrive. They will continue to be found along the entire length of the river and its main tributaries.

The presence of the Afon Tywi SAC and its special wildlife will enhance the economic and social values of the area by providing a high quality environment for ecotourism, outdoor activities and peaceful enjoyment by local people and visitors. The river catchment’s functions of controlling flooding and supplying clean water will be recognised and promoted through appropriate land management. The river will continue to be a focus for education to promote increased understanding of its biodiversity and the essential life support functions of its ecosystems.
2. **SITE DESCRIPTION**

2.1 Area and Designations Covered by this Plan

Grid reference: SN687263
Unitary authority: Caerfyrddin / Carmarthenshire County Council

Area (hectares): 363.45 ha

Designations covered: Afon Tywi / River Tywi SSSI
Afon Tywi / River Tywi SAC

Detailed maps of the designated sites are available through CCW’s web site: [http://www.ccw.gov.uk/interactive-maps/protected-areas-map.aspx](http://www.ccw.gov.uk/interactive-maps/protected-areas-map.aspx)
2.2 Outline Description

The Afon Tywi rises in the Cambrian Mountains and flows south for some 10km before entering Llyn Brianne reservoir. The reservoir was constructed in the early 1970’s to regulate water flows in the Tywi, enabling abstraction for public supply at Nantgaredig. From Llyn Brianne the Tywi falls steeply through mountain valleys for a further 20km before reaching the upper boundary of the SAC at Llandovery Road Bridge. The river then flows in a broadly south-westerly direction to Llandeilo, and then westerly through Carmarthen to outfall into Carmarthen Bay at Llansteffan. The Afon Tywi SAC boundary terminates in the tidal reaches just south of Carmarthen, where it enters the Carmarthen Bay & Estuaries SAC. The freshwater reaches of the Tywi are some 110km long, with just short of 80km designated as SAC. Within the SAC its course is more characteristic of a mature river, falling just 65m between Llandovery and the sea. The valley, formed by the movement of glaciers during the last ice age, has a classic U-shape, steep sided, with a wide, flat bottom. Its underlying geology of alluvium, glacial sands and gravels has resulted in an actively eroding river meandering across its wide floodplain, with generally sparse tree cover along the banks. This has led to the formation of extensive shingle shoals, ox-bow lakes and former river terraces. A number of significant tributaries flow into the designated reach, including the Llandovery Bran, Afon Dulais, Sawdde, Cennen, Cothi and Gwili.

The majority of the catchment is rural, urbanised areas are restricted to Llandovey, Llandeilo and Carmarthen. Land use is greatly influenced by geology and topography. In the mountainous upper catchment forestry and sheep farming is dominant, whilst dairy and livestock farming takes place in the middle and lower reaches. A limited amount of arable farming occurs in the middle and lower reaches, including maize for ensiling, and this has the potential to increase sediment loads in the river from field run-off over the winter period. There has been a major change from hay to silage production and increased grass production as well as an increase in the use of artificial fertilizers.

The line of the A40 trunk road and B4300 mirror the course of the Tywi on either side of the valley, coming in close proximity to the river in a number of places. The Heart of Wales railway line from Llanelli to Shrewsbury crosses the river at Llandeilo, Llangadog and Llanwrda, with significant lengths of track adjacent to the river.

The ecological structure and functions of the site are dependent on hydrological and geomorphological processes (often referred to as hydromorphological processes), as well as the quality and connectivity of riparian habitats. The more mobile species, such as migratory fish and otters, may also be affected by factors operating outside the site.

Hydrological processes, in particular river flow and water chemistry, determine a range of habitat factors of importance to the SAC features, including current velocity, water depth, wetted area, substrate quality, dissolved oxygen levels and water temperature. Maintenance of both high ‘spate’ flows and base-flows is essential. Reductions in flow may reduce the ability of the adults of migratory fish to reach spawning sites. The flow regime should be flows as near to natural as constraints will allow in order to support the functioning of the river ecosystem. The solid geology of the upper reaches and tributaries result in catchments which respond quickly to rainfall. The area has an extremely high annual average rainfall with variations both spatially and seasonally. Annual average rainfall is highest in the Black Mountains and the Cambrian Mountains, at 2,420mm and 2,008mm respectively. Rainfall decreases down the valley sides and into the bottoms, with lowest rainfall occurring in the coastal areas. The topography of the area is such that catchments respond quickly to rainfall events, with rapid changes in river levels along their lengths. Base flows in the Tywi are enhanced by releases from Llyn Brianne, though di-urnal variations occur below the abstraction at Nantgaredig, pumping being mainly at night and over
the weekends. This notwithstanding, the catchment is protected from low summer and drought flows.

**Geomorphological processes** of erosion by water and subsequent deposition of eroded sediments downstream create the physical structure of the river habitats. For the greater part, the river meanders over a flat valley floor, re-working previously deposited river sediments and unconsolidated drift materials of sands, tills and gravels deposited during and after the last ice age. These deposits are frequently exposed in small river cliffs, displaying evidence of the historical development of the river basin. Though rock sections are uncommon, the orientation of the river course indicates that it is controlled by features in the underlying solid geology such as faults or folds in the rocks of the valley floor.

The Tywi is the most mobile of rivers, meandering across the floodplain in its middle and lower reaches. Active erosion and deposition takes place from Llandovery all the way to Carmarthen, with gravel movement, pool filling, bank erosion and siltation occurring throughout. Large floods are responsible for larger-scale changes in channel character, while periods with higher frequencies of moderate floods are responsible for maintaining instability and large-scale movement of gravel bars and banks. The sensitivity of the river to change varies along its length, both in terms of the sequence of floods and human interventions. In addition, increases in extreme events as a result of climate change has implications for enhanced geomorphic activity.

These processes help to sustain the river ecosystem by allowing a continued supply of clean gravels and other important substrates to be transported downstream. In addition, the freshly deposited and eroded surfaces, such as shingle banks and earth cliffs, enable processes of ecological succession to begin again, providing an essential habitat for specialist, early-successional species. Processes at the wider catchment scale generally govern processes of erosion and deposition occurring at the reach scale, although locally factors such as the effect of grazing levels on riparian vegetation structure may contribute to enhanced erosion rates. In general, management that interferes with natural geomorphological processes, for example preventing bank erosion through the use of hard revetments or removing large amounts of gravel, are likely to be damaging to the coherence of the ecosystem structure and functions. Although gravel availability along the Tywi has reduced, there are many private gravel extraction sites, with commercial extraction taking place at Llwynjack below Llandovery. It is not known how much the extractions and the Llyn Brianne dam have contributed to the reduction in gravel availability. Other human interventions which have impacted on the geomorphology of the river include flood banks, river stabilisation, bank protection and construction of the railway embankment, which acts as a barrier to channel migration.

**Riparian habitats**, including bank sides and habitats on adjacent land, are an integral part of the river ecosystem. Diverse and high quality riparian habitats have a vital role in maintaining the SAC features in a favourable condition. The type and condition of riparian vegetation influences shade and water temperature, nutrient run-off from adjacent land, the availability of woody debris to the channel and inputs of leaf litter and invertebrates to support in-stream consumers. Light, temperature and nutrient levels influence in-stream plant production and habitat suitability for the SAC features. Woody debris is very important as it provides refuge areas from predators, traps sediment to create spawning and juvenile habitat and forms the base of an important aquatic food chain. Otters require sufficient undisturbed riparian habitat for breeding and resting sites. It is important that appropriate amounts of tree cover, tall vegetation and other semi-natural habitats are maintained on the riverbanks and in adjacent areas, and that they are properly managed to support the SAC features. This may be achieved for example, through managing grazing levels, selective coppicing of riparian trees and restoring adjacent wetlands. The mobility of the Tywi has resulted in the formation of significant areas of off-channel habitat in the form of ox-bows, wet woodlands, willow scrub etc. These are predominantly away from the main channel, and form important areas for otter
to rest-up in or support breeding sites. In the urban sections the focus may be on maintaining the river as a communication corridor but this will still require that sufficient riparian habitat is present and managed to enable the river corridor to function effectively.

**Habitat connectivity** is an important property of river ecosystem structure and function. Many of the fish that spawn in the river are migratory, depending on the maintenance of suitable conditions on their migration routes to allow the adults to reach available spawning habitat and juvenile fish to migrate downstream. For resident species, dispersal to new areas, or the prevention of dispersal causing isolated populations to become genetically distinct, may be important factors. Artificial obstructions including weirs and bridge sills can reduce connectivity for some species. In addition, reaches subject to depleted flow levels, pollution, or disturbance due to noise, vibration or light, can all inhibit the movement of sensitive species. The dispersal of semi-terrestrial species, such as the otter, can be adversely affected by structures such as bridges under certain flow conditions, therefore these must be designed to allow safe passage. The continuity of riparian habitats enables a wide range of terrestrial species to migrate and disperse through the landscape. Connectivity should be maintained, or restored where necessary, as a means to ensure access for the features to sufficient habitat within the SAC.

**External factors**, operating outside the SAC, may also be influential, particularly for the migratory fish and otters. Otters may be affected by developments that affect resting and breeding sites outside the SAC boundary.

### 2.3 Outline of Past and Current Management

There are many different aspects to the management of this large and complex site that may affect its conservation status. These are summarised in the Site Management Statements for the component SSSI.

### 2.4 Management Units

The plan area 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 the following:

- SAC/SSSI boundary
- Artificial barriers, where they significantly affect one or more of the features’ ranges
- Major impacts, in particular major water abstractions
- Natural hydromorphology, where there are significant differences in management issues/key features between reaches
- Estuaries: the reach below the tidal limit is treated as a separate unit
- The units include one or more of EA’s River Basin Management Plan water bodies; as far as is practicable, unit boundaries coincide with these water body boundaries.

Maps showing the management units referred to in this plan are shown on the site web page.
3. **THE SPECIAL FEATURES**

3.1 **Confirmation of Special Features**

<table>
<thead>
<tr>
<th>Designated feature</th>
<th>Relationships, nomenclature etc</th>
<th>Conservation Objective in part 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SAC features</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Annex II species that are a primary reason for selection of this site</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twaiite shad <em>Alosa fallax</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>European otter <em>Lutra lutra</em></td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

| **Annex I habitats and Annex II species present as qualifying features, but not primary reasons for site selection** | | |
| Allis shad *Alosa alosa* | Management for this feature is effectively the same as for twaiite shad | 1 |
| Sea lamprey *Petromyzon marinus* | 2 |
| Brook lamprey *Lampetra planeri* | 3 |
| River Lamprey *Lampetra fluviatilis* | These two species are generally indistinguishable for the purposes of monitoring; however management requirements are similar |
| Bullhead *Cottus gobio* | 4 |

| **SPA features** |                                  |                                 |
| **Ramsar features** |                                  |                                 |
| **SSSI features** |                                  |                                 |

| Little ringed plover *Charadrius dubius* | | |
| Sandmartin *Riparia riparia* | | |
| Shingle invertebrates | | |
| Club-tailed dragonfly *Gomphus vulgatissimus* | | |

3.2 **Special Features and Management Units**

This section sets out the relationship between the special 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 special 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 focus of management and monitoring effort, perhaps because of the dependence of a key species (see **KS** below). There will rarely be more than one Key Habitat in a unit.
- **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 focus of management and 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 focus of management or monitoring. These features will benefit from management for the key feature(s) identified in the unit. These may be classed as ‘Sym’ features because:

a) they are present in the unit but are 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).

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 with no special feature present but which are of importance for management of features elsewhere on a site e.g. livestock over-wintering area included within designation boundaries.

x – Features not present in the management unit.

The tables below set out the relationship between the special features and management units identified in this plan:

<table>
<thead>
<tr>
<th>Afon Tywi (River Tywi) SSSI</th>
<th>Management unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3  4  5  6  7</td>
</tr>
<tr>
<td>SAC</td>
<td></td>
</tr>
<tr>
<td>SSSI</td>
<td></td>
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<tr>
<td>CCW ownership</td>
<td></td>
</tr>
<tr>
<td>SAC Features</td>
<td></td>
</tr>
<tr>
<td>Twaite shad</td>
<td>Sym  Sym    KS  KS  KS  KS  KS</td>
</tr>
<tr>
<td>Allis shad</td>
<td>Sym  Sym    Sym  Sym  Sym  Sym  Sym</td>
</tr>
<tr>
<td>Sea lamprey</td>
<td>KS  KS     Sym  Sym  Sym  Sym  Sym</td>
</tr>
<tr>
<td>Brook lamprey</td>
<td>Sym  Sym    Sym  Sym  Sym  Sym  Sym</td>
</tr>
<tr>
<td>River lamprey</td>
<td>Sym  Sym    Sym  Sym  Sym  Sym  Sym</td>
</tr>
<tr>
<td>Bullhead</td>
<td>Sym  Sym    Sym  Sym  Sym  Sym  Sym</td>
</tr>
<tr>
<td>European otter</td>
<td>KS  KS     KS  KS  KS  KS  KS</td>
</tr>
<tr>
<td>SSSI Features</td>
<td></td>
</tr>
<tr>
<td>Little ringed plover</td>
<td>KS  KS     KS  KS  KS  KS  KS</td>
</tr>
<tr>
<td>Charadrius dubius</td>
<td></td>
</tr>
<tr>
<td>Shingle invertebrates</td>
<td>Sym  Sym    Sym  Sym  Sym  Sym  Sym</td>
</tr>
</tbody>
</table>

- Sea lamprey, brook lamprey and bullhead are recorded throughout the SAC.
- Twaite shad are recorded only infrequently in Units 1 & 2, as their distribution is constrained by flow and temperature barriers.
- The distribution of river lamprey is unknown. Single records exist for units
- Management for tawae shad and sea lamprey is expected to also be sympathetic for river/brook lamprey (spawning habitat) and bullhead.
- Specific management measures for otter relating to adjacent habitats and disturbance require its selection as a key feature in all units.
- The status of allis shad is uncertain on the Afon Tywi (River Tywi) SSSI. It is assumed to be present in the same units as tawae shad.
4. **CONSERVATION OBJECTIVES**

**Background to Conservation Objectives:**

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

Conservation objectives are required by the 1992 ‘Habitats’ Directive (92/43/EEC). The aim of the Habitats Directives is the maintenance, or where appropriate the restoration of the ‘favourable conservation status’ of habitats and species features for which SACs and SPAs are designated (see Box 1).

In the broadest terms, ‘favourable conservation status’ means a feature is in satisfactory condition and all the things needed to keep it that way are in place for the foreseeable future. CCW considers that the concept of favourable conservation status provides a practical and legally robust basis for conservation objectives for Natura 2000 and Ramsar sites.

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**Box 1**

**Favourable conservation status 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.”

Achieving these objectives requires appropriate management and the control of factors that may cause deterioration of habitats or significant disturbance to species.

As well as the overall function of communication, Conservation objectives have a number of specific roles:

- Conservation planning and management.

The conservation objectives guide management of sites, to maintain or restore the habitats and species in favourable condition.
Assessing plans and projects.

Article 6(3) of the ‘Habitats’ Directive requires appropriate assessment of proposed plans and projects against 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. This role for testing plans and projects also applies to the review of existing decisions and consents.

Monitoring and reporting.

The conservation objectives provide the basis for assessing the condition of a feature and the status of factors that affect it. CCW uses ‘performance indicators’ within the conservation objectives, as the basis for monitoring and reporting. Performance indicators are selected to provide useful information about the condition of a feature and the factors that affect it.

The conservation objectives in this document reflect CCW’s 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 CCW in light of new knowledge.

b. Format of the conservation objectives

There is one conservation objective for each feature listed in part 3. Each conservation objective is a composite statement representing a site-specific description of what is considered to be the favourable conservation status of the feature. These statements apply to a whole feature as it occurs within the whole plan area, although section 3.2 sets out their relevance to individual management units.

Each conservation objective consists of the following two elements:

1. Vision for the feature
2. Performance indicators

As a result of the general practice developed and agreed within the UK Conservation Agencies, conservation objectives include performance indicators, the selection of which should be informed by JNCC guidance on Common Standards Monitoring.

There is a critical need for clarity over the role of performance indicators within the conservation objectives. A **conservation objective, because it includes the vision for the feature, has meaning and substance independently of the performance indicators, and is more than the sum of the performance indicators**. The performance indicators are simply what make the conservation objectives measurable, and are thus part of, not a substitute for, the conservation objectives. Any feature attribute identified in the performance indicators should be represented in the vision for the feature, but not all elements of the vision for the feature will necessarily have corresponding performance indicators.

As well as describing the aspirations for the condition of the feature, the Vision section of each conservation objective contains a statement that the factors necessary to maintain those desired conditions are under control. Subject to technical, practical and resource constraints, factors which have an important influence on the condition of the feature are identified in the performance indicators.

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1 Web link: [http://www.jncc.gov.uk/page-2199](http://www.jncc.gov.uk/page-2199)
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.

4.1 **Conservation Objective for the watercourse**

4.1.1 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.

4.1.2 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 & quality, physical habitat, community composition & structure. It is anticipated that these limits will concur with the relevant standards used by the Review of Consents process given in Annexes 1-3.

4.1.3 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.

4.1.4 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.

4.1.5 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.

4.1.6 The river planform 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.

4.1.7 River habitat SSSI features should be in favourable condition.

4.1.8 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.

4.1.9 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.

4.1.10 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.

4.1.11 Flow objectives for assessment points in the Tywi, Taf & Gwendraeths Catchment Abstraction Management Strategy (CAMS) as they relate to the Tywi SAC will be agreed between EA and CCW as necessary. It is anticipated that these limits will concur with the standards used by the Review of Consents process given in Annex 1 of this document.
4.1.12 Levels of nutrients, in particular phosphate, will be agreed between EA and CCW for each Water Framework Directive water body in the Tywi SAC, and measures taken to maintain nutrients below these levels. It is anticipated that these limits will concur with the standards used by the Review of Consents process given in Annex 2 of this document.

4.1.13 Levels of water quality parameters that are known to affect the distribution and abundance of SAC features will be agreed between EA and CCW for each Water Framework Directive water body in the Tywi SAC, and measures taken to maintain pollution below these levels. It is anticipated that these limits will concur with the standards used by the Review of Consents process given in Annex 3 of this document.

4.1.14 Levels of suspended solids will be agreed between EA and CCW for each Water Framework Directive water body in the Tywi 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.

4.1.15 Potential sources of pollution not addressed in the Review of Consents, such as contaminated land, will be considered in assessing plans and projects.

The Atlantic salmon and sea trout are the focus for much of the management activity carried out on the Tywi catchment. Their relatively demanding water quality and spawning substrate quality requirements mean that reduction in diffuse pollution and siltation impacts is a high priority for the catchment. Despite the fact that salmon are not an SAC feature on the Tywi, actions undertaken for the benefit of salmonids will in the main be beneficial to the SAC fish species and otter. Measures to address these problems include the establishment of buffer zones on reaches adjacent to intensively managed livestock grazing or arable land. Tree management, especially coppicing and pollarding to increase light levels to the channel, is also often carried out. The EAW’s Sustainable Fisheries Project has carried out much of this work in recent years.

In the Tywi catchment, the most significant sources of diffuse pollution and siltation are from agriculture, including fertiliser run-off, livestock manure, silage effluent and soil erosion from ploughed land. 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, has a devastating impact on crayfish populations and 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 Environment Agency 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 water course/banks should be maintained, where appropriate. Some reaches may naturally have lower tree cover. Cover may also be lower in urban reaches.
4.2 Conservation Objective for Features 1-4:
- Twaite shad *Alosa fallax* (EU Species Code: 1103);
- Allis shad *Alosa alosa* (EU Species Code: 1102);
- Sea lamprey *Petromyzon marinus* (EU Species Code: 1095);
- Brook lamprey *Lampetra planeri* (EU Species Code: 1096);
- River lamprey *Lampetra fluviatilis* (EU Species Code: 1099);
- Bullhead *Cottus gobio* (EU Species Code: 1163)

Vision for features 1-4

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

<table>
<thead>
<tr>
<th>FCS component</th>
<th>Supporting information / current knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4.2.1</strong> The conservation objective for the water course as defined in 4.1 above must be met</td>
<td>Refer to sections 5.1 to 5.5 for current assessments of feature populations.</td>
</tr>
<tr>
<td><strong>4.2.2</strong> The population of the feature in the SAC is stable or increasing over the long term.</td>
<td>Entrainment in water abstractions impacts on population dynamics through reduced recruitment and survival rates. Fish stocking can adversely affect population dynamics through competition, predation and introduction of disease.</td>
</tr>
<tr>
<td><strong>4.2.3</strong> 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 e.g. food supply (as described in sections 2.2 and 5). 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 in view of 4.2.4</td>
<td>Some reaches of the Tywi SAC will be more suitable for some features than others e.g. the main shad spawning areas are located in the lower and middle reaches between Whitemill and Dryslwyn. These differences influence the management priorities for individual reaches and are used to define the site units described in section 3.2. Further details of feature habitat suitability are given in section 5. 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 in section 4.1 are secured. The characteristic channel morphology provides the diversity of water depths, current velocities and substrate types necessary to fulfil the habitat requirements of the features. The close proximity of different habitats facilitates movement of fish to new preferred habitats with age. The presence of hard bank revetments in a number of active alluvial reaches e.g. between Llanwrda and Llandeilo, adversely affects the processes that maintain suitable habitat for the SAC features. Temperature effects from the hypolimnial release at Llyn Brianne suppress river temperatures as far downstream as Llandeilo. Migration and spawning in shad are triggered by increasing water temperatures, and this is likely to be restricting their range.</td>
</tr>
</tbody>
</table>
Hydrological processes in the Tywi are currently affected by the water management regime from Llyn Brianne reservoir and the abstraction at Capel Dewi. The system is complicated, but effects can be both positive and negative, the impoundment reducing summer flood events, but also augmenting flows during low summer flows. Flow reductions downstream of the abstraction during night and weekend pumping has the potential to dry-out spawning beds and lamprey ammocoete beds. Shad migration can be affected by acoustic barriers and by high sediment loads, which can originate from a number of sources including construction works.

4.2.4 There is, and will probably continue to be, a sufficiently large habitat to maintain the feature’s population in the SAC on a long-term basis.

Allis and twaite shad are affected by range contraction due to temperature and artificial barriers to migration in the Tywi. It is likely that this loss of habitat affects their maintenance in the SAC on a long-term basis.

Performance indicators for features 1-4

The performance indicators are part of the conservation objective, not a substitute for it. Assessment of plans and projects must be based on the entire conservation objective, not just the performance indicators.

<table>
<thead>
<tr>
<th>Performance indicators for feature condition: Twaite shad (<em>Alosa fallax</em>) and Allis shad (<em>Alosa alosa</em>)</th>
<th>Attribute</th>
<th>Specified limits</th>
<th>Comments</th>
<th>Relevant unit(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1. Adult run size</td>
<td>No decline in the annual run size greater than would be expected from variations in natural mortality alone</td>
<td>Adult run size should comply with an agreed target for the river. The EAW operate an acoustic and video fish counter at Ty Castell flow gauging station immediately upstream of the Capel Dewi WTW intake. The use of hydroacoustic counters for estimating run size is currently being investigated by the EAW.</td>
<td>5-6</td>
<td></td>
</tr>
<tr>
<td>A2. Spawning distribution</td>
<td>No decline in spawning distribution</td>
<td>Spawning distribution is assessed by kick sampling for eggs and/or observations of spawning adults. A representative sample of sites within units 5 to 6 will be monitored at 3 yearly intervals. Absence from sites within reaches 5 to 6 in 2 consecutive surveys will result in an unfavourable condition assessment.</td>
<td>1-6</td>
<td></td>
</tr>
</tbody>
</table>
**Performance indicators for factors affecting the feature**

<table>
<thead>
<tr>
<th>Water quality</th>
<th>F1. Biological quality</th>
<th>Biological GQA class B</th>
<th>All classified reaches within the site that contains, or should contain, twaite or allis shad under conditions of high environmental quality should comply with the targets given.</th>
<th>1-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>F2. Chemical quality</td>
<td>RE1</td>
<td>It has been agreed through the Review of Consents process that RE1 will be used throughout the SAC (see Annex 3).</td>
<td>1-6</td>
<td></td>
</tr>
</tbody>
</table>

**Hydromorphology**

<table>
<thead>
<tr>
<th>F3. Flow</th>
<th>Targets are set in relation to river/reach type(s)</th>
<th>Targets equate to those levels agreed and used in the Review of Consents (see Annex 1). Shad are particularly sensitive to flow. The ideal regime is one of relatively high flows in March-May, to stimulate migration and allow maximum penetration of adults upstream, followed by rather low flows in June-September, which ensures that the juveniles are not washed prematurely into saline waters and grow rapidly under warmer conditions. The release of freshets to encourage salmonid migration should therefore be discouraged on shad rivers during this period.</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>F4. Temperature</td>
<td>Targets are set in relation to river/reach type(s)</td>
<td>Targets equate to those levels agreed and used in the Review of Consents (see Annex 1). Shad are particularly sensitive to temperature. The impact of the hypolimnial release from Llyn Brianne reservoir on the spawning range of shad is being assessed as part of the Review of Consents process. The release of freshets to encourage salmonid migration should therefore be discouraged on shad rivers during this period.</td>
<td>All</td>
</tr>
</tbody>
</table>
## Performance indicators for feature condition: Sea lamprey (*Petromyzon marinus*)

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Specified limits</th>
<th>Comments</th>
<th>Relevant unit(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1. Distribution within catchment</td>
<td>Suitable habitat adjacent to or downstream of known spawning sites should contain <em>Petromyzon</em> ammocoetes.</td>
<td>This attribute provides evidence of successful spawning and distribution trends, and will be applied to spawning sites known to have been utilised within the previous 10 years, and historical sites considered still to have suitable habitat. Spawning locations may move within and between sites due to natural processes and new sites may be discovered over time. Silt beds downstream of all sites identified will be sampled for presence or absence of ammocoetes. Where apparently suitable habitat at any site is unoccupied feature condition will be considered unfavourable. Monitoring undertaken by APEM in 2004 failed to yield any sea lamprey ammocoetes or transformers despite reports of adult fish spawning in the system.</td>
<td>1-6</td>
</tr>
<tr>
<td>A2. Ammocoete density</td>
<td>Ammocoetes should be present in at least four sampling sites each not less than 5km apart.</td>
<td>This standard CSM attribute establishes a minimum occupied spawning range, within any sampling period, of 15km. In the Tywi, spawning sites within units 3 to 4 will be assessed against this attribute.</td>
<td>3-4</td>
</tr>
<tr>
<td>A3. Spawning Activity</td>
<td>No reduction in extent of spawning activity year on year</td>
<td>Direct observation or redd counts Sea lamprey ammocoetes are typically much less numerous than river / brook lamprey ammocoetes, so this may be the only cost-effective means of determining that a healthy spawning population is present. Sea lampeys spawn in June – August (depending on the river) and are usually easily observed at traditional spawning sites during these months.</td>
<td>1-6</td>
</tr>
</tbody>
</table>
### Performance indicators for factors affecting the feature

#### Water quality

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Specified limits</th>
<th>Comments</th>
<th>Relevant unit(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1. Biological quality</td>
<td>Biological GQA class B</td>
<td>All classified reaches within the site that contain, or should contain sea lamprey under conditions of high environmental quality should comply with the targets given.</td>
<td>I-6</td>
</tr>
<tr>
<td>F2. Chemical quality</td>
<td>RE1</td>
<td>It has been agreed through the Review of Consents process that RE1 will be used throughout the SAC (see Annex 3).</td>
<td>I-6</td>
</tr>
</tbody>
</table>

#### Hydromorphology

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Specified limits</th>
<th>Comments</th>
<th>Relevant unit(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F3. Flow</td>
<td>Targets are set in relation to river/reach type(s)</td>
<td>Targets equate to those levels agreed and used in the Review of Consents (see Annex 1). Migration of adult sea lamprey is likely to be influenced by tide and river flows. The ideal regime is one of relatively high flows from April – June, to stimulate migration and allow maximum penetration of adults upstream to their spawning beds, followed by lower flows to help larvae disperse across suitable habitat downstream, but not be washed away.</td>
<td>All</td>
</tr>
<tr>
<td>F4. Temperature</td>
<td>Targets are set in relation to river/reach type(s)</td>
<td>Targets equate to those levels agreed and used in the Review of Consents (see Annex 1). The timing, consistency and duration of adult sea lamprey migration are closely related to temperature. Peak migration usually coincides with temperature above 10°C. The impact of the hypolimnial release from Llyn Brianne reservoir on the spawning range of sea lamprey is being assessed as part of the Review of Consents process.</td>
<td>All</td>
</tr>
</tbody>
</table>

### Performance indicators for feature condition: Brook lamprey (*Lampetra planeri*) & river lamprey (*Lampetra fluviatilis*)

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Specified limits</th>
<th>Comments</th>
<th>Relevant unit(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1. Age/size structure of ammocoete population</td>
<td>Samples &lt; 50 ammocoetes ~ 2 size classes</td>
<td>This gives an indication of recruitment to the population over the several years preceding the survey. Failure of one or more years recruitment may be due to either short or long term impacts or natural factors such as natural flow variability, therefore would trigger further investigation of the cause rather than leading automatically to an unfavourable condition assessment.</td>
<td>1-6</td>
</tr>
<tr>
<td></td>
<td>Samples &gt; 50 ammocoetes ~ at least 3 size classes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Present at not less that 2/3 of sites surveyed within natural range</td>
<td>The combined natural range of these two species in terms of ammocoete distribution includes all units above the tidal limit i.e. all except unit 7. Presence at less than 2/3 of sample sites will lead to an unfavourable condition assessment.</td>
<td></td>
</tr>
</tbody>
</table>
A3. **Ammocoete density**

<table>
<thead>
<tr>
<th>Optimal habitat:</th>
<th>Optimal habitat comprises beds of stable fine sediment or sand &gt;15cm deep, low water velocity and the presence of organic detritus.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;10m²</td>
<td></td>
</tr>
<tr>
<td>Overall catchment mean: &gt;5m²</td>
<td></td>
</tr>
</tbody>
</table>

**Performance indicators for factors affecting the feature**

**Water quality**

F1. **Biological quality**

- Biological GQA class B
- All classified reaches within the site that contain, or should contain lamprey under conditions of high environmental quality should comply with the targets given.

F2. **Chemical quality**

- RE1
- It has been agreed through the Review of Consents process that RE1 will be used throughout the SAC (see Annex 3).

**Hydromorphology**

F3. **Flow**

- Targets are set in relation to river/reach type(s)
- Targets equate to those levels agreed and used in the Review of Consents (see Annex 1).

F4. **Temperature**

- Targets are set in relation to river/reach type(s)
- Targets equate to those levels agreed and used in the Review of Consents (see Annex 1).
- River lamprey spawning in UK rivers starts when water temperatures reach 10-11°C. The impact of the hypolimnial release from Llyn Brianne reservoir on the spawning range of sea lamprey is being assessed as part of the Review of Consents process.

**Performance indicators for feature condition: Bullhead (*Cottus gobio*)**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Specified limits</th>
<th>Comments</th>
<th>Relevant unit(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1. Population densities</td>
<td>No less than 0.2 m⁻² in sampled reaches</td>
<td>CSM guidance states that densities should be no less than 0.2 m⁻² in upland rivers (source altitude &gt;100m) and 0.5 m⁻² in lowland rivers (source altitude ≤100m). A significant reduction in densities may also lead to an unfavourable condition assessment.</td>
<td>1-6</td>
</tr>
<tr>
<td>A2. Distribution</td>
<td>Bullheads should be present in all suitable reaches. As a minimum, no decline in distribution from current</td>
<td>Suitable reaches will be mapped using fluvial audit information validated using the results of population monitoring. Absence of bullheads from any of these reaches, or from any previously occupied reach, revealed by on-going monitoring will result in an unfavourable condition assessment.</td>
<td>1-6</td>
</tr>
<tr>
<td>A3. Reproduction / age structure</td>
<td>Young-of-year fish should occur at densities at least equal to adults</td>
<td>This gives an indication of successful recruitment and a healthy population structure. Failure of this attribute on its own would not lead to an unfavourable condition assessment.</td>
<td></td>
</tr>
<tr>
<td>---------------------------------</td>
<td>--------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
</tbody>
</table>

**Performance indicators for factors affecting the feature**

**Water quality**

<table>
<thead>
<tr>
<th>F1. Biological quality</th>
<th>Biological GQA class B</th>
<th>All classified reaches within the site that contain, or should contain bullhead under conditions of high environmental quality should comply with the targets given.</th>
</tr>
</thead>
<tbody>
<tr>
<td>F2. Chemical quality</td>
<td>RE1</td>
<td>It has been agreed through the Review of Consents process that RE1 will be used throughout the SAC (see Annex 3).</td>
</tr>
<tr>
<td>Hydromorphology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F3. Flow</td>
<td>Targets are set in relation to river/reach type(s)</td>
<td>Targets equate to those levels agreed and used in the Review of Consents (see Annex 1).</td>
</tr>
<tr>
<td>F4. Temperature</td>
<td>Targets are set in relation to river/reach type(s)</td>
<td>Targets equate to those levels agreed and used in the Review of Consents (see Annex 1).</td>
</tr>
</tbody>
</table>
4.3 Conservation Objective for Feature 5: - European otter (*Lutra lutra*) (EU Species Code: 1355)

**Vision for feature 5**
The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

<table>
<thead>
<tr>
<th>FCS component</th>
<th>Supporting information / current knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4.3.1</strong> 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.</td>
<td>Refer to section 5.9 for current assessment of feature population</td>
</tr>
<tr>
<td><strong>4.3.2</strong> 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 whole area of the Tywi SAC is considered to form potentially suitable breeding habitat for otters. 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 should be subject to a level of disturbance that could have an adverse effect on breeding success. Where necessary, potentially harmful levels of disturbance must be managed.</td>
<td>Survey information shows that otters are widely distributed in the Tywi catchment. While the breeding population in the Tywi is not currently considered to be limited by the availability of suitable breeding sites, there is some uncertainty over the number of breeding territories which the SAC is capable of supporting given near-natural levels of prey abundance. The decline in eel populations may be having an adverse effect on the population of otters in the Tywi.</td>
</tr>
<tr>
<td><strong>4.3.3</strong> 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.</td>
<td>Otter road deaths could have a potentially significant impact on otter populations within the Tywi catchment. 56 individuals deaths were recorded from Carmarthenshire between 1983 &amp; 2002, 12 of which were adult females. A number of mitigation schemes have been undertaken by the Trunk Roads Authority and Carmarthenshire CC Highways Dept. at sites flagged as blackspots.</td>
</tr>
</tbody>
</table>
Performance indicators for Feature 5

The performance indicators are part of the conservation objective, not a substitute for it. Assessment of plans and projects must be based on the entire conservation objective, not just the performance indicators.

### Performance indicators for feature condition: Otter: *Lutra lutra*

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Specified limits</th>
<th>Comments</th>
<th>Relevan(t) unit(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1. Distribution</td>
<td>Otter signs present at 70% of Otter Survey of Wales sites (CCW, 2005(^3))</td>
<td>The Otter Survey of Wales undertaken in 2002 surveyed 86 reference sites in the Tywi catchment, of which 77% were positive. This continued an upward trend in signs from 14% in 1977; 68% in 1984; 69% in 1991. The next survey is planned in 2009, but CCW are currently considering a rolling programme of sub-catchment survey every 2 years using Otter Survey of Wales full survey sites. The 3 sub-catchments(^2) identified in Morgan (2005) would therefore be surveyed once in every six years.</td>
<td>All</td>
</tr>
<tr>
<td>A2. Breeding activity</td>
<td>2 reports of cub/family sightings, or 2 reports of cub, lactating or pregnant female road casualties at least 1 year in 3.</td>
<td>Based on current information 5 centres of breeding activity have been estimated within the SAC. These sit with a reach of 67km and therefore exceed the estimate of 1 breeding female per 20km. However each of these centres includes the confluence of at least 1 major tributary, whose contribution is not take into account.</td>
<td>All</td>
</tr>
<tr>
<td>A3. Actual and potential breeding sites</td>
<td>No decline in number and quality of mapped breeding sites in sub-catchments Ref: as above</td>
<td>In the Tywi catchment, 101 actual or potential breeding sites have been identified, distributed throughout the catchment on the main river and tributaries.</td>
<td>All</td>
</tr>
</tbody>
</table>

\(^2\) Sub-catchment A – The estuary to Abergwili (km 0 – km 29); Sub-catchment B – Capel Dewi to Llandovery (km 30 – km 86); Sub-catchment C – Llandovery to Nant-ystalwyn (km 87 – km 116)
5. ASSESSMENT OF CONSERVATION STATUS AND MANAGEMENT REQUIREMENTS

This part of the document provides:

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

5.1 Conservation status and management requirements of Feature 1: Twaite shad *Alosa fallax* and Allis shad *Alosa alosa*

Conservation status

Status: Unfavourable: Unclassified

The JNCC have produced generic guidance for setting targets that relate to favourable condition status of shad species as a feature in SAC rivers. Each of the shad life-stage attributes (adult run size, spawning distribution and juvenile density) should have river specific targets set from baseline surveys over the first six years of the seven year SAC monitoring and reporting cycle \(^5\). However, as yet there are no strategic monitoring programmes in place for each life stage in each of the three Welsh SACs.

The River Tywi has limited data on which to base attribute targets. Although the river has an acoustic and video counter at Nantgaredig, this has only been used to count shad in one year, which is insufficient to set a target for this attribute.

Monitoring of these species in the Tywi therefore relies on two methods:

i. Kick sampling for eggs provides qualitative information on spawning distribution,

ii. Netting for juveniles in the lower river and tidal reaches during late summer/autumn when juveniles drift downstream towards the estuary

The baseline surveys for eggs and spawning sites are the most comprehensive of any of the Welsh rivers. Targets are difficult to set however due to apparent inter-annual variability in spawning distribution. 0+ surveys have only been conducted during the summer/autumn of one year (2002), and few shad were captured. Unfortunately, there are no data to indicate whether this lack of success was due to sampling problems or inter-annual variations in spawning success. As such, it is impossible to set a target for 0+ densities based on historical data in the River Tywi.

These methods do not distinguish between the two species. Allis shad is thought to be rare, with no recent records in the Tywi, while twaite shad is relatively common. Kick sampling for eggs is only able to give a broad scale indication of presence or absence at sampled locations. Netting for juveniles gives a quantitative estimate of abundance, though may be subject to a high degree of uncertainty due to sampling error. This uncertainty is likely to be compounded by variation between years in the size of the adult run, spawning success and resulting numbers of juveniles. Poor adult runs are likely to result from unsuitable flows during the March to June migration period, in particular prolonged low flows, while poor survival of eggs and juveniles is related to spate flows in the mid to late summer which can flush them into the estuary prematurely.

CSM guidance states that adult run size should comply with an agreed target for each river, with no drop in the annual run greater than would be expected from variations in natural mortality alone. The acoustic counters used on the Tywi by the Environment Agency to count migrating Atlantic salmon (*Salmo salar*) have been also used to try and count shad \(^6,7\). However, to date this work is still experimental and, despite the recommendation of the LIFE in UK Rivers report \(^3\), no strategic monitoring of adult shad has been established and the Environment Agency are undertaking the work on an ad hoc basis where funding will allow.
There are problems associated with using acoustic counters for shad, these include:

- shad exhibiting avoidance behaviour to the standard 200 kHz acoustic counter used for salmon;
- problems in counting individual fish for a species that migrates in shoals;
- problems of using standard echo integration techniques to estimate numbers in a shoal;
- problems differentiating shad from shoals of sea trout (*Salmo trutta* L.) on the River Tywi.

No data exist for shad from the acoustic counters at Nantgaredig and White Mill, primarily because the counters are set and used to monitor salmon. Furthermore, differentiation of shad from the large numbers of sea trout that migrate in the Tywi is not possible with acoustic systems. In 2005 and 2006 the Environment Agency trialled video camera techniques alongside acoustic counters at White Mill to aid differentiation between sea trout and shad. This allowed the numbers of individual shad migrating up- and downstream during the spawning season to be counted. However, these data are still under evaluation for the Review of Consents process.

The current unfavourable status results from a precautionary assessment of feature distribution and abundance, and from the presence of adverse factors, in particular flow depletion & physical barriers to migration. Temperature effects and entrainment are also thought to be impacting upon spawning distribution and population density, though they do not form part of the CSM assessment.

### Management requirements

The impacts of barriers to migration and flow depletion are highlighted in the assessment of conservation status for these features.

Artificial physical barriers are probably the single most important factor in the decline of shad in Europe. Impassable obstacles between suitable spawning areas and the sea can eliminate breeding populations of shad. Both species (but particularly allis shad) can make migrations of hundreds of kilometres from the estuary to spawning grounds in the absence of artificial barriers. Existing fish passes designed for salmon are often not effective for shad. Any new provisions need to take their requirements into account. The impact of existing barriers in the Tywi 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. Llangadog Creamery weir is considered to be the most significant barrier to fish migration in the Tywi. Consideration is being given to reduce or remove the effect of this barrier. An assessment of options will be carried out in conjunction with the other relevant competent authorities.

The River Tywi is a regulated river, with flows at certain times of the year primarily controlled by releases from Llyn Brianne. The reservoir controls releases of water for hydropower generation and the principal potable abstraction at Capel Dewi, and a seasonal abstraction at Manorafan. In addition, the EAW retains control over a 9092 ML management reserve, which can be used for ecological flows. These flows are most often used as freshets for fisheries management purposes in the spring and autumn to support migration of salmonids.

The impact of flow depletion downstream of major abstractions was assessed in the Review of Consents process. The outputs of the hydraulic model suggest that changes to water depth and water velocities occurring as a result of the abstraction at Capel Dewi are unlikely to impact upon: the ability of adult shad to migrate through the lower reaches of the river; spawning habitat downstream of Capel Dewi; or juvenile habitat downstream of the abstraction. However the diurnal operation of the pumps does expose marginal habitat and therefore has the potential to strand juveniles or expose sediments supporting juvenile habitat. There are also requirements for screening of intakes to reduce or remove the impact of impingement and entrainment on juvenile fish migrating downstream. Entrainment in water abstractions directly impacts on population dynamics through...
reduced recruitment and survival rates. Information on likely rates of entrainment of shad eggs and juveniles is required before acceptable levels can be assessed. The screening arrangements at the DCWW intakes at Manorafon and Capel Dewi are currently being assessed as part of the Habitats Directive Review of Consents process.

Llyn Brianne is a deep reservoir that exhibits thermal stratification in the spring/summer. Releases of water from the reservoir are from a fixed discharge depth of 65 m, which is below the stratification layer and results in cold water being released into the Tywi. This results in reduced temperature conditions in the main river Tywi at certain times of year. For instance, hypolimnial releases from the reservoir during summer months average 6-8°C and can lower river temperatures for 55 km below the reservoir outflow.

Allis and twaite shad are temperature dependent in critical phases of their life history. Both species are anadromous, migrating from the sea into rivers as adults to spawn. The timing of adult migrations appears to be primarily dependent upon temperature, with migration triggered at estuarine water temperatures of 11-12°C and secondarily by river flow and tides. Peak migration activity occurs at water temperatures of 11-14°C, usually between April and June. Spawning varies regionally, but typically takes place in water temperatures of above 15°C between May and July. Eggs are sensitive to water temperatures below 16-18°C. Water temperatures of above 18°C throughout June and July are therefore considered ideal for successful shad egg incubation. Temperature is also believed to be important in triggering migration of shad larvae towards the estuary, with most juvenile thought to migrate from the River Wye into the Severn estuary once water temperatures fall below 19°C.

Recent research on shad spawning within the Tywi SAC suggests that temperature is a limiting factor in the distribution of shad adults throughout the Tywi catchment. Temperature data collected from various points throughout the main River Tywi during 2005 and 2006 suggest that current hypolimnion releases from Llyn Brianne have a significant effect on water temperatures in the upper catchment. It therefore seems likely, given the ecological requirements of the species as outlined above, that the current temperature profile of the Tywi is limiting the distribution of these features.

The use of freshet releases from Llyn Brianne to stimulate salmonid smolt migration in the spring and adult migration in the autumn are also potentially damaging. Cold water releases in the spring could delay the migration of adult shad into the system, while autumn releases can flush juvenile shad into the estuary before they are sufficiently developed to cope with changing salinity regimes. This is magnified due to the majority of shad spawning occurring in the lower reaches of the Tywi.

Biological and chemical monitoring undertaken by the EAW shows the Tywi within the freshwater reaches of the SAC is compliant with the performance indicators (Biological GQA Class B; Chemical Standard RE1). The majority of reaches have been classified as GQA class A most years, all reaches met class B standard. Shad eggs and juveniles are known to be sensitive to elevated suspended solids and high nutrient concentrations. In-river engineering works, which have the potential to generate high silt loads under low flow conditions are regulated through the EA’s Land Drainage Consent process. An embargo on works between May and late July operates within the catchment. Diffuse inputs from agricultural sources are the main cause of nutrient enrichment. The Water Framework Directive will provide a driver to tackle diffuse inputs. Catchment sensitive farming initiatives, Tir Gofal and the EA’s Sustainable Fisheries Project are encouraging the use of buffer strips to reduce these impacts.

Noise/vibration e.g. due to impact piling, drilling, salmon fish counters present within or in close proximity to the river can create a barrier to shad migration. Barriers resulting from vibration, chemicals, low dissolved oxygen and artificially high sediment levels must be prevented at key times (generally April to July).

The extent and quality of suitable shad habitat must be maintained. Spawning habitat is defined as stable, clean gravel/pebble-dominated (approximately 70%) substrate without an armoured layer and with <10% fines in the top 30 cm. Water depth during the spawning and incubation periods should be
50-75 cm. Holding areas are defined as pools of at least 200 cm depth, with cover from features such as undercut banks, vegetation, submerged objects and surface turbulence.

Anglers occasionally fish for shad, and they are sometimes taken in quite large numbers. Further research is necessary to define sustainable levels of angling. If this shows there is cause for concern a temporary cessation of fishing activity in the vicinity of known spawning grounds during the spawning period should be considered, particularly where shad are known to be taken regularly. Exploitation of shad is currently unregulated and controls are being considered through the review of freshwater fisheries legislation.

Commercial fishermen also take shad as a by-catch. Changes in fishing methods need to be promoted to minimize captures, while both anglers and trawler men should be encouraged to return alive any individuals caught.

Artificially enhanced densities of other fish may introduce unacceptable competition or predation pressure and the aim should be to minimise these risks in considering any proposals for stocking.

5.2 Conservation status and management requirements of Feature 2:

Sea lamprey Petromyzon marinus

Conservation status

Status: Unfavourable: Unclassified

Sea lamprey monitoring undertaken in 2004 failed to find juvenile sea lamprey at any sites either on the main river Tywi or any of the tributaries. Therefore the Tywi SAC failed the JNCC target threshold, and targets for spawning site & ammocoete distribution.

A lack of juvenile sea lamprey in surveys of this type is common to a number of rivers despite the presence of spawning adults. The contractors postulate that separation of habitat is occurring between brook/river lamprey and sea lamprey, the former spawning earlier in the year (March/April) compared to sea lamprey which spawn in June. They consider that juvenile sea lamprey are being excluded from optimum habitat and are having to utilise silt beds in deeper water, habitat that is not monitored as part of the standard assessment.

Migrating adult sea lamprey, spawning adults and dead individuals are reported from the Tywi, Cothi and Llandovery Bran each year.

Management requirements

The impacts of barriers to migration and flow depletion are highlighted in the assessment of conservation status for this feature. The impact of barriers 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. Llangadog creamery weir is considered to be the most significant barrier to fish migration on the Tywi. An assessment of options to reduce or remove the impact of this barrier will be carried out in conjunction with the other relevant competent authorities.

The impact of acoustic (i.e. noise/vibration) and sediment/chemical barriers arising from plans or projects should also be assessed. When arising from construction or other development related activities it may be necessary to restrict the timing of such activities.

The impact of flow depletion downstream of major abstractions was assessed in the Review of Consents process. The outputs of the hydraulic model suggest that changes to water depth and water velocities occurring as a result of the abstraction at Capel Dewi are unlikely to impact upon:
the ability of adult lamprey to migrate through the lower reaches of the river; spawning habitat downstream of Capel Dewi; or juvenile habitat downstream of the abstraction. However the diurnal operation of the pumps does expose marginal habitat and therefore has the potential to strand juveniles or expose juvenile sediment habitat.

There are also requirements for screening of intakes to reduce or remove the impact of impingement and entrainment on juvenile fish migrating downstream. Entrainment in water abstractions directly impacts on population dynamics through reduced recruitment and survival rates. Information on likely rates of entrainment of lamprey ammocoetes is required before acceptable levels can be assessed. The screening arrangements at the DCWW intakes at Manorafon and Capel Dewi are currently being assessed as part of the Habitats Directive review of consents process.

The impact of lowered temperatures from the hypolimnial release at Llyn Brianne on the Tywi also has the potential to impact upon lamprey. The anadromous sea lamprey are temperature dependent at critical freshwater life stages. Migration of sea lamprey into estuaries usually occurs from April onwards at temperatures of between 10-18°C, and spawning occurs when water temperatures increase above a threshold of 15°C, usually between May and June. The critical spawning temperature range for sea lamprey is considered to be 11-25°C, and eggs require temperatures of 15-25°C to hatch. Distribution of lamprey within the Tywi catchment is therefore also likely to be limited by the current river temperature regime.

Biological and chemical monitoring undertaken by the EAW shows the Tywi within the freshwater reaches of the SAC is compliant with the performance indicators (Biological GQA Class B; Chemical Standard RE1). The majority of reaches have been classified as GQA class A most years, all reaches met class B standard.

The extent and quality of suitable sea lamprey habitat must be maintained. Elevated levels of fines (particles <0.83mm) within spawning substrates can interfere with egg survival. Spawning habitat consists of well-oxygenated gravel/pebble substrate of >10cm depth in a range of water depths (0.2 to 1.5m). Sea and river lamprey tend to spawn in deeper water than brook lamprey. Nursery habitat consists of open-structured, aerated, silty and sandy substrates between 2 and 40cm depth generally in shallow (<0.5m) slack-water channel margins.

### 5.3 Conservation status and management requirements of Feature 3:

**Brook lamprey Lampetra planeri and River lamprey Lampetra fluviatilis**

**Conservation status**

**Status: Unfavourable: Unclassified**

Brook/river lamprey monitoring undertaken in 2004 showed that overall catchment mean ammocoete density considerably exceeded the JNCC target threshold\(^1\). The populations were considered to be healthy with a good recruitment of 0+ ammocoetes in most areas in 2004. However very few lampreys were caught in sub-optimal habitat, possibly indicating that optimal habitat is not limiting within the SAC. Densities in optimal habitat were 27.7 m\(^2\) and sub-optimal habitat 0.3m\(^2\), giving a SAC mean density for all habitats of 14.0 m\(^2\) (sd=0.45). When both optimal and sub-optimal habitat are taken into account the distribution of ammocoetes within the catchment fails the performance indicator - presence at not less that 2/3 of sites surveyed within natural range, and it is for this reason together with the impacts from flow depletion (see below) that their status was recorded as unfavourable.

It has not been possible to distinguish between the two species during monitoring, due to the reliance on juvenile stages (ammocoetes), though anecdotal evidence suggests that both species are likely to be present in many reaches. More information on the relative abundance of these two species in different
parts of the Tywi SAC is desirable. Records of spawning adult river lamprey would be particularly useful.

Management requirements

The extent and quality of suitable habitat for brook and river lamprey must be maintained. Elevated levels of fines (particles <0.83mm) within spawning substrates can interfere with egg survival. Spawning habitat consists of well-oxygenated gravel/pebble substrate of >10cm depth in a range of water depths (0.2 to 1.5m). Sea and river lamprey tend to spawn in deeper water than brook lamprey. Nursery habitat consists of open-structured, aerated, silty and sandy substrates between 2 and 40cm depth generally in shallow (<0.5m) slack-water channel margins.

The impact of flow depletion downstream of major abstractions was assessed in the Review of Consents process. The outputs of the hydraulic model suggest that changes to water depth and water velocities occurring as a result of the abstraction at Capel Dewi are unlikely to impact upon: the ability of adult lamprey to migrate through the lower reaches of the river; spawning habitat downstream of Capel Dewi; or juvenile habitat downstream of the abstraction. However the diurnal operation of the pumps does expose marginal habitat and therefore has the potential to strand juveniles or expose juvenile sediment habitat.

Entrainment in water abstractions directly impacts on population dynamics through reduced recruitment and survival rates. Information on likely rates of entrainment of lamprey ammocoetes is required before acceptable levels can be assessed.

The impact of lowered temperatures from the hypolimnial release at Llyn Brianne on the Tywi also has the potential to impact upon lamprey. The freshwater brook lamprey and anadromous river lamprey are temperature dependent at critical freshwater life stages. River and brook lamprey start to spawn in British rivers when water temperatures reach 10-11°C, usually between March and April for river lamprey and March and May for brook lamprey. Distribution of lamprey within the Tywi catchment is therefore also likely to be limited by the current river temperature regime. Biological and chemical monitoring undertaken by the EAW shows the Tywi within the freshwater reaches of the SAC is compliant with the performance indicators (Biological GQA Class B; Chemical Standard RE1). The majority of reaches have been classified as GQA class A most years, all reaches met class B standard.

The currently favourable condition assessment suggests that there are no strongly adverse factors influencing these species. However, the species are likely to benefit from positive management for the other SAC features, and may see further improvement in condition as a result. On-going monitoring will allow a better understanding of population fluctuations, distributional changes etc.

5.4 Conservation status and management requirements of Feature 4: Bullhead Cottus gobio

Conservation status

Status: Unfavourable: Unclassified

The current unfavourable status results from a lack of appropriate survey data. Records obtained from juvenile salmon monitoring show that bullhead are widespread in the Tywi catchment. There is a need for quantitative information on bullhead abundance.
Management requirements

Vertical drops of >18-20 cm are sufficient to prevent upstream movement of adult bullheads. They will therefore prevent recolonisation of upper reaches affected by lethal pollution episodes, and will also lead to constraints on genetic interactions that may have adverse consequences. New instream structures should be avoided, whilst the impact of existing artificial structures needs to be evaluated.

The extent and quality of suitable bullhead habitat must be maintained. Elevated levels of fines can interfere with egg and fry survival. Spawning habitat is defined as unsilted coarse (gravel/pebble/cobble) dominated substrate: males guard sticky eggs on the underside of stones. Larger stones on a hard substrate providing clear spaces between the stream bed and the underside of pebbles/cobbles are therefore important.

The importance of submerged higher plants to bullhead survival is unclear, but it is likely that where such vegetation occurs it is used by the species for cover against predators. Weed cutting should be limited to no more than half of the channel width in a pattern of cutting creating a mosaic of bare substrate and beds of submerged plants. Slack-water areas provide important refuges against high flow conditions. Suitable refuges include pools, submerged tree root systems and marginal vegetation with >5 cm water depth.

Bullheads are particularly associated with woody debris in lowland reaches, where it is likely that it provides an alternative source of cover from predators and floods. It may also be used as an alternative spawning substrate. Debris dams and woody debris should be retained where characteristic of the river/reach. Woody debris removal should be minimised, and restricted to essential activities such as flood defence.

Maintenance of intermittent tree cover in conjunction with retention of woody debris helps to ensure that habitat conditions are suitable. Some reaches may naturally have lower tree cover. Cover may also be lower in urban reaches.

Bullhead densities have been found to be negatively correlated with densities of non-native crayfish, suggesting competitive and/or predator-prey interactions. Non-native crayfish should be absent from the SAC.

The presence of artificially high densities of salmonids and other fish will create unacceptably high levels of predatory and competitive pressure on juvenile and adult bullhead. Stocking of fish should be avoided in the SAC.

Escapes from fish farms are a form of uncontrolled introduction and should be prevented by effective screening on all intakes and discharges.

Bullheads are relatively sedentary and interactions between populations in different parts of the catchment and in different catchments are likely to be limited, suggesting the existence of genetically discrete populations. Since they are of no angling interest, deliberate transfers between sites are unlikely to have been undertaken in the past, such that the genetic integrity of populations is likely to be intact. There should be no stocking/transfers of bullhead unless agreed to be in the best interests of the population.

In general, management for other SAC features is expected to result in favourable habitat for bullhead, through improvements in water quality and flow regime and maintenance of suitable physical habitat.
5.5 Conservation status and management requirements of Feature 5:
European otter *Lutra lutra*

**Conservation status**

**Status: Favourable**

The conservation status of otters in the Tywi SAC is determined by monitoring their distribution, breeding success, and the condition of potential breeding and feeding habitat outlined in the Performance Indicators. Their current condition can be considered favourable, but with scope for further improvement, if habitat and other natural factors can be maintained and enhanced.

**Management requirements**

A survey undertaken in 2004 identified 101 breeding sites within the Tywi catchment, based on the European Commission’s Life Nature Programme methodology\(^{11}\). Of these 14 were in use, with a further 87 having potential\(^3\). The report suggested the catchment should be capable of supporting at least 22 breeding pairs, based on one breeding female per 20km stretch of river. It is possible that, if all the breeding sites achieve optimal habitat conditions and fish and amphibian stocks are secured, the catchment may then support further breeding animals. However, the amount of compression of home ranges that otters will accept cannot as yet be determined\(^3\).

Management should aim to ensure that there is sufficient undisturbed breeding habitat to support an otter population of a size determined by natural prey availability and associated territorial behaviour. The involvement of river users and land managers will be important in improving potential breeding habitat near to the river. Agri-environment schemes and the Better Woodlands for Wales scheme provide possible mechanisms for maintaining suitable sites, such as lightly grazed woodlands, areas of dense scrub, and tussocky fens with purple moor-grass. The low lying nature of the floodplain render large areas unsuitable as breeding sites, and it is likely that the tributaries and marginal areas away from the designated boundaries provide the major potential e.g. relict channels, scrub and woodland.

Food availability is an important factor. Fish biomass should stay within expected natural fluctuations. A potential problem appears to be the decline in eel populations, and similar concerns are apparent with respect to amphibian numbers on a UK scale.

A number of particular threats to the otter have been identified on the catchment, not least the number of road mortalities that have occurred. There is also considerable room to improve the bankside habitat along the main length of the Tywi and some of the tributaries. This presents difficulties on the main river, as its mobile nature and flood magnitude create problems with fencing to exclude stock.

Measures to ensure the safe movement of otters around the catchment will be promoted, in particular the provision of ledges, tunnels and fencing on new road bridge schemes. Where bridges are being repaired or replaced, or at especially bad locations for otter road deaths, such features may be retro-fitted.

Pollution of rivers with toxic chemicals, such as PCBs, was one of the major factors identified in the widespread decline of otters during the last century. There should be no increase in pollutants potentially toxic to otters.
6. ACTION PLAN: SUMMARY

This section takes the management requirements outlined in Section 5 a stage further, assessing the specific management actions required on each management unit. This information is a summary of that held in CCW’s Actions Database for sites, and the database will be used by CCW and partner organisations to plan future work to meet the Wales Environment Strategy targets for sites.

<table>
<thead>
<tr>
<th>Unit Number</th>
<th>CCW Database Number</th>
<th>Unit Name</th>
<th>Summary of Conservation Management Issues</th>
<th>Action needed?</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>000734</td>
<td>Carmarthen reach</td>
<td>Reduction in flows downstream of the DCWW Capel Dewi intake during pumping, lead to drying of habitat for spawning and juvenile fish species. Invasive species, including Himalayan balsam and Japanese knotweed are present throughout the reach. They suppress local biodiversity and can lead to bank instability. Development and infrastructure pressures and the need for flood protection associated with Carmarthen.</td>
<td>Yes</td>
</tr>
<tr>
<td>6</td>
<td>000737</td>
<td>Whitemill reach</td>
<td>Reduction in flows downstream of the DCWW Capel Dewi intake during pumping, lead to drying of habitat for spawning and juvenile fish species. Potential for disruption of migration cues for fish species. Invasive species, including Himalayan balsam and Japanese knotweed are present throughout the reach. They suppress local biodiversity and can lead to bank instability.</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>000738</td>
<td>Halfway reach</td>
<td>The DCWW abstraction at the bottom of the reach has the potential to entrain significant numbers of juvenile shad, river &amp; sea lamprey in the migration down river to sea.</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>000739</td>
<td>Golden Grove reach</td>
<td>Reach is under one riparian ownership ... Sea lamprey spawning occurs in a number of locations in the reach. Generally stable and inactive in the upper sections, though potential meander cut-through developing upstream of the Myddyfi confluence. Active meanders at Rofawr, where cut-through occurred in the late 1990's and at Dryslwyn. Good otter habitat throughout.</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>000740</td>
<td>Llandeilo reach</td>
<td>Actively meandering reach of the Tywi. Private gravel extractions, extent of impacts unknown. Bank protection works to protect the Heart of Wales railway line are impacting upon the natural functioning of the system.</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>000741</td>
<td>Llangadog reach</td>
<td>Actively meandering reach of the Tywi. Private gravel extractions, extent of impacts unknown. Bank protection works to protect the Heart of Wales railway line are impacting upon the natural functioning of the system.</td>
<td>Yes</td>
</tr>
<tr>
<td>Unit Number</td>
<td>CCW Database Number</td>
<td>Unit Name</td>
<td>Summary of Conservation Management Issues</td>
<td>Action needed?</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------------</td>
<td>----------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>1</td>
<td>000742</td>
<td>Llandovery reach</td>
<td>An actively meandering reach of the Tywi. One commercial and a number of private gravel extractions operate within the reach, the extent of impacts are unknown. Bank protection works to protect the Heart of Wales railway line are impacting upon the natural functioning of the system. The Llyn Brianne hypolimnial release is suppressing in-stream temperatures, potentially restricting the breeding range of twaite shad.</td>
<td>Yes</td>
</tr>
</tbody>
</table>
7. 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 CCW and the UK nature conservation agencies. None of these definitions is legally definitive.

**Action**
A recognisable and individually described act, undertaking or project of any kind, specified in section 6 of a Core Management Plan or Management Plan, as being required for the conservation management of a site.

**Attribute**
A quantifiable and monitorable characteristic of a feature that, in combination with other such attributes, describes its condition.

**Common Standards Monitoring (CSM)**
A set of principles developed jointly by the UK 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.

**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 assessment**
The process of characterising the condition of a feature with particular reference to whether the aspirations for its condition, as expressed in its conservation objective, are being met.

**Condition categories**
The condition of feature can be categorised, following condition assessment as one of the following:

- Favourable: maintained;
- Favourable: recovered;
- Favourable: un-classified;
- Unfavourable: recovering;
- Unfavourable: no change;
- Unfavourable: declining;
- Unfavourable: un-classified;
- Partially destroyed;
- Destroyed.

**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.

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3 See JNCC guidance on Common Standards Monitoring [http://www.jncc.gov.uk/page-2272](http://www.jncc.gov.uk/page-2272)
Conservation objective
The expression of the desired conservation status of a feature, expressed as a vision for the feature and a series of performance indicators. The conservation objective for a feature is thus a composite statement, and each feature has one conservation objective.

Conservation status
A description of the state of a feature that comprises both its condition and the state of the factors affecting or likely to affect it. Conservation status is thus a characterisation of both the current state of a feature and its future prospects.

Conservation status assessment
The process of characterising the conservation status of a feature with particular reference to whether the aspirations for it, as expressed in its conservation objective, are being met. The results of conservation status assessment can be summarised either as ‘favourable’ (i.e. conservation objectives are met) or unfavourable (i.e. conservation objectives are not met). However the value of conservation status assessment in terms of supporting decisions about conservation management, lies mainly in the details of the assessment of feature condition, factors and trend information derived from comparisons between current and previous conservation status assessments and condition assessments.

Core Management Plan
A CCW 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 conservation management can also be considered as factors.

Favourable condition
See condition and condition assessment

Favourable conservation status
See conservation status and conservation status assessment⁴

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

Key Feature
The habitat or species population within a management unit that is the primary focus of conservation 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 conservation management and monitoring can be most effectively organised. They are used as the primary basis for differentiating priorities for conservation management.

⁴ A full definition of favourable conservation status is given in Section 4.
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 **Common Standards Monitoring**, 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**

The attributes and their associated specified limits, together with factors and their associated operational limits, 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. Performance indicators are part of, not the same as, conservation objectives. See also vision for the feature.

**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 Natura 2000 and Ramsar sites are subject to specific legal and policy procedures.

**Site integrity**

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 CCW’s 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 limit**

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 for the feature**

The expression, within a conservation objective, of the aspirations for the feature concerned. See also performance indicators.

**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.
8. REFERENCES AND ANNEXES


ANNEX 1 – REVIEW OF CONSENTS STANDARDS FOR FLOW

The flow target used in the Environment Agency (EA) Resource Assessment and Management Framework (RAM) utilises the Habitats Directive Ecological River Flow (HDERF) objective during the key fish migration period in April to June. The maximum permissible percentage reduction from naturalised flow levels during this period is given in Table 1.

Table 1  HDERF1 - River flow thresholds for SAC/SSSI rivers

<table>
<thead>
<tr>
<th>EW band (sensitivity)</th>
<th>&gt;Qn50</th>
<th>Qn50-95</th>
<th>&lt;Qn95</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High</td>
<td>10</td>
<td>10</td>
<td>1-5</td>
</tr>
<tr>
<td>High</td>
<td>15</td>
<td>10</td>
<td>5-10</td>
</tr>
</tbody>
</table>

For reaches below reservoirs, the effect of abstraction from storage is excluded from the assessment, so that the target flow is a ‘benchmark’ flow, incorporating the reservoir compensation release, rather than a naturalised flow. At times of low flow, compensation releases may increase the flow downstream of the reservoir above natural levels. There may also be effects resulting from reduced water temperature.
ANNEX 2 – STANDARDS USED IN THE TYWI REVIEW OF CONSENTS FOR PHOSPHATE

INTRODUCTION
The Environment Agency, English Nature and the Countryside Council for Wales have agreed on a methodology for the determination of guideline phosphorus standards on SAC rivers. The methodology is based upon catchment geology and river size, and a set of guideline standards has been applied to the typology which permits a reasonable degree of anthropogenic change but which should be consistent with the favorable condition of SAC interest features. The full details can be found in WQTAG048b – Guideline Phosphorus Standards for SAC Rivers.

The purpose of this report is to detail how these guidelines have been applied to the Tywi SAC.

1.1 Determining River Size Class
There are three size classes, representing headwaters, river, and large river (Table 1). The division is based on the river flow categories used in the General Quality Assessment and the River Habitat Survey (Table 2). By reference to these data, the river can be allocated to one of the 3 classes.

<table>
<thead>
<tr>
<th>River size classification</th>
<th>GQA flow band</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – Headwaters</td>
<td>1 – 2</td>
</tr>
<tr>
<td>2 – River</td>
<td>3 – 8</td>
</tr>
<tr>
<td>3 – Large river</td>
<td>9 – 10</td>
</tr>
</tbody>
</table>

Table 1. River size classification

Table 2. GQA Flow Bands

<table>
<thead>
<tr>
<th>GQA flow band</th>
<th>Long Term Average Natural Flow (cumecs)</th>
<th>Equivalent in ML/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt;0.31</td>
<td>&lt;26.8</td>
</tr>
<tr>
<td>2</td>
<td>&lt;0.62</td>
<td>&lt;53.6</td>
</tr>
<tr>
<td>3</td>
<td>&lt;1.25</td>
<td>&lt;108</td>
</tr>
<tr>
<td>4</td>
<td>&lt;2.5</td>
<td>&lt;216</td>
</tr>
<tr>
<td>5</td>
<td>&lt;5.0</td>
<td>&lt;432</td>
</tr>
<tr>
<td>6</td>
<td>&lt;10</td>
<td>&lt;864</td>
</tr>
<tr>
<td>7</td>
<td>&lt;20</td>
<td>&lt;1728</td>
</tr>
<tr>
<td>8</td>
<td>&lt;40</td>
<td>&lt;3456</td>
</tr>
<tr>
<td>9</td>
<td>&lt;80</td>
<td>&lt;6912</td>
</tr>
<tr>
<td>10</td>
<td>&gt;80</td>
<td>&gt;6912</td>
</tr>
</tbody>
</table>

EAW monitoring for the Tywi at Dolauhirion gauging station, less than 1.5 km upstream of the SAC boundary at Llandovery, gives a mean annual flow of 10.53 cumecs, and at Nantgaredig in the lower reaches of 39.41 cumecs. This places the GQA flow band for the river within the SAC as between 7 & 8 and hence the river class as 2 - River.

1.2 Determining the Geological Class

Table 3. Geological classification

<table>
<thead>
<tr>
<th>Geological Classification</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Hard upland geologies (all land over 330m)</td>
<td>Igneous, plus Cambrian to Devonian series and Carboniferous. Low porosity, poor geology with hill farming and v. low population density</td>
</tr>
<tr>
<td>B. Other Cambrian – Devonian, and Carboniferous</td>
<td>Hard mudstones, sandstones, limestones. Improved pasture plus some arable, low population density</td>
</tr>
<tr>
<td>C. Jurassic and Cretaceous</td>
<td>Soft limestones and chalk. More intensive agriculture and higher...</td>
</tr>
</tbody>
</table>
limestones population densities, but relatively resistant to P enrichment due to soil/geological adsorption capacity. Form major aquifers whose P levels set background P concentrations of the rivers.

D. Triassic sandstones and mudstones Soft sandstones and mudstones in lowland areas, agriculture and population densities similar to (C) but more vulnerable to P enrichment due to low adsorption capacity. Form major aquifers whose P levels set background P concentrations of the rivers.

E. Mesozoic clay vales and Tertiary clays Very low porosity, rich soils in lowland areas. Intensive agriculture and high population densities, yielding highest background P levels.

The Methodology identifies five geological types (Table 3).

The Tywi catchment geology is predominantly alluvium, glacial sands and gravels overlying silt- and mudstones and was therefore assigned to category ‘B’.

1.3 Combining River Size and Geological Class
Combining the river size and geological class information allows an appropriate guideline standard to be allocated (Figure 1).

**Table 4.** Phosphorus values assigned to river types (total reactive phosphorus mg/l, except * total phosphorus)

<table>
<thead>
<tr>
<th>Geological class</th>
<th>1. Headwaters</th>
<th>2. River</th>
<th>3. Large river</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Natural</td>
<td>Undetectable</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td>0.02</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>Threshold</td>
<td>0.04</td>
<td>0.06</td>
</tr>
<tr>
<td>B</td>
<td>Natural</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>Threshold</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>C</td>
<td>Natural</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td>0.04</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>Threshold</td>
<td>0.06</td>
<td>0.10</td>
</tr>
<tr>
<td>D</td>
<td>Natural</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>Threshold</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>E</td>
<td>Natural</td>
<td>0.02</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td>0.06</td>
<td>0.10*</td>
</tr>
<tr>
<td></td>
<td>Threshold</td>
<td>0.10</td>
<td>0.20*</td>
</tr>
</tbody>
</table>

The Tywi SAC falls into flow category 2 ‘River’ and Geological class ‘B’, and therefore gets a P Target of 0.06 mg/l.
Table 1 sets out the targets specified in the EA Appropriate Assessment for the River Tywi Review of Consents. RE1 applies to all of the designated SAC reaches of the afon Tywi.

<table>
<thead>
<tr>
<th>RE</th>
<th>Dissolved Oxygen (% sat)</th>
<th>Biological Oxygen Demand (mg/l) 90%ile</th>
<th>Total Ammonia (mg N/l) 90%ile</th>
<th>Un-ionised Ammonia (mg N/l) 95%ile</th>
<th>pH (lower limit as 5%ile, upper limit as 95%ile)</th>
<th>Hardness (mg/l CaCO₃) Mean</th>
<th>Dissolved Copper (µg/l)</th>
<th>Total Zinc (µg/l) 95%ile</th>
</tr>
</thead>
<tbody>
<tr>
<td>RE1</td>
<td>80</td>
<td>2.5</td>
<td>0.25</td>
<td>0.021</td>
<td>6.0-9.0</td>
<td>≤10</td>
<td>&gt;10 and ≤50</td>
<td>&gt;50 and ≤100</td>
</tr>
<tr>
<td>RE2</td>
<td>70</td>
<td>4.0</td>
<td>0.6</td>
<td>0.021</td>
<td>6.0-9.0</td>
<td>≤10</td>
<td>&gt;10 and ≤50</td>
<td>&gt;50 and ≤100</td>
</tr>
</tbody>
</table>