European Site Conservation Objectives: Supplementary advice on conserving and restoring site features

River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid Special Area of Conservation (SAC)
UK0030252

River Dee: © Natural England, 2012.

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About this document

This document provides Natural England's supplementary advice about the European Site Conservation Objectives relating to River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid SAC. This advice should therefore be read together with the SAC Conservation Objectives available here.

This advice currently applies to those parts of the SAC lying in England. You should seek the advice of Natural Resources Wales (NRW) separately for parts of the SAC which fall within Wales.

This advice replaces a draft version dated January 2019 following the receipt of comments from the site's stakeholders.

You should use the Conservation Objectives, this Supplementary Advice and any case-specific advice given by Natural England, when developing, proposing or assessing an activity, plan or project that may affect this site.

This Supplementary Advice to the Conservation Objectives presents attributes which are ecological characteristics of the designated species and habitats within a site. The listed attributes are considered to be those that best describe the site's ecological integrity and which, if safeguarded, will enable achievement of the Conservation Objectives. Each attribute has a target which is either quantified or qualitative depending on the available evidence. The target identifies as far as possible the desired state to be achieved for the attribute.

The tables provided below bring together the findings of the best available scientific evidence relating to the site's qualifying features, which may be updated or supplemented in further publications from Natural England and other sources. The local evidence used in preparing this supplementary advice has been cited. The references to the national evidence used are available on request. Where evidence and references have not been indicated, Natural England has applied ecological knowledge and expert judgement. You may decide to use other additional sources of information.

In many cases, the attribute targets shown in the tables indicate whether the current objective is to 'maintain' or 'restore' the attribute. This is based on the best available information, including that gathered during monitoring of the feature's current condition. As new information on feature condition becomes available, this will be added so that the advice remains up to date.

The targets given for each attribute do not represent thresholds to assess the significance of any given impact in Habitats Regulations Assessments. You will need to assess this on a case-by-case basis using the most current information available.

Some, but not all, of these attributes can also be used for regular monitoring of the actual condition of the designated features. The attributes selected for monitoring the features, and the standards used to assess their condition, are listed in separate monitoring documents, which will be available from Natural England.

These tables do not give advice about SSSI features or other legally protected species which may also be present within the European Site.

If you have any comments or queries about this Supplementary Advice document please contact your local Natural England adviser or email HDIRConservationObjectivesNE@naturalengland.org.uk

About this site

European Site information

Name of European Site	River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid Special Area of Conservation (SAC)
Location	Cheshire, Denbighshire, Flintshire, Gwynedd, Shropshire, Wrexham
Site Map	The designated boundary of this site can be viewed here on the MAGIC website
Designation Date	English part designated on 1 April 2005 Welsh part designated on 13 December 2004
Qualifying Features	See section below
Designation Area	1308.93 hectares
Designation Changes	N/A
Feature Condition Status	Details of the feature condition assessments made at the English part of the site can be found using Natural England's Designated Sites System
Names of component Sites of Special Scientific Interest (SSSIs)	Afon Dyfrdwy (River Dee) SSSI, Llyn Tegid SSSI, River Dee (England) SSSI
Relationship with other European or International Site designations	N/A

Site background and geography

The River Dee has its source in Snowdonia at the outflow of Llyn Tegid and it includes the Ceiriog, Meloch, Tryweryn and Mynach tributaries. Its catchment contains a wide spectrum of landscape from high mountains around Bala, rugged peaks near Llangollen, steep sided wooded valleys, and the plains of Cheshire, Flintshire, north Shropshire and Wrexham. There is a tidal influence as far upstream as Farndon and high tides regularly exceed the Chester weir crest level.

The course and topography of the River Dee/ Afon Dyfrdwy has been largely influenced by glaciers. Below Bala Lake and down to Chester the River Dee/ Afon Dyfrdwy flows over predominantly sedimentary bedrock consisting of mudstones, sandstones and siltstones. These range from the Silurian to Triassic periods with progressively younger underlying bedrock with distance downstream. The catchment of the Dee above Bala gauging weir is predominantly comprised of impermeable Cambrian and Ordovician rocks overlain with thin, semi-permeable soil. The river flows east through Llangollen where there are Carboniferous limestone outcrops and coal measures.

The aquatic plant community includes Wirtgen's water-crowfoot *Ranunculus x bachii* and pond water-crowfoot *R. peltatus*, and also floating water-plantain *Luronium natans*. Water-crowfoot forms extensive beds along the whole length of the Dee where flow conditions are suitable. Other aquatic plants which occur within the site include intermediate water-starwort *Callitriche hamulata*, alternate-flowered water-milfoil *Myriophyllum alterniflorum* and bryophytes including *Rhynchostegium riparoides* and *Fontinalis*

antipyretica. Marginal vegetation consists mainly of reed canary-grass *Phalaris arundinacea* with occasional branched bur-reed *Sparganium erectum*.

The River Dee is recognised as one of North Wales' premier rivers for Atlantic salmon *Salmo salar*. The Mynach, Meloch and Ceiriog tributaries are the most important salmon spawning tributaries in the Dee catchment. Other migratory fish utilising the river system include river lamprey *Lampetra fluviatilus* and sea lamprey *Petromyzon marinus*. The Dee also supports important populations of non-migratory fish including bullhead *Cottus gobio* and brook lamprey *Lampetra planeri*. The otter *Lutra lutra* is well established throughout the river system, especially where appropriate bank side cover exists.

The SAC is underpinned by two SSSIs divided by the national boundary; the Afon Dyfrdwy (River Dee) SSSI and the River Dee (England) SSSI. The Welsh SSSI includes the upper part of the main stem Dee, Afon Mynach, Afon Meloch, Afon Tryweryn and the upper part of the River Ceiriog (except the headwaters). The English SSSI includes the lower part of the main stem Dee and the lower part of the River Ceiriog. The site is also situated within the Shropshire, Cheshire and Stafford Plain National Character Area.

About the qualifying features of the SAC

The following section gives you additional, site-specific information about this SAC's qualifying features. These are the natural habitats and/or species for which this SAC has been designated.

Qualifying habitats:

- **H3260 Water courses of plain to montane levels with *R. fluitantis***

This habitat type is characterised by the abundance of water-crowfoots *Ranunculus spp., subgenus Batrachium (Ranunculus fluitans, R. penicillatus ssp. penicillatus, R. penicillatus ssp. pseudofluitans*, and *R. peltatus* and its hybrids). Floating mats of these white-flowered species are characteristic of river channels in early to mid-summer. They may modify water flow, promote fine sediment deposition, and provide shelter and food for fish and invertebrate animals.

There are several variants of this habitat in the UK, depending on geology and river type. In each, *Ranunculus* species are associated with a different assemblage of other aquatic plants, such as water-cress *Rorippa nasturtium-aquaticum*, water-starworts *Callitriche* spp., water-parsnips *Sium latifolium* and *Berula erecta*, water-milfoils *Myriophyllum spp*. and water forget-me-not *Myosotis scorpioides*. In some rivers, the cover of these species may exceed that of Ranunculus species. Three main sub-types are defined by substrate and the dominant species within the Ranunculus community.

Qualifying Species:

- **S1106 Atlantic salmon, *Salmo salar***

The Atlantic salmon is an anadromous species (i.e. adults migrate from the sea to breed in freshwater). Spawning takes place in shallow excavations called redds, found in shallow gravelly areas in clean rivers and streams where the water flows swiftly. The young that emerge spread out into other parts of the river. After a period of 1-6 years the young salmon migrate downstream to the sea as 'smolts'. Salmon have a homing instinct that draws them back to spawn in the river of their birth after 1-3 years in the sea. This behaviour has resulted in genetically distinct stock between rivers and even within individual rivers, with some evidence of further genetic distinctiveness in the tributaries of large rivers.

Salmon rivers vary considerably in their ecological and hydrological characteristics and in the life-cycle strategies adopted by the salmon within them. There are particularly strong contrasts between southern and northern rivers, and the UK's varied climate, geology and terrain means that high diversity can be found within some of the large rivers. The cool and wet climate in the north, often with harder, more resistant rocks and steeper slopes, results in salmon rivers that are sparsely vegetated, nutrient-poor and prone to sudden increases in flow ('spates') in response to heavy downfalls or sudden snow-melt. As a result, salmon may take several years to reach the smolt stage and migrate to sea. In the south, rivers flow across gentler terrain and softer rocks, in a warmer, drier climate. Here, salmon often grow sufficiently quickly to smolt as yearlings.

The species is subject to many pressures in Europe, including pollution, the introduction of non-native salmon stocks, physical barriers to migration, exploitation from netting and angling, physical degradation of spawning and nursery habitat, and increased marine mortality

- **S1096 Brook lamprey, *Lampetra planeri***

The brook lamprey *Lampetra planeri* is a primitive, jawless fish resembling an eel, and is the smallest of the lampreys found in the UK. It is a non-migratory freshwater species, occurring in streams and occasionally in lakes in north-west Europe. Like other lamprey species, the brook lamprey requires clean gravel beds for spawning and soft marginal silt or sand for the ammocoete larvae. It spawns mostly in parts of the river where the current is not too strong.

- **S1163 Bullhead, *Cottus gobio***

The bullhead *Cottus gobio* is a small bottom-living fish that inhabits a variety of rivers, streams and stony lakes. It appears to favour fast-flowing, clear shallow water with a hard substrate (gravel/cobble/pebble) and is frequently found in the headwaters of upland streams. However, it also occurs in lowland situations on softer substrates so long as the water is well-oxygenated and there is sufficient cover. It is not found in badly polluted rivers.

- **S1831 Floating water-plantain, *Luronium natans***

Floating water-plantain *Luronium natans* occurs in a range of freshwater situations, including nutrient-poor lakes in the uplands and slowly-flowing lowland rivers, pools, ditches and canals that are moderately nutrient-rich. *Luronium natans* occurs as two forms: in shallow water with floating oval leaves, and in deep water with submerged rosettes of narrow leaves. The plant thrives best in open situations with a moderate degree of disturbance, where the growth of emergent vegetation is held in check.

Populations fluctuate greatly in size, often increasing when water levels drop to expose the bottom of the water body. Populations fluctuate from year to year, and at many sites records of *L. natans* have been infrequent, suggesting that only small populations occur, in some cases possibly as transitory colonists of the habitat. Populations tend to be more stable at natural sites than artificial ones, but approximately half of recent (post-1980) records are from canals and similar artificial habitats. Its habitat in rivers has been greatly reduced by channel-straightening, dredging and pollution, especially in lowland situations.

The 'core' natural habitat is considered to be lakes in Snowdonia and in mid-Wales, where *Luronium natans* has a very long and consistent history of occurrence. It appears to have spread eastwards along the canal system during the 19th century.

This species occurs only in the Welsh sections and is therefore not discussed further here.

- **S1355 Otter, *Lutra lutra***

The otter is a semi-aquatic mammal, which occurs in a wide range of ecological conditions, including inland freshwater and coastal areas (particularly in Scotland). Populations in coastal areas utilise shallow, inshore marine areas for feeding but also require fresh water for bathing and terrestrial areas for resting and breeding holts. Coastal otter habitat ranges from sheltered wooded inlets to more open, low-lying coasts. Inland populations utilise a range of running and standing freshwaters. These must have an abundant supply of food (normally associated with high water quality), together with suitable habitat, such as vegetated river banks, islands, reedbeds and woodland, which are used for foraging, breeding and resting.

Historically, otters occurred over most of the UK. However, persecution, habitat loss and, more recently, the impact of toxic organochlorine insecticides caused a marked reduction in the range of the species. At present, the majority of the otter population in Great Britain occurs in Scotland, with a significant proportion of this number being found in the north and west of the country. Other strong populations survive in Wales and Ireland. The otter is still scarce over much of England, where the highest concentrations are in the south-west. However, recent surveys suggest that the otter population is recovering well and recolonising parts of its former range

- **S1099 River lamprey*, Lampetra fluviatilis***

The river lamprey *Lampetra fluviatilis* is found in coastal waters, estuaries and accessible rivers. The species is normally anadromous (i.e. spawning in freshwater but completing part of its life cycle in the sea), and pollution or artificial obstacles such as weirs or dams impede migration.

- **S1095 Sea lamprey, *Petromyzon marinus***

The sea lamprey *Petromyzon marinus* is a primitive, jawless fish resembling an eel. It is the largest of the lampreys found in the UK. It occurs in estuaries and easily accessible rivers, and is an anadromous species (i.e. spawning in freshwater but completing its life cycle in the sea). Like the other species of lamprey, sea lampreys need clean gravel for spawning, and marginal silt or sand for the burrowing juvenile ammocoetes. Sea lampreys have a preference for warm waters in which to spawn. Features such as weirs and dams, as well as polluted sections of river, may impede migration to spawning grounds. In comparison to 1099 River lamprey *Lampetra fluviatilis*, sea lampreys seem to be relatively poor at ascending obstacles to migration, and are frequently restricted to the lower reaches of rivers.

Table 1: Supplementary Advice for Qualifying Features: H3260. Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation; Rivers with floating vegetation often dominated by water-crowfoot

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Extent and distribution of the feature	**Extent of the feature within the site**	Restore the total extent of the H3260 feature to that characteristic of the natural fluvial processes associated with the river type. A set target length / area extent is not appropriate; however there should be no reduction in the extent and area of this feature present at classification	There should be no measurable reduction (excluding any trivial loss) in the extent and area of this feature, and in some cases, the full extent of the feature may need to be restored. The baseline-value of extent given has been generated using data gathered from the listed site-based surveys. Area measurements given may be approximate depending on the methods, age and accuracy of data collection, and as a result this value may be updated in future to reflect more accurate information. The extent of an Annex I habitat feature covers the sum extent of all of the component vegetation communities present and may include transitions and mosaics with other closely-associated habitat features. Where a feature is susceptible to natural dynamic processes, there may be acceptable variations in its extent through natural fluctuations. Where a reduction in the extent of a feature is considered necessary to meet the Conservation Objective for another Annex I feature, Natural England will advise on this on a case-by-case basis It should be noted that the adjacent semi-natural wet riparian habitat forms and integral part of the river community Tributaries of the River Dee that have not been included within the SAC are integral to the natural functioning of the river system and also support the habitats and species for which the site was notified. These tributaries therefore have a strong relationship with the integrity of the river SAC as a whole.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Structure and function (including its typical species)	**Biological connectivity**	The movement of characteristic biota should not be artificially constrained.	Many species, including fish and invertebrates, require natural freedom of movement to complete their life cycle in rivers and maximise their population size and genetic diversity. Longitudinal connectivity within the river channel and lateral connectivity between the channel and the floodplain are both critical to a healthy river ecosystem. Constraints to longitudinal movement such as waterfalls and debris dams are a natural feature of rivers and add to the complexity and diversity of the habitat.	River Dee Restoration Management Plan (2013) Available on request from Natural England River Dee Restoration Technical Plan Core Management Plan (2013) Available on request from Natural England
Structure and function (including its typical species)	**Riparian habitat mosaic**	Restore the extent and pattern of in-channel and riparian biotopes (habitats) to that characteristic of natural fluvial processes.	Watercourses with a high degree of naturalness are governed by dynamic processes which result in a mosaic of characteristic physical habitats or biotopes, including a range of substrate types, variations in flow, channel width and depth, in-channel and side-channel sedimentation features (including transiently exposed sediments), bank profiles (including shallow and steep slopes), erosion features (such as cliffs) and both in-channel and bankside (woody and herbaceous) vegetation cover. All of these biotopes, and their characteristic patterns within the river corridor, are important to the full expression of the biological community. A range of physical habitat modifications cause simplification of biotope mosaics, resulting in declines of characteristic biota dependent upon biotopes that have been lost or reduced in extent. The majority of the main stem Dee and tributaries that comprise the SSSIs and SAC shows some degree of modification for navigation, flood alleviation, agricultural drainage or have been straightened as a result of roads, railways or urban development which need to be addressed to restore more natural geomorphological and ecological conditions. Historic and current bank protection, particularly extensive in the Upper and Lower Dee, and embankments present in Upper Dee and extensively in the Lower Dee at Dee Meanders are preventing natural	River Dee Restoration Management Plan (2013) Available on request from Natural England River Dee Restoration Technical Plan (2013) Available on request from Natural England Core Management Plan. Available from Natural England on request Restoration of the Afon Ceiriog/River Ceiriog: Potential habitat restoration schemes on the Lower Ceiriog

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			geomorphological processes from occurring. Channelisation at the confluence of the Dee and the Tryweryn and through Chester has significantly reduced the diversity of geomorphology and the channel is devoid of the typical features expected. As a result there is a reduction in optimum habitats for ecological features. However, some reaches of the river channel have adjusted or are in the process of adjusting and recovering following disturbance. The adjustment towards natural channel morphology is significant throughout the Dee/ Dyfrdwy catchment and demonstrates that the river is capable of recovering.	
Structure and function (including its typical species)	**Fisheries - introduction of salmon and/or other fish species**	Maintain fish densities at or to a level at or below the natural environmental carrying capacity of the river, and below historical levels (this means no stocking to previously unstocked rivers or river sections).	The management aim is to provide conditions in the river that support a healthy, natural and self-sustaining salmon population, achieved through habitat protection/restoration and the control of exploitation as necessary. Stocking represents a loss of naturalness and, if successful, obscures the underlying causes of poor performance (potentially allowing these risks to perpetuate). It carries various ecological risks, including the loss of natural spawning from broodstock, competition between stocked and naturally produced individuals, disease introduction and genetic alterations to the population. Fish stocking can cause elevated levels of competition and predation that may damage the characteristic biological community. Ideally, fishery management should be based on natural recruitment, with an emphasis on restoring characteristic river habitat in ways that promote natural recruitment. Stocking should be undertaken so as to avoid risks of disease transfer, including crayfish plague where white-clawed crayfish populations are at risk. Stocking for	NRW Core Management Plan. Available here

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			population conservation purposes should only be considered as an interim measure whilst underlying environmental problems are addressed, and should not be undertaken if natural recovery can be achieved in reasonable timescales.	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Fisheries - exploitation**	Ensure exploitation (e.g. netting or angling) of Atlantic salmon is undertaken sustainably without compromising any components of the population, including multi-sea winter fish and seasonal components of the adult run.	Exploitation should be controlled to suitable levels, and net limitations and catch-and-release techniques used where necessary to avoid population impacts. Exploitation and removals should not cause significant suppression of characteristic fish species (e.g. Atlantic salmon, eel, pike) or affect the balance of the fish or wider biological community	https://naturalresources.wales/media/683230/cross-border-rivers-wales-nrw-byelaws-2017-as-sealed-081117.pdf
Structure and function (including its typical species)	**Invasive, non-native and/or introduced species**	Ensure non-native species categorised as 'high-impact' in the UK under the Water Framework Directive are either rare or absent but if present are causing minimal damage to the feature	Non-native species constitute a major threat to many river systems. Impacts may be on the river habitat itself (e.g. damage to banks and consequent siltation) or directly on characteristic biota (through predation, competition and disease), or a combination of these. The UK Technical Advisory Group of the Water Framework Directive produces a regularly updated classification of aquatic alien species (plants and animals) according to their level of impact. In general high impact species are of greatest concern but low or unknown impact species may be included in the target on a site-specific basis where there is evidence that they are causing a negative impact (for example high cover values or abundances). Those taxa considered likely to colonise lakes, are indicated by an 'L' in the UKTAG guidance.	Cheshire Wildlife Trust (2016) Report for NE - Cheshire River Dee catchment invasive non-native riparian plant species: Actions 2016 River Dee INNS Project - Dee Catchment Biosecurity Action Plan 2014-2020This Strategy has been produced with financial support from the Welsh Government as part of the Resilient Ecosystem Fund. http://www.dinns.org.uk/en/
Structure and function (including its typical species)	**Riparian zone**	Restore a patchy mosaic of natural woody and herbaceous (tall and short swards) riparian vegetation (except in upland areas above the natural tree line). The riparian zone should be sufficiently wide to act as a healthy and functional habitat	A mosaic of natural and semi-natural riparian vegetation types provides conditions for all characteristic in-channel and riparian biota to thrive, creating patches of tall and short riparian swards, a mixture of light and shade on the river channel, and tree root systems and a supply of large woody debris that add channel complexity. Patchy tree cover provides shade protection against rising water temperatures caused by climate change.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		zone within the river corridor.	Between 30 and 50% riparian tree cover is generally considered optimal for in-channel and riparian habitats. Intensive cutting across significant proportions of the riparian zone is not appropriate. A restore target has been set due to lack of semi-natural riparian vegetation.	
Structure and function (including its typical species)	**Screening of intakes and discharges**	All intakes and discharges likely to trap a significant number of individuals of characteristic species are being adequately screened.	Intakes and discharges can be responsible for significant mortalities of fish. Long-distance migratory species such as Atlantic salmon sea trout and European eel can be particularly susceptible. Archimedes screw turbines may also have an impact on migratory fish species	
Structure and function (including its typical species)	**Sediment regime**	Restore the natural supply of coarse and fine sediment to the river	Coarse sediment supply is essential for the stability of the river channel and for creating and sustaining key biotopes including riffles and exposed shingle banks. Coarse sediment supply can be interrupted by weirs and other impounding structures, and by dredging or extraction, and can result in channel incision and heavy bankside erosion that have consequences for both biodiversity and river management (e.g. flood risk). Excessive fine sediment supply can lead to the smothering of coarse substrates and the loss of flora and fauna dependent on them. Where fine sediment delivery is a problem, control measures need to be planned in the catchment. Coarse and fine sediment supply should reflect natural supply levels. Fine sediment delivery should not be enhanced by catchment or riparian management practices in ways that lead to siltation problems in the channel or unnaturally high levels of turbidity. Pollution by sediment is inherently linked to phosphorous, as the majority of phosphorous lost by agricultural systems is bound to soil particles. SAGIS modelling has concluded that agricultural impacts are a major source of sediment /	Natural England Pollution Risk Assessment & Source Apportionment: River Dee Catchment

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			phosphorous loading in the Aldford, Henlake, Worthenbury lower and middle, Emral and Clywedog catchments. SCIMAP has been used to provide an indication of sediment erosion risk in the catchment, though it is considered that the outputs have underestimated the fine sediment erosion risk in the English part of the catchment. Red Brook, Grindley Brook and Wych Brook have been shown to have high suspended solid concentration.	
Structure and function (including its typical species)	**Supporting off-site habitat**	Habitats beyond the site boundary upon which characteristic biological communities of the site depend should be restored in a state that does not impair the full expression of the characteristic biota within the site.	The characteristic biological communities of the site are dependent on the integrity of sections of river channel, riparian areas, and transitional and marine waters that lie outside of the site boundary. Tributaries may not fall within the site boundary, yet a range of species characteristic of the site may use these areas for spawning and juvenile development and be critical for sustaining populations within the site. Fully developed riparian zones are essential to site integrity, yet part of this zone may lie outside of the site boundary, particularly if the river channel is operating under natural processes and moves laterally over time within the floodplain. The conditions experienced by long-distance migratory species (such as salmon, sea and river lampreys, allis and twaite shads and eels) outwith the site (through the saline transition zone, estuary, coastal waters and into the high seas) are critical to the well-being of populations within the site. The River Dee / Afon Dyfrdwy catchment covers an area of 2,251 square kilometres; within the catchment there are 21 lakes / reservoirs and 753 km of river; with the River Dee spanning only 110 km in length and the remaining 643 km being made up of the rivers' many tributaries. The headwaters and tributaries of the River Dee including Afon Mynach, Afon Meloch, Afon Tryweryn and River Ceiriog are integral to the natural functioning of the whole river	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			system and also support the habitats and species for which the site is notified.	
Structure and function (including its typical species)	**Thermal regime**	Maintain a natural thermal regime to the river subject to a changing climate, ensuring that water temperatures should not be significantly artificially elevated	Climate change is driving increases in river temperatures which will create stress for a range of characteristic riverine species, particularly those on the southern limit of their range. This must not be exacerbated by catchment activities that are likely to raise water temperatures further. Within existing records there is evidence of increasing winter and summer water temperatures within the River Dee, with an increase in temperature by 1–2°C between 1974 and 2005 UK climate modelling: UKCP09 projections predict river temperatures are expected to rise by between 2°C and 4°C by the 2050s compared to the long-term 1961-90 average temperature). It is also understood that a step change in climate at the end of the 1980s had an effect on rainfall patterns and temperature influencing conditions in riverine habitats and impacting on the Atlantic salmon population, in particular.	NATURAL ENGLAND AND RSPB. 2014. Climate Change Adaptation Manual: 10. Rivers and Streams. Natural England Publications available at: http://publications.naturalengland.org.uk/file/5558226472927232 ENVIRONMENT AGENCY. 2005. Climate change impacts and water temperature Science Report: SC060017/SR https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/290975/scho0707bnag-e-e.pdf
Structure and function (including its typical species)	**Key structural, influential and/or distinctive species**	Restore the abundance of the species listed to enable each of them to be a viable component of the Annex I habitat feature. *Plant communities characterised by pond water crowfoot Ranunculus peltatus and associated aquatic herbs and grasses* *Populations of fish species including bullhead, salmon, brook lamprey, sea lamprey and river lamprey*	Some plant or animal species (or related groups of such species) make a particularly important contribution to the necessary structure, function and/or quality of an Annex I habitat feature at a particular site. These species will include; • **Structural** species which form a key part of the Annex I habitat's structure or help to define that habitat on a particular SAC (see also the attribute for 'vegetation community composition'). • **Influential** species which are likely to have a key role affecting the structure and function of the habitat (such as bioturbators (mixers of soil/sediment), grazers, surface borers, predators or other species with a significant functional role linked to the habitat)	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		Club tailed dragonfly *Gomphus vulgatissimus* Fluvial geomorphology at Rhewl, just upstream of Llangollen and in the meandering section of the main Dee between Holt and Worthenbury, and Carboniferous stratigraphy at Dee Bridge Otter	• **Site-distinctive** species which are considered to be a particularly special and distinguishing component of an Annex I habitat on a particular SAC. There may be natural fluctuations in the frequency and cover of each of these species. The relative contribution made by them to the overall ecological integrity of a site may vary, and Natural England will provide bespoke advice on this as necessary. The list of species given here for this Annex I habitat feature at this SAC is not necessarily exhaustive. The list may evolve, and species may be added or deleted, as new information about this site becomes available.	
Structure and function (including its typical species)	**Vegetation structure: cover of submerged macrophytes**	Maintain a sufficient proportion of all aquatic macrophytes to allow them to reproduce in suitable habitat and unaffected by river management practices.	Removal of submerged aquatic vegetation (often called 'weed-cutting') might be undertaken for flood risk management or fishery purposes. Except in situations of extreme flood risk, best practice is for cutting to leave a mosaic of submerged and marginal vegetation, and should promote a characteristic diversity of plant species. For the Dee percentages of total habitat area or total macrophyte population cannot be expressed because the total area covered by the habitat is not known. Therefore in this SAC, the value expressed applies to a percentage of the width of channel, but only at locations where control measures such as weed cutting are an established practice as agreed by NRW / NE. In all other locations there should be no cutting of feature vegetation. The Lower Dee is also periodically affected by high nutrient levels, resulting in significant growth of water crowfoot (*Ranunculus* sp.) that can disrupt fish habitats and bind gravel together so tightly that spawning cannot take place.	NRW Core Management Plan. Available here

<table>
<tr><th colspan="2">Attributes</th><th>Targets</th><th>Supporting and Explanatory Notes</th><th>Sources of site-based evidence (where available)</th></tr>
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Table 6-1 Summary of habitat suitability recorded for Ranunculion fluitantis and Callitricho-Batrachion vegetation
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<tr><td>Upper and Mid River Dee</td><td>Some suitable habitat in the upper reaches of faster and shallower flow</td></tr>
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<tr><td>Structure and function (including its typical species)</td><td>Vegetation structure: riparian zone</td><td>Restore grazing activity in the riparian zone and in the river channel at or to suitably low levels.</td><td>Excessive levels of livestock grazing denudes the riparian zone, causes artificially high bank instability, and degradation of the fauna and flora of exposed riverine sediments. Low levels of grazing by suitable livestock are important in generating the full expression of riparian biotopes.</td><td></td></tr>
<tr><td>Structure and function (including its typical species)</td><td>Water course flow</td><td>Restore the natural flow regime of the river</td><td>River flow affects a range of habitat factors of critical importance to characteristic flora and fauna, including current velocity, water depth, wetted area, substrate quality, dissolved oxygen levels and water temperature. The maintenance of both flushing flows and seasonal base flows, based on natural hydrological processes, is vital. Detailed and ecological robust investigations of habitat-flow relationships may indicate that a more or less stringent threshold may be appropriate for a specified reach.

The ‘Dee and Clwyd River Authority Act 1973’ makes provision for the operation and management of the River Dee regulation scheme. The ‘Act’ states that the operating rules should not compromise the availability of water for public water supply abstractions. Maintaining a prescribed flow, flood mitigation, water supply to the Shropshire Union Canal and safeguarding of fisheries are also stipulated.

The ‘Control Rules’ govern the reservoirs operational bandwidths and the volumes to be released at specific times of the year. During the summer, releases ensure</td><td>River Dee Restoration Management Plan (2013) Available on request from Natural England

River Dee Restoration Technical Plan (2013) Available on request from Natural England</td></tr>
</table>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			that Llyn Tegid is maintained above 'Lower Amenity Level' and that the river downstream is supported for abstraction and environmental requirements. In the winter, runoff from the upstream catchment is stored during flood events and excess water is released as soon as practical after each event. On regulated sections of the Dee, flows are generally less extreme than they would be under a natural regime. This is because regulation releases for abstractions (usually in the summer) prevent the occurrence of very low flows; whereas reservoir refill (usually in the winter) results in the attenuation of flood peaks. As a flow regime other than natural has existed for so long the recent actual regime is deemed a more appropriate baseline for the setting of conservation objectives. Whilst guidance suggests that baseline flows should be created by removing artificial influences, these influences in the Dee are long established and authorised under several acts of parliament and therefore treated as fixtures of the catchment. For the managed stretches of the Dee flow targets were based on a benchmark (recent actual) flow regime, rather than on the perceived 'natural' flow regime. After comparison with 'natural flows' this was deemed appropriate as it represents the established flow regime that exists in the Dee and has done for decades supporting the ecology. (The meaning of "recent actual flow" is as described by Bethune (2006)) At Chester 83% of the upstream catchment area is influenced by the reservoirs, therefore a significant input to the catchment is unmanaged and the flow duration curves still exhibit a relatively 'natural' shape. **Note: Flow targets may be reassessed in future to ensure that flow regulation is optimised as much as possible for the ecological and the geomorphological**	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			benefit of the river.	
Structure and function (including its typical species)	**Woody debris**	Restore the presence of coarse woody debris within the structure of the channel (except in upland areas above the natural tree line). In smaller watercourses, temporary debris dams should be a feature of channel dynamics.	Dead woody material that falls into streams ('woody debris') plays an important role in increasing habitat diversity, providing shelter for fish, supplying a food source for aquatic invertebrates, and for slowing the passage of nutrients downstream. Woody debris is therefore a key feature of healthy rivers.	Jacobs (2013a). River Dee/Afon Dyfrdwy SSSI Restoration Management Report; Natural England, Environment Agency, Environment Agency Wales, Countryside Council for Wales (Sponsored by Welsh Government) Jacobs (2013b). River Dee/Afon Dyfrdwy SSSI Restoration Technical Report; Natural England, Environment Agency, Environment Agency Wales, Countryside Council for Wales (Sponsored by Welsh Government) Welsh Dee Trust / Natural England (2015) Restoration of the Afon Ceiriog/River Ceiriog Potential habitat restoration schemes on the Lower Ceiriog Mark Pierce and Dr. Rosie Anthony
Supporting processes (on which the feature relies)	**Air quality**	Maintain as necessary, the concentrations and deposition of air pollutants to at or below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk).	This habitat type is considered sensitive to changes in air quality. Exceedance of these critical values for air pollutants may modify the chemical status of its substrate, accelerating or damaging plant growth, altering its vegetation structure and composition and causing the loss of sensitive typical species associated with it. Critical Loads and Levels are recognised thresholds below which such harmful effects on sensitive UK habitats will not occur to a significant level, according to current levels of scientific understanding. There are critical levels for ammonia (NH3), oxides of nitrogen (NOx) and sulphur dioxide (SO2), and critical loads for nutrient nitrogen deposition and acid deposition. There are currently no critical loads or levels for other pollutants such as Halogens, Heavy Metals, POPs, VOCs or Dusts. These should be considered as appropriate on a case-by-case	More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			basis. Ground level ozone is regionally important as a toxic air pollutant but flux-based critical levels for the protection of semi-natural habitats are still under development. It is recognised that achieving this target may be subject to the development, availability and effectiveness of abatement technology and measures to tackle diffuse air pollution, within realistic timescales. No critical loads currently available on APIS for the features of interest.	
Supporting processes (on which the feature relies)	**Water chemistry - alkalinity**	Maintain natural levels of alkalinity	Natural alkalinity levels are critical to characteristic biological communities, with many species adapted to certain parts of the alkalinity range. Mass transfers of water can disrupt the natural alkalinity regime.	
Supporting processes (on which the feature relies)	**Water quality - acidification**	Maintain levels of acidity to those which reflect unimpacted conditions Acid Neutralising Capacity (ANC) and pH to meet targets for high ecological status under the WFD.	Acid deposition can cause major changes to flora, fauna and ecosystem functioning and affects organisms as diverse as diatoms, invertebrates and fish. Upland streams are particularly susceptible owing to the higher rainfall in these areas. Acid impacts are typically sporadic and tend to be greatest during the winter months. In humic (peat-stained) waters, pH is naturally lower due to the presence of weak acids, and the pH standard is correspondingly lower for these waters. However, humic compounds also provide buffering capacity that helps to reduce fluctuations in pH. Acidification lowers dissolved organic carbon in these waters, reducing the buffering capacity and altering ecosystem functioning. The values given should be applied throughout the site, not just at routine sampling points. Note that, in respect of ANC, some allowance may need to be made for anthropogenically elevated levels of humic	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			substances in rivers and streams draining degraded peat bodies - this artificially raises the buffering capacity of the water and may under-estimate the anthropogenic acid load. The values given are the same numerical values as used to protect high ecological status under the WFD in the UK. These are: ANC: mean ANC for all waters: >80 pH Clear Waters with DOC <10mg/L: mean >6.54 pH Humic Waters with DOC>10mg/L-1: mean >5.1	
Supporting processes (on which the feature relies)	**Water quality - nutrients**	Restore the natural nutrient regime of the river should be protected, with any anthropogenic enrichment above natural/background concentrations should be limited to levels at which adverse effects on characteristic biodiversity are unlikely.	Elevated nutrient levels interfere with competitive interactions between higher plant species and between higher plants and algae, leading to dominance by attached forms of algae and a loss of characteristic plant species (which may include lower plants such as mosses and liverworts). Through changes to plant growth and plant community composition and structure they also affect the wider food web, altering the balance between species with different feeding and behavioural strategies. The respiration of artificially large growths of benthic or floating algae may generate large diurnal sags in dissolved oxygen and poor substrate conditions (increased siltation) for fish and invertebrate species. The management focus is typically on phosphorus in rivers, on the assumption that it can be more easily controlled at levels that limit the growth of plant species. However, nitrogen may also be important in river eutrophication and ideally co-limitation would be the management aim. Large areas of these catchments are not connected to the foul sewer network, and the many private treatment systems are a mix of biological treatment systems and septic tanks to soakaway; some septic tanks discharge direct to watercourses. Poor agricultural land management practices can also be a factor e.g. general agricultural runoff, land-spreading	Natural England (2017) River Dee SAC Water Quality Targets. Unpublished River Dee Diffuse Water Pollution Plan. Available from Natural England and Environment Agency on request

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			activities, wastewater management. SAGIS modelling was undertaken across the Dee catchment to identify the relative contributions made by different sectors, with respect to nutrient loading. Some catchments are dominated by agricultural inputs, particularly from livestock areas e.g. Aldford, Henlake, Worthenbury lower and middle, as well as the Emral and Clywedog catchment. Others e.g Pulford, Worthenbury, Upper, Wych and the main Dee are dominated by loading from point source, sewage discharges The most significant contribution to phosphorous loading in the lower Dee is from STWs, notably Five Fords and Huntington. SAGIS concluded that the River Alyn (Mold STW) and Pulford Brook (Pulford Brook STW) were significant sources of phosphorous to the River Dee Current annual mean SRP concentrations are within the water quality target in the upstream reaches of the Dee SSSI/SAC at all monitoring locations and almost double the target concentration in downstream reaches. **Note:** Further work is being undertaken associated with the Diffuse Water Pollution Consent Order for the River Dee to establish the inputs and causes of raised nutrient levels. The nutrient targets within this document may be reassessed in future as part of this work,	
Supporting processes (on which the feature relies)	**Water quality - organic pollution**	Organic pollution levels should be controlled to levels that have minimal impact on the characteristic biota Un-ionised ammonia (95 percentile) <0.025mgl-1 Total ammonia (95 percentile) < 0.025mgl-1 NH3-N	Organic pollution effects the biota in a number of ways, including direct toxicity (from ammonia and nitrite), reduced dissolved oxygen levels (from microbial breakdown of organic material), and nutrient enrichment. Reducing organic pollution levels reduces toxic effects but unmasks enrichment effects. Controlling the continuous input of low levels of organic material is critical to controlling the enrichment effect. The values given apply throughout the site not just at routine	Diffuse Water Pollution Plan, River Restoration, unpublished SAC water quality targets for English sections. Available on request from Natural England

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		DO (10 percentile) 85% Biological oxygen demand (BOD): Mean BOD <1.5mgl-1 Calculation based on 3 years of data	sampling points - assessment can be made by modelling (assuming full mixing of effluents at the point of discharge). Farming and agricultural activities such as run off from fields or input of organic may influence dissolved oxygen levels. The geographical nature of the river (low lying, slow flowing) and the fact that it is artificially regulated by flow releases from reservoirs upstream and the presence of Chester Weir may also influence dissolved oxygen levels.	
Supporting processes (on which the feature relies)	**Water quality - other pollutants**	Achieve at least 'Good' chemical status (i.e. compliance with relevant Environmental Quality Standards).	A wide range of pollutants may impact on habitat integrity depending on local circumstance. Good chemical status includes a list of Environmental Quality Standards (EQS) for individual pollutants that are designed to protect aquatic biota with high levels of precaution. These values should be applied throughout the site, not just at routine sampling points. In addition to these pollutants, high levels of natural hormones, such as oestradiol, testosterone, 11-ketotestosterone, prostaglandins and the synthetic ones such as 17α-ethinyloestradiol, are known to occur downstream of fish farms and sewage treatment works. Further investigation is required to determine the significance of any impact on habitat integrity and also on the SAC species Atlantic Salmon. EQSs for the steroid oestrogens have been proposed under the requirements of the WFD.	CEFAS. 2009. Diffuse pollution and freshwater fish populations. Defra Research Project SF0244 https://www.cefas.co.uk/publications/techrep/tech119.pdf
Supporting processes (on which the feature relies)	**Conservation measures**	Restore the management measures (either within and/or outside the site boundary as appropriate) which are necessary to Restore the structure, functions and supporting processes associated with the feature	Active and ongoing conservation management is needed to protect, maintain or restore this feature at this site. Further details about the necessary conservation measures for this site can be provided by contacting Natural England. This information will typically be found within, where applicable, supporting documents such as Natura 2000 Site Improvement Plan, Site Management Strategies or	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Plans, the Views about Management Statement for the underpinning SSSI and/or management agreements.	
Structure and function (including its typical species)	**Adaptation and resilience**	Maintain the feature's ability, and that of its supporting processes, to adapt or evolve to wider environmental change, either within or external to the site	This recognises the increasing likelihood of natural habitat features to absorb or adapt to wider environmental changes. Resilience may be described as the ability of an ecological system to cope with, and adapt to environmental stress and change whilst retaining the same basic structure and ways of functioning. Such environmental changes may include changes in sea levels, precipitation and temperature for example, which are likely to affect the extent, distribution, composition and functioning of a feature within a site. The vulnerability and response of features to such changes will vary. The overall vulnerability of this SAC to climate change has been assessed by Natural England (2015) as being high, taking into account the sensitivity, fragmentation, topography and management of its habitats/supporting habitats. This means that this site is considered to be the most vulnerable sites overall and are likely to require the most adaptation action, most urgently. A site based assessment should be carried out as a priority. This means that action to address specific issues is likely, such as reducing habitat fragmentation, creating more habitat to buffer the site or expand the habitat into more varied landscapes and addressing particular management and condition issues. Individual species may be more or less vulnerable than their habitat itself. In many cases, change will be inevitable so appropriate monitoring would be advisable.	NATURAL ENGLAND, 2015. Climate Change Theme Plan and supporting National Biodiversity Climate Change Vulnerability assessments ('NBCCVAs') for SACs and SPAs in England [Available at http://publications.naturalengland.org.uk/publication/4954594591375360].

Version Control Advice last updated: **24 March 2019**.

1) Text relating to detailed management solutions removed from the explanatory notes for the following attributes: **Biological connectivity; Riparian habitat mosaic; Fisheries – introduction of salmon and / or other fish species; Fisheries exploitation; Thermal regime; Vegetation structure: riparian zone**; and **Woody debris** as considered to be outside the scope of this advice.
2) *Luronium natans removed from list of **Key structural, influential and/or distinctive species*** as within this SAC the species only occurs on land within Wales.
3) Additional text added to explanatory notes for **Water quality – organic pollution** expanding on factors influencing Dissolved Oxygen levels.
4) Detailed targets removed from the following attributes: **Vegetation structure: cover of submerged macrophytes; Fisheries: introduction of salmon and / or other fish species.** The detailed targets are currently being reviewed and advice will be provided on a case by case basis; generic targets for these attributes have been

Attributes	Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
retained.			
Variations from national feature-framework of integrity-guidance: N/A			

Table 2: Supplementary Advice for Qualifying Features: S1095. *Petromyzon marinus* Sea lamprey; S1096. *Lampetra planeri* Brook lamprey; S1099. *Lampetra fluviatilis* River Lamprey;

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Population (of the feature)	**Juvenile densities**	Restore juvenile densities at those expected under unimpacted conditions throughout the site, taking into account natural habitat conditions and allowing for natural fluctuations **Age structure (Lampetra sp. only)** For samples of 50 or less, at least two distinct size classes should normally be present. If more than 50 ammocoetes are collected, at least three size classes should be present. If more than 100 lampreys are collected, at least three size classes should be present. **Ammocoetes density** **Lampetra spp:** Optimal habitat:>10m-2 Overall catchment mean:>5m-2 **Petromyzon:** Ammocoetes should be present in at least four sampling sites, each not less than 5km apart.	Impacts on physical, chemical or hydrological integrity, or from non-native species, may suppress juvenile densities. **Age Structures** Lamprey ammocoetes grow at a reasonably steady rate and distinct size classes are usually apparent. Ammocoetes typically range from 10 – 150 mm, corresponding to up to six year classes. The largest ammocoetes are usually brook lampreys (river lampreys metamorphose at about 100 – 120mm), while the smallest individuals are likely to be young-of year sea lampreys, since this species spawns later in the year The full range of age classes of ammocoete larvae, from 0+ up to metamorphosis should be present. However, sampling error may make these difficult to discern unless large samples are taken. During a 2011 survey of the Dee Catchment (wider than SAC), at least two age classes were present at most sites. The exceptions were Sites 2, 5, and 8 in the lower Dee sub-catchment. The greatest number of age cohorts were recorded at Site 15 in the Upper Dee where individuals were caught representing 0 to 5 years old (inclusive) **Ammocoetes density** *Lampetra* ammocoetes cannot be distinguished in the field, so it will not normally be possible to set separate targets for *L. fluviatilis* and *L. planeri*. However, lampreys upstream of a natural barrier to migration (which are currently unknown on the River Dee) will always be *L.planeri*. *Petromyzo*n ammocoetes can be distinguished in the field but typically occur at very much lower densities than *Lampetra* – approximately 1 ammocoete in 50 in UK rivers is normally *Petromyzon*. Setting of density targets for this species is therefore impractical.	NRW Core Management Plan. Available here CCW Contract Science Report No. 975 - Lamprey monitoring on the River Dee Special Area of Conservation (SAC) 2011 N. Teague, H. Webb, V. Allen, C. P. Cesar, Rh. Thomas & T. Hatton-Ellis. CCW Contract Science Report No. 975 © Maitland, P.S., Ecology of the river, brook and sea lamprey. Conserving Natura 2000 Rivers Ecology Series No.5, English Nature: Peterborough, 2003.

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		Sea Lamprey Spawning Activity No reduction in extent of spawning activity year on year.	Surveys in 2011 suggested that within the SAC the mean density of Lampetra spp. in the optimal habitat sites was 7.5 m-2, below the 10 m-2 condition target. In both optimal and sub-optimal habitat the mean density of Lampetra spp. in the SAC was 4.4 m-2 and therefore below the 5 m-2 target. **Sea Lamprey Spawning Activity:** 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 lampreys spawn in June-August (depending on the river) and are usually easily observed at traditional spawning sites during these months.	
Population (of the feature)	**Population abundance**	Restore the abundance of the population to a level which is close to that expected under unimpacted conditions throughout the site (subject to natural habitat conditions and allowing for natural fluctuations), whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. **Distribution of population:** Lampreys should be present at not less than 2/3 of sites surveyed**.**	This will ensure there is a viable population of the feature which is being maintained at or increased to a level that contributes as appropriate to its Favourable Conservation Status across its natural range in the UK. Due to the dynamic nature of population change, the target-value given for the population size or presence of this feature is considered to be the minimum standard for conservation/restoration measures to achieve. This minimum-value may be revised where there is evidence to show that a population's size or presence has significantly changed as a result of natural factors or management measures and has been stable at or above a new level over a considerable period (generally at least 10 years). The values given here may also be updated in future to reflect any strategic objectives which may be set at a national level for this feature. Given the likely fluctuations in numbers over time, any impact-assessments should focus on the current size of the site's population, as derived from the latest known or estimated level established using the best available data. This advice accords with the obligation to avoid deterioration of the site or significant disturbance of the species for which the site is designated, and seeks to avoid plans or projects that may affect the site giving rise to the risk of deterioration. Similarly, where there is evidence to show that a feature has historically been more	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			abundant than the stated minimum target and its current level, the ongoing capacity of the site to accommodate the feature at such higher levels in future should also be taken into account in any assessment. Unless otherwise stated, the population size or presence will be that measured using standard methods, such as peak mean counts or breeding surveys. This value is also provided recognising there will be inherent variability as a result of natural fluctuations and margins of error during data collection. Whilst we will endeavour to keep these values as up to date as possible, local Natural England staff can advise that the figures stated are the best available. Distribution in the catchment should be appropriate to the natural geomorphology. Any accessible silt beds should be expected to contain ammocoetes of Lampetra spp, although in practice some beds are likely to be naturally unoccupied (e.g. due to washout). Any silt beds adjacent to or downstream of known *Petromyzon* spawning sites should contain *Petromyzon* ammocoetes. The distribution of *Petromyzon* in the catchment is unknown so surveys of spawning sites should be carried out in June-July. Also, little is known about the effect of barriers in the River Dee or pollution on lamprey numbers and distribution. Both of these factors are due to be investigated further.	
Supporting habitat: extent and distribution	**Distribution of supporting habitat**	Restore the distribution and continuity of the feature and its supporting habitat, including where applicable its component vegetation types and associated transitional vegetation types, across the site	See relevant text above in Table 1	
Supporting habitat: extent and distribution	**Extent of supporting habitat**	Restore the total extent of the H3260 feature to that characteristic of the natural fluvial processes associated with the river type.	See relevant text above in Table 1.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Supporting habitat: structure/ function	**Biological connectivity**	See general advice for river habitat (H3260)	Lampreys can pass some potential barriers by attaching themselves to structures or river banks by their suctorial discs and creeping up by strong bursts of swimming. However, many in-channel structures are known to either completely or partially block access to historical spawning grounds. Whilst in-channel structures can artificially generate both siltbeds and clean gravels, both of value to lamprey species, this is not a justification for their continued existence or the construction of new structures. Suitable habitat for lamprey and other species can and should be generated by natural processes - where physical restoration of the channel is required this may involve changes in the distribution of species within the river system. Sea lamprey will require safe passage between rivers, coastal waters and estuaries. This is particularly important to the sea lamprey, which does not readily ascend over structures as the river lamprey and as such is often restricted to lower river habitats. During a 2011 survey of Lamprey within the River Dee there was only one site (upstream of Rossett Weir in Alyn sub-catchment) where an absence of Brook / River Lamprey could potentially be attributable to the presence of a barrier to migration. The presence of individuals of these two species throughout the remainder of the whole catchment suggests that the distribution of brook and river lamprey is not controlled by the presence of migratory obstructions. For sea lamprey however anecdotal evidence suggests that Erbistock Weir could present a barrier to migration. The assessment undertaken in relation to barriers to migration however relied on information gathered in relation to salmonids. To make a better assessment of the potential for artificial barriers to prevent adults from reaching spawning grounds information on the passability of these barriers with lamprey in mind would be required. There may also exist additional	CCW Contract Science Report No. 975 - Lamprey monitoring on the River Dee Special Area of Conservation (SAC) 2011 N. Teague, H. Webb, V. Allen, C. P. Cesar, Rh. Thomas & T. Hatton-Ellis. CCW Contract Science Report No. 975 ©

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			barriers to lamprey migration throughout the catchment which have not been noted due to their passability by salmonids.	
Supporting habitat: structure/ function	**River Biotope (habitat) mosaic**	See general advice for river habitat (H3260)	Habitat conditions for lamprey species vary naturally in rivers. Some river sections may provide optimal habitat for some or all life stages whilst others may be largely unsuitable. Adult lamprey require spawning substrates of coarse material in which to deposit eggs in shallow scrapes (redds). Larval lamprey (ammocoetes) live in silt beds, which are often in channel margins but in relation to sea lamprey are known to occur in deep water in main river reaches. The advice for H3260 is based on natural river function, which provides a characteristic biotope mosaic that caters for lamprey life stages to a degree characteristic of the river.	
Supporting habitat: structure/ function	**Control of livestock grazing activity**	See general advice for river habitat (H3260)	Over-grazing of riparian areas can have a dramatic effect on lamprey habitat, trampling marginal siltbeds, eliminating marginal vegetation and generating excessive loads of fine sediment on spawning gravels.	
Supporting habitat: structure/ function	**Fisheries - exploitation**	All exploitation (e.g. netting or angling) of lamprey species should be undertaken sustainably without compromising any components of the population,	Controls on exploitation should include migratory passage within territorial waters, including estuarine and coastal net fisheries, as well as exploitation within the river.	
Supporting habitat: structure/ function	**Fisheries - introduction of fish species**	Ensure fish stocking/introductions do not interfere with the ability of the river to support self-sustaining populations of the feature	The presence of artificially high densities of fish may create unacceptably high levels of predatory pressure on brook lamprey and ammocoetes of all species. The management aim is to provide conditions in the river that support a healthy, natural and self-sustaining salmon population, achieved through habitat protection/restoration and the control of exploitation as necessary. Stocking represents a loss of naturalness and, if successful, obscures the underlying causes of poor performance (potentially allowing these risks to perpetuate). It carries various ecological risks, including the loss of natural spawning from broodstock, competition between stocked and naturally produced individuals, disease introduction and genetic alterations to the population	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Supporting habitat: structure/ function	**Flow regime**	See general advice for river habitat (H3260).	The natural flow regime is critical to all aspects of lamprey life cycle. It shapes the characteristic biotope mosaic, maintains water in critical biotopes (including marginal siltbeds), and provides adequate flows for migratory passage (which is important not only for river and sea lamprey but also brook lamprey in its shorter distance migrations within the river).	
Supporting habitat: structure/ function	**Integrity of off-site habitats**	See general advice for river habitat (H3260)	Lamprey populations may be dependent on the integrity of sections of river channel, riparian areas and transitional and marine waters that lie outside of the site boundary. Headwater areas and tributaries may not fall within the site boundary, yet lamprey (particularly brook and river lamprey) may use these areas for spawning and juvenile development and be critical for sustaining populations within the site. River and sea lamprey require safe passage through coastal waters and estuaries.	
Supporting habitat: structure/ function	**Riparian zone**	See general advice for river habitat (H3260)	Active marginal vegetation including riparian trees provides important habitat for lamprey ammocoetes, as it encourages and stabilises the formation of silt beds in which ammocoetes burrow. Riparian trees also add substrate diversity and aid the formation of siltbeds and clean gravels. They also provide temperature gradients in the channel that improves the availability of suitable micro-habitat.	
Supporting habitat: structure/ function	**Screening of intakes and discharges**	See general advice for river habitat (H3260)	Adult lamprey and migrating sub-adults (transformers) can be entrained in intakes and discharges along with other fish species.	The survival of lamprey on travelling screens at potable water intakes N. Teague & S. C. Clough APEM Ltd, Heaton Mersey, Stockport, UK - International Fish Screening Techniques
Supporting habitat: structure/ function	**Sediment regime**	See general advice for river habitat (H3260)	Natural levels of coarse sediment supply are critical to the maintenance of high quality spawning habitat for lamprey species, maintaining bed substrates in optimal condition for egg-laying and juvenile and adult cover. Excessive delivery of fine sediment, from the catchment or	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			artificially enhanced bank erosion, can cause siltation of egg-laying sites and juvenile and adult refugia.	
Supporting habitat: structure/ function	**Soils, substrate and nutrient cycling**	See general advice for river habitat (H3260)	See relevant text in Table 1 above.	
Supporting habitat: structure/ function	**Vegetation composition: invasive non-native species**	See general advice for river habitat (H3260)	Species such as signal crayfish can have a serious effect on lamprey habitat and may predate heavily ammocoetes of all lamprey species if present at high densities. Chinese mitten crab is also of concern, not only in the lower reaches of main river but due to its potential to migrate long distances upstream.	
Supporting habitat: structure/ function	**Water quality - acidification**	See general advice for river habitat (H3260)	Maps of critical loads provide an indication of acidification hotspots.	
Supporting habitat: structure/ function	**Water quality - nutrients**	Restore the natural nutrient regime of the river, with any anthropogenic enrichment above natural/background concentrations limited to levels at which adverse effects on the features are unlikely.	Nutrient enrichment can lead to loss of substrate condition for bullhead and lamprey spawning, egg development and lamprey ammocoete growth, due to benthic algal growth and associated enhanced siltation and sediment anoxia. Lamprey species and Episodic pollution causes direct mortalities whilst chronic pollution affects substrate condition through the build-up of excessive microbial populations	
Supporting habitat: structure/ function	**Water quality - organic pollution**	See the target above for the H3260 habitat feature	Lamprey species may be affected by both episodic and chronic organic pollution. Episodic pollution causes direct mortalities whilst chronic pollution affects substrate condition through the build-up of excessive microbial populations.	
Supporting habitat: structure /function	**Water quality - nutrients**	Restore the natural nutrient regime of the rivers, with any anthropogenic enrichment above natural/background concentrations limited to levels at which adverse effects on the feature are unlikely.	Nutrient enrichment can lead to loss of substrate condition for spawning, egg development and ammocoete growth, due to benthic algal growth and associated enhanced siltation and sediment anoxia. Lamprey species may be affected by both episodic and chronic organic pollution. Episodic pollution causes direct mortalities whilst chronic pollution affects substrate condition through the build-up of excessive microbial populations.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Supporting habitat: structure/ function	**Woody debris**	See general advice for river habitat (H3260)	Woody debris is an important component of river habitat for lampreys as well as the wider biological community. It encourages characteristic heterogeneity in biotopes, provides a mosaic of substrates types that lamprey species need to fulfil their life cycle.	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Adaptation and resilience**	See general advice for river habitat (H3260)	See relevant text above in Table 1.	See Reference in Table 1
Supporting processes (on which the feature and/or its supporting habitat relies)	**Air quality**	See general advice for river habitat (H3260)	See relevant text above in Table 1	More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).
Supporting processes (on which the feature and/or its supporting habitat relies)	**Conservation measures**	Restore as necessary the management measures (either within and/or outside the site boundary as appropriate) which are necessary to Restore] the structure, functions and supporting processes associated with the feature and/or its supporting habitats.	Active and ongoing conservation management is needed to protect, maintain or restore this feature at this site. Further details about the necessary conservation measures for this site can be provided by contacting Natural England. This information will typically be found within, where applicable, supporting documents such as Natura 2000 Site Improvement Plan, site management strategies or plans, the Views about Management Statement for the underpinning SSSI and/or management agreements.	MAITLAND P.S 2003. Ecology of the River, Brook and Sea Lamprey. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough. http://publications.naturalengland.org.uk/file/118013 APEM. 2008 River Avon SAC Low Flows Project Ecological Investigation Final Report for Wessex Water. AMP5 Low Flow Investigation for the Environment Agency. - Available from Wessex Water on request
Supporting processes (on which the feature and/or its supporting	**Water quantity/ quality**	See general advice for river habitat (H3260)	See relevant text in Table 1	

Attributes	Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
habitat relies)			
Version Control Advice last updated: N/A			
Variations from national feature-framework of integrity-guidance: N/A			

Table 3: Supplementary Advice for Qualifying Features: S1106. *Salmo salar*; Atlantic salmon

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Population (of the feature)	**Adult run size**	Restore the population to that expected under un-impacted conditions, allowing for natural fluctuations. This should include a seasonal pattern of migration characteristic of the river and maintenance of the multi-sea-winter component. As a minimum, the Conservation Limit for the river system should be complied with. For the river Dee the Conservation Limit (CL) is 5100 spawning adults per year and the Management Limit (ML) is 6300 spawning adults per year	Impacts on physical, chemical or hydrological integrity, or from non-native species, or from exploitation in freshwater or marine and coastal waters, may suppress adult run size. Stocking may also artificially augment adult run size, and may mask environmental problems or generate impacts on naturally spawned individuals. The Conservation Limit should be based on the adult run size required to fully utilise all parts of the catchment that would be suitable for spawning and juvenile development under unimpacted conditions. Since 2015, annual reports have been produced by NRW which describe the status of the salmon and sea trout populations for the River Dee Catchment	NRW Core Management Plan - (from Davidson (2005) but details also given in Pisces Conservation Ltd, (2007). https://naturalresources.wales/guidance-and-advice/business-sectors/fisheries/know-your-rivers-salmon-and-sea-trout-catchment-summaries/?lang=en
Population (of the feature)	**Juvenile densities**	Maintain juvenile densities at those expected under unimpacted conditions throughout the site, taking into account natural habitat conditions and allowing for natural fluctuations	Impacts on physical, chemical or hydrological integrity, or from non-native species, or from exploitation of spawning adults in freshwater or marine and coastal waters, may suppress juvenile densities. Expected densities for each sample site should be calculated using HABSCORE	(Cowx and Fraser, 2003).
Population (of the feature)	**Spawning distribution**	Restore the distribution of spawning to reflect unimpacted conditions through the site, and avoid reductions in existing levels.	After a year or more at sea, adult salmon return from their feeding grounds back to their river. Once it is time for them to spawn they will migrate upstream to the areas of the SAC where they were born to spawn themselves. These spawning areas may be in small tributaries of river systems where there is clean gravel and a good flow of fresh clean water.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Maintaining these spawning areas is critical to the successful reproduction and long-term viability of this feature.	
Supporting habitat: extent and distribution	**Distribution of supporting habitat**	Restore the distribution and continuity of the feature and its supporting habitat, including where applicable its component vegetation types and associated transitional vegetation types, across the site	See relevant text in Table 1 above.	
Supporting habitat: extent and distribution	**Extent of supporting habitat**	Restore the total extent of the H3260 feature to that characteristic of the natural fluvial processes associated with the river type.	See relevant text in Table 1 above.	
Supporting habitat: structure/ function	**Biological connectivity**	See general advice for river habitat (H3260)	Freedom of movement throughout the river system is critical to all life stages of salmon. Barriers to adult migration have cumulative effects on the ability of individuals to reach spawning grounds and need to be considered in combination.	
Supporting habitat: structure /function	**Biotope mosaic**	See general advice for river habitat (H3260)	Within the river, a characteristic habitat mosaic shaped by natural processes provides the diversity of water depths, current velocities and substrate types necessary to fulfil the spawning, juvenile, adult and migratory requirements of salmon as well as other characteristic species. Some river sections will be naturally sub-optimal for some salmon life stages, and this is just a characteristic of the river. The species requires: • adult holding areas (generally pools of at least 150 cm depth, with cover from features such as undercut banks, vegetation, submerged objects and surface turbulence) • spawning habitat (stable, clean gravel/pebble-dominated substrate without an armoured layer and with <10% fines in the top 30cm, and with 15-75cm of overlying water), • Nursery habitat (for fry, water of <20 cm deep and a gravel/ pebble/ cobble substrate; for parr, water 20-40 cm deep and similar substrate).	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Close juxta position of biotopes is needed to allow easy movement of individuals between suitable areas of the channel under different flow conditions and with age.	
Supporting habitat: structure/ function	**Flow regime**	See general advice for river habitat (H3260).	The natural flow regime is critical to all aspects of the salmon life cycle, including migratory passage through the estuary and up the river to spawning grounds, egg incubation in redds, fry and parr habitat quality and extent, and downstream smolt migration.	
Supporting habitat: structure /function	**Riparian zone**	See general advice for river habitat (H3260)	High riparian tree cover is beneficial to salmon, in terms of physical habitat provision and combatting increasing temperatures caused by climate change. However, the extent of tree cover needs to be optimised to provide suitable conditions for the whole characteristic biological community.	
Supporting habitat: structure function	**Sediment regime**	See general advice for river habitat (H3260)	Natural levels of coarse sediment supply are critical to the maintenance of high quality juvenile and salmon habitat, maintaining spawning gravels and characteristic biotope mosaics. Excessive delivery of fine sediment, from the catchment or artificially enhanced bank erosion, can damage gills, impair vision and cause siltation of spawning and nursery areas.	
Supporting habitat: structure/ function	**Soils, substrate and nutrient cycling**	See general advice for river habitat (H3260)	See relevant text in Table 1	
Supporting habitat: structure/ function	**Thermal regime**	See general advice for river habitat (H3260)	Water temperature can affect egg development, fish survival, feeding and growth. The salmon is considered particularly vulnerable to increasing temperatures in the southern part of its English range, most notably in chalk streams It is now known that higher sea and river temperatures may be affecting salmon survival and migration in some years. Summer temperatures are reaching levels that may reduce the quality of eggs that female salmon produce and be directly impacting on parr survival. They may also be inhibiting migration into the river and increasing the mortality of adult salmonids.	
Supporting habitat: structure/	**Vegetation composition: invasive non-**	See general advice for river habitat (H3260)	Species such as signal crayfish can have a serious effect on salmon habitat and can predate heavily on salmon juveniles if present at high densities. Chinese mitten crab has the potential	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
function	**native species**		to migrate long distances up rivers and damage marginal habitats used by both adult and juvenile salmon.	
Supporting habitat: structure/ function	**Water quality - acidification**	See general advice for river habitat (H3260)	Salmon are highly sensitive to acidification stress.	
Supporting habitat: structure /function	**Water quality - nutrients**	See general advice for river habitat (H3260).	In addition to the wider ecosystem effects of eutrophication that have a detrimental effect on salmon habitat, enrichment can place salmon at a competitive disadvantage, for instance relative to brown trout. Salmon are efficient foragers that are adapted to low productivity environments, and increased productivity makes efficient foraging obsolete. Eutrophication and episodic pollution causes direct mortalities, whilst chronic pollution affects substrate condition through the build-up of excessive microbial populations. Salmon are particularly sensitive to reduce dissolved oxygen levels, in the water column and within the gravel substrate of spawning redds (nests).	
Supporting habitat: structure/ function	**Woody debris**	See general advice for river habitat (H3260)	Woody debris is an important component of river habitat for salmon as well as the wider biological community.	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Adaptation and resilience**	Maintain the feature's ability, and that of its supporting habitat, to adapt or evolve to wider environmental change, either within or external to the site	See relevant text in Table 1 above. Changes in river flows also affect the number of fish – by impacting on their migration, habitat and food availability. A more 'flashy' and extreme hydrograph could impact on salmonids in a number of ways. Of particular concern is the potential for an increased sediment load in the river from terrestrial and riverine riparian sources during extreme high rain flow events. Restoration of the supporting habitat for water courses of plain to montane levels with the *Ranunculion fluitantis* and Callitricho-Batrachion vegetation is critical in enabling the species to be resilient to changing prevailing conditions due to extremes in weather patterns – increased storminess and	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			flooding to increased droughts and a long term trend for increasing river temperature through climate change.	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Air quality**	See general advice for the H3260 habitat feature	See relevant text in Table 1 above.	More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).
Supporting processes (on which the feature and/or its supporting habitat relies)	**Conservation measures**	Restore the management measures (either within and/or outside the site boundary as appropriate) which are necessary to Restore] the structure, functions and supporting processes associated with the feature and/or its supporting habitats.	See relevant text in Table 1 above. Habitat outside the SAC boundary including small tributaries, back streams and back waters is also important in providing habitat for the species, in particular fry and juvenile habitat.	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Control of livestock grazing activity**	See general advice for river habitat (H3260)	Over-grazing of riparian areas can have a dramatic effect on salmon habitat.	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Fisheries - exploitation**	Ensure exploitation (e.g. netting or angling) of Atlantic salmon is undertaken sustainably without compromising any components of the population, including multi-sea winter fish and seasonal components of the adult run.	Controls on exploitation should include migratory passage within territorial waters, including estuarine and coastal net fisheries, as well as exploitation within the river from rod fisheries	Assessment of Salmon Stocks and Fisheries in England and Wales (CEFAS, EA, NRW)
Supporting processes (on which the feature and/or its supporting habitat relies)	**Fisheries - introduction of salmon and other fish species**	Ensure fish stocking/introductions do not interfere with the ability of the river to support self-sustaining populations of the feature	The management aim is to provide conditions in the river that support a healthy, natural and self-sustaining salmon population, achieved through habitat protection/restoration and the control of exploitation as necessary. Stocking represents a loss of naturalness and, if successful, obscures the underlying causes of poor performance (potentially allowing these risks to perpetuate). It carries various ecological risks, including the loss of natural spawning from	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			broodstock, competition between stocked and naturally produced individuals, disease introduction and genetic alterations to the population.	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Integrity of off-site habitats**	See general advice for river habitat (H3260)	Salmon populations are dependent on the integrity of sections of river channel, riparian areas, and transitional and marine waters that lie outside of the site boundary. Headwater areas and tributaries may not fall within the site boundary, yet salmon may use these areas for spawning and juvenile development and be critical for sustaining populations within the site. Fully developed riparian zones are essential for salmon habitat, yet part of this zone may lie outside of the site boundary, particularly if the river channel is operating under natural processes and moves laterally over time within the floodplain. The conditions experienced by salmon on their marine migration (through the saline transition zone, estuary, and coastal waters and into the high seas) are critical to the well-being of populations within the river, and vice versa.	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Screening of intakes and discharges**	See general advice for river habitat (H3260)	Salmon can be seriously affected by inadequate screening on their adult and smolt migrations, as well as on their smaller juvenile dispersion movements between spawning grounds and nursery areas.	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Vegetation structure: cover of submerged macrophytes**	See general advice for river habitat (H3260)	In rivers where it naturally occurs, submerged and marginal vegetation is an important element of juvenile salmon habitat.	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Water quantity/ quality**	See general advice for river habitat (H3260)	See relevant text in Table 1 above	
Version Control Advice last updated: **24 March 2019**. Text relating to detailed management solutions removed from the explanatory notes for the following attributes: **Fisheries exploitation** as considered to be outside the scope of this advice.				

Attributes	Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Variations from national feature-framework of integrity-guidance: N/A			

Table 4: Supplementary Advice for Qualifying Features: S1163. *Cottus gobio*; Bullhead

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Population (of the feature)	**Juvenile densities**	Maintain juvenile densities at those expected under unimpacted conditions throughout the site, taking into account natural habitat conditions and allowing for natural fluctuations Young-of-year fish should occur at densities at least equal to adults	Impacts on physical, chemical or hydrological integrity, or from non-native species, may suppress juvenile densities. Young-of-year fish should be easily identifiable using length-frequency analysis. In September they are typically less than 30mm long.	NRW Core Management Plan. Available here Definition of Favourable Condition (2009) River Dee (England) SSSI – Consultation Draft.
Population (of the feature)	**Population abundance**	Maintain the abundance of the population at a density which is close to that expected under unimpacted conditions throughout the site (subject to natural habitat conditions and allowing for natural fluctuations), whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. **Population Density:** No less than 0.2 m-2 in sampled reaches **Population Distribution:** Bullheads should be present in all suitable reaches. As a minimum, no decline in distribution from current.	This will ensure there is a viable population of the feature which is being maintained at or increased to a level that contributes as appropriate to its Favourable Conservation Status across its natural range in the UK. Due to the dynamic nature of population change, the target-value given for the population size or presence of this feature is considered to be the minimum standard for conservation/restoration measures to achieve. This minimum-value may be revised where there is evidence to show that a population's size or presence has significantly changed as a result of natural factors or management measures and has been stable at or above a new level over a considerable period (generally at least 10 years). The values given here may also be updated in future to reflect any strategic objectives which may be set at a national level for this feature. Given the likely fluctuations in numbers over time, any impact-assessments should focus on the current size of the site's population, as derived from the latest known or estimated level established using the best available data. This advice accords with the obligation to avoid deterioration of the site or significant disturbance of the species for which the site is designated, and seeks to avoid plans or projects that may affect the site giving	TOMLINSON, M. L. & PERROW M. R. (2003). Ecology of the Bullhead. Conserving Natura 2000 Rivers Ecology Series No. 4. English Nature, Peterborough. htpp://publications.naturalengland.org.uk/file/111020 NRW Core Management Plan. Available here Definition of Favourable Condition (2009) River Dee (England) SSSI – Consultation Draft.

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			rise to the risk of deterioration. Similarly, where there is evidence to show that a feature has historically been more abundant than the stated minimum target and its current level, the ongoing capacity of the site to accommodate the feature at such higher levels in future should also be taken into account in any assessment. Unless otherwise stated, the population size or presence will be that measured using standard methods, such as peak mean counts or breeding surveys. This value is also provided recognising there will be inherent variability as a result of natural fluctuations and margins of error during data collection. Whilst we will endeavour to keep these values as up to date as possible, local Natural England staff can advise that the figures stated are the best available.	
Supporting habitat: extent and distribution	**Distribution of supporting habitat**	Restore the distribution and continuity of the feature and its supporting habitat, including where applicable its component vegetation types and associated transitional vegetation types, across the site	See relevant text above in Table 1.	
Supporting habitat: extent and distribution	**Extent of supporting habitat**	Restore the total extent of the H3260 feature to that characteristic of the natural fluvial processes associated with the river type.	See relevant text above in Table 1.	
Supporting habitat: structure/ function	**Biological connectivity**	See general advice for river habitat (H3260)	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 or drought, and more generally will also lead to constraints on genetic interactions that may have adverse consequences.	
Supporting habitat: structure/ function	**Biotope mosaic**	See general advice for river habitat (H3260)	Habitat conditions for bullhead vary naturally in rivers. Some river sections may provide optimal habitat whilst others may be largely unsuitable. Optimal conditions typically occur in relatively shallow, fast flowing reaches with coarse substrates (used for egg-laying and juvenile/adult cover).	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			A characteristically diverse biotope mosaic allows the bullhead and other species to move within the channel to locate optimal habitat conditions in the face of a fluctuating flow regime. Pools, exposed tree root systems and marginal shallows are important high-flow refugia for the species. The advice for H3260 is based on natural river function, which provides a characteristic biotope mosaic that caters for bullhead to a degree characteristic of the river.	
Supporting habitat: structure/ function	**Control of livestock grazing activity**	See general advice for river habitat (H3260)	Over-grazing of riparian areas can have a dramatic effect on bullhead habitat, eliminating marginal habitat and generating excessive loads of fine sediment.	
Supporting habitat: structure /function	**Fisheries - introduction of fish species**	Ensure fish stocking/introductions do not interfere with the ability of the river to support self-sustaining populations of the feature	The presence of artificially high densities of fish can creates unacceptably high levels of predatory pressure on bullhead. Stocking represents a loss of naturalness and, if successful, obscures the underlying causes of poor performance (potentially allowing these risks to perpetuate). It carries various ecological risks, including the loss of natural spawning from broodstock, competition between stocked and naturally produced individuals, disease introduction and genetic alterations to the population	
Supporting habitat: structure/ function	**Flow regime**	See general advice for river habitat (H3260).	The natural flow regime is critical to all aspects of the bullhead life cycle, maintaining the high current velocities and substrate conditions that are optimal for the species.	
Supporting habitat: structure/ function	**Integrity of off-site habitats**	See general advice for river habitat (H3260)	Bullhead populations within the SAC may be dependent on the integrity of sections of river channel and riparian areas that lie outside of the site boundary. Headwater areas and tributaries may not fall within the site boundary, yet bullhead may use these areas for spawning and juvenile development and be critical for sustaining populations within the site.	
Supporting habitat: structure/ function	**Riparian zone**	See general advice for river habitat (H3260)	Active marginal vegetation including riparian trees provides important cover for bullhead. A mosaic of vegetation types and sward heights provides suitable conditions for the whole characteristic biological community including bullhead.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Supporting habitat: structure/ function	**Screening of intakes and discharges**	See general advice for river habitat (H3260)	Bullhead can be entrained in intakes and discharges along with other fish species.	
Supporting habitat: structure/ function	**Sediment regime**	See general advice for river habitat (H3260)	Natural levels of coarse sediment supply are critical to the maintenance of high quality bullhead habitat, maintaining bed substrates in optimal condition for egg-laying and juvenile and adult cover. Excessive delivery of fine sediment, from the catchment or artificially enhanced bank erosion, can cause siltation of egg-laying sites and juvenile and adult refugia.	
Supporting habitat: structure/ function	**Soils, substrate and nutrient cycling**	See general advice for river habitat (H3260)	See relevant text in Table 1 above.	
Supporting habitat: structure/ function	**Vegetation composition: invasive non-native species**	See general advice for river habitat (H3260)	Species such as signal crayfish can have a serious effect on bullhead habitat (by destabilising banks and enhancing fine sediment input), and can predate heavily on bullhead if present at high densities. Chinese mitten crab has the potential to migrate long distances up rivers and can cause similar damage to bullhead habitat.	
Supporting habitat: structure/ function	**Vegetation structure: cover of submerged macrophytes**	See general advice for river habitat (H3260)	In rivers where it naturally occurs, submerged and marginal vegetation can provide important cover for bullhead, particularly if coarse (cobble) substrates are in short supply for cover.	
Supporting habitat: structure/ function	**Water quality - acidification**	See general advice for river habitat (H3260)	The bullhead is susceptible to acidification stress in low alkalinity waters. Maps of critical loads provide an indication of acidification hotspots.	
Supporting habitat: structure/ function	**Water quality - nutrients**	Maintain the natural nutrient regime of the river s, with any anthropogenic enrichment above natural/background concentrations limited to levels at which adverse effects on the feature are unlikely.	Nutrient enrichment can lead to loss of substrate condition for bullhead due to benthic algal growth and associated enhanced siltation. The bullhead is susceptible to both episodic and chronic organic pollution. Episodic pollution causes direct mortalities whilst chronic pollution affects substrate condition through the build-up of excessive microbial populations.	
Supporting habitat: structure/	**Woody debris**	See general advice for river habitat (H3260)	Woody debris is an important component of river habitat for bullhead as well as the wider biological community. Bullheads are particularly associated with woody debris in lowland	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
function			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.	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Adaptation and resilience**	See general advice for river habitat (H3260)	See relevant text above in Table 1.	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Air quality**	See general advice for river habitat (H3260)	See relevant text above in Table 1.	More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).
Supporting processes (on which the feature and/or its supporting habitat relies)	**Conservation measures**	See general advice for river habitat (H3260)	See relevant text above in Table 1.	Maitland, P.S., Ecology of the river, brook and sea lamprey. Conserving Natura 2000 Rivers Ecology Series No.5, English Nature: Peterborough, 2003. TOMLINSON, M. L. & PERROW M. R. (2003). Ecology of the Bullhead. Conserving Natura 2000 Rivers Ecology Series No. 4. English Nature, Peterborough. htpp://publications.naturalengland.org.uk/file/111020
Supporting processes (on which the feature and/or its supporting habitat relies)	**Water quantity /quality**	See general advice for river habitat (H3260)	See relevant text above in Table 1	
Version Control Advice last updated: N/A				
Variations from national feature-framework of integrity-guidance: N/A				

Table 5: Supplementary Advice for Qualifying Features: S1355. *Lutra lutra*; Otter

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Population (of the feature)	**Anthropogenic mortality**	Reduce levels of mortality as a result of anthropogenic (man-made) factors so that they are not adversely affecting the overall abundance and viability of the population.	High numbers of otter casualties within or adjacent to SAC catchments will adversely affect the condition and viability of the population and mitigation measures should be initiated as quickly as possible. Causes of mortality may include roads, accidents with fishing equipment (nets, lobster creels), poisoning, pollutants, hunting and acidification/contamination of water courses (which reduces fish populations). It should be noted that otters are also a European protected species, and that it is an offence to deliberately disturb, capture, injure or kill an otter.	
Population (of the feature)	**Population abundance [all sites]**	Maintain the continued presence of an actively-breeding otter population within the SAC, whilst avoiding deterioration from current levels as indicated by the latest mean peak count, estimate or equivalent.	This will ensure there is a viable population of the feature which is being maintained at or increased to a level that contributes as appropriate to its Favourable Conservation Status across its natural range in the UK. Due to the dynamic nature of population change, the target-value given for the population size or presence of this feature is considered to be the minimum standard for conservation/ restoration measures to achieve. This minimum-value may be revised where there is evidence to show that a population's size or presence has significantly changed as a result of natural factors or management measures and has been stable at or above a new level over a considerable period (generally at least 10 years). The values given here may also be updated in future to reflect any strategic objectives which may be set at a national level for this feature. Given the likely fluctuations in numbers over time, any impact-assessments should focus on the current size of the site's population, as derived from the latest known or estimated level established using the best available data. This advice accords with the obligation to avoid deterioration of the site or significant disturbance of the species for which the site is designated, and seeks to avoid plans or projects that may affect the site giving rise to the risk of deterioration. Similarly, where there is evidence to show that a feature has historically been more abundant than the stated minimum target and its current level, the ongoing capacity of the site to accommodate the feature at	Morgan, P. L., (2004), Current and Potential Distribution, Condition and Breeding Success of the Otter (*Lutra lutra*) in the River Dee Catchment, CCW 2004. APEM (2015) River Dee Otter Survey. APEM Scientific Report 413492 to Natural England.

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			such higher levels in future should also be taken into account in any assessment. For otters, it is difficult to estimate population size. It could be assumed that where there is a high frequency of positive signs in an area, such as a large number of spraints (of several ages), that otters are likely to be occupying the site. Breeding will be indicated by the presence of natal dens, cub sightings and intensive otter activity (e.g. feeding, sprainting, pathways through vegetation). DNA analysis of spraints is now being used as a technique for identifying otters. In 2004 Morgan provided an intuitive estimate of the catchment population size of 22 breeding pairs. However, he states that this not accurate as it is based on an assessment of the habitat available. A survey of the River Dee catchment showed evidence of otters in between 56% - 64% of stops surveyed. Chanin (2003) states that an otter population within a defined area can be said to be in a healthy state when evidence of otters is found in more than 45% of spot surveys (the approach employed during the 2014/15 survey. Adopting this 45% value, it appears that all three sub-catchments within the 2014/15 survey exceed the thresholds suggested by Chanin and based on this, there was considered to be a healthy population of otters within the SAC at that time.	
Supporting habitat: extent and distribution	**Distribution of supporting habitat**	Restore the distribution and continuity of the feature and its supporting habitat, including where applicable its component vegetation types and associated transitional vegetation types, across the site	See relevant text above in Table 1	
Supporting habitat: extent and distribution	**Extent of supporting habitat**	Restore the total extent of the H3260 feature to that characteristic of the natural fluvial processes associated with the river type.	See relevant text above in Table 1	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Supporting habitat: structure/ function	**Abundance of breeding and resting places**	Maintain an abundance of natural breeding and resting sites within the site	It should be noted that otters are highly mobile and are likely to spend their time within wider territories, where designated sites only form a proportion of their range and make a contribution to their wider requirements. Otters are a European protected species, and it is an offence to disturb their resting places. Otters will often use many holts at any one time. They may give birth in one, but raise their young in another. Important features of a successful breeding site are the availability of food, limited disturbance and safety from the risk of flooding. It is important to consider the whole site and not just the known holts as appropriate management will influence all of these factors. Some natal den structures have a limited lifespan (e.g. hollow tree trunks, piles of timber etc.) and if alternative opportunities for natal dens are limited, suitable replacements can be created or constructed. Maintaining dense bank vegetation, areas of reed etc. will ensure that there are suitable areas for resting couches.	
Supporting habitat: structure/ function	**Availability of refugia**	Maintain an abundance of dense bankside vegetation to limit significant disturbance to animals	For rivers, most of the floodplain is outside the boundary of the site, yet the integrity of the interest feature will often be dependent upon the quality of the adjacent habitat outwith the boundary of the site. This is likely to be the case where bankside vegetation may be an important barrier to disturbing activity but may lie adjacent to and outside the boundary. Nevertheless it will be important to maintain, or in some cases, to restore dense bankside cover.	
Supporting habitat: structure/ function	**Food availability**	Maintain fish biomass within expected natural levels for the supporting habitat (subject to natural fluctuations).	In freshwater, key fish prey sources for otters include eels, salmonids, roach and sticklebacks. Frogs can also form an important part of the diet, depending on the habitat and time of year. Crayfish and water beetles may also form part of the diet, as well as an occasional waterbird (young coots, moorhens, ducks) or mammal (rabbits, water voles - although this is uncommon). The diet of otters varies depending on the availability of prey, which in turn varies with the time of year. There should be a diverse range of food sources available throughout the year,	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			within the normal expectations of each particular water course.	
Supporting habitat: structure/ function	**Habitat quality - river habitat**	See general advice for river habitat (H3260)	Dense bank vegetation, marshes and reedbeds are important for otters, but they will use a long stretch of river and this won't necessarily fall within a protected site. Dense bank vegetation and reedbeds are favoured as resting areas, but otters will often travel some distance to a preferred 'couch' and this will not necessarily be along the edge of the river. The structure and quality of bankside vegetation, reedbeds and other nearby habitats should be maintained, particularly where there is evidence of use by otters. However, it is thought that the most significant determinant of otter usage of a habitat is the abundance of prey.	
Supporting habitat: structure/ function	**Habitat quality - waterway habitat**	Maintain the quality of supporting waterway habitat features	Smaller tributaries of larger river systems (streams, becks etc.) are extremely important for otters and have been shown to have been used more frequently by otters than larger rivers. This is thought to be in part due to differences in fish density and preference for hunting in shallow water with areas of riffles and boulders.	
Supporting habitat: structure/f unction	**Soils, substrate and nutrient cycling**	See general advice for river habitat (H3260)	See relevant text in Table 1 above.	
Supporting habitat: structure/ function	**Water flow - rivers**	See general advice for river habitat (H3260)	Permanent or long-lasting reductions in flow may affect the availability and diversity of prey. This could lead to otters moving into new areas, increasing the likelihood of conflict with other otters. This may also alter they prey targeted by otters as they may hunt for low-preference food such as birds, rabbits, fish carrion or for frogs, depending on the time of year.	
Supporting habitat: structure/ function	**Water quality/ quantity**	See general advice for river habitat (H3260)	See relevant text in Table 1 above.	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Adaptation and resilience**	See general advice for river habitat (H3260)	See relevant text above in Table 1.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Supporting processes (on which the feature and/or its supporting habitat relies)	**Air quality**	See general advice for river habitat (H3260)	See relevant text above in Table 1.	More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).
Supporting processes (on which the feature and/or its supporting habitat relies)	**Connectivity within and to the site**	Ensure there are no significant artificial barriers to the safe passage and movement of otters into, within and away from the site	Barriers such as roads, weirs etc. can generally increase the risk of harm to animals as they traverse or avoid them. If these barriers are considered a problem then mitigating measures could be taken. Otter populations within the SAC are dependent on the integrity of sections of river channel, riparian areas, freshwater still-waters, floodplains and transitional and marine waters that lie outside of the site boundary. Headwater areas and tributaries may not fall within the site boundary, yet otters may use these areas for feeding and these will be critical for sustaining populations within the site. Boundaries to river SACs often follow the first break of slope on the bank, with the result that much of the riparian habitat will lie outside the SAC, particularly if the river channel is operating under natural processes and moves laterally over time within the floodplain. It is possible that holts of otters that form part of the population for a SAC may lie on the adjacent floodplain outwith the boundary of the SAC.	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Conservation measures**	See general advice for river habitat (H3260)	See relevant text above in Table 1.	http://publications.naturalengland.org.uk/file/82038 Ecology of European Otter
Supporting processes (on which the feature and/or its supporting habitat relies)	**Water quality : Toxic chemicals**	Reduce the presence of pollutants affecting the site, which are potentially toxic to otters.	The major cause of the decline in otter populations in the 60s and 70s was toxic chemicals such as dieldrin and related pesticides. Contaminants that might have an effect on otters may have an indirect effect (e.g. on food supply - organic pollution, eutrophication, acidification from mine waste and acid rain), a	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			mainly direct effect (e.g. oil spillage, radioactivity) or effects of bioaccumulation (e.g. metals, especially mercury, cadmium and lead; pesticides and PCBs). PCBs, organochlorine pesticides and heavy metals all being seen as detrimental to otters, although the use of many of these is now banned.	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Water quantity/ quality**	See general advice for river habitat (H3260)	See relevant text above in Table 1.	
Version Control Advice last updated: **24 March 2019**. 5) Text relating to detailed management solutions removed from the explanatory notes for the following attributes: **Food Availability** as considered to be outside the scope of this advice.				
Variations from national feature-framework of integrity-guidance: N/A				

Table 6: Supplementary Advice for Qualifying Features: S1831. *Luronium natans*; Floating water-plantain

Attributes	Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
This SAC is a cross-border site. This feature occurs on parts of the SAC that lie wholly in Wales. You should also refer to the SAC Core Management Plan previously published by Natural Resources Wales			