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

River Lambourn Special Area of Conservation (SAC)
Site Code: UK0030257

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About this document

This document provides Natural England's supplementary advice about the European Site Conservation Objectives relating to River Lambourn SAC.

This advice should therefore be read together with the SAC Conservation Objectives available here.

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.

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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 Lambourn Special Area of Conservation (SAC)
Location	Berkshire
Site Map	The designated boundary of this site can be viewed here on the MAGIC website
Designation Date	1 April 2005
Qualifying Features	See section below
Designation Area	27.27 ha
Designation Changes **Feature Condition Status**	Not applicable Details of the feature condition assessments made at this site can be found using Natural England's Designated Sites System
Names of component Sites of Special Scientific Interest (SSSIs)	River Lambourn SSSI
Relationship with other European or International Site designations	Parts of this site abut directly onto component parts of the Kennet and Lambourn Floodplain SAC.

Site background and geography

The River Lambourn is a classic example of a lowland chalk river which is situated within the Berkshire and Marlborough Downs National Character Area. The river rises 152 metres above sea level north of Lambourn in West Berkshire, and flows down to a confluence with the River Kennet east of Newbury. For most of its length the Lambourn is in the Berkshire and Marlborough Downs National Character Area, and flows through a rural chalk downland landscape. The river is fed by the Chalk aquifer of the north Wessex Downs, which gives rise to highly calcareous water. The river has a stable, gently meandering form, with a characteristic gravel rich substrate and because the river is dominated by spring flow from the aquifer, the flow in the river is dependent on groundwater levels. As levels in the aquifer naturally decline throughout the summer, flows will decline.

In the upper river, the spring flows will cease entirely and the river will dry up. This section of the river will only return once winter rains have filtered into the aquifer, and groundwater levels rise. These temporary reaches of chalk rivers are known as 'winterbourne', and they have developed their own unique ecology. On the Lambourn, the winterbourne reach runs from springs in Lambourn, down to Maidencourt Farm, just upstream of Great Shefford. Between the villages of Lambourn and Great Shefford the river flows mainly through agriculturally improved pasture and arable fields, whilst the section south of Great Shefford to Bagnor meanders through disused water meadow systems, wet pastures and woodlands. Additional habitats associated with the river include areas of fringing reed swamp, tall fen and willow carr. In places the river has been modified by creating side channels to feed water meadows and mills, and there are a number of weirs and sluices. Nevertheless, the River Lambourn is regarded as one of the least-modified and least abstracted rivers in lowland England.

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 the Ranunculion fluitantis and Callitricho-Batrachion vegetation**

The River Lambourn is an example of a lowland river wholly in a chalk catchment in central southern England. It is a chalk stream tributary of the River Kennet and part of the catchment of the River Thames. In its upper reach it is a winterbourne, drying through the summer months. It is one of the least-modified rivers of this type, with a characteristic flora dominated by pond water-crowfoot *Ranunculus peltatus,* as well as fool's watercress *Apium nodiflorum* and the moss *Fontinalis antipyretica*. In the downstream perennial sections the stream water-crowfoot *R. penicillatus* var. *pseudofluitans* tends to be the dominant plant species. The occurrence of the pollution-sensitive red algae *Lemanea fluviatilis* in the Lambourn appears to be unique on the lowland southern rivers. This species is usually found in upland streams. The river supports a diverse assemblage of native fish species, including bullhead, brook lamprey, grayling, brown trout and minnow.

Qualifying Species:

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

The River Lambourn supports populations of the brook lamprey *Lampetra planeri*. Lampreys are amongst the most primitive of all living vertebrates. Most species feed on fishes by attaching themselves to the side of the fish and using their mouthparts to rasp away skin and muscle. However, brook lamprey do not feed on other fish, indeed the adults do not feed at all. During the larval stage, which may last up to 7 years, brook lamprey live submerged in deposits of sediment on the bed of the river feeding on tiny organisms such as diatoms extracted from the surrounding water. The River Lambourn provides good habitat conditions for brook lamprey. Like the bullhead, brook lamprey are dependent upon the availability of features typical of natural rivers including the absence of barriers to upstream and downstream movement, gravel beds for spawning, silt beds to support the larval stage, good water quality and low levels of abstraction. The presence of healthy brook lamprey populations is therefore regarded as an indication of good river habitat quality.

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

The River Lambourn supports strong populations of bullhead *Cottus gobio.* The bullhead is the only representative of the Cottid family of fishes in the UK. This is a small, bottom-dwelling fish which is mostly associated with lowland streams. It is dependent upon good water quality, and good quality habitat conditions which provide critical features such as stones on the river bed, submerged tree roots, woody debris dams and macrophyte beds for shelter, feeding and egg-laying. In common with many other freshwater fishes bullhead populations are adversely affected by pollution, siltation, river engineering, the presence of impoundments and other structures, and abstraction. The presence of strong populations of bullhead are therefore an indication of very good overall river habitat condition and a healthy ecosystem.

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**	Maintain the total extent of the feature to the baseline value of 28.78 hectares.	There should be no measurable reduction (excluding any trivial loss) in the extent and area of the H3260 feature. The baseline value of extent is that calculated at the time of SAC classification. 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, but is essentially the combined total extent of the river and side channels to the top of the bank or first break of slope. However, it is important to note that rivers are dynamic features and there may be acceptable variation in extent through natural processes. 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.	
Structure and function (including its typical species)	**Biotope (habitat) mosaic**	Maintain or restore, as appropriate, 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 transient exposed sediments), bank profiles (including shallow and steep slopes), erosion features (such as vertical bank edges) 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. Physical habitat modifications tend to reduce natural habitat complexity, the number of habitat niches available and hence reduce biodiversity. They may remove some habitat features altogether. Rivers that have sections that are already significantly physically modified should be subject to a process of planning and implementing physical restoration measures. This should be based on restoring natural geomorphological processes (including restoration of hydrological continuity between river and floodplain) as far as possible to allow restoration of	Ardeola Environmental Services (1994) Floodplain Survey and Strategic River Corridor Survey of Selected Reaches of the Middle Reaches of the Middle Kennet Report 6 vol 2. National Rivers Authority (Thames Region). Environment Agency (2011) Whole River Restoration Plan for the River Lambourn and River Kennet. Available here Environment Agency (Thames Region) (1999) A Fluvial Audit of the River Lambourn. River form and ‘naturalness’ are aspects used in the assessment of the condition of the River Lambourn SSSI by Natural England.

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			characteristic and sustainable biotope mosaics, working within the practical constraints of essential flood protection for people and the built environment (it is acknowledged that sections flow through built-up areas where restoration of natural river structure is impractical). Modification of river habitat can also be caused by excessive levels of livestock grazing. This can denude the riparian zone, cause artificially high bank instability, and degradation of the fauna and flora of exposed riverine sediments.	
Structure and function (including its typical species)	**Riparian zone**	Maintain a patchy mosaic of natural woody and herbaceous (tall and short swards) riparian vegetation. The riparian zone should be sufficiently wide to act as a healthy and functional habitat zone within the river corridor.	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. Between 30 and 50% riparian tree cover is generally considered optimal for in-channel and riparian habitats. Intensive cutting of a significant proportion of the riparian zone and intensive stock grazing over long stretches is generally undesirable. The width of the riparian zone will vary according to the type of land use alongside the river. However, the objective should be to seek to maintain a sufficient width of natural or semi-natural vegetation that it functions effectively in providing habitat linkage up and downstream and provides a 'buffering' effect. This aspect is assessed using a sample-based method by the Environment Agency through a process known as river corridor survey.	Environment Agency (2003) River Habitat Survey in Britain and Ireland. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/311579/LIT_1758.pdf Ardeola Environmental Services (1994) Floodplain Survey and Strategic River Corridor Survey of Selected Reaches of the Middle Reaches of the Middle Kennet Report 6 vol 2. National Rivers Authority (Thames Region).
Structure and function (including its typical species)	**Woody debris**	Maintain the presence of coarse woody debris within the structure of the channel, including features such as temporary or seasonal debris dams.	Dead woody material that falls into streams ('woody debris') plays an important role in providing habitat diversity, giving shelter for fish, supplying a food source for aquatic invertebrates, and for slowing the passage of nutrients downstream. In chalk streams such as the Lambourn woody debris provides a vital function in creating localised pockets of high energy flow, which allows scour and deposition, in a	Natural England, The presence of woody debris is considered in the course of assessment of the condition of the River Lambourn SSSI. Data may be available from Natural England upon request. .

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			system where these effects may be scarce. Woody debris is therefore a key feature of healthy rivers. Woody debris should be left in situ, unless there are overriding reasons of public safety (for example to prevent flooding or damage to bridges and other structures).	
Structure and function (including its typical species)	**Water course flow**	Maintain or restore as necessary the natural flow regime of the river, with daily flows as close to what would be expected in the absence of abstractions and discharges (the 'naturalised flow').	The natural flow regime both shapes and sustains characteristic biotope mosaics, affecting factors such as current velocities and bed hydraulics (ie movement of sediment), water levels and depths, wetted area (ie floodplain area liable to inundation), temperature regime and dissolved oxygen regime. All parts of the natural flow regime are important, including flushing flows (ie flow essential for channel maintenance), seasonal baseflows and natural low flows. Natural seasonal flow recession is critical in supporting the full expression of ephemeral habitats (marginal and riparian vegetation, exposed riverine sediments, ephemeral headwaters). Any significant impacts on the natural flow regime should be rectified sustainably by reducing flow modifications, not by artificial augmentation or by altering channel form to fit reduced levels of flow. There should be no increase in the existing level of impact on the natural flow regime, and any significant impacts should be controlled to acceptable levels. The river should be free to flow unimpeded by artificial structures as far as possible, where this will not result in increased flood risk to property. Flow targets for Water Framework Directive high ecological status should be used to avoid deterioration and for restoration where this is technically feasible. These are: <5% deviation at <Qn95 and <10% at >Qn95 - based on 'natural' flow regime (i.e. a river with no abstraction pressure)). These should be considered a minimum acceptable level and it may be appropriate to seek a higher standard given the relatively low level of abstraction in the catchment and low level of river channel modification. Where multiple natural channels exist, flow targets should apply across all of these channels - any artificial channels should not create non-compliances in natural channels, although it is acknowledged that there may be instances of long-standing traditional rights (such as 'millers rights') which may be a constraint in meeting this objective.	Ward D (1999) A Water Level Management Plan for the River Lambourn SSSI. Andrews Ward Associates, for Environment Agency. Environment Agency (2011) Whole River Restoration Plan for the River Lambourn and River Kennet. Available here

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Priorities for habitat restoration are set out in the River Lambourn River Restoration Plan. The potential impacts of abstraction across the catchment as a whole have been considered by the Environment Agency in connection with the requirement to review all existing abstraction consents. An estimated 90% of water supply to the River Lambourn is from groundwater. This means that water levels and flow rates are vulnerable to changes in aquifer water levels and re-charge from rainfall. The Lambourn is particularly susceptible to lack of aquifer re-charge in the event of prolonged winter drought which may then result in low water levels and low flow rates over an extended period of the following year.	
Structure and function (including its typical species)	**Sediment regime**	Maintain the natural supply of coarse and fine sediment to the river	Natural processes including the erosion, transport and deposition of sediment, are vital for the natural functioning of any river. Without this, habitat diversity will decline. Coarse and fine sediment supply can be interrupted by weirs and other impounding structures, and by dredging or extraction, and can result in channel and bank erosion that may have consequences for both biodiversity and river management (e.g. flood risk). In chalk rivers coarse sediment supply is generally very low, due to low energy availability. Large woody debris plays an important role in creating localised areas of higher energy, which will help provide areas of scour and deposition. On the Lambourn, the presence of structures or channel modification, generally results in an elevated degree of fine sediment deposition. Excessive fine sediment supply can lead to the smothering of coarse substrates and the loss of flora and fauna dependent on them (impoundment of the river can have the same effects). Where fine sediment delivery is a problem, control measures may be required. Priorities for action to address sediment input sources are set out in the River Lambourn Diffuse Water Pollution Plan. Water Framework Directive targets in relation to sediment regime and progress towards meeting targets are set out in the River Basin Management Plan.	Environment Agency (2010) River Lambourn Diffuse Water Pollution Plan. Data may be available from Natural England upon request. Environment Agency (2015) Thames River Basin District Management Plan updated 2015.
Structure and function	**Thermal regime**	Maintain a natural thermal regime to the river subject to a	Most freshwater habitats are considered to have high vulnerability of risk of significant damage as a consequence of	NATURAL ENGLAND (2015). Climate Change Theme Plan and

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
(including its typical species)		changing climate, ensuring that water temperatures should not be significantly artificially elevated	predicted climate change. The River Lambourn SAC has been assessed as having an overall vulnerability of 'HIGH'. This means that active measures are likely to be required to mitigate against likely impacts. Predicted impacts on chalk rivers include an increase 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. These would include impoundment, abstraction, discharges, excessive tree removal or inappropriate management of the riparian zone. Restoration of riparian tree cover to suitable levels may be needed where shading is currently lacking. The installation of heat exchange systems which extract solar energy from rivers and lakes as a sustainable source of heat is a relatively new development which is supported by government policy. These systems should be compatible with the objective of avoiding artificial elevation of river water temperature if suitably designed and maintained.	supporting National Biodiversity Climate Change Vulnerability assessments ('NBCCVAs') for SACs and SPAs in England [Available at http://publications.naturalengland.org.uk/publication/4954594591375360]. NERC 2016 Climate Change Impact Report Cards.
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 woody debris dams are a natural feature of rivers and add to the complexity and diversity of the habitat. New artificial constraints to movement should be avoided and existing artificial constraints should be addressed through strategic river restoration as outlined above. Barriers should be removed wherever possible to restore all aspects of habitat integrity - fish passes constitute a partial mitigation measure for longitudinal biological movement and should only be considered where it is not possible to remove a barrier. Where established, they should allow for the passage of as many characteristic species as possible, including the Annex II	Environment Agency (2011) Whole River Restoration Plan for the River Lambourn and River Kennet. Available here

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			species brook lamprey and bullhead. On a wider scale, development, engineering projects and the construction of new roads and bridges can all affect the ability of animals to move up and down the river corridor and measures may be required to avoid such impacts when planning such projects.	
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. For example, species such as signal crayfish have been responsible for much of the decline of native crayfish through competition, habitat damage and the introduction of crayfish plague. 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 this case, high impact species which are considered to pose significant risk of damage or which are known to have caused damage are Water Fern and Signal Crayfish. Water Fern causes damaging impacts on aquatic vegetation through shading, whilst Signal Crayfish predate fish eggs and invertebrates, cause damage to soft banks through burrowing and compete directly with and predate bottom-living species such as bullhead and lamprey. There is currently no nationally agreed strategy for effective control of non-native crayfish. This is kept under review by the UK Non-native Invasive Species Secretariat. The commercial exploitation of crayfish is not currently viewed as an effective means of control. This can increase damaging impacts through effects on local population dynamics, ie promote even greater population density by reducing competition from large adult specimens.	UK Technical Advisory Groupon the Water Framework Directive (2015) Revised classification of aquatic alien species according to their level of impact. The Non-native Species Secretariat (2011) Risk Assessment of Signal Crayfish as an invasive non-native species in the Uk
Structure and function (including its typical	**Key structural, influential and/or**	Maintain or restore the abundance of the species listed to enable each of them to be a viable component of the Annex I	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;	Grieve N, Clarke S Caswell B & Newman JR (2003) Macrophyte Surveys of the River Lambourn SAC. Report by Centre for

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
species)	**distinctive species**	habitat feature: In-channel species River water-crowfoot *Ranunculus penicillatus* subsp *pseudofluitans* Pond water-crowfoot *Ranunculus peltatus* Water parsnip *Berula erecta* Water starwort *Callitriche stagnalis* Fish and lamprey Brook lamprey *Lampetra planeri* Bullhead *Cottus gobio* Brown trout *Salmo trutta* Grayling *Thymallus thymallus* Mammals Water vole *Arvicola amphibia* Otter *Lutra lutra*	• 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) • 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. A key feature of chalk rivers is the presence of distinctive assemblages of river flies and other invertebrates which form important prey items for fish. These include a wide diversity of mayflies, blackflies, caddis flies and stoneflies which, collectively form a fundamental part of the food chain of river ecological systems.	Aquatic Plant Management on behalf of English Nature. Ardeola Environmental Services (1994) Floodplain Survey and Strategic River Corridor Survey of Selected Reaches of the Middle Reaches of the Middle Kennet Report 6 vol 2. National Rivers Authority (Thames Region).
Structure and function (including its typical species)	**Fisheries**	Maintain fish densities at or below the natural environmental carrying capacity of the river, such that the river supports a fish community with a density and composition typical of a wild, native assemblage characteristic of the river type.	Fish stocking for fishery management (ie introduction of farmed fish to artificially supplement native stock or to maintain a particular species composition) can cause damaging impacts. These may include elevated levels of competition for food, spawning sites and shelter from predation, and direct predation of other fish and invertebrates. Ideally, fishery management should be based on sustainable natural fish recruitment, with an emphasis on restoring characteristic river habitat in ways	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			that promote natural processes of egg-laying, spawning, successful development and movement upstream and downstream of young fish. Natural, self-sustaining native fish populations will generally be more resilient to disease and the predicted impacts of climate change, and will generally give rise to a healthier river ecosystem. Exploitation (i.e. fishing) should be at a level which is compatible with the maintenance of self-sustaining fish populations. The selective removal of certain fish species can also have damaging impacts if this alters the natural balance of species. Stocking for 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. Fish used for conservation stocking should be sourced to avoid impacts on the genetic integrity of local populations (including sub-catchment genetics where appropriate, e.g. for brown trout).	
Structure and function (including its typical species)	**Vegetation structure: riparian zone**	Ensure that stock grazing activity in the riparian zone and in the river channel will not result in significant adverse impacts.	In natural river systems animals will utilise favoured accessible watering points, producing valuable habitat diversity. However, in a modern agricultural landscape setting continuous access by grazing stock to river banks can be destructive in removing riparian zone vegetation, eroding banks, disturbing riverbed and exposed in-channel deposits and adding sediment and nutrients. Ideally, grazing levels should be managed so as to ensure that impacts on the riparian zone are minimised. Where this is not feasible there are a range of options available to avoid damaging impacts. The River Lambourn is part of the Catchment Sensitive Farming initiative, a mechanism for providing advice, training and grant–aid for measures to address areas of concern in relation to agricultural activity.	Natural England (2018) https://www.gov.uk/guidance/catchment-sensitive-farming-reduce-agricultural-water-pollution
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') is traditionally carried out 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. Good practice guidance for weed	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			cutting in chalk rivers is widely available. Management should seek to ensure that there is a sufficient proportion of in-channel and marginal vegetation in the river to support characteristic biota (in terms of cover, food supply and spawning substrate). Weed-cutting should not interfere with the ability of the river channel to downsize through encroachment of marginal vegetation during the summer flow recession. A lack of or very low levels of weed cutting activity is unlikely to result in adverse impacts from a nature conservation perspective, although processes of natural habitat succession may result in changes in vegetation composition.	
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 adequately screened.	Intakes and discharges can be responsible for significant mortalities of fish. Long-distance migratory species such as European eel can be particularly susceptible. Archimedes screw turbines are a recent development in small-scale hydropower and should also be screened until such times that there is robust evidence that they cause no damage to characteristic fish populations.	
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 maintained 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 associated river corridor habitats and tributaries that lie outside of the site boundary. 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. Effective buffering by a well-vegetated riparian zone is essential to maintain a healthy ecosystem - 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. A large proportion of the organisms associated with rivers are critically dependent upon terrestrial habitats for at least part of their life cycle. It is important that the river is part of a wider mosaic of semi-natural floodplain habitats such as wet woodland, fens, ephemeral pools and wet grassland, and that there is good connectivity of such habitats across the floodplain.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
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 - nutrients**	The natural nutrient regime of the river should be protected. Anthropogenic enrichment above natural/background concentrations should be limited to levels at which adverse effects on characteristic biodiversity are unlikely. Targets for soluble reactive phosphorus are: 20ug/l^{-3} in winterbourne section and 30ug/l^{-3} in perennial section	The phosphorus concentration in groundwater in chalk catchments can be naturally high, and this will influence river P levels. The challenge of reducing groundwater P will be particularly influential in meeting the target level in the winterbourne section. Reducing P levels in chalk rivers can take a long time as the nutrient is bound up in soils, clay particles and sediment. Major point sources of P are sewage treatment works and smaller 'package' treatment plants serving single properties or groups of properties. A major programme of investment in the sewage treatment works to improve the level of P removal from discharges has been implemented on the River Lambourn and further work has been identified. The use of best available technology in P removal is now a general requirement when new development is permitted close to the river. Elevated nutrient levels interfere with competitive interactions between higher plant species 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 depression in dissolved oxygen and poor substrate conditions (increased siltation) for fish and invertebrate species. The focus is typically on reducing phosphorus levels rather than other nutrients, 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 should be the objective. The whole of the Kennet and Lambourn catchment is designated as a Nitrate Vulnerable Zone which aims to limit nitrate levels in groundwater.	Joint Natural England/ Environment Agency statement (2014), Proposed water quality targets and progress goals for River Lambourn SAC and SSSI (based on revised Common Standards Monitoring Guidance) - Record of decision.

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
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 (mg/l NH_3-N, as 95percentile) target = 0.021 Total ammonia (mg/l NH_3-N, as 90percentile)) target = 0.25 Biochemical Oxygen Demand (BOD) (mg/l (mean))) target = 1.5 Dissolved Oxygen (% saturation (10percentile))) target = 85	Organic pollution affects 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 sampling points - assessment can be made by modelling (assuming full mixing of effluents at the point of discharge).	Joint Natural England/ Environment Agency statement (2014) Proposed water quality targets and progress goals for River Lambourn SAC and SSSI (based on revised Common Standards Monitoring Guidance) - Record of decision.
Supporting processes (on which the feature relies)	**Water quality - other pollutants**	Maintain 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.	This aspect is monitored by the Environment Agency via a sample-based approach
Supporting processes (on which the feature relies)	**Air quality**	Maintain or restore 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	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)
			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 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.	
Version Control Advice last updated: N/A				
Variations from national feature-framework of integrity-guidance: Attribute relating to **Acidification** removed as considered not relevant for this feature on this site.				

Table 2: Supplementary Advice for Qualifying Features: S1096. *Lampetra planeri*; Brook lamprey

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 natural conditions throughout the site, taking into account natural habitat variation and allowing for natural population fluctuations	Impacts on physical, chemical or hydrological integrity, or from non-native species, may suppress juvenile densities. Populations will tend to naturally fluctuate in response to availability of supporting habitat features and natural events such as floods and prolonged drought. It is thought that signal crayfish may have significant impacts on brook lamprey populations through predation and disturbance of silt beds. Predatory fish such as pike and perch may also have significant impacts on juvenile lamprey.	Perrow MR & Tomlinson ML (2002) River Lambourn cSAC Baseline Survey: Bullhead and Lamprey Populations. Econ Environmental Consultancy report for English Nature.
Population (of the feature)	**Population abundance**	Maintain or restore as necessary the abundance of the population at or to a level which is close to that expected under natural conditions throughout the site (allowing for natural population fluctuations).	The objective of this target is to seek to ensure that the river supports a population of brook lamprey which could reasonably be expected to occur in the absence of damaging human impacts. Clearly, this may not be a realistic expectation in all stretches due to the impracticality of restoring some sections or potential conflicts with flood defence objectives. The aim is to 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. It is not possible to set a clearly defined target figure for this aspect given the difficulties in assessing population size and the destructive nature of current sampling methods. However, sample-based surveys can give an indication of population density and distribution, and help to indicate sources of negative impacts such as the presence of signal crayfish or predation by coarse fish. 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	Perrow MR & Tomlinson ML (2002) River Lambourn cSAC Baseline Survey: Bullhead and Lamprey Populations. Econ Environmental Consultancy report for English Nature. Anon (2006) Investigation in to the Spawning habitat of the Kennet System. Jacobs-Babtie report for Environment Agency.

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			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.	
Supporting habitat: extent and distribution	**Distribution of supporting habitat**	Maintain 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	A contraction in the range, or geographic spread, of the supporting habitat will reduce the overall viability of brook lamprey populations. The critical supporting habitat features are undisturbed silt beds and areas of clean gravel. Loss of extent of these features may also reduce and break up the continuity of a habitat within a site and how well the species feature is able to occupy and use habitat within the site. Sample surveys indicate that side channels (of which the Lambourn has many) are of significant importance in providing extensive areas of undisturbed silt bed habitat. Marginal areas of silt associated with areas of slack flow and woody debris are also thought to provide important supporting habitat. Loss of these features would be of particular concern.	Perrow MR & Tomlinson ML (2002) River Lambourn cSAC Baseline Survey: Bullhead and Lamprey Populations. Econ Environmental Consultancy report for English Nature.
Supporting habitat: extent and distribution	**Extent of supporting habitat**	Maintain the total extent of the habitat(s) which support the feature at a level which could be reasonably expected in a natural river system.	In order to contribute towards the objective of achieving an overall favourable conservation status of the feature at a UK level, it is important to maintain or if appropriate restore the extent of supporting habitats and their range within this SAC. The river restoration strategy for the River Lambourn seeks to restore a range of natural features, including those of value as supporting habitat for brook lamprey. Clearly, in a natural river system the extent and distribution of supporting habitat will vary over time in relation to dynamic river processes but the aim is to seek to ensure that there is widespread availability of good quality spawning and larval habitat.	Ward D (1999) A Water Level Management Plan for the River Lambourn SSSI. Andrews Ward Associates, for Environment Agency. Environment Agency (2006) River Lambourn SSSI Water Level Management Plan Review. Environment Agency (2011) Whole River Restoration Plan for the River Lambourn and River Kennet. Available here Perrow MR & Tomlinson ML (2002) River Lambourn cSAC Baseline Survey: Bullhead and Lamprey Populations. Econ Environmental Consultancy report for English Nature.

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)	Lamprey can pass some potential barriers by attaching themselves to structures or river banks by their mouthparts and by strong bursts of swimming. However, structures such as weirs and sluices can prevent upstream and downstream movement and may render areas of potential supporting habitat unavailable. Whilst some structures can artificially generate both silt beds and clean gravels, both of value to lamprey, this is not a justification for their continued presence or the construction of new structures. Suitable habitat for lamprey should be generated by natural river processes - where physical restoration of the channel is required it should be accepted that this may involve changes in the distribution of species within the river system.	
Supporting habitat: structure/ function	**Biotope mosaic**	See general advice for river habitat (H3260)	Habitat conditions for lamprey species vary naturally in rivers. Some stretches 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. Larval lamprey live in silt beds, which are often in channel margins and side channels. The general objective will be to seek to maintain a wide diversity of river habitat features which are characteristic of natural conditions. This will benefit not only lamprey but a wide diversity of other organisms.	Maitland PS (2003) Ecology of the River, Brook and Sea Lamprey. Conserving Natura 2000 Rivers. Ecology Series no5. English Nature. Peterborough. Available here Anon (2006) Investigation in to the Spawning Habitat of the Kennet System. Report by Jacobs-Babtie for Environment Agency.
Supporting habitat: structure/ function	**Community composition: invasive non-native species**	See general advice for river habitat (H3260)	The invasive non-native species signal crayfish can have a serious effect on lamprey habitat and may predate heavily on brook lamprey. Studies on the River Lambourn indicate that there is a direct relationship between population density and individual size of signal crayfish and reduction in lamprey numbers. The invasive plant water fern *Azolla* spp can have significant indirect impacts by reducing oxygen levels and altering the flow regime. The overall objective should be to ensure that, where present, invasive species are not having adverse impacts on the brook lamprey feature.	Perrow MR & Tomlinson ML (2002) River Lambourn cSAC Baseline Survey: Bullhead and Lamprey Populations. Econ Environmental Consultancy report for English Nature.
Supporting habitat: structure/	**Control of livestock grazing**	See general advice for river habitat (H3260)	Over-grazing of riparian areas and access by stock to the river can have very damaging impacts on lamprey habitat, through trampling of silt beds, removal of marginal and in-stream	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
function	**activity**		vegetation and generating excessive loads of fine sediment on spawning gravels.	
Supporting habitat: structure/ function	**Fisheries - exploitation**	Exploitation of lamprey should be undertaken sustainably without compromising any life stage	Lamprey are not currently known to be exploited on the River Lambourn. However, in other parts of the country there is increasing demand from the angling community for lamprey as bait. Unregulated capture of lamprey or even searching for lamprey can be highly destructive of the supporting habitat and is generally unsustainable. Exploitation should only be permitted if properly regulated and undertaken in a non-destructive manner.	
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. The aim is to provide conditions in the river that support a healthy, natural and self-sustaining assemblage of native fish and lamprey which is characteristic of the River Lambourn. This will require measures which deliver habitat protection/restoration and sympathetic fishery management. Stocking represents a loss of naturalness and obscures the underlying causes of poor fish recruitment (potentially promoting a continuation of poor habitat management). Stocking carries a number of ecological risks, including the introduction of disease and non-native species, and increased predation of natural fish and lamprey species.	
Supporting habitat: structure/ function	**Flow regime**	See general advice for river habitat (H3260).	A 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 flow for up and downstream movement.	
Supporting habitat: structure/ function	**Riparian zone**	See general advice for river habitat (H3260)	Brook lamprey populations will generally be favoured by the availability of habitat niches provided by natural river processes, including the development of marginal and in-channel vegetation, presence of woody debris, retention of bankside trees and absence of grazing stock from the river or banks.	
Supporting habitat: structure/ function	**Screening of intakes and discharges**	See general advice for river habitat (H3260)	Adult lamprey and sub-adults can be accidentally captured in intakes and discharges along with other fish species.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
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, 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	**Water quality - nutrients**	Maintain or restore as necessary the natural nutrient regime of the river, 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 larval stage growth, due to the growth of benthic algae and associated enhanced siltation and sediment anoxia. Lamprey may be affected by both episodic and chronic pollution. Episodic pollution may be related to, for example, rainfall after prolonged drought or sewage treatment works failure, whilst chronic pollution may be related to factors such as regular access to the river by grazing stock, accidental effluent spillage or run-off from roads. Pollution can cause direct mortality or may affect indirectly through rendering the supporting habitat unsuitable.	Natural England (2016) Catchment Sensitive Farming – South East River Basin District Strategy 2016 - 2021
Supporting habitat: structure/ function	**Woody debris**	See general advice for river habitat (H3260)	Woody debris is an important component of river habitat for lamprey as well as the wider biological community. It can be important in providing diversity in flow dynamics and sedimentation, ie creates slack areas where silt is deposited, and areas of faster flow with clean gravel bed.	
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	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. 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.	Maitland PS (2003) Ecology of the River, Brook and Sea Lamprey. Conserving Natura 2000 Rivers. Ecology Series no5. English Nature. Peterborough. Available here 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/495459459137

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
				5360]. Ormerod SJ & Durance I (2016) A climate change report card for water - Working Technical Paper 7. Climate change and the UK's freshwater ecosystems. Available here
Supporting processes (on which the feature and/or its supporting habitat relies)	**Air quality**	Maintain or, where necessary, restore 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).	The supporting habitat of this feature 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 (including food-plants) and reducing supporting habitat quality and population viability of this feature. 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 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.	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**	Maintain the management measures (either within and/or outside the site boundary as appropriate) which are necessary to maintain the structure, functions and supporting	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	Maitland PS (2003) Ecology of the River, Brook and Sea Lamprey. Conserving Natura 2000 Rivers. Ecology Series no5. English Nature. Peterborough. Available here.

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		processes associated with the feature and/or its supporting habitats.	Plan, site management strategies or plans, the Views about Management Statement for the underpinning SSSI and/or management agreements. In the case of brook lamprey it is particularly important that the habitat requirements of the species are considered when planning management to ensure that key features such as silt beds and gravel beds are not adversely affected or removed.	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Water quantity/ quality**	Maintain or restore as necessary water quality and quantity to a standard which provides the necessary conditions to support the feature.	Maintaining the quality and quantity of water supply will be critical in maintaining viable populations of brook lamprey. Both water flow and water quality are of prime importance in maintaining suitable supporting habitat in a favourable condition for spawning, the larval stage and allowing up and downstream movement. In general terms, meeting the surface water and groundwater environmental standards set out by the Water Framework Directive (WFD 2000/60/EC) will usually be sufficient to support the achievement of SAC Conservation Objectives. However, over and above this, it will be important to ensure that, as far as is reasonably possible, measures are in place to provide adequate water depth to support the larval stage, and to provide suitable conditions for breeding and egg-laying in locations along the entire length of the perennial section of the river. Similarly, measures should be in place to ensure that appropriate flow characteristics are maintained throughout the length of the perennial section, meaning that there should be widespread availability of fast-flowing areas over gravel and slow-flowing or slack areas where silt can accumulate.	European Commission (2016) Introduction to the New Water Framework Directive
Version Control Advice last updated: N/A				
Variations from national feature-framework of integrity-guidance: The following attributes have been removed as considered not to be relevant to this feature on this site: • **Soils** • **Acidification** • **Off-site habitat**				

Table 3: 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 natural conditions throughout the site, taking into account natural habitat variation and allowing for natural fluctuations	Impacts on physical, chemical or hydrological integrity, or from non-native species, may suppress juvenile densities. Populations will tend to naturally fluctuate in response to availability of supporting habitat features and natural events such as flooding and prolonged drought. It is thought that signal crayfish may have significant impacts on bullhead populations through competition for favoured stones on the river bed, competition for food and direct predation. Predatory fish such as pike and perch may also have impacts, particularly on juvenile bullhead, so activities which may promote an increase in these species should be carefully considered.	Perrow MR & Tomlinson ML (2002) River Lambourn cSAC Baseline Survey: Bullhead and Lamprey Populations. Econ Environmental Consultancy report for English Nature.
Population (of the feature)	**Population abundance**	Maintain or restore as necessary the abundance of the population at a density which is close to that expected under natural conditions throughout the site (allowing for natural population fluctuations).	The objective of this target is to seek to ensure that the river supports a population of bullhead which could reasonably be expected to occur in the absence of damaging human impacts. Clearly, this may not be a realistic expectation in all stretches due to the impracticality of restoring some sections or potential conflicts with flood defence requirements. The aim is to 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. It is not possible to set a clearly defined target figure for this aspect given the difficulties in assessing population size and the destructive nature of current sampling methods. However, sample-based surveys can give an indication of population density and distribution, and help to indicate sources of negative impacts such as the presence of signal crayfish or predation by coarse fish. 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	Perrow MR & Tomlinson ML (2002) River Lambourn cSAC Baseline Survey: Bullhead and Lamprey Populations. Econ Environmental Consultancy report for English Nature. Anon (2006) Investigation in to the Spawning habitat of the Kennet System. Jacobs-Babtie report for Environment Agency.

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			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 such higher levels in future should also be taken into account in any assessment.	
Supporting habitat: extent and distribution	**Distribution of supporting habitat**	Maintain 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	A contraction in the range, or geographic spread, of the supporting habitat across the site will reduce the overall viability of the bullhead populations. The critical supporting habitat features are areas of clean gravel bed with larger stones and in-channel macrophyte beds to provide cover (bullhead are highly vulnerable to predation by larger fish and fish-eating birds). Loss of extent of such supporting habitat may reduce the ability of the species to move up and down stream and affect the resilience of the species in response to adverse impacts such as climate change.	
Supporting habitat: extent and distribution	**Extent of supporting habitat**	Maintain the total extent of the habitat(s) which support the feature at a level which could be reasonably expected in a natural river system.	In order to contribute towards the objective of achieving an overall favourable conservation status of the feature at a UK level, it is important to maintain or if appropriate restore the extent of supporting habitats and their range within this SAC. The river restoration strategy for the River Lambourn seeks to restore a range of natural features, including those of value as supporting habitat for bullhead. Clearly, in a natural river system the extent and distribution of supporting habitat will vary over time in relation to dynamic river processes but the aim is to seek to ensure that there is widespread availability of good quality habitat with essential features.	Perrow MR & Tomlinson ML (2002) River Lambourn cSAC Baseline Survey: Bullhead and Lamprey Populations. Econ Environmental Consultancy report for English Nature. Environment Agency (2011) Whole River Restoration Plan for the River Lambourn and River Kennet. Available here
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 bullhead. They will therefore prevent re-colonisation of upper reaches affected by lethal pollution incidents or drought, and more generally will also lead to constraints on genetic interactions that may have adverse consequences. The river restoration plan seeks to remove all man-made barriers to fish movement.	Environment Agency (2011) Whole River Restoration Plan for the River Lambourn and River Kennet. Environment Agency. Available here
Supporting habitat: structure/ function	**Biotope mosaic**	See general advice for river habitat (H3260)	Habitat conditions for bullhead vary naturally in rivers. Some river stretches may provide optimal habitat whilst others may be largely unsuitable. Optimal conditions typically occur in relatively shallow, fast flowing reaches with coarse substrates	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			(used for egg-laying and juvenile/adult cover). A naturally diverse habitat 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 provide important high-flow refugia for the species. The general objective should be to seek to maintain a wide diversity of habitat features which are characteristic of natural conditions. This will benefit not only bullhead but a wide diversity of other organisms.	
Supporting habitat: structure/ function	**Control of livestock grazing activity**	See general advice for river habitat (H3260)	Over-grazing of riparian areas can have very damaging impacts on bullhead habitat, through trampling of the river bed, removal of in-stream and marginal vegetation and generating excessive loads of fine sediment on spawning gravels.	
Supporting habitat: structure/ function	**Fisheries - introduction and removal of fish species**	Ensure fishery management does 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 create unacceptably high levels of predatory pressure on bullhead. The management aim is to provide conditions in the river that support a healthy, natural and self-sustaining bullhead population, achieved through habitat protection/restoration and sympathetic fishery management. Historically, bullhead were actively removed from rivers because of a misconception that a significant part of their diet consists of fish eggs and therefore can damage native trout populations. Fish 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).	A 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	**Riparian zone**	See general advice for river habitat (H3260)	Bullhead populations will generally be favoured by the availability of habitat niches provided by natural river processes, including the development of marginal and in-channel beds of vegetation, presence of woody debris, retention of bankside trees and absence of grazing stock from	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			the river or banks.	
Supporting habitat: structure/ Function	**Screening of intakes and discharges**	See general advice for river habitat (H3260)	Bullhead can become trapped 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. However, 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	**Vegetation composition: invasive non-native species**	See general advice for river habitat (H3260)	The invasive non-native signal crayfish can have a serious impact on bullhead habitat by destabilising banks and enhancing fine sediment input, they compete for cover under stones and predate on both young and adult bullhead. The invasive plant water fern (*Azolla*) can also be very harmful to bullhead populations where it forms dense mats on the water surface. This can result in de-oxygenation of the water column and loss of invertebrate prey.	
Supporting habitat: structure/ function	**Vegetation structure: cover of submerged macrophytes**	See general advice for river habitat (H3260)	In-stream beds of macrophytes are of critical importance in providing cover and protection from predation for bullhead, particularly where coarse, stony substrates are in short supply.	
Supporting habitat: structure/ function	**Water quality - nutrients**	Maintain or restore as necessary the natural nutrient regime of the river, 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 pollution. Episodic pollution may be related to, for example rainfall after prolonged drought or sewage treatment works failure, whilst chronic pollution may be related to factors such as regular access to the river by grazing stock, accidental effluent leaks or road run-off. Pollution can cause direct mortality or may affect indirectly through rendering the supporting habitat unsuitable.	
Supporting habitat: structure/ function	**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. Bullhead are particularly associated with woody debris in rivers such as the Lambourn where the availability of large stones on the	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			riverbed to provide cover is limited. It may also provide refuge areas in times of flood and may be used as an alternative spawning substrate.	
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	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. 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.	Tomlinson ML & Perrow MR (2003) Ecology of the Bullhead *Cottus gobio*. Conserving Natura 2000 Rivers Ecology Series no4. Life in UK Rivers. English Nature. Peterborough. Available here 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]. Ormerod SJ & Durance I (2016) A climate change report card for water - Working Technical Paper 7. Climate change and the UK's freshwater ecosystems Available here
Supporting processes (on which the feature and/or its supporting habitat relies)	**Air quality**	Maintain or, where necessary, restore 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).	The supporting habitat of this feature 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 (including food-plants) and reducing supporting habitat quality and population viability of this feature. 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	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)
			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 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.	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Conservation measures**	Maintain the management measures (either within and/or outside the site boundary as appropriate) which are necessary to maintain 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. As for brook lamprey, the key issue is to ensure that the habitat requirements of bullhead are considered when planning river management. In particular, it is important that features which provide cover and refuge are not removed or made unsuitable and that gravel beds are widely available and maintained in good condition.	Tomlinson ML & Perrow MR (2003) Ecology of the Bullhead *Cottus gobio*. Conserving Natura 2000 Rivers Ecology Series no4. Life in UK Rivers. English Nature. Peterborough. Available here
Supporting processes (on which the feature and/or its supporting habitat relies)	**Water quantity/ quality**	Maintain or restore as necessary water quality and quantity to a standard which provides the necessary conditions to support the feature.	Maintaining the quality and quantity of water supply will be critical, especially at certain times of year, in maintaining viable populations of bullhead. The species is dependent upon the maintenance of high levels of oxygen and high flow rate. In general terms, meeting the surface water and groundwater environmental standards set out by the Water Framework Directive (WFD 2000/60/EC) will usually be sufficient to support the achievement of SAC Conservation Objectives. However, over and above this, it will be important to ensure that, as far as reasonably possible, measures are in place to provide adequate water depth to support spawning and to enable fish to move between areas of cover.	European Commission (2016) Introduction to the New Water Framework Directive

Attributes	Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Version Control Advice last updated: N/A			
Variations from national feature-framework of integrity-guidance: The following attributes have been removed as considered not to be relevant to this feature on this site: • **Soils** • **Acidification** • **Off-site habitat**			