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

Roman Wall Loughs Special Area of Conservation (SAC)
Site code: UK0030267

Date of Publication: 12 March 2019

About this document

This document provides Natural England's supplementary advice about the European Site Conservation Objectives relating to the Roman Wall Loughs SAC. This advice should therefore be read together with the SAC Conservation Objectives available here.

This advice replaces a draft version dated 21 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	Roman Wall Loughs Special Area of Conservation (SAC)
Location	Northumberland
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	684.26ha
Designation Changes	No changes
Feature Condition Status	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)	Roman Wall Loughs SSSI (part of the Roman Wall Escarpments SSSI also underpins the site)
Relationship with other European or International Site designations	N/A

Site background and geography

The Roman Wall Loughs SAC lies within the Tyne Gap & Hadrian's Wall National Character Area and comprises Broomlee, Crag and Greenlee Loughs. These loughs lie within the wider Roman Wall Loughs SSSI which also includes an in-filled waterbody (Caw Lough) which now supports high value mire vegetation.

Lying directly to the north of Hadrian's Wall itself, the three loughs were formed by glaciation during the last ice age. They lie in the natural dips in the landscape, sitting on peaty or loamy soils. Broomlee Lough flows into Greenlee Lough, at the top of the Haltwhistle Burn Catchment which flows into the South Tyne. Crag Lough falls into a different subcatchment and flows into Chainley Burn which enters the South Tyne at Bardon Mill.

The water bodies sit within a very high value wetland complex which also supports Active and Degraded raised bogs that have developed in shallow in-filled depressions, Alkaline Fens fed by base-rich water emerging from the Carboniferous limestone, and mires transitional in both a successional (i.e. open water – terrestrial wetland) and chemical (i.e. along acid - base-rich gradients) sense are also present. Lying at a relatively high altitude, they are exposed to strong westerly winds that blow through the Tyne Gap, they are also shallow which leads to mixing and wave action upon the shore. Around the northern or eastern edges the loughs merge into various wetland habitat types characterised by deep peat.

The three loughs are relatively remote. Broomlee lough is surrounded by semi-natural open habitats, largely comprising mire, heath and grassland. Greenlee Lough abuts similar habitats to Broomlee, but has a larger catchment which includes part of Kielder Forest which lies to the north. A number of inflows to the lough originate within the forested area, which is thought to impact the lake. Like Crag Lough its catchment also contains semi-improved farmland stocked with sheep.

The Roman Wall Loughs form part of one of the richest areas for wetlands and peatlands in England, with Muckle Moss NNR and SAC to the south and the Border Mires SAC to the north.

Greenlee Lough has also been designated a National Nature Reserve and is managed by Northumberland National Park.

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:

- **H3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation; 'naturally nutrient-rich lakes or lochs which are often dominated by pondweed'.**

Natural eutrophic lakes have nutrient levels that are higher than those of oligotrophic, dystrophic or mesotrophic lakes, resulting in higher natural productivity, and are typically species-rich. However, many such lakes have been damaged by over-enrichment with nutrients, resulting in hypertrophic conditions and a reduction in species-richness.

In the UK, natural eutrophic lakes typically contain aquatic macrophyte communities dominated by pondweeds *Potamogeton* spp., spiked water-milfoil *Myriophyllum spicatum*, yellow water-lily *Nuphar lutea*, and occasionally by associations of stoneworts *Chara* spp. Many eutrophic lakes are fringed by stands of tall marginal vegetation. They are often formed on soft rocks but wave-washed rocky shores form an important part of the habitat on larger lakes.

The Roman Wall Loughs comprises three lakes; Crag, Broomlee and Greenlee Loughs. Together the loughs contain 11 species of pondweed *Potamogeton* including *P. lucens*, *P. pusillus*, and *P. obtusifolius. P. gramineus* occurs in all three loughs in a now rare association with stoneworts *Chara* spp. The nationally-rare autumnal water-starwort *Callitriche hermaphroditica* occurs in Crag Lough. Shoreweed *Littorella uniflora* grows in Broomlee and Greenlee Loughs, and greater bladderwort *Utricularia vulgaris* in the latter.

The lakes are notified as naturally eutrophic (nutrient-rich), however recent analysis suggests that whilst they can be considered to be relatively borderline between high alkalinity and moderate alkalinity lakes, their natural nutrient levels are more akin to those found in mesotrophic lakes. It is these lower nutrient levels combined with their relatively high alkalinity, which has enabled these loughs to continue to support the macrophytes which have been lost from many eutrophic lakes due to anthropogenic nutrient enrichment.

Qualifying Species:

- None

Table 1: Supplementary Advice for Qualifying Features: H3150. Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation; 'Naturally nutrient-rich lakes or lochs which are often dominated by pondweed'

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 H3150 feature at 84.36 hectares. Greenlee Lough 46.36ha Broomlee Lough 27.94ha Crag Lough 10.06ha	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. Lake habitat and the biodiversity it supports is integrally linked to the surrounding wetland which many species are reliant on and which affects the functioning of the lake. Consequently the full hydrosere (the zonation of vegetation from open water to terrestrial habitat) should be incorporated in the lake habitat. At the Roman Wall loughs, particularly at Broomlee and Greenlee Loughs this is extensive including large areas of transition mire.	
Structure and function (including its typical species)	**Fisheries**	Maintain a total projected estimate for biomass of total fish production at less than 200kg/ha	Fish communities may exert a strong influence on overall lake ecology and may cause or exacerbate eutrophication symptoms. Where fisheries are present it should be a balanced mixed fishery. There should be a presumption against stocking non-native species, carp and bream within Crag loughs which is an active fishery and the presumption of no stocking of any fish in Greenlee and Broomlee. Any changes to the fish assemblage should be properly considered. Currently only Crag Lough is used as an active fishery. In naturally relatively unproductive lakes such as the Roman Wall Loughs the fish biomass would naturally be lower than 200kg/ha. Consequently fish biomass should not be increased in these loughs.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			This should take into account the growth potential of the resident and stocked fish).	
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 open water systems. Impacts may be on the 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 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. Examples of such high-impact species may include Water Fern *Azolla filiculoides*, New Zealand pygmyweed *Crassula helmsii* and the zebra mussel *Dreissena polymorpha.* Non-native species that might be present within the loughs include *Crassula helmsii, Hydrocotyle ranunculoides, Myriophyllum aquaticum*, *Azolla filiculoides* and *Elodea canadensis.* Signal crayfish or other non-native crayfish are a major threat in these loughs. White clawed crayfish are still present in the loughs and the surrounding catchment. Currently there are no signal crayfish identified but they pose a significant threat if they did get into the loughs. All surveys, work etc. in the loughs and catchments should contain risk assessments and methodology to prevent introduction of crayfish or crayfish plague in line with Northumberland Crayfish Strategy.	Roman Wall Loughs Site Improvement Plan (SIP023) CaBA. 2018. Northumberland Conservation Crayfish Strategy 2019-2023 CaBA. 2018. Northumberland Conservation Crayfish Strategy: Delivery Plan 2019-2023

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Structure and function (including its typical species)	**Macrophyte community structure**	Maintain a characteristic zonation of vegetation;	All three loughs have more sheltered shorelines that are dominated by emergent vegetation and more exposed shorelines dominated by shoreweed or bare rocks. With increasing depth pondweeds are more frequently found along with Nitella spp. The Chara spp can be found throughout this zonation. They do not dominate the plant assemblage as they do in marl lakes but form part of the assemblage. This is a strongly characteristic structural aspect of this habitat feature. It will be a response to water transparency, sediment type and disturbance.	Natura 2000 Standard data form Available here This attribute will be periodically monitored as part of Natural England's site condition assessments and recorded within the relevant Favourable Condition Table (FCT). FCT may be available from Natural England upon request.
Structure and function (including its typical species)	**Macrophyte community structure**	Maintain maximum depth of plant colonisation. This will often be the maximum depth of these lakes.	This is a strongly characteristic structural aspect of this habitat feature. It will be a response to water transparency, sediment type and disturbance. Depth of colonisation should not be compromised by changes in water quality. In these shallow lakes plants should still be able to grow in the deepest part of the lakes.	Natura 2000 Standard data form Available here This attribute will be periodically monitored as part of Natural England's site condition assessments and recorded within the relevant FCT
Structure and function (including its typical species)	**Macrophyte community structure**	Maintain a characteristic and well defined hydrosere associated with the water body where this is present	A 'hydrosere' is a naturally-occurring transition from open water to terrestrial conditions including the wetland stages in between. Many species utilize both the open water and the wetland habitats. The presence of a full hydrose increases habitat heterogeneity and provides additional food sources and refugia. The wetland habitat is also integral to lake functioning, influencing the hydrological, nutrient and sediment regime. This wetland	Natura 2000 Standard data form Available here This attribute will be periodically

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			habitat is not sacrificial and needs protecting as part of the lake habitat. An extensive hydrosere can be found on the western shores of both Greenlee and Broomlee loughs, Whilst it is not as extensive on other shores where it occurs it should be maintained or restored. The presence of the escarpment along the southern shore of Crag Lough prevents the development of an extended hydrosere at this location. However a reedbed is present on the northern shore.	monitored as part of Natural England's site condition assessments and recorded within the relevant FCT
Structure and function (including its typical species)	**Physical structure - lake shoreline**	Maintain the natural shoreline of the lake.	Inclusion of hard engineering solutions to lake management may have detrimental effects on lake ecology, replacing near-natural substrates with man-made materials. Alteration of the shoreline may also result in changes in water movements within the lake, which would have effects on patterns of sediment deposition.	Natura 2000 Standard data form Available here This attribute will be periodically monitored as part of Natural England's site condition assessments and recorded within the relevant FCT
Structure and function (including its typical species)	**Physical structure - lake substrate**	Maintain the natural and characteristic substrate for the lake. The character and extent of types of substrate should be considered.	The distribution of sediment particle size and organic content influences the biology of the lake and will affect the suitability of within-lake habitats for invertebrates and macrophytes, and fish spawning grounds. Increases in sediment loading from activities in the catchment area, including those on the lake shore, may result in the smothering of coarse sediments. Increased inputs of leaf litter, as a result of scrub encroachment, may also be cause for concern, as organic-rich sediments may be a poor rooting medium for macrophytes. Typical substrates: **Greenlee Lough:** Well defined mix of rocks, large and small stones, sand and peat. Sands on the eastern shore and mud on the western. **Crag Lough**: Rocks and large stones at Eastern end and southern edges;	Natura 2000 Standard data form Available here This attribute will be periodically monitored as part of Natural England's site condition assessments and recorded within the relevant FCT

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			peats and sands in the central section and peats mixed with organic mud at the western end. **Broomlee Lough**: Fine sands on the northern, eastern and south eastern shorelines, interspersed with occasional stones or sheet boulders. On the southern shore peat overlays the basic geology.	
Structure and function (including its typical species)	**Key structural, influential and/or distinctive species**	Maintain the abundance of the species listed to enable each of them to be a viable component of the Annex I habitat feature *Potamogeton spp: P. lucens, P. perfoliatus, P. praelongus, P. alpinus, P. gramineus, P. x angustifolius, P. x nitens* (or any other hybrid with one of the above three species as a parent). *P. obtusifolius, Chara spp, (Chara aspera and Chara virgata* previously recorded at these loughs*) Callitriche spp.(Callitriche hermaphroditica* previously recorded at these loughs*), , Utricularia australis / vulgaris, Littorella uniflora* White clawed crayfish are present in Broomlee, and in all probability, also Greenlee.	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) • **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.	Natura 2000 Standard data form Available here This attribute will be periodically monitored as part of Natural England's site condition assessments and recorded within the relevant FCT
Supporting processes (on which the feature relies)	**Air quality**	Maintain as necessary the concentrations and deposition of air pollutants at or below the site-relevant Critical Load or Level values given for this feature of	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.	More information about site-relevant Critical Loads and Levels for this SAC is available by using

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		the site on the Air Pollution Information System (www.apis.ac.uk).	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 (NH_3), oxides of nitrogen (NO_x) and sulphur dioxide (SO_2), 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.	the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).
Supporting processes (on which the feature relies)	**Functional connectivity/ isolation**	Maintain and Restore the natural connectivity/ lack of connectivity of the water body to other water bodies.	The natural isolation of some standing water bodies can provide some protection from threats such as pollution and invasive species. Hydrological isolation can also lead to unique or diverse species assemblages this may be due to genetic isolation or the absence of predators. These water bodies should have their isolated state maintained. In contrast other standing water bodies naturally rely on hydrological connectivity to other freshwater systems for water supply, and can support migratory species. Hydrological connectivity may also be important for geneflow, and habitat and species resilience. These water bodies should have their hydrological connectivity maintained. Connectivity between lakes and surrounding wetlands are important for resource protection and ecosystem functioning and are particularly at risk from drainage, water level stabilisation and shoreline modifications. The natural hydrological connections to these loughs should be maintained e.g. the connection to Haltwistle burn and Jenkins Burn. The connectivity of these lakes to the adjacent wetlands also need to be maintained, however any additional man-made drains should be blocked to restore the wetlands and reduce the inflow of sediment and nutrients to the lakes. Currently Crag lough is not currently linked to the South Tyne.	Natura 2000 Standard data form Available here This attribute will be periodically monitored as part of Natural England's site condition assessments and recorded within the relevant FCT

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Supporting processes (on which the feature relies)	**Hydrology**	At a site, unit and/or catchment level (as necessary), maintain natural hydrological processes to provide the conditions necessary to sustain the feature within the site	Defining and maintaining the appropriate hydrological regime is a key step in moving towards achieving the conservation objectives for this site and sustaining this feature. Changes in source, depth, duration, frequency, magnitude and timing of water supply can have significant implications for the assemblage of characteristic plants and animals present. This target is generic and further site-specific investigations may be required to fully inform conservation measures and/or the likelihood of impacts. Hydrology influences lake ecosystem functioning in two ways: determining residence time (flushing) and water level fluctuations. Flushing of lakes is important for dilution and removal of nutrients and phytoplankton, and for reduction in sedimentation. The timing of different flushing rates within the year influences the biology of the lake. For example, reduced flushing in summer would encourage bloom conditions. Modifications of inflows and outlets or changes in hydrology, e.g. from flood control regimes, abstraction and gravel removal can lead to unnatural changes in lake levels. Broomlee Lough and Crag Lough both drain relatively small catchments and have a number of small inflow stream and spring-fed seepages entering around the shore. There is no obvious outflow from Crag Lough but it is thought to drain west; the main outflow from Crag Lough, Jenkin's Burn also drains to the west. Water levels in both lakes appear to be under natural influence. Greenlee Lough has an extensive catchment which includes areas of rough and semi-improved grassland, coniferous forestry and low lying bog. There are a number of inflow streams entering the site including two from the north-east which drain from significant areas of coniferous forest plantation. A third, Jenkins Burn, enters from the south-east and is the outflow from the nearby Broomlee Lough. The outflow drains to the west. The hydrology appears natural	Natura 2000 Standard data form Available here This attribute will be periodically monitored as part of Natural England's site condition assessments and recorded within the relevant FCT
Supporting processes (on which the feature relies)	**Sediment load**	Maintain the natural sediment load to the feature	Increased sediment loadings may result in clogging of the lake bed, increased siltation in the basin and deoxygenation of sediments. Blockage of coarser substrates with finer sediment restricts water flow-through, whilst increases in organic matter increase biochemical oxygen demand. Increases in the sediment load also increases nutrient loads to a site.	Natura 2000 Standard data form Available here This attribute will be

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Examples of causes of increases in siltation include: increased lake productivity; changes in catchment land-use; such as housing developments; intensification of agriculture including poaching from livestock; lake level fluctuations; climatic fluctuations; forestry and forestry felling and associated changes in drainage patterns. Further, measures to prevent sediment accumulation from these sources should be put in place.	periodically monitored as part of Natural England's site condition assessments and recorded within the relevant FCT
Supporting processes (on which the feature relies)	**Supporting off-site habitat**	Maintain/restore the extent, quality and spatial configuration of land or habitat surrounding or adjacent to the site which is known to support the feature.	The structure and function of the qualifying habitat, including its typical species, may rely upon the continued presence of areas which surround and are outside of the designated site boundary. Changes in surrounding land-use may adversely (directly/indirectly) affect the functioning of the feature and its component species. The catchment of the loughs is mainly unimproved hill grazing with areas of heather *Calluna vulgaris* and mire vegetation with deer-grass *Trichophorum cespitosum*, purple moor-grass *Molinia caerulea* and hare's-tail cotton grass *Eriophorum vaginatum*. However, it should be noted that surrounding forestry and the improvement in grazing land has the potential for impact on the processes of the loughs and their connections. There are further some areas around the loughs which are ungrazed, including around the inflows, which should remain ungrazed where possible. Caw Lough is thought to have developed from open water to a peat-filled basin relatively recently. Parts have fen communities similar to those surrounding the open water loughs, being dominated by bottle-sedge and marsh cinquefoil whilst there are also areas of reed swamp and a herb-rich fen-meadow vegetation.	Natura 2000 Standard data form Available here This attribute will be periodically monitored as part of Natural England's site condition assessments and recorded within the relevant FCT
Supporting processes (on which the feature relies)	**Water quality - acidity**	Maintain acidity levels to those reflecting unimpacted conditions; values of are typically pH 6.5-8.0 for these lakes.	Changes in pH can alter the entire freshwater community present within a water body affecting all trophic levels. Potential causes of a shift in pH include air pollution and direct application of lime to the water column as an acidification amelioration strategy (this should not be carried out). Acidity levels should reflect unimpacted conditions - values of Acid Neutralising Capacity (ANC) considered to avoid significant impact on characteristic biota are laid out in the site's FCT (these are the same numerical values as used to protect high ecological status under the WFD in	Natura 2000 Standard data form Available here This attribute will be periodically monitored as part of Natural England's site condition

<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>
<tr><td></td><td></td><td></td><td>the UK). As a guide, pH 6.5-8.0 for these lakes.

Although, pH naturally fluctuates throughout the year, e.g. snow melt may lead to pulses of acid water, and increased plant biomass in summer may result in large fluctuations in pH, including daytime increases in pH values. Therefore pH is not used as a monitoring target, however its importance in affecting many in lake processes means that the pH of a water body should not be artificially altered.

<table><tr><td></td><td>2005 – 2010 Mean pH</td><td>2005 – 2010 pH range</td></tr><tr><td>Broomlee Lough</td><td>7.4</td><td>7.32 – 7.7</td></tr><tr><td>Crag Lough</td><td>7.5</td><td>7.43 – 7.8</td></tr><tr><td>Greenlough</td><td>7.06</td><td>6.81 – 7.31</td></tr></table></td><td>assessments and recorded within the relevant FCT

Natural England Assessment reports.</td></tr>
<tr><td>Supporting processes (on which the feature relies)</td><td>Water quality - algae</td><td>Restore chlorophyll concentrations to levels which comply with 'high' ecological status</td><td>Chlorophyll is the pigment used for photosynthesis by plants, and the concentration of chlorophyll in the water column during the growing season therefore provides a good measure of the abundance of phytoplankton.

Phytoplankton is an important driver of structure and function in lakes and high phytoplankton levels (algal blooms) are usually associated with nutrient enrichment. Characteristic and representative algal cover may be significant, but excessive growths of uncharacteristic, filamentous algae on lake substrate or macrophytes are indicative of nutrient enrichment.

Presence of extensive cover of, e.g. Cladophora glomerata, is indicative of a site in unfavourable condition. Assessment Methods: Phytoplankton. Chlorophyll a and Percentage Nuisance Cyanobacteria. Available online at: http://www.wfduk.org/sites/default/files/Media/Characterisation%20of%20the%20water%20environment/Biological%20Method%20Statements/lake%20phytoplankton.pdf

Mean Chlorophyll levels 2008 – 2016 (ug/l-1)

Broomlee Lough: 6.13
Crag Lough: 7.56
Greenlee Lough: 6.93</td><td>Natura 2000 Standard data form Available here

This attribute will be periodically monitored as part of Natural England’s site condition assessments and recorded within the relevant FCT</td></tr>
</table>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Supporting processes (on which the feature relies)	**Water quality - dissolved oxygen**	Maintain dissolved oxygen levels to >7mg/l throughout the year.	As for species in terrestrial environments, dissolved oxygen (DO) is required for respiration by aquatic organisms. Anthropogenic activities leading to phytoplankton blooms and increased loadings of organic matter to lakes can cause decreases in the concentration of dissolved oxygen available to support the species present. Mean dissolved oxygen refers to DO being measured at 0.5m intervals throughout the entire water column where the watercolumn is not stratified and measurements taken at 0.5 m intervals below the thermocline only where stratification occurs.	Natura 2000 Standard data form Available here This attribute will be periodically monitored as part of Natural England's site condition assessments and recorded within the relevant FCT
Supporting processes (on which the feature relies)	**Water quality - nitrogen**	Maintain a stable nitrogen concentration at less than 1.5mg/l	There is an increasing understanding that some standing waters are sensitive to nitrogen (N) enrichment and eutrophication may be driven by increases in N, but site-specific information is usually required to determine whether N or P is more important. Where P levels are significantly above their target values and there is evidence that the lake is N limited (for example by N levels falling to negligible levels in summer), N targets should be set in addition to P targets. We recommend that such targets should preferably be developed using site-specific information, but should be based around the threshold of 1-2mg/l identified by James et al. (2005). In this situation N targets should be used in combination with P targets to drive a management strategy for the lake that reduces all nutrient inputs. Mean Total Nitrogen levels (2008-2016) (target 1.5) mg/l-1 Broomlee Lough: 0.70 Crag Lough: 0.88 Greenlee Lough: 0.84	Natura 2000 Standard data form Available here This attribute will be periodically monitored as part of Natural England's site condition assessments and recorded within the relevant FCT EA WFD monitoring
Supporting processes (on which the feature relies)	**Water quality - other pollutants**	Maintain water quality to a 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 EQSs for individual pollutants that are designed to protect aquatic biota with high levels of precaution.	Natura 2000 Standard data form Available here This attribute will be

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
				periodically monitored as part of Natural England's site condition assessments and recorded within the relevant FCT
Supporting processes (on which the feature relies)	**Water quality - phosphate**	Restore total phosphate levels to a maximum annual mean concentration to 20 micrograms/litre (µg P l-1)	Increased loadings of P to a water body are likely to lead to higher algal biomass in the water column, which in turn can have significant impacts on the standing water ecosystem through, for example, competition with vascular plants for nutrients and light, changes in pH, oxygen depletion and production of toxins. Decreasing dissolved oxygen and increasing ammonia levels are associated with death and decay of algal blooms, as is a release of toxins from toxin-producing species. If palaeolimnological techniques or hindcast modelling have been employed to reconstruct natural background phosphorus concentrations for a particular lake, these can be used to set targets, although it may be necessary to accept a small deviation from these background conditions. Alternatively, historical water chemistry data may exist for individual lakes. Where existing, site-specific water column TP concentrations are consistently lower than the standard appropriate for the habitat type, a lower target should be applied to prevent deterioration from current status. P levels have been agreed for all freshwater lakes between NE and the EA and for the Roman Wall Loughs this is 20 – this is lower than the level for eutrophic lakes as they are considered to be naturally mesotrophic. Broomlee currently meets this target. However, currently Greenlee and Crag lough are above the 20ug threshold and measures should be put in place to reduce these levels.	Natural England, 2014. Proposed total phosphorus targets for Lake Natura 2000 Protected Area Special Areas of Conservation for the updated river basin management plan consultation http://publications.naturalengland.org.uk/file/6419908728455168
Supporting processes (on which the feature relies)	**Water transparency**	Maintain the clarity of water to at least a depth of 2.5 metres or the maximum depth of the lake if this is shallower.	Water transparency is the major determinant of the depth of colonisation by macrophytes, therefore, it should not be reduced. This should allow plant colonisation to at least 2.5m, but if maximum depth of colonisation has previously been recorded at greater water depths this should be maintained. Increased nutrient loads leading to increased algal growth will reduce water	Natura 2000 Standard data form Available here This attribute will be

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			transparency, disturbance of the sediment by water sports and bottom feeding fish such as carp and bream also increase turbidity and reduce water transparency. Increased sediment loads to a lake would also have this effect. Within the Roman Wall Loughs SAC water transparency can also be reduced by peat staining of the water Greenlee Lough tends to have a higher degree of staining from peat as a higher proportion of its catchment contains peat.	periodically monitored as part of Natural England's site condition assessments and recorded within the relevant FCT
Version Control Advice last updated: **19 February 2019:** Following stakeholder comments. **'Fisheries**' attribute inclusion of Crag loughs as being an active fishery and the presumption of no stocking of any fish in Greenlee and Broomlee; '**Invasive, non-native and/or introduced species**' attribute expanded description of white clawed crayfish and threat signal crayfish pose if found; **'Functional connectivity**' attribute clarifying that currently Crag lough is not currently fully linked to the South Tyne; '**Sediment Load**' attribute potential impact of forestry and forestry felling include the potential impact of forestry and forestry felling; '**Supporting off-site habitat**' attribute include the importance of ungrazed areas and '**Water Quality**' attribute Greenlee and Crag lough are currently above the 20ug.				
Variations from national feature-framework of integrity-guidance: n/a				