

NPWS

Black Head–Poulsallagh Complex SAC
(site code 20)

**Conservation objectives supporting document-
Water courses of plain to montane levels with the
Ranunculion fluitantis and *Callitricho-Batrachion*
vegetation (habitat code 3260)**

Version 1

April 2014

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1 Introduction

1.1 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation

“Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation” (habitat code 3260) is a habitat in Annex I of the Habitats Directive. The description of the habitat is broad, covering rivers from upland bryophyte and macroalgal dominated stretches, to lowland depositing rivers with pondweeds and starworts (European Commission, 2007, Hatton-Ellis and Grieve, 2003). Selection of Special Areas of Conservation for the habitat in Ireland has used this broad interpretation. Thus, it must be recognised that a number of sub-types of this habitat exist in Ireland. As in the UK, it is considered that the habitat as defined is too broad for a single set of conservation guidelines to cover it (Hatton-Ellis and Grieve, 2003). Site-specific conservation objectives for the habitat identify and concentrate upon the high-conservation value sub-types.

1.2 Black Head–Poulsallagh Complex SAC

The Black Head-Poulsallagh Complex SAC, situated on the north-western coast of County Clare, comprises a range of karstic and coastal habitats. Large areas of the site are covered by exposed karstified limestone, with the sands of Fanore Dunes and tills of the upper Caher River valley notable exceptions. Inland, the site is dominated by limestone pavement, with important areas of heath and pockets of species-rich grassland. The Fanore dune system consists of both mobile and stabilised areas, and holds a small population of the rare liverwort, *Petalophyllum ralfsii*. A highly exposed vegetated shingle bank occurs at Poulsallagh. The shoreline has important intertidal reefs. The site is selected for ten terrestrial, coastal and marine habitats listed on Annex I of the EU Habitats Directive, three of which are priority habitats. It is also selected for the Annex II species *Petalophyllum ralfsii*.

The Black Head–Poulsallagh Complex SAC was selected for Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation owing to the presence of a highly calcareous sub-type in the Caher River. This sub-type includes stream crust tufa deposits, or an in-stream form of the Habitats Directive priority Annex I habitat “Petrifying springs with tufa formation (*Cratoneurion*)” (7220).

The Caher River is the only major over-ground river in the high Burren. It is recognised to be of very high, international conservation value, and was evaluated as the priority river (out of 56 river stretches surveyed) for conservation by Heuff (1987). It is a shallow, spring-fed system of approximately 7.4 km in length and may flow underground for part of its course during dry periods. For much of its course, the Caher River runs over limestone-derived drift. This upper section is heavily shaded by Hazel scrub that, in places, is periodically flooded. The consequent high humidity has led to the development of a luxuriant epiphytic lichen and bryophyte flora, and several rare species of lichen have been recorded in the locality. Along the lower section, the river has cut through the drift and runs on limestone bedrock strewn with boulders. This lower section appears to periodically dry out and is dominated by mosses and algal crusts, both of which are heavily calcified. Tufa deposits of considerable thickness occur in the river bed.

1.3 Conservation Objectives

A site-specific conservation objective aims to define the favourable conservation condition of a habitat or species at site level. The maintenance of habitats and species within sites at favourable condition will contribute to the maintenance of favourable conservation status of those habitats and species at a national level.

Conservation objectives are defined using attributes and targets that are based on parameters as set out in the Habitats Directive for defining favourable status, namely area, range, and structure and functions.

Note that the attributes and targets may change/become more refined as further information becomes available.

2 Area

It is not generally possible to quantify the area of Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation in a site, as rivers are linear features of variable width, along which the habitat varies both spatially and temporally in its extent. Consequently, NPWS use length of occupied channel in kilometres as the quantitative measure for habitat area. Based on the OSi Discovery Series (1:50,000) river vectors, the Caher River is approximately 7.4 km long (see Appendix 1 for map).

See section 4.5 and 4.6 below for descriptions of the habitat sub-type found in the Caher River.

The target for habitat area is: stable or increasing, subject to natural processes.

3 Range

The known distribution of Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation in the Black Head–Poulsallagh Complex SAC is shown in Appendix 1. It covers the full course of the Caher River, including some stretches that may periodically dry out. Based on the OSi Discovery Series (1:50,000) river vectors, the habitat is distributed along approximately 7.4 km of river channel.

The target for the habitat distribution attribute is: no decline, subject to natural processes.

4 Structure and functions

Structure and functions relates to the physical components of a habitat (“structure”) and the ecological processes that drive it (“functions”). For Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation these include attributes such as hydrology, substrata and various water quality attributes.

4.1 Hydrological regime

Owing to regular disturbance (through variations in flow), river macrophytes rarely reach a climax condition but frequently occur as transient communities. A natural (relatively unmodified) flow regime is required for both plant communities and channel geomorphology to be in favourable condition, exhibiting typical dynamics for the river type (Hatton-Ellis and Grieve, 2003). For many of the sub-types of this habitat, high flows are required to maintain the substratum necessary for the characteristic species (see Section 4.2 below). Flow variation can be particularly important, with high and flood flows being critical to the hydromorphology. For the highly calcareous, spring fed sub-type found in the Caher River, groundwater discharge is extremely important and flows may be lower than for other sub-types, possibly resulting in more stable community structure.

4.1.1 River flow

Kelly-Quinn *et al.* (2003) said that the Caher River appears to have at least some water flowing even in relatively dry summers. The authors said there was only one indication that the lower section of the river had come close to drying completely, as suggested by macroinvertebrate diversity at Fanore Bridge. By contrast, Heuff (1987) says that the Caher periodically dries out. Internal NPWS files note the importance of Hazel woodland in the upper catchment that floods periodically from the river. As for most rivers, it is likely that the Caher shows significant variation in flows in response to precipitation and groundwater recharge. It is important for all biological communities that a natural hydrological regime is maintained in the river.

4.1.2 Groundwater contribution

The Caher is a groundwater-fed system, and receives little, and likely infrequent, surface-run off. The catchment is dominated by karstified limestone bedrock at the surface, with pockets of calcareous, well-drained mineral soil overlying limestone till, and some mineral alluvium along the river valley¹. Shallow groundwater flow is likely to dominate the discharge to the river. The catchment is approximately 2,091ha in area and the flow paths may be relatively short. Never the less, the groundwater discharging to the river is highly calcareous, as evidenced by the widespread deposition of tufa (see also Section 4.3).

Springs are distributed throughout the river length, with the most tufaceous examples occurring in the lower sections. It is essential that the appropriate groundwater contribution necessary for the natural functioning of the habitat be maintained and that there is no significant disturbance of the catchment's groundwater regime.

The target for hydrological regime is: maintain appropriate hydrological regime necessary for the natural structures and functioning of the river habitat.

¹ Based on Soils and Subsoils data generated by Teagasc with co-operation of the Forest Service, EPA and GSI. Project completed May 2006.

4.2 Substratum composition

The size and distribution of substratum particles is largely determined by the river flow. Different habitat sub-types and species have different substratum requirements. The chemical composition (particularly minerals and nutrients) of the substratum is also important. The quality of finer sediment particles is a notable driver of rooted plant communities.

In the Caher River, the groundwater springs and seepages exert a significant influence on the river bed, through the precipitation of tufa. The substratum of the Caher varies from limestone bedrock and boulders to cobbles and gravel and fine deposited mud, with different plant and invertebrate assemblages associated with each.

The target for substratum composition is: Maintain appropriate substratum particle size range, quantity and quality, subject to natural process.

4.3 Chemical processes: Calcium carbonate deposition/Tufa formation

The Caher River has extensive, thick tufa deposits over much of its lowermost stretches, and calcium carbonate deposition has been noted throughout its length. Lyons and Kelly (2012) described the tufa in the Caher Rivers as fitting the stream crust formation type described by Pentecost and Viles (1994). Stream crusts are sheet-like deposits of tufa, with smooth surfaces and frequently ripple-like patterns, which form on the beds of shallow streams (Lyons and Kelly, 2013). Lyons and Kelly (2012) noted that this type of tufa often forms in the absence of bryophytes and vascular plants, however Heuff (1987) said that the biological action of algae and bryophytes leads to the formation of tufa in the Caher River.

Both physical and biological processes clearly play a part in precipitating CaCO_3 as tufa from saturated/ super-saturated groundwater. While it may appear difficult to change CaCO_3 precipitation, it could be affected by drainage activities in the river (or other in-stream morphological changes) or in the zone of contribution (groundwater catchment). These could impact the CaCO_3 and/or CO_2 concentrations in the spring water, or change the biological communities, impacting the precipitation processes.

Preliminary results indicate rapid tufa accumulation rates across a range of sites, with one coastal spring having a mean increase of 4 cm in 12 months (Lyons and Kelly, 2013). The authors also noted frequent shifts in the zones of deposition, as tufa deposits inhibit flow and cause the groundwater to alter its flow path.

Kelly-Quinn *et al.* (2003) provided detailed water chemistry data for the Caher River, noting the unusually low alkalinity values (see table 1) and concentrations of ions other than calcium (e.g. mean magnesium concentrations of 1.92 and 2.00 mg l⁻¹ Mg). The alkalinity concentrations quoted were low relative to those recorded in petrifying springs by Lyons and Kelly (2013) and turloughs by da Cunha Pereira (see table 1).

Table 1 Hydrochemical character of the Caher River, compared to other karstic habitats

Parameter	Caher River	Petrifying springs in Ireland	Turloughs
Source	Kelly-Quinn <i>et al.</i> (2003)	Lyons and Kelly (2013)	da Cunha Pereira (2011)*
pH	8.27-8.40	7.00-8.35	7.71-8.27
Alkalinity mg l ⁻¹ CaCO ₃	74.8-75.0	120-528 mg †	112-236
Calcium mg l ⁻¹ Ca	33.85-56.99	33-181	
Conductivity μS cm ⁻¹	424-456		

† alkalinity values converted from mg l⁻¹ HCO₃⁻ quoted in the report.

* values quoted are means (min and max) for 22 study turloughs.

The target for the attribute chemical processes, Calcium carbonate deposition/tufa formation is: maintain appropriate CaCO₃ concentration in groundwater and appropriate deposition rates in the river to support the natural structure and functioning of the river habitat.

4.4 Water quality

Water quality is a key driver of river ecology. It has also been significantly impacted by anthropogenic activities, and eutrophication of freshwaters is one of the most significant environmental challenges globally. For these conservation objectives, water quality can be described by:

- nutrients
- water colour, turbidity and suspended solids
- pH
- biological status

4.4.1 Nutrients

Phosphorus (MRP) is typically the limiting nutrient in Irish freshwater, however increased nitrogen (particularly nitrate, NO₃⁻) negatively impacts upon some aquatic plant communities. Nutrient enrichment typically leads to increased filamentous-green-algal biomass, and consequent changes in other algae, bryophyte and macrophyte species composition and abundance.

The Caher River is an oligotrophic/low nutrient river and its important plant and invertebrate communities are considered very sensitive to nutrient enrichment (Heuff, 1987, Kelly-Quinn *et al.*, 2003). It is a recognised high status water body, was considered to be at reference condition and was, therefore, used in the development of a river typology for WFD purposes (Kelly-Quinn *et al.*, 2005). Phosphate and ammonia concentrations were below the limits of detection (10 μg l⁻¹ P and N respectively) and nitrate values were low (1.4 and 2.0 mg l⁻¹ N) (Kelly-Quinn *et al.*, 2003).

In calcium-rich waters, such as those of karstic wetlands, dissolved phosphorus can bind to the metal, however such bonding may not prevent the phosphorus from becoming bio-available. As a result, enrichment may not be apparent as increased dissolved phosphate concentrations and it is

advisable to pay particular attention to biological responses and nitrogen concentrations (particularly nitrate and ammonia) when investigating nutrient cycling in karst rivers.

The target for nutrient concentrations in the Caher Rivers is at least WFD high status. Standards for total ammonia and molybdate reactive phosphorus in rivers were established by Schedule Five of the European Communities Environmental Objectives (Surface Water) Regulations (S.I. 272 of 2009). Mean annual total ammonia must be $\leq 0.040 \text{ mg N l}^{-1}$ and the annual 95th percentile must be $\leq 0.090 \text{ mg N l}^{-1}$. Mean molybdate reactive phosphorus must be $\leq 25 \text{ } \mu\text{g l}^{-1} \text{ P}$ and the annual 95th percentile must be $\leq 75 \text{ } \mu\text{g l}^{-1} \text{ P}$. However, as the available evidence indicates the concentrations in the river are significantly below these standards (the high-good boundaries), there should be no decline within class, i.e. no upward trend in nutrient concentrations.

The target for water quality, nutrients is: The concentration of nutrients in the water column should be sufficiently low to support the natural structure and functioning of the river habitat.

4.4.2 Water colour, turbidity and suspended solids

The water of the Caher River is extremely clear with no obvious peat-staining (Kelly-Quinn *et al.*, 2003). The important communities found in the River, particularly the algae and bryophytes, are likely to be highly sensitive to increases in colour and fine sediment load. Increased colour and fines decrease water clarity and impact upon the quality and quantity of light reaching primary producers. Higher colour can also be associated with increases in dissolved organic carbon (DOC) that can enrich the river system through microbial and fungal decomposers.

The target for water quality, colour, turbidity and suspended solids is: Maintain appropriate water clarity to support the natural structure and functioning of the river habitat.

4.4.3 pH

Acidification is not a threat to highly calcareous waters such as those of the Caher River, however enrichment can lead to at least temporary increases in pH to toxic levels ($>9/9.5$ pH units) as a result of increased photosynthetic activity.

Maximum pH should be < 9.0 pH units, in line with the surface water standards. See The European Communities Environmental Objectives (Surface Water Objectives) Regulations 2009.

The target for water quality, pH is: Maintain appropriate pH to support the natural structure and functioning of the river habitat.

4.4.4 Biological status

In Ireland, aquatic macroinvertebrates ('the Q-value system') has been used by the EPA to monitor river water quality since the 1970s. This method detects impacts from organic pollution and other

enrichment, has been 'intercalibrated' for WFD purposes and provides key information for determining the WFD status of a river water body. High WFD status is defined in by Schedule Five of the European Communities Environmental Objectives (Surface Water) Regulations (S.I. 272 of 2009) and requires a Q value of Q5 or Q4-5 (equivalent to an ecological quality ratio (EQR) of 0.85 or higher). Q values have been monitored at three stations in the Caher River since 1988 and were constantly at Q5 until 2003, when the Q at the remaining Carha Bridge site declined to Q4-5 (Clabby, *et al.*, 2004, see excerpt from report in Appendix 2). The Q at Carha Bridge remained at 4-5 in 2006 and 2009 (Clabby *et al.*, 2008, McGarrigle *et al.*, 2010). As the baseline for Habitats Directive purposes is 1994, the target for benthic invertebrate fauna in the Caher River is high status and to restore to Q 5.

The biological status of rivers should also be determined by macrophytes, phytobenthos, and fish, however the macrophyte metric has not yet been standardised in Ireland. An ecological quality ratio (EQR) of 0.93 has been set for high phytobenthos status (Trophic Diatom Index – TDI) in Schedule Five of the European Communities Environmental Objectives (Surface Water) Regulations (S.I. 272 of 2009) and is the appropriate target for the Caher River. The fish metric is not considered relevant to the river habitat at this time.

The target for water quality, biological status is: Maintain high biological status.

The overall target for water quality is: maintain appropriate water quality to support the natural structure and functioning of the river habitat.

4.5 Typical species

The sub-types of this habitat are poorly understood and their typical species have not yet been fully defined. The typical species may include higher plants, bryophytes, macroalgae and microalgae, and invertebrates.

The Caher River is considered to be unique, in being oligotrophic, fed by calcareous groundwater and having petrifying springs (a priority Habitats Directive Annex I habitat, 7220) on the river bed with excellent tufa formations. The river has been surveyed a number of times, notably for vascular plants, bryophytes and algae by Heuff in 1981 (Heuff, 1987), C.D. Preston and N.F. Stewart in 1988 and M.D. Lyons in 2010/11. The aquatic macroinvertebrates have also been studied (Kelly-Quinn *et al.*, 2003, 2005)

The upper sections of the river, those that flow over glacial till, have a flora consisting of the aquatic moss *Fontinalis antipyretica*, encrusting algae and *Apium nodiflorum* communities. The lower sections on limestone bedrock and boulders are dominated by communities of petrifying springs with tufa formations, namely agal crusts and *Cratoneurion* mosses. Tufa deposits of considerable thickness are found in the river.

Typical species are considered further below under the headings algae, lichens, bryophytes, higher plants and invertebrates.

4.5.1 Algae

Heuff (1987) recorded submersed *Hildebrandia rivularis* and *Nostoc* sp. at her upland survey site and noted that calcareous algal crusts were common. Her lowland site was covered in moss and calcareous algal crust. The algae recorded at the lowland site included the red alga *Bangia atropurpurea*, and cyanobacteria *Tolypothrix distorta* var. *penicillata*, *Phormidium* sp. (*calcareum/incrustatum*), *Scytonema myochrous* and *Rivularia* spp., as well as *Cladophora* (Heuff, 1987).

Heuff (1987) recorded charophytes at her lowland site, namely: *Chara vulgaris*, *Chara globularis* and *Nitella flexilis* agg. N.F. Stewart and C.D. Preston recorded *Tolypella glomerata*, *Chara aspera* and *Chara vulgaris* in the Caher River, S.E. of Caher Lower in August 1988. All three species were described as occurring on 'fallen mud blocks in the bed of the river'. C.D. Preston noted that "it was interesting to see frequent *Tolypella* in the stream, growing on the top of blocks of mud which had fallen from the banks into the stream and on the bare soil of the bank sides".

Lyons and Kelly (2013) noted that tufa stream crusts below karst springs "are typically coated with algae and cyanobacteria of varying colours". The algal flora of the stream crusts of the Caher River are worthy of further investigation, both through field survey and study of the 'grey literature'. The potential linkages between the encrusting algal community of the Caher River and the recently described 'krustenstein' that is a characteristic and important component of hard water lakes in Ireland should also be studied (Roden and Murphy, 2013, in prep.).

4.5.2 Lichens

The lower section of the Caher River is the only known locality in Ireland for the rare *Collembosidium caesium* (*Arthopyrenia caesia*) (Mitchell, 1983). A luxuriant lichen flora has also been recorded on the hazel scrub alongside the upper section of the river.

4.5.3 Bryophytes

Fontinalis antipyretica is the dominant moss over much of the course of the Caher River, however the characteristic *Cratoneurion* community of petrifying springs with tufa formations occurs in the lower river sections. Heuff (1987) recorded *Palustriella falcata* (*Cratoneuron commutatum* var. *falcatum*) associated with the tufa deposits in the lower Caher River. Melinda Lyons surveyed an area of petrifying spring in the Caher River (E. of Fanore Bridge) as part of her PhD study on that priority habitat. She recorded the following widespread petrifying spring species: the liverwort *Pellia endiviifolia* and mosses *Bryum pseudotriquetrum*, *Campylium stellatum* s.l., *Cratoneuron filicinum*, *Didymodon tophaceus*, *Palustriella falcata* and *Philonotis calcarea*; as well as other distinctive species of petrifying springs: liverwort *Jungermannia atrovirens*, mosses *Pohlia wahlenbergii* and *Scorpidium cossonii*. She also noted the wetland generalist mosses *Brachythecium rivulare* and *Calliergonella cuspidata*. Further study of the bryophytes of the stream bed, edge and riparian zone of the Caher River is recommended.

4.5.4 Higher plants

C.D. Preston and N.F. Stewart recorded a variety of vascular plants in the river in August 1988. In the stretches near Caher Lower they found frequent patches of the pondweed *Potamogeton* x

lanceolatus (a rare hybrid of *Potamogeton berchtoldii* and *Potamogeton coloratus*) on highly calcareous substratum (Preston 1993, Preston, 2003, NPWS internal files). In a still backwater *Potamogeton x lanceolatus* was found with *Potamogeton coloratus*. Other associated species recorded by Preston and Stewart were *Apium nodiflorum*, *Juncus articulatus*, *Littorella uniflora*, *Mentha aquatica*, *Potamogeton natans*, *Sparganium erectum*, *Ranunculus flammula*, *Ranunculus ?tricophyllus* and *Zannichellia palustris*, as well as charophytes (see section 4.5.1 above) (Preston, 1993). *Potamogeton x lanceolatus* has been known from this location since its discovery in 1891 (Peston, 1993). T.C.G. Rich and A. McVeigh also recorded this hybrid in June 2007 west of Formoyle while surveying for the rare hawkweed *Hieracium basalticola* (Rich *et al.*, 2010).

Heuff (1987) surveyed two sites on the Caher River, an upland site (M175060) and a lowland site (M140088). The upland site was described as a “shallow stony stream shaded by hazel scrub, alternating with more open areas where *Apium nodiflorum* and *Berula erecta* are abundant, with *Phalaris arundinacea* occurring in still, silty areas” (Heuff, 1987). Deeper, still pools had abundant *Callitriche* and *Apium nodiflorum* (Heuff, 1987). At the lowland site, calcareous algal crust dominated, with low abundance of *Caltha palustris* and *Agrostis stolonifera* (Heuff, 1987). Where the river bed was covered in tufa, very few vascular plants occurred (Heuff, 1987).

4.5.5 Invertebrates

Kelly-Quinn *et al.* (2003) described the macroinvertebrate fauna of the Caher River as fairly typical of the middle reaches of Irish alkaline rivers and of excellent water quality. One noteworthy species encountered was *Dinocras cephalotes*, a predatory perlid plecopteran, that is uncommon in Ireland and occurred in high abundance in the Caher River (Kelly-Quinn *et al.* 2003). Specimens were quite black, but frequently with calcareous encrustations (Kelly-Quinn *et al.*, 2003). Clabby *et al.* (2004) noted a dramatic decline in the species in 2003, however, with only one specimen recorded during routine river monitoring (see Appendix 2). Two trichopteran species with limited Irish records were also highlighted: *Metalype fragilis* and *Lype reducta* (Kelly-Quinn *et al.*, 2003). Overall macroinvertebrate abundance was lower than for other Irish limestone rivers (Kelly-Quinn *et al.*, 2003).

Owing to the pale colour of the calcium carbonate encrusted substratum, the invertebrates are generally very pale-coloured, notably *Gammarus* and *Baetis* (Kelly-Quinn *et al.*, 2003).

The target for typical species is: Typical species of the relevant habitat sub-type should be present and in good condition.

4.6 Vegetation composition –communities

The Caher River is considered to be unique, in being fed by calcareous groundwater and having petrifying springs (a priority Habitats Directive Annex I habitat, 7220) on the river bed with excellent tufa formations. The river has a well-developed algal flora, and conspicuously well zoned bryophyte and lichen communities occur on boulders in and adjacent to the river. A species-rich vascular plant community occurs in parts, including the rare hybrid Pondweed *Potamogeton x lanceolatus*. Charophytes are also widespread.

The lower section on limestone bedrock is dominated by mosses (*Cratoneurion*) and algal crusts, both of which are heavily calcified and in places. Tufa deposits are of considerable thickness in these river stretches. C.D. Preston described the river downstream of the church towards the seaward end as “a dramatic example of a karst feature’ being devoid of vascular plants, and having tufaceous sides and a more or less bare limestone floor”. C.D. Preston and N.F. Stewart also surveyed stretches near Caher Lower in August 1988, recording a variety of vascular plants (including *Potamogeton x lanceolatus*) and charophytes.

Heuff (1987) surveyed two sites on the Caher River, a lowland site (M140088) and an upland site (M175060). At the lowland site, calcareous algal crust dominated, with *Palustriella falcata* (*Cratoneurion commutatum* var. *falcatum*), and low abundance of *Caltha palustris* and *Agrostis stolonifera* (Heuff, 1987). The channel was a step-cascade. The upland site was described as a ‘shallow stony stream shaded by hazel scrub, alternating with more open areas where *Apium nodiflorum* and *Berula erecta* are abundant, with *Phalaris arundinacea* occurring in still, silty areas” (Heuff, 1987). Deeper, still pools had abundant *Callitriche* and *Apium nodiflorum* (Heuff, 1987).

Heuff (1987) identified ten river stretch types, based on eighteen vegetation units, of which two occurred in the Caher River, namely ‘*Glycerio-Sparganion x Apium nodiflori* stretches’ in the upland site, and ‘Tufa-producing stretches’ in the lowland site. The Caher River was the only site for the nutrient poor sub-type of the Tufa-producing stretches.

The target for vegetation composition, communities is: The characteristic communities of the Caher River sub-type should be present, in good condition and should not decline in area (subject to natural processes).

4.7 Floodplain connectivity

River connectivity with the floodplain is important for the functioning of this habitat. Channels with a naturally functioning floodplain are better able to maintain habitat and water quality (Hatton-Ellis and Grieve, 2003). Floodplain connectivity is particularly important in terms of sediment sorting and nutrient deposition. High-conservation-value rivers are intimately connected to floodplain habitats and function as important wildlife corridors, connecting otherwise isolated or fragmented habitats in the wider countryside (Hatton-Ellis and Grieve, 2003).

As mentioned in a number of earlier sections (including 1.2 and 4.1.1, the upper section of the Caher River is surrounded and shaded by Hazel scrub that, in places, is periodically flooded. This results in high humidity and has led to the development of a luxuriant epiphytic lichen and bryophyte flora.

The target for floodplain connectivity is: The area of active floodplain at and upstream of the habitat should be maintained.

4.8 Riparian Habitats

Riparian habitats, even where they do not form part of a natural floodplain, are an integral part of the structure and functioning of river systems. Riparian scrub/woodland along river corridors is

important in terms of humidity and, therefore, fringing bryophyte communities. Fringing habitats can contribute to the aquatic food web (e.g. allochthonous matter such as leaf fall), provide habitat (refuge and resources) for certain life-stages of fish, birds and aquatic invertebrates, assist in the settlement of fine suspended material, protect riverbanks from erosion and contribute to nutrient cycling. Many aquatic invertebrates, in particular, use the fringing habitats for shelter, feeding and mating of the winged adults. Shade may also be important in suppressing algal growth in enriched rivers and moderating temperatures. Equally, fringing habitats are dependent on the river, particularly its water levels, and support wetland communities and species of conservation concern.

The target for riparian habitat is: maintain riparian habitats necessary to support the natural structure and functioning of the river habitat

5 References and other relevant literature

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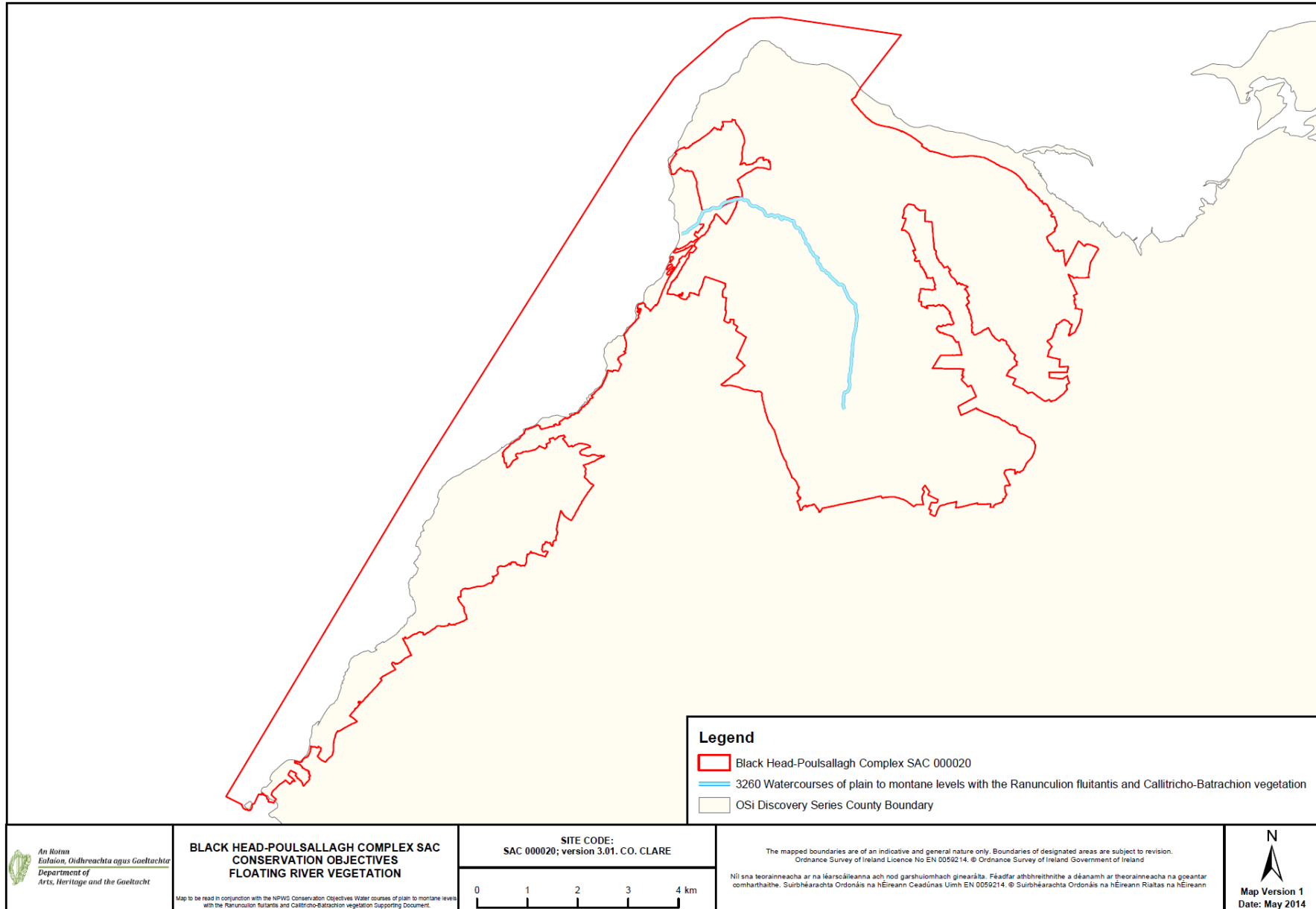
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Appendix 1 Distribution map



Appendix 2 Caher River Water quality

Excerpt from EPA report on interim results on river quality for 2003 (Clabby *et al.*, 2004)

River and Code	: CAHER (CLARE)	28/C/01
Tributary of	: Sea - Black Head	OS Catchment No: 147
OS Grid Ref	: M 137 083	Date(s) Surveyed : 14/10/2003

Sampling Stations No. Location	Biological Quality Ratings (Q Values)				
	1988	1991	1997	2000	2003
0100 Br S Formoyle East	5	5	-	-	-
0200 Carha Br	5	5	5	5	4-5
0300 Fanore Br	5	5	-	-	-

Assessment: The Caher catchment is almost entirely within the Black Head, Poulsallagh complex SAC and is itself a unique river being almost the only river that flows all year round in the Burren area. In the past it has been characterised by large numbers of *Dinocras*. This species appear to have declined dramatically in numbers, however, in 2003 with only one specimen taken in the main sample. This is a worrying decline in a key element of the river's biodiversity and it is to be hoped that it is merely due to year-to-year variation as opposed to a pollution impact. A number of new houses were noted in the catchment and it is vital that local water abstraction does not cause the river to run dry or reach critically low levels in summer. Similarly, in a highly vulnerable groundwater zone such as the Caher catchment, septic tank discharges are liable to contaminate the river. In karst areas such as this the flow pathways from groundwater to surface water and from surface to groundwater are very direct.

Sampling Stations No. Location	National Grid Ref.		Discovery Series No.	County Code
	X	Y		
0100 Br S Formoyle East	117331	206789	51	CE
0200 Carha Br	116316	208235	51	CE
0300 Fanore Br	114453	208917	51	CE