ISSN 2009-4086

National Parks and Wildlife Service

Conservation Objectives Series

Lough Ennell SAC 000685



National Parks and Wildlife Service, Department of Housing, Local Government and Heritage,

90 King Street North, Dublin 7, D07 N7CV, Ireland.

Web: www.npws.ie E-mail: natureconservation@npws.gov.ie

Citation:

NPWS (2024) Conservation Objectives: Lough Ennell SAC 000685. Version 2. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage.

> Series Editors: Maria Long and Colin Heaslip ISSN 2009-4086

Introduction

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

A site-specific conservation objective aims to define favourable conservation condition for a particular habitat or species at that site.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:

- its natural range, and area it covers within that range, are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance
- exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:

• population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and

• the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and

• there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Notes/Guidelines:

1. The targets given in these conservation objectives are based on best available information at the time of writing. As more information becomes available, targets for attributes may change. These will be updated periodically, as necessary.

2. An appropriate assessment based on these conservation objectives will remain valid even if the targets are subsequently updated, providing they were the most recent objectives available when the assessment was carried out. It is essential that the date and version are included when objectives are cited.

3. Assessments cannot consider an attribute in isolation from the others listed for that habitat or species, or for other habitats and species listed for that site. A plan or project with an apparently small impact on one attribute may have a significant impact on another.

4. Please note that the maps included in this document do not necessarily show the entire extent of the habitats and species for which the site is listed. This should be borne in mind when appropriate assessments are being carried out.

5. When using these objectives, it is essential that the relevant backing/supporting documents are consulted, particularly where instructed in the targets or notes for a particular attribute.

Qualifying Interests

a priority habitat under the Habitats Directive
Lough Ennell SAC
Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.
Alkaline fens

Please note that this SAC overlaps with Lough Ennell SPA (004044). See map 2. The conservation objectives for this site should be used in conjunction with those for the overlapping site as appropriate. IMPORTANT: This 'Version 2' document includes 1 additional QI (3140). The conservation objectives for pre-existing QIs have not been updated.

Supporting documents, relevant reports & publications

Supporting documents, NPWS reports and publications are available for download from: www.npws.ie/Publications

NPWS Documents

	2007		
Title :	Supporting documentation for the Habitats Directive Conservation Status Assessment - backing documents. Article 17 forms and supporting maps		
Author :	NPWS		
Series :	Unpublished report to NPWS		
Year :	2012		
Title :	Ireland Red List No. 8: Bryophytes		
Author :	Lockhart, N.; Hodgetts, N.; Holyoak, D.		
Series :	Ireland Red List series, NPWS		
Year :	2013		
Title :	A survey of the benthic macrophytes of three hard-water lakes: Lough Bunny, Lough Carra and Lough Owel		
Author :	Roden, C.; Murphy, P.		
Series :	Irish Wildlife Manuals, No. 70		
Year :	2013		
Title :	The status of EU protected habitats and species in Ireland. Volume 2. Habitats assessments		
Author :	NPWS		
Series :	Conservation assessments		
Year :	2013		
Title :	Conservation status assessments for three fen habitat types - 7230 – Alkaline fens, 7210 – Calcareous fens with <i>Cladium mariscus</i> and species of Caricion davallianae and 7140 – Transition mires and quaking bogs		
Author :	Kimberley, S.		
Series :	Unpublished report to NPWS		
Year :	2014		
Year : Title :	2014 Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland, Version 2.0		
Year : Title : Author :	2014 Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland, Version 2.0 Perrin, P.M.; Barron, S.J.; Roche, J.R.; O'Hanrahan, B.		
Year : Title : Author : Series :	2014 Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland, Version 2.0 Perrin, P.M.; Barron, S.J.; Roche, J.R.; O'Hanrahan, B. Irish Wildlife Manuals, No. 79		
Year : Title : Author : Series : Year :	2014 Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland, Version 2.0 Perrin, P.M.; Barron, S.J.; Roche, J.R.; O'Hanrahan, B. Irish Wildlife Manuals, No. 79 2015		
Year : Title : Author : Series : Year : Title :	2014 Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland, Version 2.0 Perrin, P.M.; Barron, S.J.; Roche, J.R.; O'Hanrahan, B. Irish Wildlife Manuals, No. 79 2015 Habitats Directive Annex I lake habitats: a working interpretation for the purposes of site- specific conservation objectives and Article 17 reporting		
Year : Title : Author : Series : Year : Title : Author :	2014 Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland, Version 2.0 Perrin, P.M.; Barron, S.J.; Roche, J.R.; O'Hanrahan, B. Irish Wildlife Manuals, No. 79 2015 Habitats Directive Annex I lake habitats: a working interpretation for the purposes of site-specific conservation objectives and Article 17 reporting O Connor, Á.		
Year : Title : Author : Series : Year : Title : Author : Series :	2014 Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland, Version 2.0 Perrin, P.M.; Barron, S.J.; Roche, J.R.; O'Hanrahan, B. Irish Wildlife Manuals, No. 79 2015 Habitats Directive Annex I lake habitats: a working interpretation for the purposes of site- specific conservation objectives and Article 17 reporting O Connor, Á. Unpublished document by NPWS		
Year : Title : Author : Series : Year : Title : Author : Series : Year : Year :	2014 Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland, Version 2.0 Perrin, P.M.; Barron, S.J.; Roche, J.R.; O'Hanrahan, B. Irish Wildlife Manuals, No. 79 2015 Habitats Directive Annex I lake habitats: a working interpretation for the purposes of site-specific conservation objectives and Article 17 reporting O Connor, Á. Unpublished document by NPWS 2016		
Year : Title : Author : Series : Year : Title : Author : Series : Year : Title : Title :	2014 Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland, Version 2.0 Perrin, P.M.; Barron, S.J.; Roche, J.R.; O'Hanrahan, B. Irish Wildlife Manuals, No. 79 2015 Habitats Directive Annex I lake habitats: a working interpretation for the purposes of site- specific conservation objectives and Article 17 reporting O Connor, Á. Unpublished document by NPWS 2016 Ireland Red List No. 10: Vascular Plants		
Year : Title : Author : Series : Year : Title : Author : Series : Year : Title : Author : Author : Series : Year : Year : Year : Author : Series : Year : Year : Author : Series : Year : Year : Author : Series : Year : Year : Year : Author : Series : Year :	 2014 Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland, Version 2.0 Perrin, P.M.; Barron, S.J.; Roche, J.R.; O'Hanrahan, B. Irish Wildlife Manuals, No. 79 2015 Habitats Directive Annex I lake habitats: a working interpretation for the purposes of site-specific conservation objectives and Article 17 reporting O Connor, Á. Unpublished document by NPWS 2016 Ireland Red List No. 10: Vascular Plants Wyse Jackson, M.; FitzPatrick, Ú.; Cole, E.; Jebb, M.; McFerran, D.; Sheehy Skeffington, M.; Wright, M. 		
Year : Title : Author : Series : Year : Title : Author : Series : Year : Title : Author : Series : Series :	2014 Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland, Version 2.0 Perrin, P.M.; Barron, S.J.; Roche, J.R.; O'Hanrahan, B. Irish Wildlife Manuals, No. 79 2015 Habitats Directive Annex I lake habitats: a working interpretation for the purposes of site- specific conservation objectives and Article 17 reporting O Connor, Á. Unpublished document by NPWS 2016 Ireland Red List No. 10: Vascular Plants Wyse Jackson, M.; FitzPatrick, Ú.; Cole, E.; Jebb, M.; McFerran, D.; Sheehy Skeffington, M.; Wright, M. Ireland Red Lists series, NPWS		
Year : Title : Author : Series : Year : Title : Author : Series : Year : Title : Author : Series : Year :	 2014 Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland, Version 2.0 Perrin, P.M.; Barron, S.J.; Roche, J.R.; O'Hanrahan, B. Irish Wildlife Manuals, No. 79 2015 Habitats Directive Annex I lake habitats: a working interpretation for the purposes of sitespecific conservation objectives and Article 17 reporting O Connor, Á. Unpublished document by NPWS 2016 Ireland Red List No. 10: Vascular Plants Wyse Jackson, M.; FitzPatrick, Ú.; Cole, E.; Jebb, M.; McFerran, D.; Sheehy Skeffington, M.; Wright, M. Ireland Red Lists series, NPWS 2019 		
Year : Title : Author : Series : Year : Title : Series : Year : Year : Title :	 2014 Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland, Version 2.0 Perrin, P.M.; Barron, S.J.; Roche, J.R.; O'Hanrahan, B. Irish Wildlife Manuals, No. 79 2015 Habitats Directive Annex I lake habitats: a working interpretation for the purposes of sitespecific conservation objectives and Article 17 reporting O Connor, Á. Unpublished document by NPWS 2016 Ireland Red List No. 10: Vascular Plants Wyse Jackson, M.; FitzPatrick, Ú.; Cole, E.; Jebb, M.; McFerran, D.; Sheehy Skeffington, M.; Wright, M. Ireland Red Lists series, NPWS 2019 The Status of EU Protected Habitats and Species in Ireland. Volume 2: Habitat Assessments 		
Year : Title : Author : Series : Year : Year : Author : Series : Year : Year : Author : Series : Year : Year : Author : Series : Year :	2014 Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland, Version 2.0 Perrin, P.M.; Barron, S.J.; Roche, J.R.; O'Hanrahan, B. Irish Wildlife Manuals, No. 79 2015 Habitats Directive Annex I lake habitats: a working interpretation for the purposes of site- specific conservation objectives and Article 17 reporting O Connor, Á. Unpublished document by NPWS 2016 Ireland Red List No. 10: Vascular Plants Wyse Jackson, M.; FitzPatrick, Ú.; Cole, E.; Jebb, M.; McFerran, D.; Sheehy Skeffington, M.; Wright, M. Ireland Red Lists series, NPWS 2019 The Status of EU Protected Habitats and Species in Ireland. Volume 2: Habitat Assessments NPWS		

Year :	2020
Title :	Marl Lake (Habitat 3140) Survey and Assessment Methods Manual
Author :	Roden, C.; Murphy, P.; Ryan, J.; Doddy, P.
Series :	Irish Wildlife Manuals, No. 125
Year :	2020
Year : Title :	2020 Benthic vegetation in Irish marl lakes: monitoring habitat 3140 condition 2011 to 2018
Year : Title : Author :	2020 Benthic vegetation in Irish marl lakes: monitoring habitat 3140 condition 2011 to 2018 Roden, C.; Murphy, P.; Ryan, J.

Other References

Year :	1893
Title :	Notes on Irish Characeae
Author :	Groves, H.; Groves, J.
Series :	The Irish Naturalist, 2(6): 163-164
Year :	1895
Title :	The distribution of the Characeae in Ireland
Author :	Groves, H.; Groves, J.
Series :	The Irish Naturalist, 4: 7-11, 37-41
Year :	1920
Title :	The British Charophyta. Volume I. Nitelleae.
Author :	Groves, J.; Bullock-Webster, G.R.
Series :	Ray Society, London.
Year :	1924
Title :	The British Charophyta. Volume II. Charaea.
Author :	Groves, J.; Bullock-Webster, G.R.
Series :	Ray Society, London.
Year :	1975
Title :	A preliminary survey of Irish lakes
Author :	Flanagan, P.J.; Toner P.F.
Series :	An Foras Forbartha
Year :	1982
Title :	Eutrophication of waters. Monitoring assessment and control
Author :	OECD
Series :	OECD, Paris
Year :	1982
Title :	The changing status of Characeae in four marl lakes in the Irish Midlands
Author :	John, D.M.; Champ, W.S.T.; Moore, J.A.
Series :	Journal of Life Sciences of the Royal Dublin Society, 4(1): 47-71
Year :	1996
Title :	A guide to the restoration of nutrient-enriched shallow lakes
Author :	Moss, B.; Madgwick, J.; G. Phillips
Series :	The Broads Authority, Norwich

Year :	2004
Title :	Common Standards Monitoring guidance for lowland wetland habitats
Author :	JNCC
Series :	Joint Nature Conservation Committee, Peterborough
Year :	2004
Title :	Ecology of Shallow Lakes
Author :	Scheffer, M.
Series :	Population and Community Biology Series. Springer, Dordrecht
Year :	2004
Title :	Shifts between clear and turbid states in a shallow lake: multi-causal stress from climate, nutrients and biotic interactions.
Author :	Hargeby, A.; Blindow, I.; Hansson, L.A.
Series :	Archiv fur Hydrobiologie, 161(4), 433-454.
Year :	2009
Title :	The marl lakes of the British Isles
Author :	Pentecost, A.
Series :	Freshwater Reviews, 2(1): 167-197
Year :	2011
Title :	Review and revision of empirical critical loads and dose-response relationships. Proceedings of an expert workshop, Noordwijkerhout, 23-25 June 2010
Author :	Bobbink, R.; Hettelingh, J.P.
Series :	RIVM report 680359002, Coordination Centre for Effects, National Institute for Public Health and the Environment (RIVM)
Year :	2011
Title :	The distribution and expansion of ornamental plants on the Shannon Navigation.
Author :	Minchin, D.; Boelens, R.
Series :	Biology and Environment: Proceedings of the Royal Irish Academy Volume 111B, No.3, Plant invasions
Year :	2014
Title :	Facilitation of clear-water conditions in shallow lakes by macrophytes: differences between charophyte and angiosperm dominance
Author :	Blindow, I; Hargeby, A.; Hilt, S.
Series :	Hydrobiologia, 737: 99–110
Year :	2016
Title :	A narrative for conserving freshwater and wetland habitats in England
Author :	Mainstone, C.; Hall, R.; Diack, I.
Series :	Natural England Research Reports Number 064
Year :	2016
Title :	Lake ecological assessment metrics in Ireland: relationships with phosphorus and typology parameters and the implications for setting nutrient standards
Author :	Free, G.; Tierney, D.; Little, R.; Kelly, F.L.; Kennedy, B.; Plant, C.; Trodd, W.; Wynne, C.; Caroni R.; Byrne, C.
Series :	Biology and Environment: Proceedings of the Royal Irish Academy, 116B: 191-204
Year :	2019
Title :	Microbialite crusts in Irish limestone lakes reflect lake nutrient status
Author :	Doddy, P.; Roden, C.M.; Gammell, M.P.
Series :	Biology and Environment: Proceedings of the Royal Irish Academy, 119(1): 1–11

Year :	2019
Title :	Cyanobacterial communities in limestone lakes and pools in Ireland: Effects of nutrient enrichment on community structure, and implications for conservation of marl lakes
Author :	Doddy, P.
Series :	Unpublished Ph.D. thesis, Galway-Mayo Institute of Technology

Page 8 of 14

Conservation Objectives for : Lough Ennell SAC [000685]

3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.

To restore the Favourable conservation condition of Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. in Lough Ennell SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes	Lough Ennell is of national and European ecological importance despite suffering significant eutrophication. Rare charophyte species have survived and recovered since the 1980s, and the marl lake habitat has recovered to Poor conservation condition, but not yet Good (Roden et al., 2020). For additional information see Flanagan and Toner (1975), John et al. (1982), Pentecost (2009) and Doddy et al. (2019). The surface area of the lake is the simplest measure of extent and should be stable or increasing. See map 3. Further information on all attributes is provided in Roden et al. (2020) and Connor (2015). See also Pentecost (2009) and Roden et al. (2020) for an overview of marl lakes in Britain and Ireland. Lake habitat 3140 was in Bad, deteriorating Conservation Status across Ireland in the three reporting periods, 2006-2018 (NPWS, 2007, 2013, 2019)
Habitat distribution	Occurrence	No decline, subject to natural processes	Lake habitat 3140 occurs throughout Lough Ennell (Roden et al., 2020). The charophytes of Lough Ennell were first investigated in the 1840s, and again in 1860 - 1890s (Groves and Groves, 1893). Oncoids or oncolites were reported from Ennell since the 1880s (John et al., 1982; Pentecost, 2009; Doddy, 2019). The related cyanobacterial crust was first reported by John et al. (1982) and investigated by Doddy et al. (2019). John et al. (1982) studied the impacts of inadequately-treated sewage on the lake's flora. Habitat 3140 was in Poor conservation condition in Ennell in 2012, having improved since the 1980s (Roden et al., 2020). A shoreline survey in 2023 suggested that the lake has remained in Poor condition (N.F. Stewart, pers. comm.)
Vegetation composition: typical species	Occurrence	Typical species present, in good condition, and demonstrating typical abundances and distribution. Restore condition and extent of typical charophyte species and cyanobacterial crust	Thirteen charophyte taxa are known from Ennell; all have been seen since 2000 (<i>Chara aculeolata, C.</i> <i>aspera, C. contraria, C. curta, C. dissoluta, C.</i> <i>globularis, C. hispida, C. subspinosa, C. tomentosa,</i> <i>C. virgata, C. virgata</i> var. <i>annulata, C. vulgaris,</i> <i>Tolypella glomerata</i>). The first Irish record for <i>C.</i> <i>tomentosa,</i> a specialist of marl lakes not found in Great Britain, was from Ennell (Groves and Groves, 1893, 1895; Groves and Bullock Webster, 1920, 1924). Vascular plant abundance is higher than expected in marl lakes in Good condition, with several species indicative of eutrophic conditions, e.g. <i>Ceratophyllum demersum, Hippuris vulgaris,</i> and certain duckweeds (Roden et al., 2020). Roden et al. (2020) list species present in marl lakes in good condition and other typical species. See also Article 17 assessments (NPWS, 2013, 2019) and O Connor (2015) for lists of 3140 typical species (cyanobacteria, algae, higher plants and water beetles)

Vegetation composition: characteristic zonation	Occurrence	Restore characteristic charophyte and crust zones	Four vegetation zones were recorded in 2012, comprising cyanobacterial crust and charophytes <i>Chara curta, C. subspinosa, C. contraria, C. virgata,</i> <i>C. dissoluta, Tolypella glomerata</i> (Roden et al., 2020). Owing to the shallow euphotic depth, however, zones are compressed. In 2016, average microbial crust cover at Lough Ennell was 94% and average thickness 6mm (Doddy et al., 2019). The characteristic zonation of lake habitat 3140 in marl lakes was described in Roden and Murphy (2013) and updated by Roden et al. (2020). Marl lakes in good condition have four or more characteristic vegetation zones, typically a cyanophyte crust zone with occasional <i>Chara virgata</i> var. <i>annulata</i> , a <i>C.</i> <i>curta</i> zone, a <i>C. subspinosa</i> zone, a <i>C. virgata</i> zone and, in some lakes, a <i>C. dissoluta</i> (in Ennell) or <i>Nitella flexilis</i> zone (Roden et al., 2020)
Vegetation distribution: maximum depth	Metres	Restore maximum depth of vegetation (euphotic depth), subject to natural processes	The maximum depth of vegetation at Lough Ennell in 2012 was 6.1m (Roden and Murphy, 2013). The target for maximum depth of vegetation colonisation (euphotic depth) in marl lakes is more than 7m (Roden et al., 2020). Euphotic depth is considered to be a key measure of the structure and functions of marl lake vegetation and has been found to exceed 10m in some Irish marl lakes (Roden et al., 2020)
Hydrological regime: water level fluctuations	Metres	Maintain/restore appropriate hydrological regime necessary to support the habitat	The hydrological regime of Lough Ennell was modified by arterial drainage (Brosna Scheme 1948- 55; lowering lake level, permanently exposing areas of former lake bed and connecting former islands to the shoreline) and is influenced by on-going drainage maintenance. Investigation is needed of water level fluctuations at Ennell and their effects on vegetation structure and functions. In undisturbed marl lakes, fluctuations follow predictable seasonal trends and relationships exist with the vegetation zones (Roden et al., 2020). In summer, more than 90% of the crust zone should be covered and water levels should never be lower than the top of the <i>Chara curta</i> zone; in winter, all zones should be submerged (Roden et al., 2020). Groundwater exerts a strong influence on the hydrology of marl lakes. Increased water level fluctuations can increase wave action, up-root vegetation, increase turbidity, alter the substratum and lead to nutrient release from sediment
Lake substratum quality	Various	Maintain/restore appropriate substratum type, extent and chemistry to support the vegetation	Roden et al. (2020) recorded rock and white marl in Lough Ennell. In general, marl lakes are dominated by limestone bedrock, calcareous silt and sand, and loose stones (Roden et al., 2020). Deposited peat may indicate excessive sediment inputs and inorganic sediments can accumulate phosphorus and release it into the water column (Roden et al., 2020). Investigation is needed of sediment phosphorus concentrations in Lough Ennell to understand their contribution to observed eutrophication and unfavourable vegetation structure and functions. Wider research into acceptable sediment phosphorus concentrations and other aspects of substratum quality in marl lakes would be beneficial

pH and Alkalinity	pH units, mg/l	Maintain appropriate water and sediment pH, alkalinity and cation concentrations to support the habitat, subject to natural processes	Average alkalinity and pH in Lough Ennell were 164mg/l and 8.3 pH units, respectively (WFD data Mar 2007-Aug 2023). The lower alkalinity boundary for habitat 3140 may lie between 80mg/l and 100mg/l, however alkalinity for lake habitat 3140 is far higher in most Irish marl lakes, exceeding 200mg/l in some cases (Roden et al., 2020). Acidification is not considered a threat to habitat 3140, however eutrophication can lead to at least temporary increases in pH to toxic levels (>9/9.5 pH units). Maximum pH should be <9.0 pH units, in line with the surface water standards (The European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2019). Further study of the sediment pH, alkalinity and cation concentration may assist in understanding of nutrient cycling
Nutrients	mg/l P; mg/l N	Restore the concentration of nutrients in the water column to sufficiently low levels to support the habitat and its typical species	Roden et al. (2020) reported total phosphorus (TP) concentration of 0.019mg/l for Lough Ennell. WFD data for 2007-2023 show average TP of 0.021mg/l; values of >0.04mg/l were recorded over 30 times including in summer months. Roden et al. (2020) found the majority of marl lakes in Good condition had TP \leq 0.01mg/l. While vegetation attributes determine the conservation condition of the habitat and some Good condition marl lakes have had higher TP concentrations, \leq 0.01mg/l is the target for Good condition (Roden et al., 2020). The \leq 0.01mg/l TP target is equivalent to oligotrophic (OECD, 1982) and WFD High Status (The European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2019). WFD High Status targets for total ammonia (annual average \leq 0.04mg/l N and annual 95th percentile \leq 0.09mg/l N) may also be appropriate. See also Free et al. (2016)
Water colour	mg/l PtCo	Restore appropriate water colour to support the habitat	Roden et al. (2020) reported water colour of 24mg/l Platinum-Cobalt (PtCo) for Lough Ennell. WFD data for 2007-2023 also show average true colour of 24mg/l PtCo. Drainage and forestry operations on catchment peatlands may have increased colour in Lough Ennell. Roden et al. (2020) found that water colour (dissolved light-absorbing compounds) is negatively correlated with euphotic depth, charophyte species richness and cover, and positively correlated with vascular plant cover in marl lakes. Roden et al. (2020) set Good condition at <15mg/l PtCo, however the most important Irish marl lakes have very clear waters with colour of <5mg/l PtCo. Average water colour in Lough Owel was 7.6mg/l PtCo (WFD data, 2007-2023) and this may be a more appropriate target for Ennell. Roden et al. (2020) also set a TP×Colour Index with a target of <0.1 for Good; Ennell was 0.45 in 2012
Dissolved organic carbon (DOC)	mg/l	Maintain/restore appropriate organic carbon levels to support the habitat	Dissolved organic carbon (DOC) in the water column is linked to water colour. It can provide a substrate (food source) for heterotrophic organisms, which can impact directly (e.g. shading) and indirectly (e.g. nutrient release) on the characteristic lake communities. Damage and degradation of peatlands, e.g. through afforestation or turf-cutting, leading to decomposition of peat is likely to be the predominant source of dissolved and particulate organic carbon in Ireland. Average DOC was 6.4mg/I from 40 measurements in 2014 and 2015 (May-Oct, WFD data)

Turbidity	Nephelometric turbidity units/ mg/l SS/ other appropriate unit	Maintain/restore appropriate turbidity to support the habitat	Turbidity can significantly affect the quantity and quality of light reaching rooted and attached vegetation and can, therefore, impact on lake habitats. The settlement of higher loads of inorganic or organic material on lake vegetation communities may also have impacts on sensitive, delicate species. It can also lead to the release of sediment-bound phosphorus. Much has been published on turbidity in shallow calcareous lakes, interactions with submerged vegetation and alternative stable states (e.g. Moss et al., 1996; Hargeby et al., 2004; Scheffer, 2004; Blindow et al., 2014). Turbidity can increase as a result of re-suspension of material within the lake, higher loads entering the lake, or eutrophication. Turbidity measurement and interpretation is challenging. As a result, it may be necessary to set site-specific turbidity targets within broad habitat-specific guidelines. Arterial drainage maintenance operations are likely to increase turbidity in Lough Ennell
Transparency	Metres	Restore appropriate Secchi transparency. There should be no decline in Secchi depth/transparency	Lough Ennell Secchi depth was 5m in 2012 (Roden et al., 2020). WFD data show average Secchi depth of 2.8m (2007-2022) with few measurements >3.5m since 2020. Transparency relates to light penetration and, hence, to the depth of colonisation of vegetation. Roden et al. (2020) said it is preferable to measure euphotic depth directly by observation, but noted that a decreasing trend in Secchi depth indicates declining water quality. Transparency can be affected by phytoplankton blooms, water colour and turbidity. Secchi depth in Marl lakes in Good condition is generally >6m. The OECD fixed boundary system set oligotrophic lake targets of ≥6m annual mean Secchi disk depth and ≥3m annual minimum Secchi disk depth
Attached algal biomass	Algal cover	Maintain/restore trace/absent attached algal biomass (<5% cover)	The significant biological changes at Lough Ennell in the 1970s included large prolonged increases in filamentous algal biomass (John et al., 1982), however filamentous algae were not abundant in 2012 (Roden et al., 2020). The average cyanobacterial crust chlorophyll a concentration at Ennell, however, was one of the highest measured (85µg/cm ³) indicating enrichment of the crust and Poor condition (Doddy et al., 2019). Nutrient enrichment can favour epiphytic and epipelic algae that can out-compete the submerged vegetation. Roden et al. (2020) noted that occasional blooms of filamentous algae occur in marl lakes in the absence of excess nutrients, especially species of the orders Zygnematales or Oedogoniales. Drifting masses of <i>Cladophora</i> species may indicate a decline in water quality. In general, the cover abundance of attached algae in marl lakes (3140) should be trace/absent (<5% cover)
Fringing habitat: area and condition	Hectares	Restore the area and condition of fringing habitats necessary to support the natural structure and functioning of habitat 3140	Much of the shoreline of Lough Ennell is rocky, with important areas of Alkaline fen. Species-rich calcareous grassland was documented in areas of former lake bed exposed by arterial drainage. Some patches of mixed woodland also occur. There are extensive reedbeds at river inflows. Restoration of hydrologically-functioning, open, species-rich fen and fringing semi-natural grasslands, as well as control of dense swamp and reedbed would benefit charophyte vegetation in the SAC. The invasive <i>Hottonia palustris</i> was first recorded at Lough Ennell in 2023 (for information on the species, see Minchin and Boelens, 2011; Wyse Jackson et al., 2016). Fringing habitats along lakes intergrade with and support the structure and functions of the lake habitat. Equally, fringing wetland habitats are dependent on the lake, particularly its water levels, and support invertebrate and plant communities and species of high diversity and conservation concern. See also Mainstone et al. (2016)
02	Jul 2024	Version 2	Page 12 of 14

7230 Alkaline fens

To maintain the favourable conservation condition of Alkaline fens in Lough Ennell SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes	Alkaline fen has not been mapped in detail for Lough Ennell SAC and thus the total area of the qualifying habitat in the SAC is unknown. The habitat occurs in scattered areas around the shores of Lough Ennell and grades into reed swamp, freshwater marsh and wet woodland in places. It is best developed particularly at Robinstown, Derries, on the eastern side of the lake, and at the inlets and outlets of the River Brosna (NPWS internal files)
Habitat distribution	Occurrence	No decline, subject to natural processes	See the notes for Habitat area above
Ecosystem function: soil nutrients	Soil pH and appropriate nutrient levels at a representative number of monitoring stops	Maintain soil pH and nutrient status within natural ranges	Relevant nutrients and their natural ranges are yet to be defined. However, nitrogen deposition is noted as being relevant to this habitat in NPWS (2013). See also Bobbink and Hettelingh (2011)
Ecosystem function: peat formation	Percentage cover of peat-forming vegetation and water table levels	Maintain active peat formation, where appropriate	In order for peat to form, water levels need to be slightly below or above the soil surface for c.90% of the time
Ecosystem function: hydrology - groundwater levels	Water levels (centimetres); duration of levels; hydraulic gradients	Maintain, or where necessary restore, appropriate natural hydrological regimes necessary to support the natural structure and functioning of the habitat	Fen habitats require high groundwater levels (i.e. water levels at or above the ground surface) for a large proportion of the calendar year (i.e. duration of mean groundwater level). Fen groundwater levels are controlled by regional groundwater levels in the contributing catchment area (which sustain the hydraulic gradients of the fen groundwater table). Regional abstraction of groundwater may affect fen groundwater levels
Ecosystem function: hydrology - surface water flow	Drain density and form	Maintain, or where necessary restore, as close as possible to natural or semi-natural drainage conditions	Drainage, either within or surrounding the fen habitat, can result in the drawdown of the alkaline fen groundwater table. The depth, geometry and density of drainage (hydromorphology) will indicate the scale and impact on fen hydrology. Drainage can result in loss of characteristic species and transition to drier habitats
Ecosystem function: water quality	Water chemistry measures	Maintain appropriate water quality, particularly pH and nutrient levels, to support the natural structure and functioning of the habitat	Fens receive natural levels of nutrients (e.g. iron, magnesium and calcium) from water sources. However, they are generally poor in nitrogen and phosphorus, with the latter tending to be the limiting nutrient under natural conditions. Water supply should also be relatively calcium-rich
Community diversity	Abundance of variety of vegetation communities	Maintain variety of vegetation communities, subject to natural processes	The entire diversity of alkaline fen vegatation communities within this SAC is unknown. Information on the vegetation communities associated with alkaline fens in the uplands is presented in Perrin et al. (2014)
Vegetation composition: brown mosses	Percentage cover at a representative number of 2m x 2m monitoring stops	Maintain adequate cover of typical brown moss species	Typical brown moss species include <i>Bryum</i> <i>pseudotriquetrum, Calliergonella cuspidata,</i> <i>Calliergon giganteum, Campylium stellatum,</i> <i>Cratoneuron filicinum, Ctenidium molluscum,</i> <i>Fissidens adianthoides, Palustriella commutata,</i> <i>Scorpidium cossonii, S. revolvens</i> and <i>S.</i> <i>scorpioides.</i> A variety of brown moss species have been recorded in the habitat in the SAC (NPWS internal files)

Vegetation composition: typical vascular plants	Percentage cover at a representative number of 2m x 2m monitoring stops	Maintain adequate cover of typical vascular plant species	For lists of typical plant species see the Article 17 conservation status assessment for alkaline fens (NPWS, 2013) and the fen habitats supporting document (Kimberley, 2013). See also Perrin et al. (2014) and JNCC (2004). In this SAC, the alkaline fen is species-rich. Species recorded include black bog-rush (<i>Schoenus nigricans</i>) and a diversity of other sedges (e.g. <i>Carex nigra, C. panicea, C.</i> <i>flacca, C. rostrata, Eriophorum angustifolium</i>), including the Near Threatened (Wyse Jackson et al., 2016) fibrous tussock-sedge (<i>Carex appropinquata</i>). Also recorded were water mint (<i>Mentha aquatica</i>), meadowsweet (<i>Filipendula ulmaria</i>), pale butterwort (<i>Pinguicula lustanica</i>), lousewort (<i>Pediularis sylvatica</i>), ragged robin (<i>Lychnis flos-cuculi</i>), grass- of-parnassus (<i>Parnassia palustris</i>), pyramidal orchid (<i>Anacamptis pyramidalis</i>) and early marsh-orchid (<i>Dactylorhiza incarnata</i>) (NPWS internal files)
Vegetation composition: native negative indicator species	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of native negative indicator species at insignificant levels	Negative indicators include species not characteristic of the habitat and species indicative of undesirable impacts such as overgrazing, undergrazing, nutrient enrichment, agricultural improvement or impacts on hydrology. Native negative indicators may include graminoids such as canary reed-grass (<i>Phalaris</i> <i>arundinacea</i>) and reed sweet-grass (<i>Glyceria</i> <i>maxima</i>), tall herbs such as great willowherb (<i>Epilobium hirsutum</i>), bracken (<i>Pteridium</i> <i>aquilinum</i>), bramble (<i>Rubus fruticosus</i>) and common nettle (<i>Urtica dioica</i>), and bryophytes such as <i>Brachythecium rutabulum</i> and <i>Kindbergia</i> <i>praelonga</i>
Vegetation composition: non- native species	Percentage cover at, and in local vicinity of, a representative number of 2m x 2m monitoring stops	Cover of non-native species less than 1%	Attribute and target based on Perrin et al. (2014). Non-native species can be invasive and have deleterious effects on native vegetation. A low target is set as non-native species can spread rapidly and are most easily dealt with when still at lower abundances
Vegetation composition: native trees and shrubs	Percentage cover in local vicinity of a representative number of monitoring stops	Cover of scattered native trees and shrubs less than 10%	Attribute and target based on Perrin et al. (2014). Scrub and trees will tend to invade if fen conditions become drier
Vegetation composition: soft rush and common reed cover	Percentage cover in local vicinity of a representative number of monitoring stops	Total cover of soft rush (<i>Juncus effusus</i>) and common reed (<i>Phragmites</i> <i>australis</i>) less than 10%	Attribute and target based on Perrin et al. (2014)
Vegetation structure: litter	Percentage cover in local vicinity of a representative number of monitoring stops	Total cover of litter not more than 25%	Attribute and target based on JNCC (2004). More than 25% litter cover may indicate insufficient removal of biomass by grazing and/or undesirable water table levels
Physical structure: disturbed bare ground	Percentage cover at, and in local vicinity of, a representative number of 2m x 2m monitoring stops	Cover of disturbed bare ground not more than 10%	Attribute and target based on Perrin et al. (2014). While grazing may be appropriate in this habitat, excessive areas of disturbed bare ground may develop due to unsuitable grazing regimes. Disturbance can include hoof marks, wallows, human foot prints, vehicle and machinery tracks. Excessive disturbance can result in loss of characteristic species and presage erosion for peatlands
Physical structure: tufa formations	Percentage cover in local vicinity of a representative number of monitoring stops	Disturbed proportion of vegetation cover where tufa is present is less than 1%	Attribute and target based on Perrin et al. (2014)
Indicators of local distinctiveness	Occurrence and population size	No decline in distribution or population sizes of rare, threatened or scarce species associated with the habitat; maintain features of local distinctiveness, subject to natural processes	This includes species on the Flora (Protection) Order, 2015 and/or the red data lists (Lockhart et al., 2012; Wyse Jackson et al., 2016). The Near Threatened fibrous tussock-sedge (<i>Carex</i> <i>appropinquata</i>) (Wyse Jackson et al., 2016) occurs in the habitat in the SAC (NPWS internal files)





Gaybrook	
Gaybrook	



Legend 3140 Hard oligo-mesotrophic v Lough Ennell SAC 000685	vaters with benthic vegetation of <i>Chara</i> spp.		
An tScirbhís Páirceanna Nisiúnta agus Fiadhúira Naisiúnta agus Fiadhúira	MAP 3: LOUGH ENNELL SAC CONSERVATION OBJECTIVES	SITE CODE: SAC 000685; version 3.04 CO. WESTMEATH	The mapped boundaries are of an indicative and general nature only. B © Includes National Mapping Division reproduced under National Mapping Division of Tailte Éi
Jer Jerre	Map to be read in conjunction with the NPWS Conservation Objectives Document	0 0.25 0.5 1 Kilometre	Nil sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Fe comharthaithe. © Folaíonn sé rannán Náisiúnta M arna atáirgeadh faoin rannán mapála Náisiúnta d'uimhir cl

Boundaries of designated areas are subject to revision. n of Tailte Éireann data cireann Licence number CYAL50351092.

⁻éadfar athbhreithnithe a déanamh ar theorainneacha na gceantar Mapála de shonraí Tailte Éireann cheadúnais Táilte Éireann CYAL50351092

