

Lough Ennell Wetlands Study

Survey and assessment of wetland habitats at Lough Ennell

Report to LAWPRO & Westmeath County Council

January 2022



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Images are the authors' unless stated.

1. SUMMARY

- *A habitat survey was carried out on key areas of wetland habitat around Lough Ennell in 2021 extending to approx. 700ha.*
- *This study complements, and significantly adds to, earlier habitat surveys of Westmeath County Council landholdings carried out in 2019.*
- *Lough Ennell is designated as a SAC for its suite of wetland habitats, with particular interest for Alkaline fen. The scope and extent of Alkaline Fen, and associated habitats, is documented in this study and includes information from a parallel study specifically on this habitat (Kelly, 2021).*
- *The extent of overlap is substantial and habitat areas identified as containing alkaline fen or associated habitats are largely consistent. Information from Key 2021 details approx. 27ha of alkaline fen while this study recognises that this lies within a wider mosaic of associated fen types extending to over 100 ha.*
- *The condition of alkaline fen and associated habitats is variable with relatively little in favourable condition.*
- *Other main habitats include nearly 400 ha of grassland types, predominantly improved agricultural grassland but with pockets of dry and wet calcareous grassland, and around 80ha of wet woodland types including bog woodland.*
- *Sympathetic management of calcareous grasslands is lacking throughout.*
- *Bog habitats in the area are limited and are heavily degraded by cutting. In all cases, habitat condition is compromised as a result.*
- *There are extensive Phragmites reedbeds, while these form a valuable habitat for a range of bird and invertebrate species, particularly where they fringe the lake edge, they are otherwise problematic in encroaching on more sensitive habits and as a sign of high levels of eutrophication.*
- *This study recognises the remaining gap in habitat knowledge of the submerged aquatic macrophyte communities within the lough itself and recommends this be prioritised in future studies associated with lake catchment management.*
- *The preparation of a site conservation management plan with an identified delivery mechanism for habitat management is recommended as a high priority as part of any catchment management initiatives.*
- *The study also identifies six areas which have potential to deliver multiple benefits by the application of habitat creation or restoration to form buffer areas and areas of new wetland which would be of potentially significant value in assisting the overall condition of the habitats, the lake ecosystem and a range of public benefits.*
- *Restoration of Lough Ennell's wetland habitats would be a significant contributor to a range of international commitments including the habitats directive, the Ramsar Convention and UN sustainability goals.*
- *Westmeath County Council and LAWPRO in conjunction with local communities, hope to explore funding opportunities to act on the recommendations of this report.*

2. PURPOSE AND CONTEXT OF THIS REPORT

This report examines the extent and condition of wetland habitats around Lough Ennell, Co Westmeath as a result of habitat survey work carried out in 2021.

The primary outputs are:

- Habitat mapping of wetland habitat types (Fossitt level 3 habitat types)
- Cross referencing of EU priority habitat types where this is feasible
- Assessment of the condition of key habitats

The results will also contribute towards management planning for the lake and its catchment in future. The report also provides recommendations for habitat conservation and identifies opportunities for habitat enhancement or creation.

3. SITE DESCRIPTION

Location and extent

Lough Ennell lies to the south west of Mullingar. It is a limestone lake extending to c.13km² with a catchment of over 500km².

A map detailing the location of Lough Ennell and the indicative extent of the target area for survey is at figure 1

Previous habitat survey has been carried out on Westmeath County Council lands in 2019 as indicated in figure 1. Revisions to this, where re-surveyed, are included in this report.

Importance, ecological and social context

Lough Ennell is an Special Area of Conservation (SAC) and Special Protection Area (SPA) under the EU Habitats and Birds directives respectively. It is also a Ramsar site¹² on account of its international importance as a wetland. It is a large limestone lake fringed by calcareous grassland, marshes, fens, reedbeds and mixed woodland and has significance as a highly productive lake rich in lower plants and invertebrates, a range of rare flora and as a wintering area and breeding area for high numbers of waterbirds including some populations which exceed the 1% threshold for national significance.

The Lough is culturally important in holding sites of historical importance (e.g. Belvedere House and Lilliput) and of social value for recreation, notably angling³. The angling on the lough is particularly notable for Brown Trout *Salmo trutta*.

¹ <https://rsis.ramsar.org/ris/848?language=en>

² <https://www.ramsar.org/about-the-ramsar-convention>

³ <https://fishinginireland.info/trout/shannon/ennell/>



Figure 1 Habitat survey target areas

Natura designations

The site is designated as an SPA and SAC (see appendix 1 – site synopses)

The habitats are important in supporting a range of species which are notable as qualifying interests. In terms of habitats themselves, the main interest away from the lake itself are the areas of alkaline fen (EU priority habitat) and a range of other complementary wetland habitats which support the site integrity and range of characteristic species. Alkaline fen is listed on Annex I of the EU Habitats Directive:

Alkaline fens [7230] *



Figure 2 Alkaline Fen – areas of alkaline fen are still present in the fringing wetland areas but are drying and becoming more rank in some places and transitioning to reed and scrub as a result of drainage, eutrophication and a lack of sympathetic management, such as low-intensity grazing

There are a range of other wetland habitats present around the lake as well as habitats which are transitional or mosaics of different habitat types. Those which are of highest conservation priority and which may represent examples of priority EU habitats are mapped and identified in this study.

Notes on Habitat condition are provided and an assessment of threats to habitat condition, including extent are noted.

4. HABITAT SURVEY METHODOLOGY

Following a desk top study to review the scope of existing data and prepare target areas, aerial images were used to produce field maps for survey. Methodology broadly followed the Heritage Council's (2011) 'Best Practice Guidance for Habitat surveying and Mapping' with habitats classified during a walkover survey. The key points are noted below:

The survey was carried out over a series of 7 days around the end of September 2021 with two field surveyors operating on each survey day.

- Each habitat or habitat mosaic was identified and classified to Fossitt level 3 habitat classification⁴.
- Weather across the days of survey was relatively consistent with only 2 periods of rain. Coverage of 80% of the targeted shoreline area was achieved, with only 2 areas not reached due to landowner permission, time and safety constraints.
- The extent of the survey area is broadly indicated in figure 1. These areas avoid the main areas of County Council land which has been previously habitat mapped but include areas of alkaline fen previously mapped by NPWS staff (T. Kelly pers. comm.).
- Assessment stops consisting of at least one quadrat (2m x 2m), were allocated to each perceived wetland habitat/habitat mosaic unit. This relevé data was then used to inform an assessment of the habitat type and to identify the potential conservation condition/value of the habitat unit.
- Relevés were not recorded within woodland habitats, with these habitats categorised by habitat descriptions and species lists with average coverage of occurrence of each species throughout the habitat given.

The major constraint on the survey was the timing of the habitat surveys, with the main flowering period (mid May-June) for many plants being missed. Despite this, all dominant species were identified limiting the extent of the constraint on the habitat classification.

It is considered that a significant number of species including positive indicator species for alkaline fen and calcareous grassland habitats would be recorded if further surveys were carried out at the appropriate time of year (e.g. May/June). Due to the timing constraint, confirmation of Annex I alkaline fen or other annex I habitats present, cannot be provided in all cases, although this classification is indicated where likely.

⁴ Fossitt, J. A., (2000) A Guide to Habitats in Ireland. The Heritage Council.
<https://www.npws.ie/sites/default/files/publications/pdf/A%20Guide%20to%20Habitats%20in%20Ireland%20-%20Fossitt.pdf>

5. RESULTS

The habitat survey focussed on wetland habitats in the surrounds of the lough and extending to the boundary of the SAC. This focussed on areas previously un-surveyed or where survey work was of limited extent. A few remaining un-surveyed areas are those which consist predominantly of woodland or other, lower priority, terrestrial habitats.

In total c. 710 ha was surveyed.

Land in Westmeath County Council ownership was surveyed in 2019 and where overlaps exist this is indicated in the detailed maps in Appendix 2. Habitat maps for these areas are provided in Appendix 4.

5.1 Habitats overview

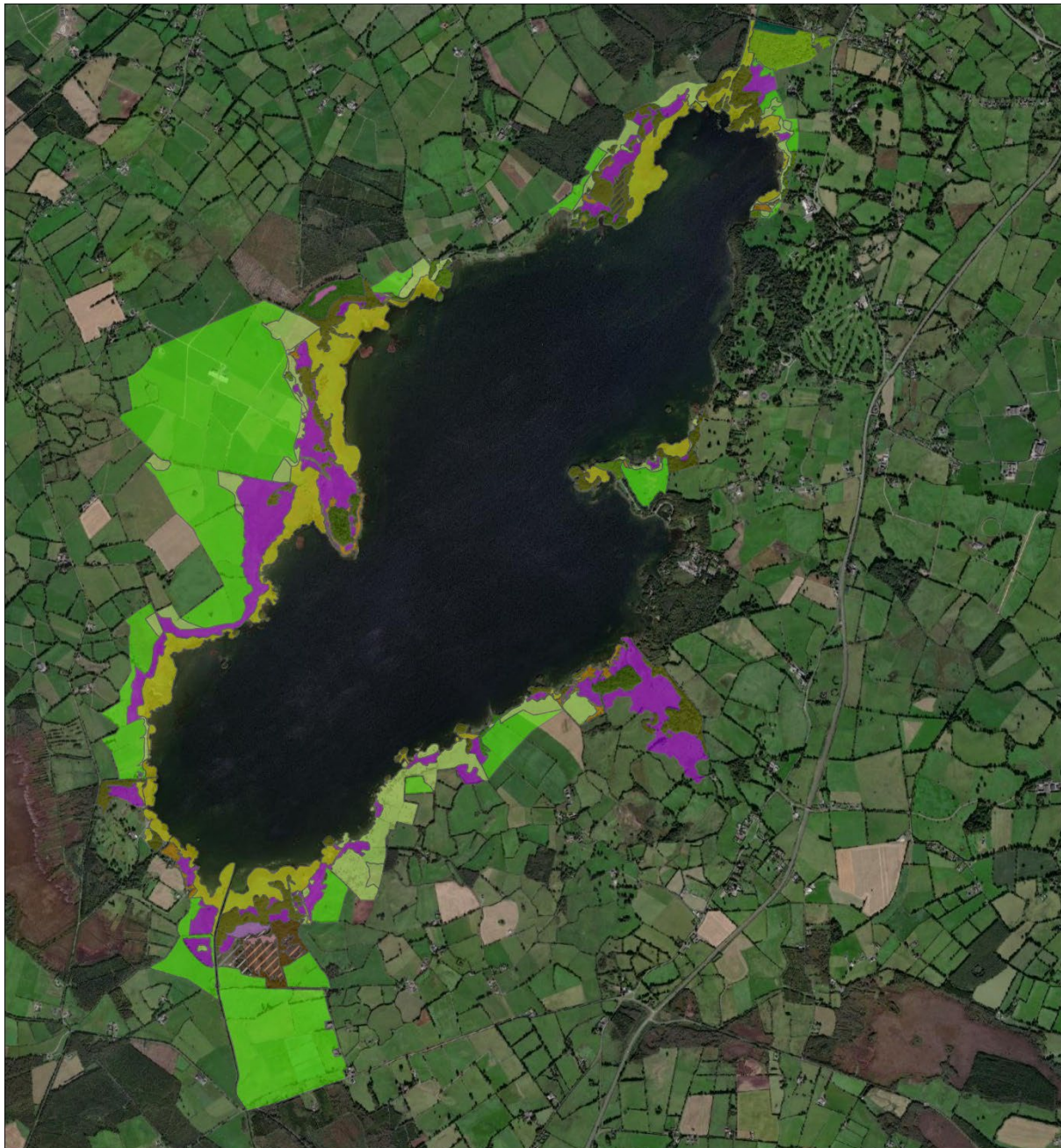
Figure 3 shows an overview map of the habitats. Further detailed maps for each area are provided in appendix 2.

Table 1 provides a breakdown of the total area of each habitat type by Fossitt habitat code.

Box 1 provides a key to habitat codes used on maps.

The total area, in hectares, of each habitat found is indicated in table 1.

BOX 1 Habitat codes		
Habitat Code	Habitat Name	Relevant equivalent EU Annex I habitats
BL1	Built land/roads and tracks surfaces	
ED2	Spoil and bare ground	
ED3	Recolonizing bare ground	
FL3	Limestone/marl lakes	Hard oligo-mesotrophic waters with benthic vegetation of <i>Chara</i> spp. (3140)
FS1	Reed & large sedge swamp	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430)
FS2	Tall herb swamp	
GA1	Improved agricultural grassland	
GS1	Dry calcareous & neutral grassland	
GS4	Wet grassland	
HH2	Dry calcareous heath	
PB1	Raised bog	Active raised bog (7110), Degraded raised bogs capable of natural regeneration (7120)
PB4	Cutover bog	
PF1	Rich fen & flush	Alkaline fens (7230)
PF2	Poor fen & flush	
WD1	(Mixed) broadleaved woodland	
WD2	(Mixed) broadleaved/conifer woodland	
WD4	Conifer plantation	
WN1	Oak-birch-holly woodland	Old sessile oak woods with <i>Ilex</i> and <i>Blechnum</i> in the British Isles (91A0)
WN2	Oak-ash-hazel woodland	
WN4	Wet pedunculate oak-ash woodland	Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno padion</i> , <i>Alnion incanae</i> , <i>Salicion albae</i>) (91E0)
WN6	Wet willow-alder-ash woodland	
WN7	Bog woodland	Bog woodland (91D0)
WS1	Scrub	
WS2	Immature woodland	



The general pattern of habitat distribution, is of wetland habitats being in better condition and more intact closest to the lake, as may be expected. Large areas furthest from the lake are dominated by improved agricultural grassland, often formed from reclaimed former wetland habitat areas which are now heavily drained and re-seeded. There is then a fringe of patchy woodland or scrub habitat often dominated by non-native species such as spruce and then closest to the lake the remaining fringe of wetland habitats remains somewhat intact, albeit with various pressures.

Larger scale habitat maps are included at appendix 2 with.

Table 2 provides an overview of the extent of habitats present, the main characteristics and the main pressures affecting them. Further detail, at a habitat compartment level, is included in the table at appendix 3.

Table 1 Extent of habitats recorded in this survey

Habitat Code	Area (ha)	Comments
BL1	0.16	
ED2	1.84	
ED3	2.30	
FL3	0.02	
FS1	105.19	Mainly reedswamp
FS2	0.64	
GA1	291.97	
GS1	49.88	
GS4	24.23	
HH2	0.84	
PB1	0.89	
PB4	6.81	
PF1	106.31	includes up to c.102ha alkaline fen/alkaline fen mosaic (see fig 5)
PF2	2.02	
WD1	1.23	
WD2	6.39	
WD4	1.82	
WN1	11.96	
WN2	6.32	
WN4	11.35	
WN6	59.70	
WN7	6.44	
WS1	9.29	
WS2	2.42	
Total	710	

Of particular note, is the extent of alkaline fen habitat and associated habitats, with >100ha identified as encompassing alkaline fen and associated habitats, not all classified as purely alkaline fen. An earlier study specifically locating and assessing these habitats in selected areas at Lough Ennell (T. Kelly, 2020 pers comm) found c. 27 ha. of alkaline fen. This is encompassed within the wider mosaic of associated fen types recorded by this study and the comparison is shown in Figure 4 and overlies the areas of alkaline fen mosaic identified in this study.

5.2 Habitat condition

Table 1 below provides a summary of the habitat types present with overall condition notes. Appendix 3 provides detailed condition notes on individual habitat compartments.

Overall, the habitats are in widely varying condition. Some areas show evidence of significant impacts from various pressures, mostly associated with intensification of land-use practices, including: drainage, intensive grazing, reseeding, eutrophication from slurry and fertilizer application and the presence of non-native invasive species. The location of these areas is highlighted in the individual habitat descriptions in appendix 3 which are cross referenced to the maps in appendix 2.

It is important to note that nearly all the farmland bordering the lake retains a semi-natural habitat boundary between the improved areas and Lough Ennell itself. This buffer ranges in width, diversity and extent with some large areas covering a range of habitats and others only a single thin strip. These buffer habitats, however, can be bypassed hydrologically in most cases where land has been improved, by the complex system of field drains and ditches entering the often deepened or canalised main feeder streams. This is illustrated in Figure 4. The efficacy, therefore, of natural habitats acting as a buffer to surrounding land-use practices at present is limited. To achieve this significant actions to rehabilitate water courses and create or rehabilitate habitats as buffers would be necessary.

The extent and condition of the high priority, qualifying interest SAC feature, Alkaline fen (EU priority habitat) was previously unknown. Work by Therese Kelly (NPWS) to identify and classify the habitat combined with the results of this survey indicate there to be at least 27ha of this habitat type present with associated habitats and potential or degraded alkaline fen extending in total to over 100ha. The condition in nearly all cases was found to be affected by either over grazing, grassland intensification or in some cases a lack of management. In the latter case this included encroachment by scrub and reedbed. The habitat areas identified should form a focus of future work to identify and deploy suitable management practices and regularly monitor the extent and condition.



Figure 4 Alkaline fen – this section is in relatively good condition with grazing maintained and water table remaining high



Figure 5 Degraded alkaline fen - this area is suffering from encroachment by scrub and reed and the sward indicates a lack of grazing management

Non-native invasive species are present in several wetland habitat areas. These include spruce spp. and lodgepole pine encroachment from plantation forestry. Canadian Waterweed *elodea canadensis*, was recorded in a single drain in the south east of the site, although this was the only instance recorded of this species, the drain was entirely choked with it and it is noted as being present in several areas of the lake. The presence of Invasive alien species is noted in particular in woodland areas at Belvedere and wetland areas at Butler’s Bridge (Lauder, 2019⁵)

Table 2 Habitat survey summary table

Habitat	Fossitt Code	Value/ importance	Annex I Potential	Description & condition assessment notes
High Bog (Degraded)	PB1	Local-Regional	No, too small and integrity compromised	One area. High bog dry & hard to access due to steep peat cutting. Sphagnum palustre in drains. Ling dominant, with encroaching Scots pine and birch
Cutover Bog	PB4	Regional-International		One area of cutover Bog is variably dominated by expanses of <i>Calluna vulgaris</i> and <i>Molinia caerulea</i> though with some scattered regenerating peat depressions (bog pools) but with extensive drainage channels throughout. Although the internal drains have not been maintained and vegetation is regenerating and recovering the external drains are maintained , with up to 1.5m depth in places.
Bare Peat	ED2	Low		Bare peat with recent evidence of machinery activity, including drain upkeep.

⁵ Lauder A. (2019) Conservation Land Management Recommendations for Westmeath County Council Lands at Lough Ennell. Report to Westmeath County Council

Habitat	Fossitt Code	Value/ importance	Annex I Potential	Description & condition assessment notes
Recolonising bare peat	ED3	Low		Comprised of 40-60% bare peat with encroaching <i>Molinia</i> , Deer grass, sedges, creeping bent and <i>Phragmites</i> in places. Likely to develop into rich fen due to adjacent habitat.
Wet Willow/Birch Woodland	WN6	Regional		Wet willow, birch & alder woodland with a frequent understory of hawthorn, blackthorn, birch and alder with occasional guelder rose. The majority of this habitat is variably dominated by monospecific tall, dense stands of yellow iris, <i>Phragmites</i> , <i>Phalaris</i> or <i>Carex riparia</i> . Although often with a mix of these species and others which are tolerant of permanent waterlogging. This woodland is actively encroaching onto adjacent habitats along the majority of its border, although this is limited to some extent on the lakeward side by water depth.
Bog Woodland	WN7	Local-Regional	No, situated on bog	Relatively dry mature birch-dominated woodland with scattered Scots & lodgepole pine. Dense understory of immature birch, gorse and bracken with scattered ling, billberry and <i>Molinia</i> .
Reed & Large Sedge Swamp	FS1	Local		This habitat is characterised by dense, tall generally monospecific although occasionally mixed stands of <i>Phragmites</i> , <i>Phalaris</i> , bulrush and common clubrush. With the latter solely dominating the aquatic marginal extremities of this habitat. <i>Phragmites</i> is the overall dominant species within this habitat, other broad-leaved herbs and large sedges and grasses were also occasionally recorded.
Tall Herb Swamp	FS2	Local	Unlikely to support 6430	This habitat is characterised by standing water with dense, tall mixed stands of yellow iris, horsetails and foals watercress, with some scattered, hemlock water-dropwort, <i>Phragmites</i> , sedges and bulrush. There is evidence of grazing by horses, although this is not extensive and covers c. 15% of the habitat, this area is evidently used by the horses relatively frequently, although it is currently inaccessible to livestock.
Improved Grassland	Ag. GA1	Low		Located around the lake although not reaching the lake shore in any of the areas surveyed. Generally comprising monospecific sward of perennial rye grass with some clover. The majority of this has been reseeded in the last 5-10 years, with large areas on the west recently converted to an intensive dairy farm.
Dry – humid calcareous grassland	GS1	Regional-International		Largest areas located along south-eastern shore, but with some small other areas scattered around the shoreline. Mostly comprising dry semi-improved calcareous grassland and in some places remaining fairly unimproved. Retains some natural calcareous species rich state, but in places influenced by adjacent reseeded regimes, with some agricultural herbs evident in places. Where grazed generally no evidence of extensively poached or trampled areas. Sward is dominated by <i>Molinia</i> in places with abundant <i>Succisa</i> , timothy, crested dog's-tail and cock's foot grasses, with an average sward height of c.10-30cm. Willow and hawthorn scrub is patchy and bramble is present in some areas. Damper areas can support alder.
Wet calcareous grassland	GS4	Local		This habitat encompasses a single small clearing/meadow on the northern edge of the surveyed area, at the entrance to the large woodland plantation. It is comprised of waterlogged soils dominated by <i>Molinia</i> and other tall tussocky grasses including <i>Deschampsia</i> and tall fescue. The bryophyte layer is extremely well developed with extensive cover throughout. There is scrub encroachment (willow & birch) which is the natural expansion of the adjacent woodland
Wet Semi-improved Grassland	GS4	Local		This habitat is characterised by knee-waist (30-80cm) high rank wet calcareous grass which has some influence from adjacent reseeded regimes. This habitat is dominated by rank grasses including cock's foot and <i>Molinia</i> with scattered perennial rye grass and juncus. Agricultural broadleaved herbs including dock, thistle and nettle are common.

Habitat	Fossitt Code	Value/ importance	Annex I Potential	Description & condition assessment notes
Dry Alkaline Heath	HH2	Local		This habitat was difficult to categorise, the area was, in the past, mounded and drained for conifer plantation but the majority of these plantings did not survive due to the extremely wet conditions present throughout. The area has been significantly damaged by the drainage and mounding works, causing the original Calcareous fen habitat to dry out leading to the creation of a habitat matrix of Dry Calcareous Heath (on the dryer mounds where the trees were planted) and Rich fen in the hollows between the mounds. Some scattered lodgepole pine and Sitka spruce have survived from the planting stage. Birch, alder and willow are actively encroaching into this habitat
Rich Fen	PF1	International	7230	There are several areas of alkaline fen (EU habitat code 7230) and areas of fen mosaic with marsh, wet grassland and calcareous grassland. This habitat is found mostly along the western and south-eastern shorelines in waterlogged peaty soils. It is dominated by black bog-rush and characterised by small-medium sedges and grasses. There are areas which are succeeding towards reedbed and tall herb swamp, areas which are heavily altered and damaged from improvement and over grazing and areas which have encroachment of scrub species. Several Orchid species remains were recorded across this habitat. Willow, birch and alder saplings and seedlings (active encroachment) are occasional along the western and southern portions.
Poor (regenerating Cutover Bog)	Fen PF2	Local-Regional		This habitat is characterised by numerous sedges, grasses, bryophytes and broadleaved herbs in a transitional stage between cutover bog (bare peat) and fen habitat. Bare peat retains a small % of cover across the habitat. <i>Molinia</i> and Cottongrass are dominant, with frequent phragmites, deergrass and ling.
Mixed Broadleaved Woodland	WD1	Local		Areas of dry broadleaved woodland associated or close to wetland habitats. Usually with a canopy of birch, alder, sycamore and occasional ash. Willow and birch have naturally encroached and formed a dense edge and sparse understory with hawthorn, ash and elder. The ground flora is dominated by bramble, ivy, <i>Molinia</i> and <i>Deschampsia</i> with occasional hogweed and dog rose among others. Extensive coverage of sycamore within the canopy have driven the classification to WD1 Mixed Broadleaved woodland.
Mixed Broadleaved/Conifer Woodland	WD2	Low-Local		This habitat is located along the western shoreline and surrounds the habitat HH2. This habitat, like HH2, is the remnant of past conifer plantation on rich fen (probably alkaline fen!). The soil has been mounded and drained, this area has retained a portion of the original conifer plantation, with self-seeded seedlings and saplings also evident throughout. Birch and willow, with occasional alder have infilled the areas where the planted conifers have died off. The ground is treacherous with a significant (<1m) difference between the bottom of the scrapes and the tops of the mounds sections. The ground flora is extensive in places although this is often relatively species poor, being dominated by <i>Molinia</i> , bramble, thistle, rose-bay willowherb and reed
Conifer Plantation	WD4	Low		This habitat is comprised of mature conifer plantation located at the extreme north of the surveyed area. This habitat is of low value with a very low species diversity. Bramble, ivy and bryophytes dominate the ground flora, with scattered ling and bilberry.

Habitat	Fossitt Code	Value/ importance	Annex Potential	I	Description & condition assessment notes
Damp Oak-Birch woodland	WN1		Potential 91A0		This woodland is located along the northern extent of the survey area, it is a relatively complex habitat and shows elements of both WN1 & WN2 and is likely a matrix of these. The canopy is dominated by birch with occasional ash. The sub-canopy is dominated by hawthorn with occasional holly and rowan. the ground flora is variably dominated by areas of bramble and ferns or ling and bilberry, <i>Cladonia</i> lichens and sphagnum are abundant in the areas dominated by ling and bilberry. Bryophyte cover is extensive across the habitat. Oak seedlings and saplings are regenerating across the woodland. A number of mature and veteran yew are scattered across the woodland. This habitat appears to have been previously used as conifer plantation, but has now regenerated to a mostly semi-natural state. some scattered conifer trees remain especially in the southern extents, although these do not dominate.
Dry Woodland	Oak-Ash	WN2	Regional-National		Characterised by dry calcareous woodland with a canopy dominated by oak and ash, with abundant birch and occasional beech, sycamore, lime and horse chestnut. A frequent understorey of hazel, blackthorn and hawthorn, with occasional holly and dogrose. The ground flora is grassy in places with abundant wood false-brome and remote sedge but is generally dominated by ivy, bramble and a mix of broadleaved herbs. Poaching by livestock is evident in some areas although this is not extensive.
Wet woodland	Oak-Ash	WN4	Potential 91E0		Characterised by a mixed canopy of oak, ash and birch with frequent alder. Beech is also occasional. The sub-canopy is abundant and includes alder, birch, hazel, hawthorn and willow. The ground flora is rank and lush throughout, with patches dominated by bramble and/or grasses and abundant broadleaved herbs, including meadowsweet, enchanter's nightshade, angelica, ivy and creeping buttercup among others
Wet Willow-Birch Woodland	Ash-Alder-	WN6	Local-Regional	N/A	Ash, birch and alder dominated woodland with frequent willow. Soils waterlogged in places with drier areas. Sub-canopy is generally dominated by hawthorn and willow, with occasional blackthorn, birch and ash. The ground flora is variable with the drier areas generally being dominated by bramble with meadowsweet, hemp agrimony and creeping buttercup abundant and wetter areas including sedges, rushes and bryophytes. Drainage of nearby areas may, or could, affect some areas and some sections have livestock access causing poaching.
Birch/Willow Scrub		WS1	Local	N/A	This habitat is found across the survey area, generally in small pockets or patches. Characterised by dense stands of immature birch, willow and alder, with occasional guelder rose, blackthorn and hawthorn. Ground flora is variable but generally reflects the habitat that was encroached into, this being fen for the majority of this habitat. A lack of management or grazing has led to the development of this habitat in most cases and while of some value is generally lower priority than that of its original state.
Immature Woodland	Carr	WS2	Regional-International	Potential 7230	This habitat is characterised by a transitional stage of habitat progression, with extensive cover of black bog-rush and tussocky sedge dominated rich fen, a continuation of adjacent habitats but with a developing immature woodland of willow, with occasional birch and alder. Given time this is likely to develop into WN4 Carr woodland.

The main watercourses are augmented by an extensive network of drainage channels. These are evident across much of the land surrounding the lake, varying in depth, state of repair and ecological status. Most are heavily maintained and deep but with, at times, an extensive margin of dense stands of *Phragmites* reed. Eutrophication is evident in many habitats and is typified by giving rise to dense, monospecific, stands of phragmites. While reedbeds can be of high value in certain circumstances, notably where they fringe the lake and are of value for shelter for wintering and breeding waterbirds



Figure 6 Extent of alkaline fen and related habitats - comparison of the recorded extent of alkaline fen across two surveys - further detailed survey should be a high priority associated with future management

and a range of reed-specialist invertebrates, they can and do become problematic and overcompetitive in situations where eutrophication and lack of management enables them to encroach into other habitats, such as rich fen areas.



Figure 7 Reedbeds at Lough Ennell – the reed growth is vigorous and can extend into, encroach and dominate scarcer habitats as a result of a combination of eutrophication and lack of management.

Extensive filamentous algae growth is evident in shallow water but most prevalent along the northern and western shores, especially in proximity to the River Brosna, with the majority of the low-lying wetland habitats along the northern shore entirely dominated by *Phragmites* expanses. Both of these aspects indicating high levels of eutrophication.

Overall the lake edge habitats show several characteristic signs of eutrophication and the more fragile low growing wetland habitats, such as alkaline fen, are under threat of change through encroachment by a shift to conditions suiting more nutrient tolerant species like Soft Rush *Juncus effusus* and Common Reed *Phragmites australis*.

The priority submerged aquatic habitats of the lake bed are not covered by this report and the effect of eutrophication, or other effects on these habitats, is unknown.

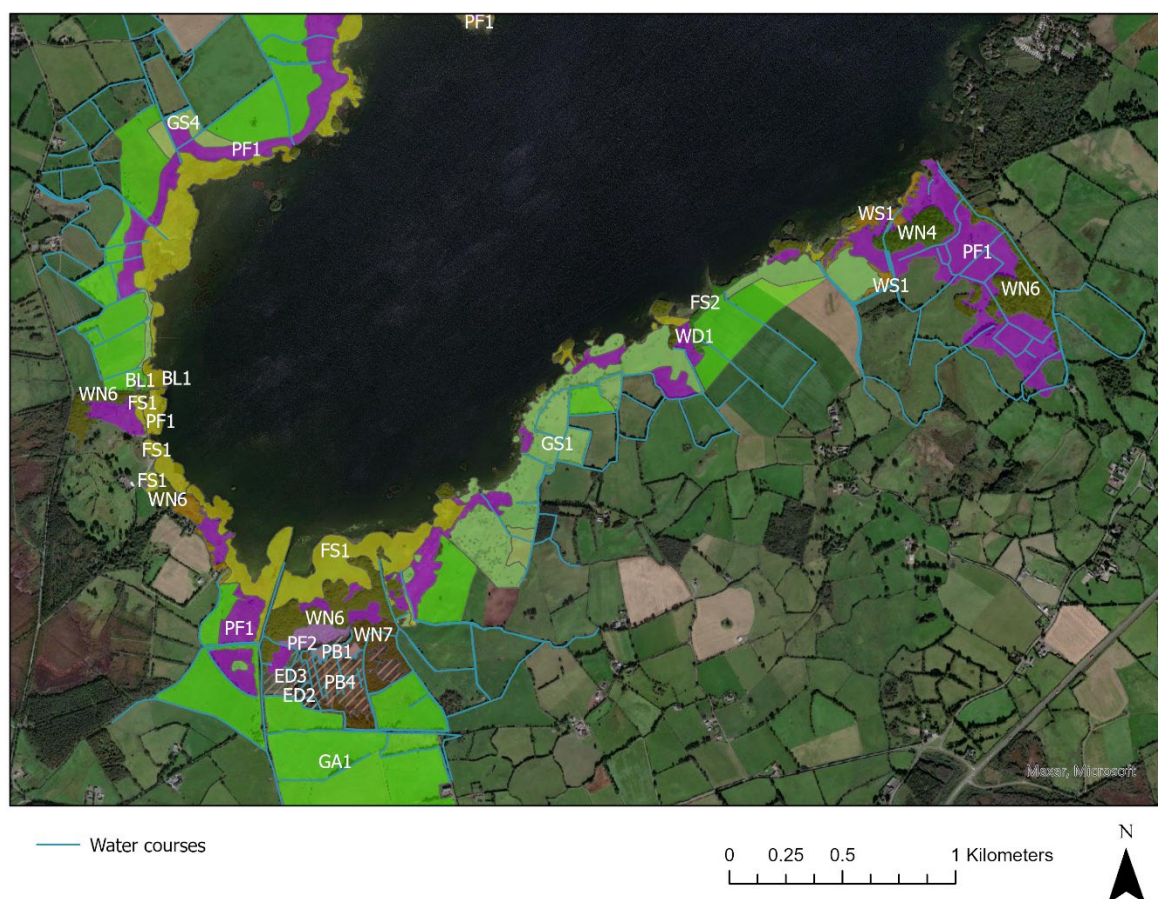


Figure 8 Water courses - ditches and other watercourses identified during habitat survey at the southern portion of the area and illustrating the means of nutrient loading bypassing wetland habitat buffers

5.3 Habitat management opportunities

Much of the surrounding land of Lough Ennell is agricultural, mainly for dairy herds. Land use in this scenario is fairly intensive and requires high inputs of nutrients. In addition, the low-lying land around the lough is relatively poorly drained where left alone, and as such, farming relies on active drainage to maintain pasture land. As a result of this, there has been long-term historical loss of the fringing wetlands, in part through conversion to agriculture and in more recent times due to both direct land use pressures such as forestry and indirect pressures on water quality.

During production of a nutrient and pathogen loading assessment in early 2022 (Lauder, 2022⁶) the potentially important long-term role of wetland habitat restoration and creation in the Lough Ennell catchment was highlighted. From findings in that report, combined with knowledge of the extent and nature of habitats found in this study, several areas which provide potential opportunities for nature based solutions to assist the condition of Lough Ennell, for its wildlife, ecosystem services and for its amenity value, present themselves.

Figure 9 indicates six areas which present significant opportunities for enhancement provided the right approaches and agreements could be achieved. These are further outlined in Table 3.

⁶ Lauder, A. (2022) *Lough Ennell nutrient and pathogen load assessment - Phase 1 catchment management scoping*. Commissioned report to LAWPRO & Westmeath County Council.

The remaining areas all have the potential for enhanced management to improve conservation condition and biodiversity value of the habitats but with mixed land ownership and management responsibilities it would be prudent to bring these into a consistent framework to best seek and deploy resources effectively.

The recommendation by Lauder (2022⁶) for integrated catchment management through the FILLM⁷ approach would hold the potential to provide the structure for suitable planning and delivery of targeted management across all the areas noted and with the wide community sign-up that is needed to achieve it.

Table 3 Potential wetland habitat management areas with multiple benefits (see figure 9)

#	Action	Main objective	Outline prescription
1	buffer strips, new wetlands	reduce nutrient & pathogen loading to lake	wetland habitat buffer strips (20m+) along stream courses, restoration of river channel, creation of new wetlands for reduction in nutrient transfer
2	buffer strips	reduce nutrient loading to lake	wetland habitat buffer strips (20m+) along stream courses, restoration of river channel
3	restore wetland habitat	reduce nutrient loading, enhance wetland habitat extent & condition	restore wetland habitat to create larger extent better gradation to lake
4	buffer strips, new wetlands	reduce nutrient & pathogen loading to lake	wetland habitat buffer strips (20m+) along stream courses, restoration of river channel, creation of new wetlands for reduction in nutrient transfer
5	restoration of floodplain wetlands	reduce nutrient & pathogen loading to lake, urban fringe wetlands	restore river channels, create naturalised wetlands and new wetland features
6	buffer strips	reduce nutrient & pathogen loading to lake	wetland habitat buffer strips (20m+) along stream courses and lake habitat edge

One of the most significant areas with potential for wetland restoration is the floodplain to the SW of Mullingar, approximately 0.5 km upstream of Lough Ennell. This area of drained, rush dominated grassland is of apparent low agricultural quality, is fragmented with forestry and drainage ditches but has the potential for restoration to an urban fringe wetland⁸ of high quality. There are attendant ecosystem service benefits in re-habilitating the area to wetland such as potentially alleviating nutrient and pathogen transfer to Lough Ennell and enhancement for biodiversity close to Mullingar.

Other areas are focussed on buffering the direct transmission of nutrients from agriculture to the lake or via transfer from fields via feeder streams. The reduction in both nutrients and pathogen loading from the use of well designed buffer areas alongside the potential to create small water bodies⁹ would be of potential value in acting to reduce nutrient and pathogen transfer^{10,11} and could form a key component of catchment management in future. Previous reports and recent actions, focussing on Lilliput bathing water quality, have highlighted the potential for wetland creation, restoration and management to act as a significant buffer against pathogen loading from agriculture.

⁷ <https://thewaterforum.ie/framework-for-integrated-land-and-landscape-management/>

⁸ Alikhani, S.; Nummi, P.; Ojala, A. (2021) Urban Wetlands: A Review on Ecological and Cultural Values. *Water* 2021, 13, 3301. <https://doi.org/10.3390/w13223301>

⁹ Biggs, J., von Fumetti, S. & Kelly-Quinn, M. The importance of small waterbodies for biodiversity and ecosystem services: implications for policy makers. *Hydrobiologia* 793, 3–39 (2017). <https://doi.org/10.1007/s10750-016-3007-0>

¹⁰ Robotham, J.; Old, G.; Rameshwaran, P.; Sear, D.; Gasca-Tucker, D.; Bishop, J.; Old, J.; McKnight, D. Sediment and Nutrient Retention in Ponds on an Agricultural Stream: Evaluating Effectiveness for Diffuse Pollution Mitigation. *Water* 2021, 13, 1640. <https://doi.org/10.3390/w13121640>

¹¹ O'Geen, A.T. (2015) Using wetlands to remove microbial pollutants from farm discharge water. University of California. <https://anrcatalog.ucanr.edu/pdf/8512.pdf>



Figure 9 Areas with high potential for beneficial habitat management

As a wetland SAC, the future management and restoration of Lough Ennell's wetland habitats would be a significant contributor to the identified need to take management measures on designated sites¹² under the habitats directive.

Lough Ennell is a Ramsar site¹³. As a signatory to the Ramsar Convention on Wetlands of International Importance, Ireland is duty bound to recognise the interdependence of humans and the environment as well as the ecological functions of wetlands, such as wildlife habitat, nutrient cycling, and flood control. This also helps meet Ireland's range of commitments towards international climate and biodiversity goals (e.g. the European Climate Target Plan¹⁴, European Biodiversity Strategy¹⁵ which, in turn, contribute to a range of UN sustainability goals.

Westmeath County Council and LAWPRO in conjunction with the local communities, hope to explore funding opportunities to act on the recommendations of this report.

¹² https://ec.europa.eu/commission/presscorner/detail/en/IP_20_1235

¹³ <https://rsis.ramsar.org/rsis/848>

¹⁴ https://ec.europa.eu/clima/eu-action/european-green-deal/2030-climate-target-plan_en#:~:text=With%20the%202030%20Climate%20Target,below%201990%20levels%20by%202030.

¹⁵ https://ec.europa.eu/environment/strategy/biodiversity-strategy-2030_en

6. RECOMMENDATIONS

The following recommendations are made in relation to future habitat survey, further consideration of the role of wetland habitats and the planning of a future approach to habitat management as part of an integrated catchment management plan.

Recommendation 1

Carry out a submerged aquatic macrophyte survey of Lough Ennell

Rationale

A key element of the Natura interest of Lough Ennell, one which underpins much of the lake ecology and an aspect which is particularly sensitive to changes in water quality, is the suite of aquatic macrophyte communities in the lake itself. These communities were studied previously (c. 1981) and found to have undergone significant changes due to water quality effects¹⁶. The continued high levels of nutrient input to the lake may have had significant further impacts on these communities. Their importance to the ecological communities of the lake is potentially high and impacts have previously been noted. There is no recent survey effort on this group at the site and this creates a significant gap in the knowledge of the habitats of the lake and the impact on the lake ecology of catchment activities to date. Their extent and status should be evaluated in light of potential improvements in how nutrient loading is dealt with and the possibility of the development of a catchment management plan

Additional notes: Any survey should be in conjunction with NPWS and should encompass both extent and condition of the submerged plant communities.

Recommendation 2

Prepare a site conservation management plan and identify a delivery mechanism for habitat management for high priority wetland habitats (as part of catchment management)

Rationale

Site conservation objectives for the SAC exist but these are not underpinned by a mechanism for delivery of practical measures. A plan which identifies high priority habitat management measures should be prioritised in order to address site condition issues. This is also highlighted by Lauder (2022⁶).

Additional notes: This should form a key element within an integrated catchment management plan.

Recommendation 3

Carry out further investigation into potential habitat creation opportunities in the catchment for multiple benefits

Rationale

The proposals for integrated catchment management at Lough Ennell are recognised to have potentially wide ranging public benefits. The wetland habitats identified by this study are the remnants of a much larger area of habitats much of which has been lost over the long-term. The role of wetlands for biodiversity, for providing sustainable solutions to nutrient and pathogen loading and for providing high landscape value is significant and their restoration, creation and subsequent management in association with management of existing wetland habitats, watercourses and

¹⁶ John, David & Champ, W.S.T. & Moore, J.A.. (1982). The changing status of Characeae in four marl lakes in the Irish Midlands. *Journal of Life Sciences of the Royal Dublin Society*. 4. 47-71. Available from: https://www.researchgate.net/publication/291868307_The_changing_status_of_Characeae_in_four_marl_lakes_in_the_Irish_Midlands

pollution mitigation can make a very important contribution to the long-term recovery of the lake, its ecology and its value for people. Not least, the role of wetland habitats in buffering the effects of climate change could be of particular value. There is the potential to reduce flooding in the OPW's Brosna arterial drainage scheme, the protection of banks from storm surge and erosive wave action in storm events which, due to climate change, are now more frequent. Maintaining hydrology to keep wetland habitats functioning effectively e.g. carbon and nutrient capture, rather than its release, is critically important. Again, an integrated catchment plan using the FILLM approach would provide for identifying and managing this alongside other sectoral needs.

Additional notes: A scoping study to further examine opportunities and constraints at key sites and their potential contribution would be of value in informing practical catchment management measures.

APPENDICES

Appendix 1 SAC site synopsis



An Roinn
Ealaíon, Oidhreacht agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht

SITE SYNOPSIS

Site Name: Lough Ennell SAC

Site Code: 000685

Lough Ennell is a large, open, steep-sided lake, located 3 km south of Mullingar in Co. Westmeath. The lake bottom is of limestone with a marl deposit. The water is markedly alkaline and mesotrophic, possibly owing to effluents received from Mullingar town and to fertilizer inputs from farmland surrounding the lake. The River Brosna flows into the lake from the north at Butler's Bridge, and out from the south.

The site is a Special Area of Conservation (SAC) selected for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (* = priority; numbers in brackets are Natura 2000 codes):

[7230] Alkaline Fens

Lough Ennell supports a diverse aquatic flora. Seven stonewort species have been identified, including two Red Data Book species, *Chara denudata* and *C. tomentosa*.

Much of the lakeshore consists of dry, stony ground colonised by calcareous grassland. These areas were formerly part of the lake bed but are now exposed as a consequence of drainage. Species such as Mountain Everlasting (*Antennaria dioica*), Hairy Lady's-mantle (*Alchemilla filicaulis* subsp. *vestita*), Frog Orchid (*Coeloglossum viride*), Fairy Flax (*Linum catharticum*) and Yellow-wort (*Blackstonia perfoliata*) occur here.

Alkaline fen is also found on the lake shore, with species such as Grass-of-parnassus (*Parnassia palustris*), Marsh Pennywort (*Hydrocotyle vulgaris*) and Bottle Sedge (*Carex rostrata*). In wet marshy patches along the shore Marsh-marigold (*Caltha palustris*), Brookweed (*Samolus valerandi*) and Lesser Water-plantain (*Baldellia ranunculoides*) are common.

Reedbeds and species-poor swamp vegetation fringe the lake in places, particularly around the points of inflow and outflow, and on the eastern shore around Tudenham Park. Common Reed (*Phragmites australis*) is abundant here. Water-plantain (*Alisma plantago-aquatica*), Cowbane (*Cicuta virosa*), Frogbit (*Hydrocharis morsus-ranae*) and Tufted-sedge (*Carex elata*) also occur. The latter two species are of note in that they have restricted distributions in Ireland. The rare Fibrous Tussock-sedge (*Carex appropinquata*) has also been recorded from this site.

Mixed woodland of Beech (*Fagus sylvatica*), Ash (*Fraxinus excelsior*) and Downy Birch (*Betula pubescens*) fringes the lakeshore to the north-west. Bluebell (*Hyacinthoides non-*

scripta) and Lords-and-ladies (*Arum maculatum*) are among the woodland ground flora.

Yellow Archangel (*Lamiastrum galeobdolon*), a rare plant listed in the Red Data Book, has been recorded in the woods along the eastern shores of Lough Ennell. This is the only record for this species outside the south-east of Ireland.

The rare Myxomycete fungus, *Licea castanea*, has been recorded from woodland in the site. A species of blue-green alga (*Schizothrix fasciculata*), which forms little pebbles of lime that are cast up on the lakeshore, occurs in Lough Ennell and has not been recorded elsewhere in Ireland.

Scharff's Char (*Salvelinus scharffi*), a distinct race of char which was once found only in Lough Owel and Lough Ennell, is now thought to be extinct. Notable aquatic invertebrates recorded from the lake include *Tinodes maculicornis* (Order Trichoptera), *Metalype fragilis* (Order Trichoptera), *Limnephilus nigriceps* (Order Trichoptera), *Picromerus bidens* (Order Heteroptera), *Monarthia humili* (Order Hemiptera) and *Donacia obscura* (Order Coleoptera).

This site shares an internationally important Greenland White-fronted Goose flock with Loughs Iron, Glen and Owel. The numbers of geese which visit Lough Ennell are lower than for the other lakes: 91 birds (3 year average peak). Nationally important bird populations which have been recorded on Lough Ennell are: Cormorant (average peak 149; absolute maximum 448); Mute Swan (average peak 424); Pochard (average peak 889; maximum 2,600 on 8/11/85); Tufted Duck (average peak 720) and Coot (average peak 639). All of these data were compiled from counts made over 3 seasons, 1984/85 - 1986/87. A single count of 522 Golden Plover was obtained in that period, constituting a regionally important population.

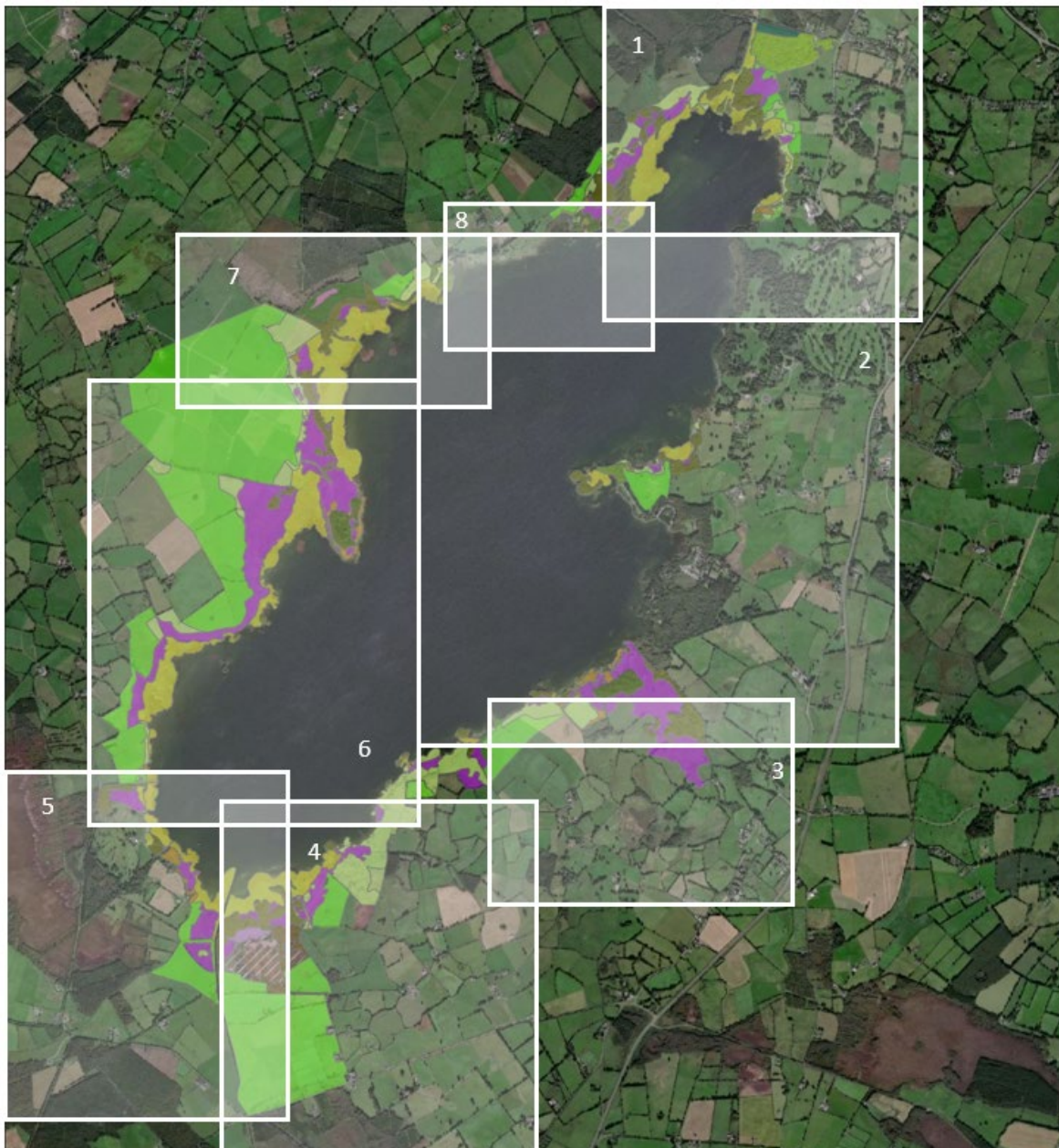
Lough Ennell is an important amenity area, much used for fishing, boating and camping. Sections of the shoreline are managed for visitor access and amenity. The chemical composition of effluent from the Mullingar sewage treatment plant has a significant impact on the water quality of Lough Ennell. The mid-1970s saw the introduction of treatment of the sewage to reduce phosphates, with a resulting improvement in water quality (according to data compiled during 1987-90). However, levels of planktonic algal growth in the lake water continue to fluctuate, in response to the variable efficiency of the phosphate removal facility at the sewage treatment plant and the re-mobilization of phosphate from the lake sediments.

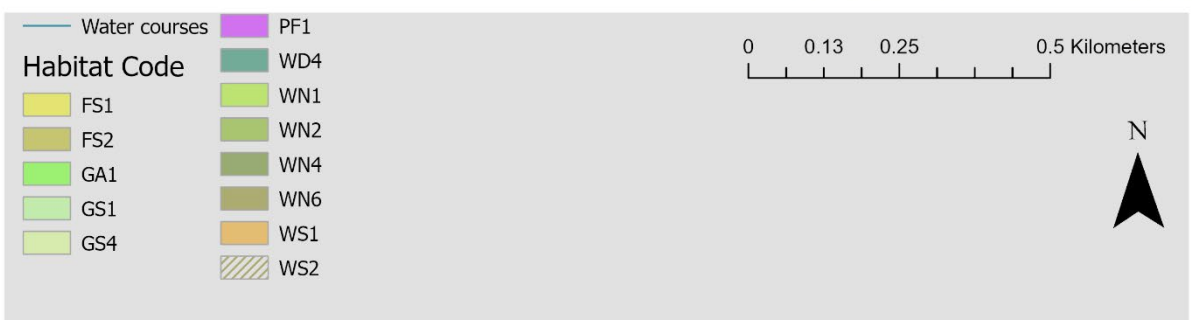
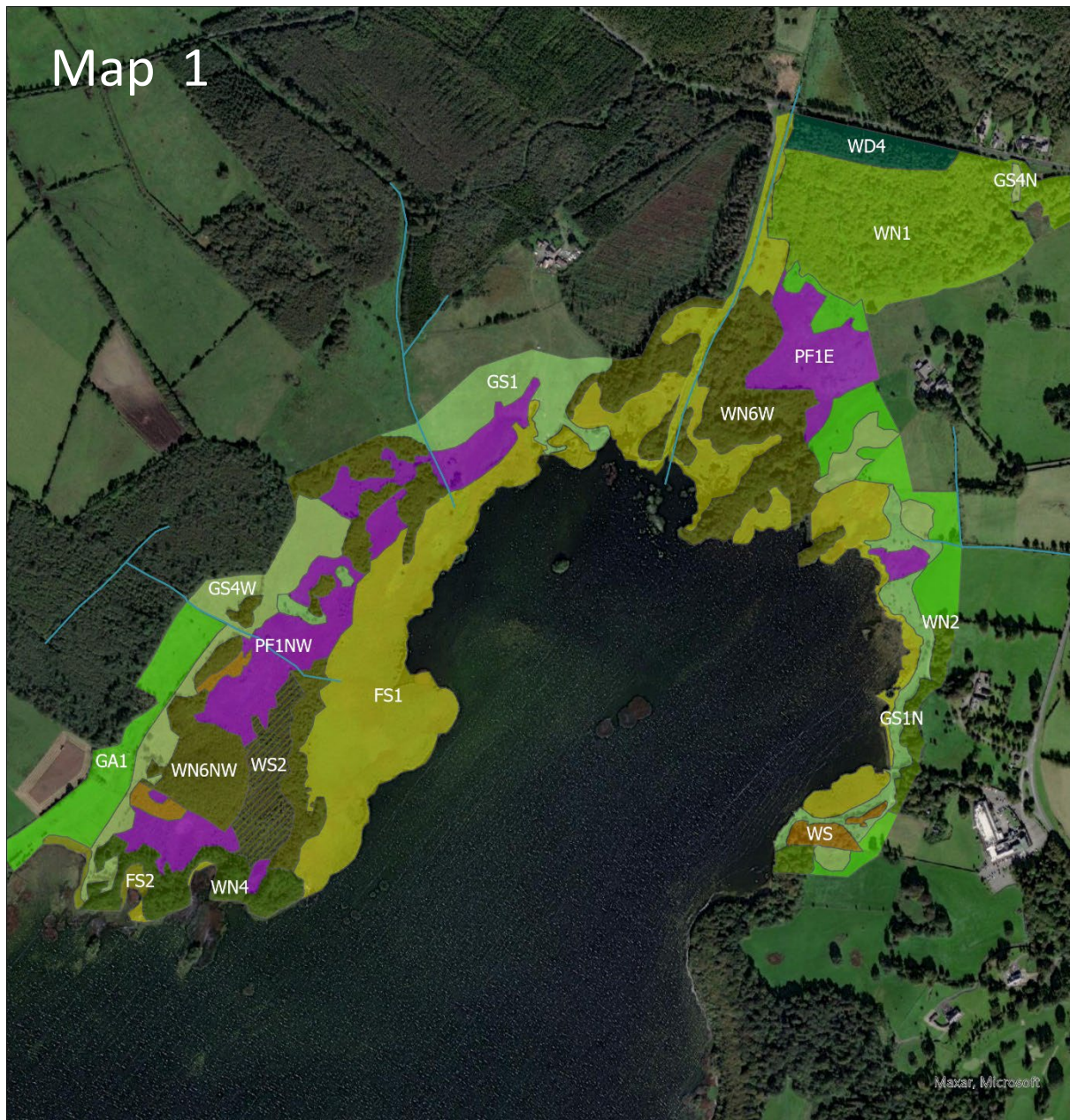
Lough Ennell is of significance as a highly productive lake which supports a rich variety of lower plant and invertebrate species. Its lakeshore habitats, which include alkaline fen, a habitat listed on Annex I of the E.U. Habitats Directive, support a diverse flora. These habitats also provide important refuges for wildfowl.

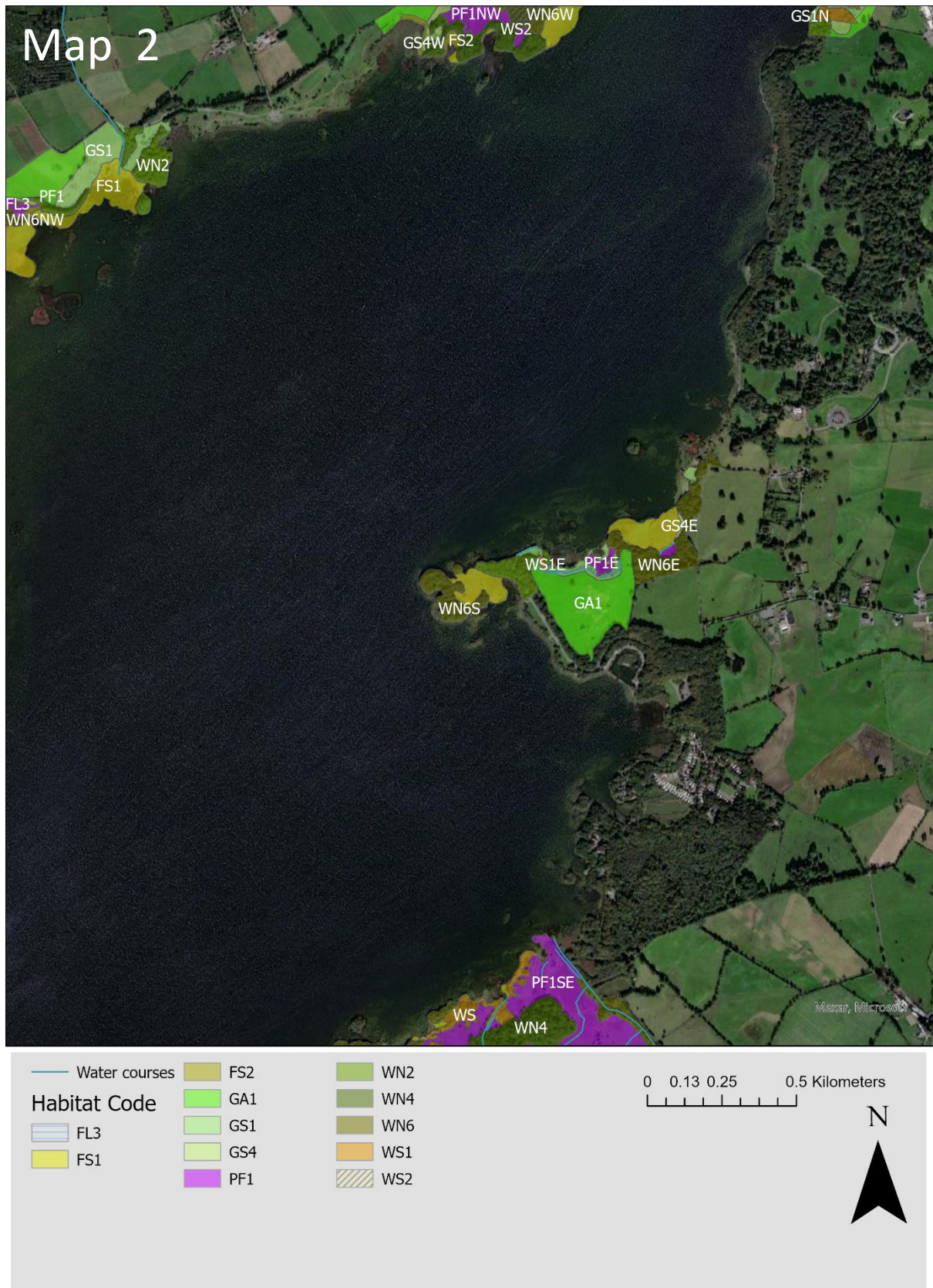
Appendix 2 Habitat mapping

Key to habitat codes used on the maps & map overview

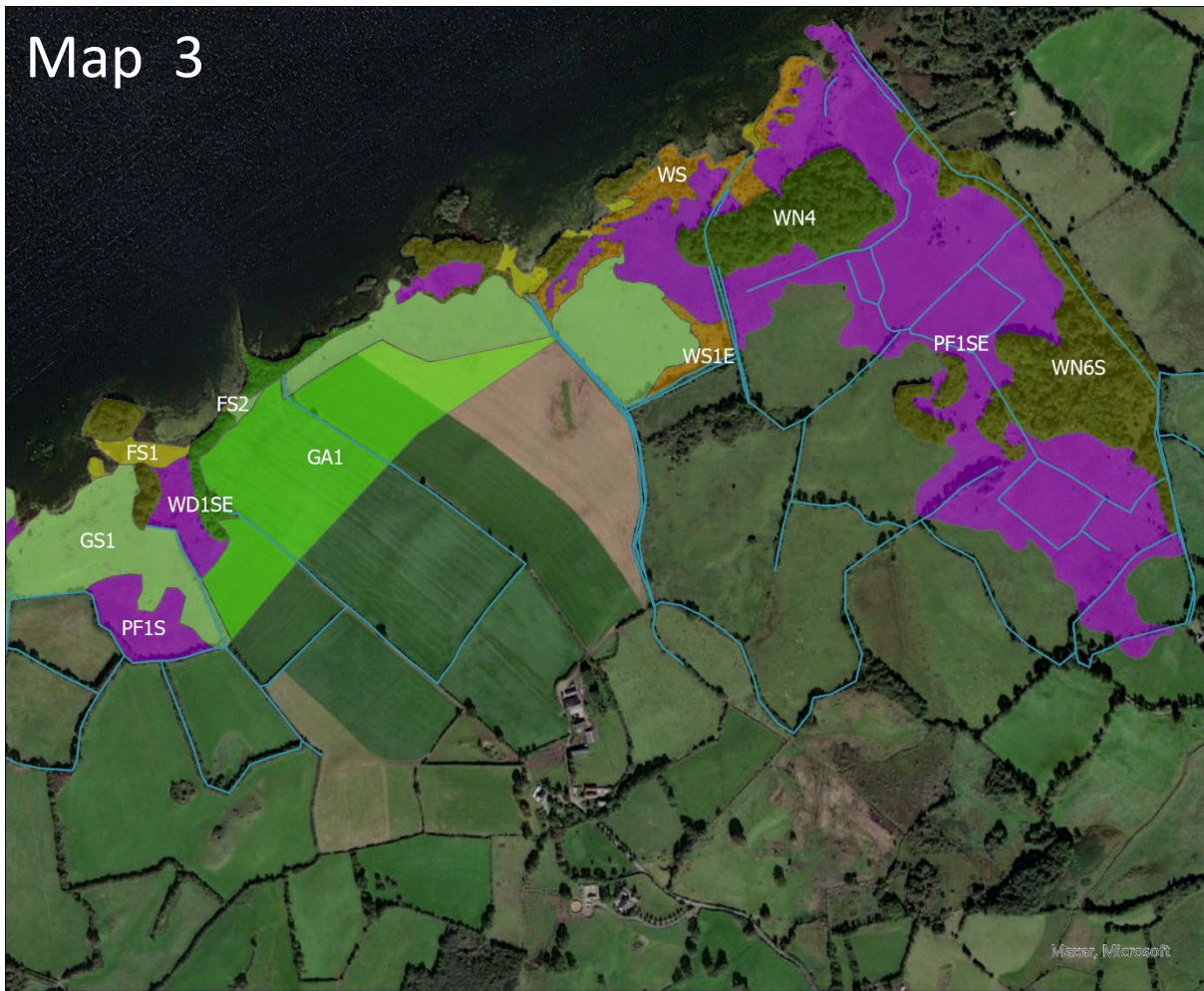
Habitat Code	Habitat Name	Relevant equivalent EU Annex I habitats
BL1	Built land/roads and tracks surfaces	
ED2	Spoil and bare ground	
ED3	Recolonizing bare ground	
FS1	Reed & large sedge swamp	
FS2	Tall herb swamp	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430)
GA1	Improved agricultural grassland	
GS1	Dry calcareous & neutral grassland	
GS4	Wet grassland	
PB1	Raised bog	Active raised bog (7110), Degraded raised bogs capable of natural regeneration (7120)
PB4	Cutover bog	
PF1	Rich fen & flush	Alkaline fens (7230)
PF2	Poor fen & flush	
WD1	(Mixed) broadleaved woodland	
WN2	Oak-ash-hazel woodland	
WN4	Wet pedunculate oak-ash woodland	Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (Alno padion, Alnion incanae, Salicion albae) (91E0)
WN6	Wet willow-alder-ash woodland	
WN7	Bog woodland	Bog woodland (91D0)
WS1	Scrub	





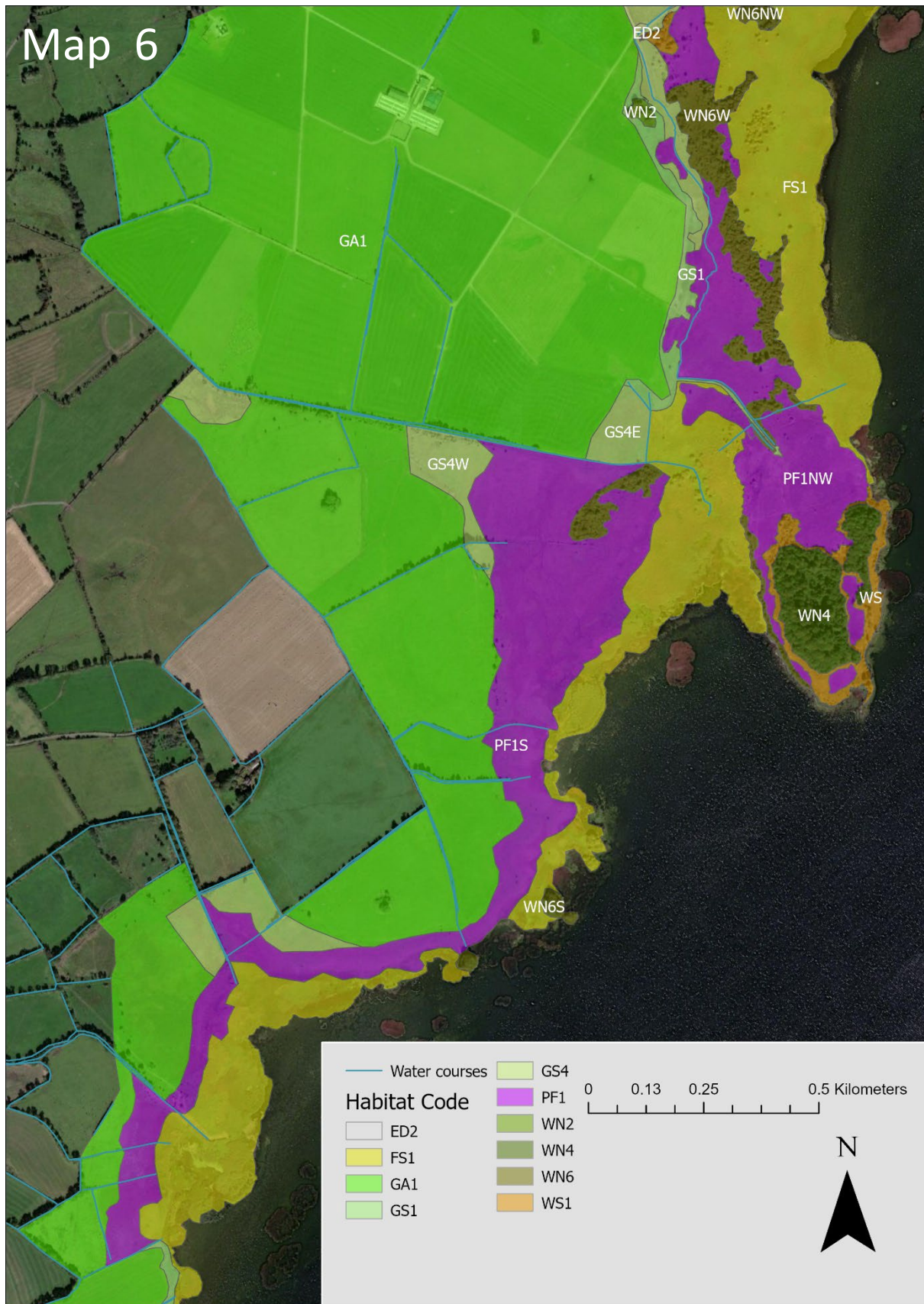


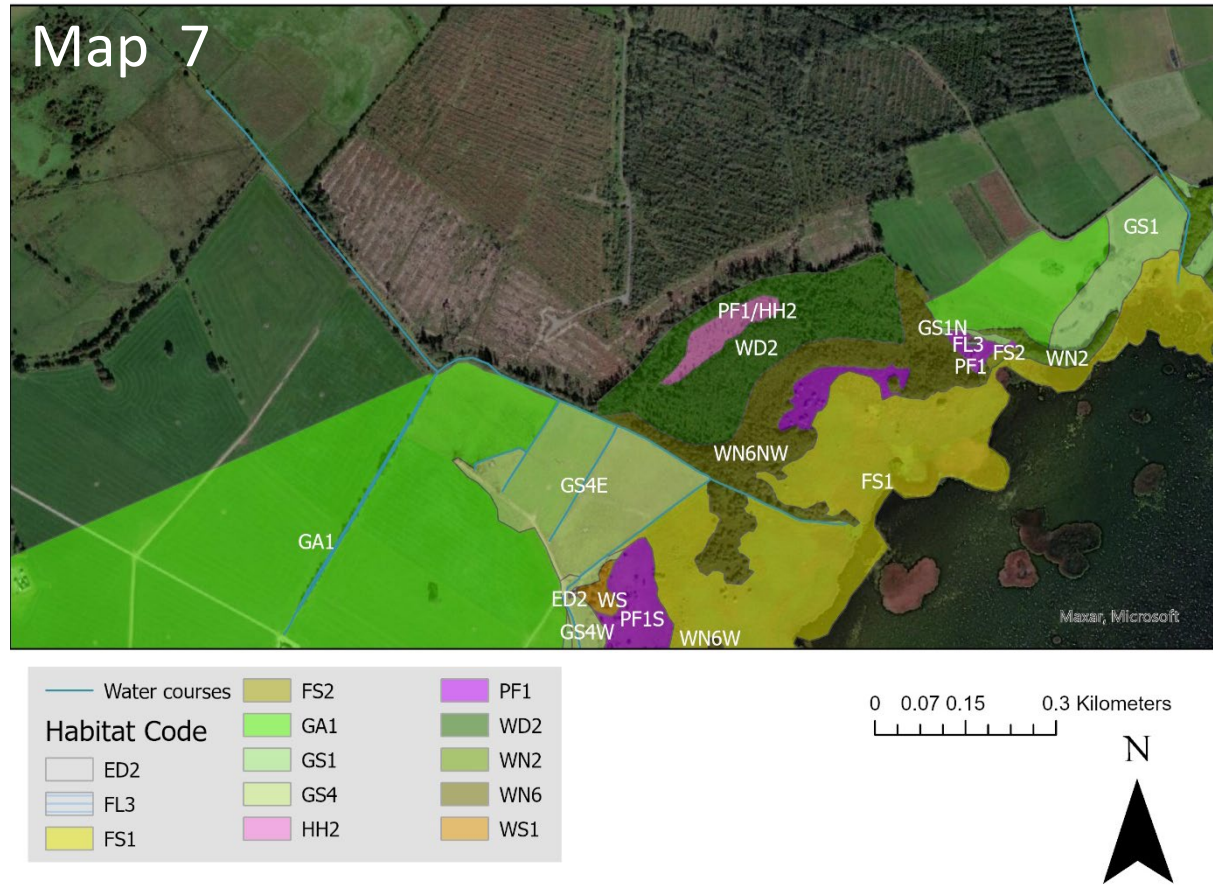
Map 3

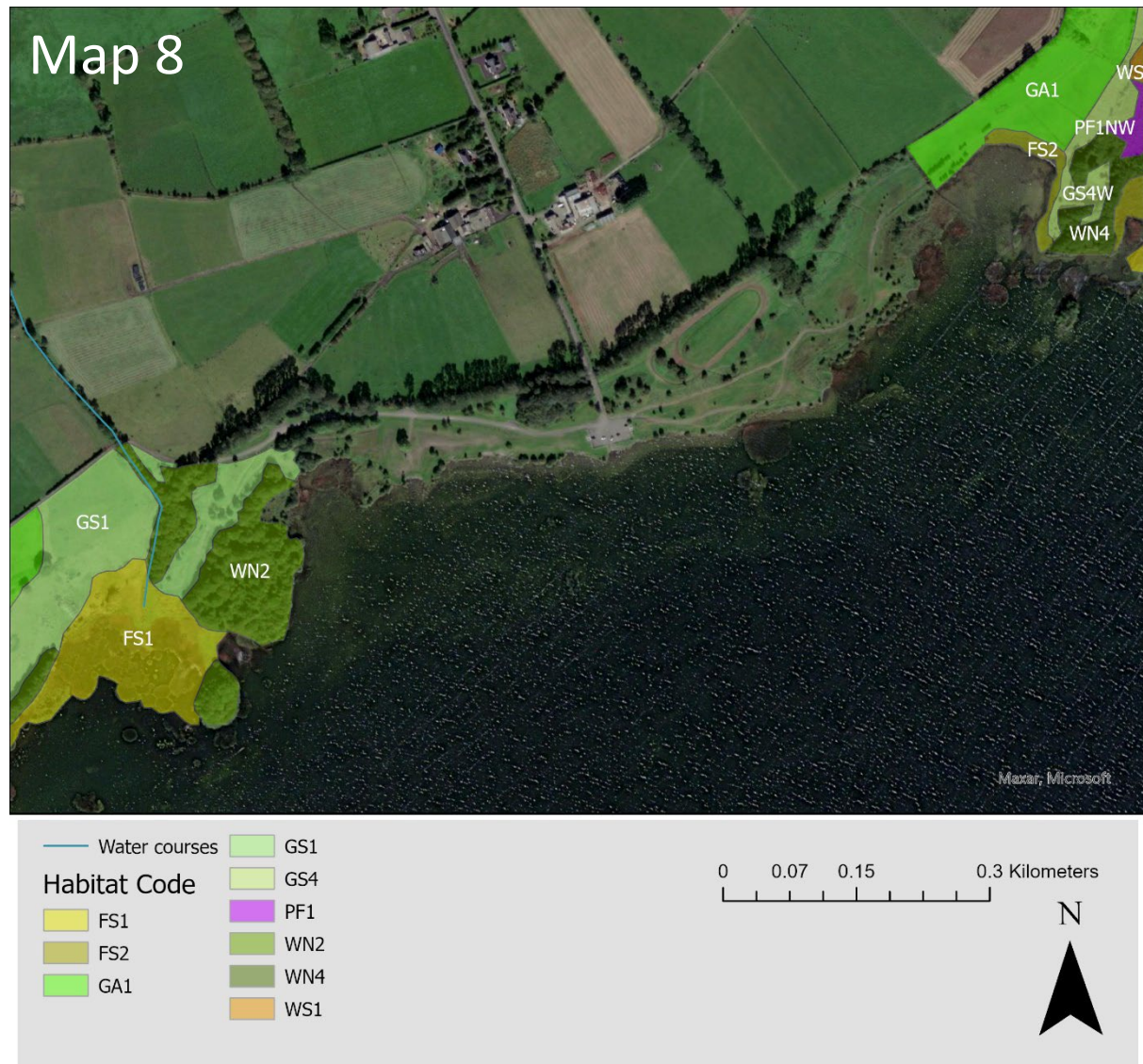












Appendix 3 – Habitat map attributes

Habitat	Identifier	Fossitt Code	Location	Value	Annex I Potential	Description
High Bog (Degraded)	PB1	PB1	South	Local-Regional	No, too small an area	Facebank and sub-marginal ecotope. Quite dry & Impossible to access due to steep peat cutting. Sphagnum palustre in drains and on facebank. Ling visibly dominant, with encroaching Scots pine and birch
Bare Peat	ED2	ED2	South	Low	N/A	Bare peat with recent evidence of machinery activity, including drain upkeep.
Cutover Bog	PB4	PB4	South	Regional-International	7150	Cutover Bog variably dominated by expanses of <i>Calluna Vulgaris</i> or <i>Molinia caerulea</i> some scattered regenerating peat depressions (bog pools) with limited <i>Rhynchosporion</i> present. Extensive drainage channels throughout this habitat, although the internal drains have not been maintained in a number of years and vegetation is regenerating and recovering. The external drains surrounding this habitat are maintained, with up to 1.5m depth in places.
Bog Woodland	WN7	WN7	South	Local-Regional	No, situated on Cutover bog	Relatively dry Mature Birch dominated woodland with some scattered Scots Pine & Lodgepole pine. Dense understory of immature birch, gorse and bracken with scattered ling, billberry and <i>Molinia</i> . This habitat is encroaching onto the remaining High bog and the adjacent cutover bog. Some extensive coverage of <i>Cladonia</i> in places.
Recolonising bare peat	ED3	ED3	South	Low	N/A	Comprised of 40-60% bare peat with encroaching <i>Molinia</i> , Deer grass, sedges, creeping bent and <i>Phragmites</i> in places. Likely to develop into rich fen due to adjacent habitat.
Wet Willow/Birch Woodland	WN6W	WN6	South, west & north	Regional	N/A	Wet willow, birch & alder woodland with a frequent understory of hawthorn, blackthorn, birch and alder with occasional guelder rose. The majority of this habitat is variably dominated by monospecific tall, dense stands of yellow iris, <i>Phragmites</i> , <i>Phalaris</i> or <i>Carex riparia</i> . Although often with a mix of these species and others which are tolerant of permanent waterlogging. This woodland is actively encroaching onto adjacent habitats along the majority of its border, although this is limited to some extent on the lakeward side by water depth.
Reed & Large Sedge Swamp	FS1	FS1	Majority along W, N & S shores	Local	N/A	This habitat is characterised by dense, tall generally monospecific although occasionally mixed stands of phragmites, <i>Phalaris</i> , bulrush and common clubrush. With the latter solely dominating the aquatic marginal extremities of this habitat. <i>Phragmites</i> is the overall dominant species within this habitat, other broad-leaved herbs and large sedges and grasses were also occasionally recorded.
Tall Herb Swamp	FS2	FS2	N & SE	Local	Unlikely to support 6430	This habitat is characterised by standing water with dense, tall mixed stands of yellow iris, horsetails and fools watercress, with some scattered, hemlock water-dropwort, phragmites, sedges and bulrush. There is evidence of grazing by horses, although this is not extensive and covers c. 15% of the habitat, this area is evidently used by the horses relatively frequently, although it is currently inaccessible to livestock.

Habitat	Identifier	Fossitt Code	Location	Value	Annex I Potential	Description
Improved Grassland Ag.	GA1	GA1	Surrounding lake	Low	N/A	Located around the lake although not reaching the lake shore in any of the areas surveyed. Generally comprising monospecific sward of perennial rye grass with some clover. The majority of this has been reseeded in the last 5-10 years, with large areas on the west recently converted to an intensive dairy farm.
Dry semi-improved calcareous grassland	GS1	GS1	Mostly SE	Regional-International	Potential 6210 & 6410	Largest area located along south-eastern shore, but with some small other areas scattered around the shoreline. Comprising dry semi-improved calcareous grassland. This habitat has retained a portion of its natural calcareous species rich state, but has been influenced by adjacent reseeding regimes, with some agricultural herbs evident in places. This habitat is grazed by cattle with no evidence of extensively poached or trampled areas. the sward is dominated by <i>Molinia</i> in places with abundant <i>Succisa</i> , timothy, crested dog's tail and cock's foot, with an average sward height of c.10-30cm.
Rank calcareous grassland	GS1N	GS1		Regional-National	Potential 6410	The habitat is located along the eastern shore between GA1 and FS1 with gradations of fen evident in the wetter margins although these areas are not clearly defined. The sward is dominated by waist high rank grasses and broad-leaved herbs dominated by <i>Molinia</i> and cock's foot, with meadowsweet and hemp agrimony. Willow saplings and bramble are occasional, with some scattered immature willow.
Wet calcareous grassland	GS4E		Western side of lake	Low-Local	N/A	This habitat is characterised by recent improvement and drainage works, including mowing and intensive grazing. The habitat appears to have been waterlogged fen/marsh habitat previously, indicated by the remnant plants. Intensively poached by livestock (C.75% of the area) and machinery. Currently dominated by emerging <i>Juncus</i> , grasses and yellow iris. The most abundant broadleaved herbs are creeping jenny, hemlock water-dropwort, fools water-cress and Marsh ragwort. This area is being actively drained and appears to be being prepped for reseeding, although this is unconfirmed.
Wet calcareous grassland	GS4N	GS4	Northern edge of surveyed area	Local	Potential 6210 & 6410	This habitat encompasses a single small clearing/meadow on the northern edge of the surveyed area, at the entrance to the large woodland plantation. It is comprised of waterlogged soils dominated by <i>Molinia</i> and other tall tussocky grasses including <i>Deschampsia</i> and tall fescue. The bryophyte layer is extremely well developed with extensive cover throughout. There is scrub encroachment (willow & birch) which is the natural expansion of the adjacent woodland
Wet Semi-improved Grassland	GS4W	GS4	Mostly on the north and west shores of the lake	Local	N/A	This habitat is characterised by knee-waist (30-80cm) high rank wet calcareous grass which has some influence from adjacent reseeding regimes. This habitat is dominated by rank grasses including cock's foot and <i>Molinia</i> with scattered perennial rye grass and <i>Juncus</i> . Agricultural broadleaved herbs including dock, thistle and nettle are common.

Habitat	Identifier	Fossitt Code	Location	Value	Annex I Potential	Description
Dry Alkaline Heath	HH2	HH2	Located along the western shore	Local	N/A	This habitat is difficult to categorise, the area was, in the past, mounded and drained for conifer plantation but the majority of these plantings did not survive due to the extremely wet conditions present throughout. The area has been significantly damaged by the drainage and mounding works, causing the original Calcareous fen habitat to dry out leading to the creation of a habitat matrix of Dry Calcareous Heath (on the dryer mounds where the trees were planted) and Rich fen in the hollows between the mounds. Some scattered lodgepole pine and Sitka spruce have survived from the planting stage. Birch, alder and willow are actively encroaching into this habitat
Rich Fen	PF1S	PF1		International	7230 & potential 7210 & 6210	This habitat is found mostly along the western and south-eastern shorelines in waterlogged peaty soils. It is dominated by Black-bog rush and characterised by small-medium sedges and grasses, with occasional gradations of tall-medium sedges and grassy areas with abundant broadleaved herbs throughout. Several Orchid remains were recorded across this habitat. Willow, birch and alder saplings and seedlings (active encroachment) are occasional along the western and southern portions.
Rich Fen	PF1E	PF1		Regional-National	Potential 7230	Is located on the eastern shores of the lake, with a number of areas also recorded in the north-east. The habitat is characterised by black bog-rush dominated rich fen which has experienced a significant level of poaching and damage from intensive grazing of livestock. Extensive patches and trails of poached peaty soil extend throughout these areas. Some of these areas are older than others with extensive bryophyte cover developing in patches.
Rich Fen	PF1	PF1		International	7230 with potential for 7210, 6210	This habitat encompasses two relatively small waterlogged areas of Rich Fen, one along the mid-eastern shore and one along the mid-western shore. The habitat is characterised by a roughly equal dominance between <i>Molinia</i> and black bog rush with abundant sedges and broadleaved herbs, including a number of species of orchid, of which a number of remains were recorded. Both instances of this habitat grade into <i>Phragmites</i> dominated FS1. Bryophyte cover is abundant throughout.
Rich Fen	PF1NW	PF1		International	7230, potential for 7210, 6410 & 6210	This habitat covers an extensive area along the western shore, it is characterised by black bog rush dominated Rich fen, with frequent <i>Molinia</i> , cotton grass and tussocky sedges, and frequent broadleaved herbs. Bryophyte cover is extensive with birch seedlings encroaching, especially in proximity to the adjacent scrub and woodland areas.

Habitat	Identifier	Fossitt Code	Location	Value	Annex I Potential	Description
Rich Fen	PF1SE	PF1		National - International	7230, potential for 7210, 6410 & 6210	This habitat covers an extensive area along the south-eastern shore. Extending in places from the edge of the lake up to over 1km. Although the areas farther from the lake have been subjected to significant levels of drainage, which is likely to impact this habitat into the future. the habitat is characterised by a variable co-dominance between <i>Molinia</i> and black bog-rush, with abundant cotton grass, sedges and broadleaved herbs. The frequency of <i>Molinia</i> increases and black bog-rush decreases as you progress away from the lake in tandem with the increasing levels of drainage, leading to the conclusion that this habitat is transitioning from Rich fen to Wet Calcareous Grassland.
Rich Fen	PF1SW	PF1		Local	Potential 7230	This habitat is located along the southern shoreline to the west of the River Brosna outflow, it is characterised by being a mix of black-bog rush and <i>Molinia</i> and is actively being drained. This habitat has been impacted by adjacent reseeding regimes, with numerous agricultural herbs and grasses being evident. Despite this the area still retains at least some of its natural characteristics
Poor Fen (regenerating Cutover Bog)	PF2	PF2		Local-Regional	N/A	This habitat is characterised by numerous sedges, grasses, bryophytes and broadleaved herbs in a transitional stage between cutover bog (bare peat) and fen habitat. Bare peat retains a small % of cover across the habitat. <i>Molinia</i> and cotton grass are dominant, with frequent <i>Phragmites</i> , deergrass and ling.
Mixed Broadleaved Woodland	WD1	WD1		Local	N/A	This habitat consists of a dry fenced expanse of broadleaved woodland with a canopy of birch, alder, sycamore and occasional ash. Willow and birch have naturally encroached and formed a dense edge and sparse understory with hawthorn, ash and elder. The ground flora is dominated by bramble, ivy, <i>Molinia</i> and <i>Deschampsia</i> with occasional hogweed and dog rose among others. The extensive coverage of sycamore within the canopy have driven the classification to WD1 Mixed Broadleaved woodland.
Mixed Broadleaved/Conifer Woodland	WD2	WD2		Low-Local	N/A	This habitat is located along the western shoreline and surrounds the habitat HH2. This habitat, like HH2, is the remnant of past conifer plantation on Rich fen. The soil has been mounded and drained, this area has retained a portion of the original conifer plantation, with self-seeded seedlings and saplings also evident throughout. Birch and willow, with occasional alder have infilled the areas where the planted conifers have died off. The ground is treacherous with a significant (<1m) difference between the bottom of the scrapes and the tops of the mounds sections. The ground flora is extensive in places although this is often relatively species poor, being dominated by <i>Molinia</i> , bramble, thistle, rose-bay willowherb and <i>Phragmites</i> , with occasional other broadleaved herbs
























Habitat	Identifier	Fossitt Code	Location	Value	Annex I Potential	Description
Conifer Plantation	WD4	WD4		Low	N/A	This habitat is comprised of mature conifer plantation located at the extreme north of the surveyed area. This habitat is of low value with a very low species diversity. Bramble, ivy and bryophytes dominate the ground flora, with scattered ling and bilberry.
Damp Oak-Birch woodland	WN1	WN1			Potential 91A0	This woodland is located along the northern extent of the survey area, it is a relatively complex habitat and shows elements of both WN1 & WN2 and is likely a matrix of these. The canopy is dominated by birch with occasional ash. The sub-canopy is dominated by hawthorn with occasional holly and rowan. the ground flora is variably dominated by areas of bramble and ferns or ling and bilberry, <i>Cladonia</i> lichens and sphagnum are abundant in the areas dominated by ling and bilberry. Bryophyte cover is extensive across the habitat. Oak seedlings and saplings are regenerating across the woodland. A number of mature and veteran yew are scattered across the woodland. This habitat appears to have been previously used as conifer plantation, but has now regenerated to a mostly semi-natural state. some scattered conifer trees remain especially in the southern extents, although these do not dominate.
Dry Oak-Ash Woodland	WN2	WN2		Regional-National		This habitat is characterised by dry calcareous woodland with a canopy dominated by oak and ash, with abundant birch and occasional beech, sycamore, lime and horse chestnut. A frequent understorey of hazel, blackthorn and hawthorn, with occasional holly and dogrose. The ground flora is grassy in places with abundant wood false-brome and remote sedge but is generally dominated by ivy, bramble and a mix of broadleaved herbs. Poaching by livestock is evident in some areas although this is not extensive.
Wet Oak-Ash woodland	WN4	WN4			Potential 91E0	This habitat can be found along the eastern, western and northern shores, it is characterised by a mixed canopy of oak, ash and birch with frequent alder. Beech is also occasional. The sub-canopy is abundant and includes alder, birch, hazel, hawthorn and willow. The ground flora is rank and lush throughout, with patches dominated by bramble and/or grasses and abundant broadleaved herbs, including meadowsweet, enchanter's nightshade, angelica, ivy and creeping buttercup among others

Habitat	Identifier	Fossitt Code	Location	Value	Annex I Potential	Description
Wet Ash-Alder-Willow-Birch Woodland	WN6S	WN6		Local-Regional	N/A	This habitat is located along the south-eastern shore and is characterised by ash, birch and alder dominated woodland with frequent willow. The soils are waterlogged at the peripheries and normally dry out towards the centre of the woodlands as they are generally located on small islands which lie above the water table. the sub-canopy is generally dominated by Hawthorn and willow, with occasional blackthorn, birch and ash. The ground flora is variable with the drier areas generally being dominated by bramble, although meadowsweet, hemp agrimony and creeping buttercup are abundant throughout. The largest area of this habitat on the south-eastern extent of the survey area is likely to be impacted by the adjacent drainage scheme implemented in the surrounding fen habitat, although during the survey this was not currently evident.
Wet Willow/Birch Woodland	WN6E	WN6		Local	N/A	This habitat is located mid-way along the eastern shore. It is characterised by an ash, alder and birch canopy, with frequent willow and occasional beech, sycamore, lime and horse chestnut. The soils are damp with some scattered waterlogged hollows. the subcanopy is dominated by hawthorn, with frequent elder, willow, birch and alder with occasional hazel and yew. The ground flora is relatively sparse with areas dominated by bramble, ivy and grasses with frequent broadleaved herbs. The southern half of this habitat has been extensively poached by livestock, with >60% of the area being churned and disturbed. This poaching extends into the northern portions of this habitat although not to the same extent.
Wet Willow/ Birch Woodland	WN6NW	WN6		Local-Regional	N/A	This habitat is located along the north-western shore and is characterised by a canopy dominated by birch and alder, with frequent ash and willow. The soils are mostly waterlogged with some drier patches throughout. The sub-canopy is dominated by birch and willow with frequent alder, blackthorn and ash and occasional guelder rose. The ground flora is abundant throughout with water loving broadleaved herbs, grasses, sedges and rushes. bryophyte cover is extensive.
Birch/Willow Scrub	WS1	WS		Local	N/A	This habitat is found across the survey area, generally in small pockets or patches. This habitat is characterised as a transitional woodland phase, where the adjacent woodland habitats are actively expanding into surrounding habitats, mostly fen or grassland. This habitat is characterised by dense stands of immature birch, willow and alder, with occasional guelder rose, blackthorn and spindle. The ground flora is variable but generally reflects the habitat that was encroached into, this being fen for the majority of this habitat.
Bramble/willow scrub	WS1	WS1E		Low-Local	N/A	This habitat comprises two relatively small areas along the eastern shore. Both areas are characterised by a lack of management or grazing, leading to the development of rank dry grassland which has become dominated with stands of bramble and young willow.

Habitat	Identifier	Fossitt Code	Location	Value	Annex I Potential	Description
Immature Carr Woodland	WS2	WS2		Regional-International	Potential 7230	This habitat is located along the north-western shore and is characterised by a transitional stage of habitat progression, with extensive cover of black bog-rush and tussocky sedge dominated rich fen, a continuation of adjacent habitats but with a developing immature woodland of willow, with occasional birch and alder. Given time this is likely to develop into WN4 Carr woodland.

Appendix 4 – Habitats maps of Westmeath County Council lands
(extract from 2019 management recommendations report⁵)

Key to habitat codes used:

	BC4	Flower Beds and Borders
	BL3	Buildings and Artificial surfaces (roads etc)
	ED1	Exposed sand, gravel or till
	ED2/ED3	Spoil and bare ground/recolonising bare ground
	FL3	Limestone/marl lakes
	FL8	Other artificial lakes and ponds
	FS1	Reed and large sedge swamps
	FS1(Alk. Fen mosaic)	Reed swamp/Alkaline Fen mosaic
	FS2	Tall-herb swamps
	FW2	Depositing/lowland rivers
	GA1	Improved agricultural grassland
	GA2	Amenity grassland
	GM1	Marsh
	GS1	Dry calcareous grassland (including damp)
	GS1/GM1	(Damp) calcareous/marsh mosaic
	WD1	(Mixed)broadleaved woodland
	WD5	Scattered trees and parkland
	WL1	Hedgerows
	WL2	Treelines
	WN4	Wet Oak – Ash woodland
	WN6	Wet Willow-Alder-Ash woodland
	WS1	Scrub
	WS3	Ornamental shrubs



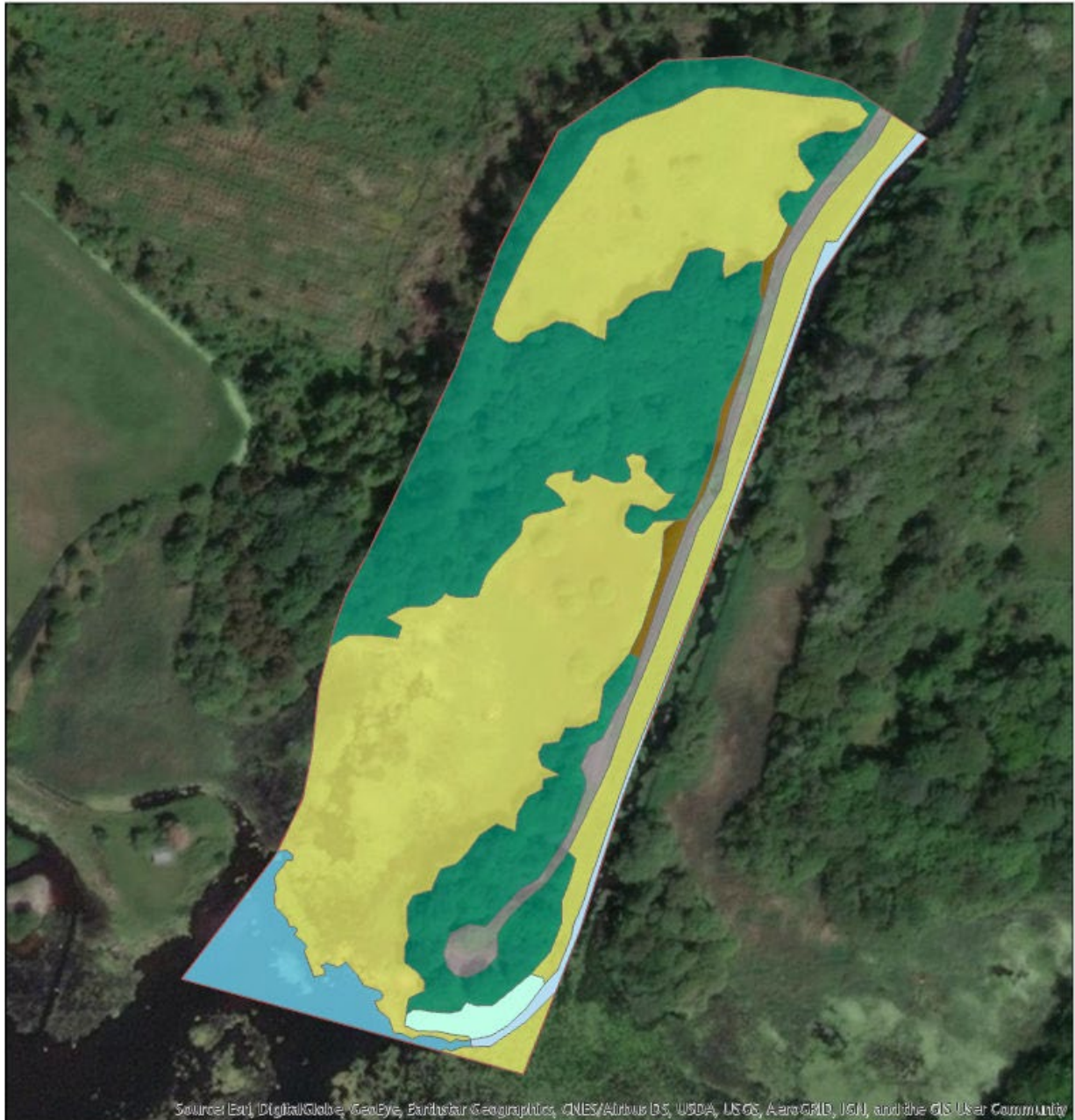


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Habitats	
HabitatCode	GM1
BC4	GS1
BL3	GS1/GM1
ED1	WD1
ED2/ED3	WD5
FL3	WD5
FL8	WL1
PS1	WL2
PS1(Allr. Fen mosaic)	WL4
PS2	WL6
FW2	WS1
GA1	WS3
GA2	<all other values >
	LoughEnnell_WMCC_Owned_Lands



Lilliput



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Habitats	
HabitatCode	GM1
BC4	GS1
BL3	GS1/GM1
ED1	WD1
ED2/ED3	WD5
FL3	WL1
FL8	WL2
FS1	WH4
FS1(Alk. Fen mosaic)	WH6
FS2	WS1
FW2	WS3
GA1	<all other values >
GA2	LoughEnnell_WMCC_Owned_Lands



Butler's Bridge



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Habitats	
HabitatCode	GM1
BC4	GS1
BL3	GS1/GM1
ED1	WD1
ED2/ED3	WD5
FL3	WD5
FL8	WL1
PS1	WL2
PS1(Allr. Fen mosaic)	WH4
PS2	WH6
FW2	WS1
GAI	WS3
GA2	<all other values >
	LoughEnnell_WMCC_Owned_Lands

0 0.05 0.1 0.2 Kilometers



Tudenham



