National Parks & Wildlife Service

Tóchar Midlands Wetland Restoration Scheme

Lough Mareegan

NFS site No.

104012

Fen Restoration Plan

July 2026

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Midlands Wetland Restoration

ARUP

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National Parks and Wildlife Service

Fen Restoration Plan

Lough Mareegan

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ARUP

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Executive Summary

Lough Mareegan is located approximately 10 km northeast of Athlone in County Westmeath. The site is not a formally designated habitat, however, it is important for supporting the following a range of important Annex I quality habitats: 7230 Alkaline fens, 7210 *Cladium* fens, 3140 Hard-water lakes, 91E0 Alluvial woodland and 7140 Transition mires. Although not formally designated, the site is of high ecological value.

The restoration plan identifies the main pressures affecting habitat conditions such as drainage, undergrazing, water quality impacts and invasive species. The assessment was informed by previous NPWS surveys, desktop analysis of drainage networks, and hydrological and ecological field surveys. Restoration measures were prioritised based on their likely effectiveness and feasibility, with further stakeholder consultation and site investigations required before implementation

The plan also includes provisions to protect archaeological features, manage peat stability risks, and ensure ongoing stakeholder engagement. Collectively, these measures aim to improve hydrological functioning, enhance habitat condition and resilience, and support the long-term conservation of the site's Annex I habitats and associated biodiversity.

Actions of the Fen Restoration Plan

The key measures proposed by this assessment are:

On-site Measures:

- Drain blocking: drain blocking will help raise the water levels in localised areas near the bog road, eastern spring drain, central drains and wider site
- Water quality monitoring: to understand nutrient dynamics between springs, fen and lakes.
- Conservation grazing: to reduce sward dominance, maintain open fen conditions and restore structural diversity.
- Vegetation monitoring: on-going vegetation monitoring to inform and adapt appropriate measures and understand the effectiveness of measures undertaken.

Off-site Measures:

- Inclusion of farmers within the catchment area in a Farm Plan or similar to ensure improved land and water management to reduce nutrient loading to sensitive fen habitat.

The plan includes measures to protect archaeological features and to assess and manage any risks to peat stability, thereby safeguarding both the cultural heritage and the physical integrity of the site. Finally, the plan recognises the importance of stakeholder engagement and compliance. Active engagement with landowners, statutory bodies, and other local

stakeholders will help ensure that restoration actions are practical, widely supported, and compliant with relevant legislation.

Benefits of the Fen Restoration Plan

The restoration plan is expected to deliver significant benefits for a range of habitats and species at Lough Mareegan. Improved understanding of hydrological conditions will support the identification of appropriate management actions to maintain or restore suitable wet conditions across the site.

Targeted vegetation management will control rank vegetation helping to maintain open fen structure and support characteristic species assemblages. Collectively, these measures will enhance habitat condition and resilience, supporting the long-term conservation of Annex I fen habitats and associated biodiversity.

Habitat and Restoration Map

The habitats recorded during the 2022 NFS and classified according to the Fossitt Habitat Classification system is presented in Figure 1.1.

The Restoration and Monitoring Map including both hydrological and ecological measures is presented in Figure 1.2.

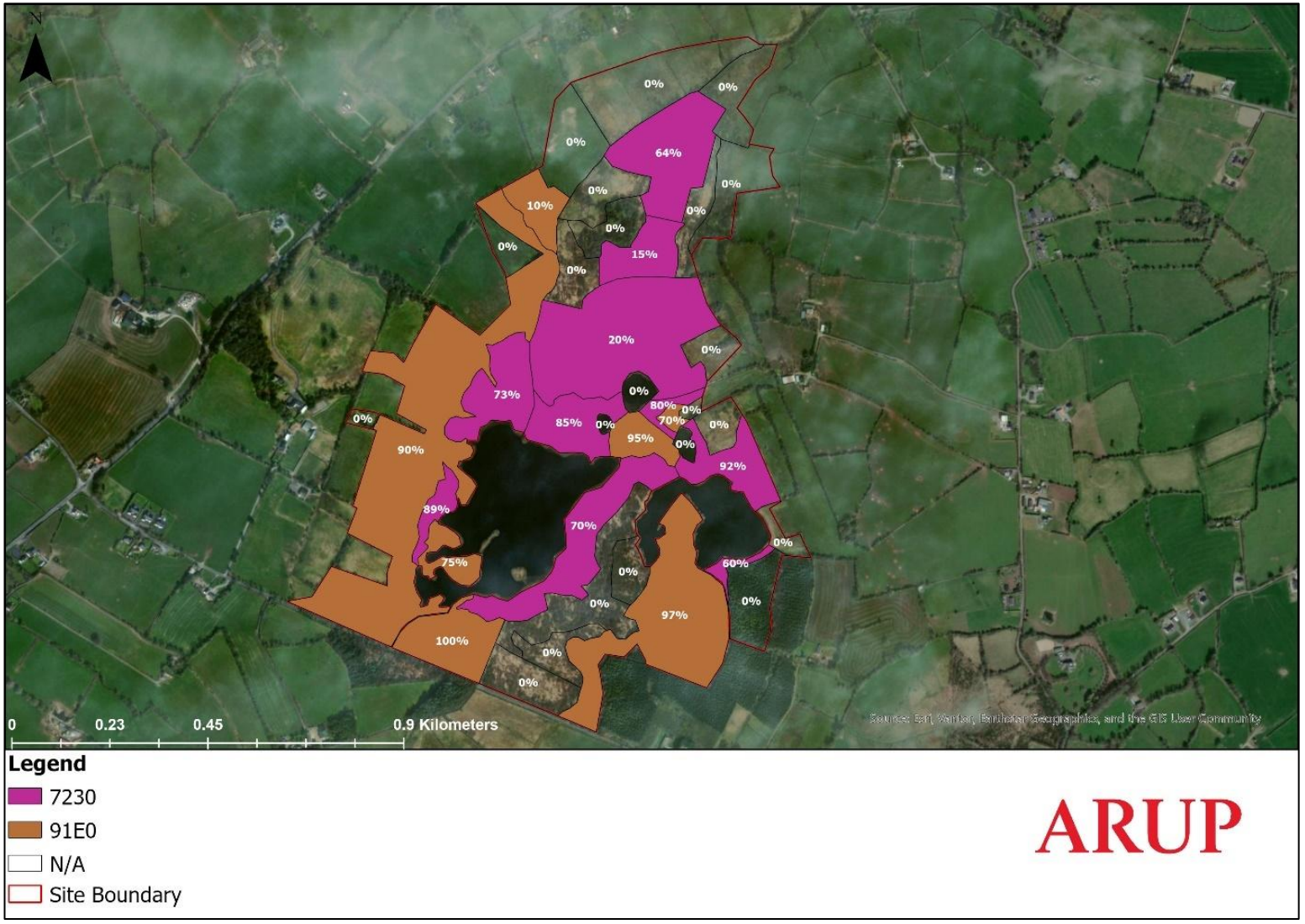


Figure 1-1 Annex I quality habitats recorded and mapped as part of the 2022 NFS. Note the % value indicates the % cover of the dominant Annex I quality habitat recorded in the polygon

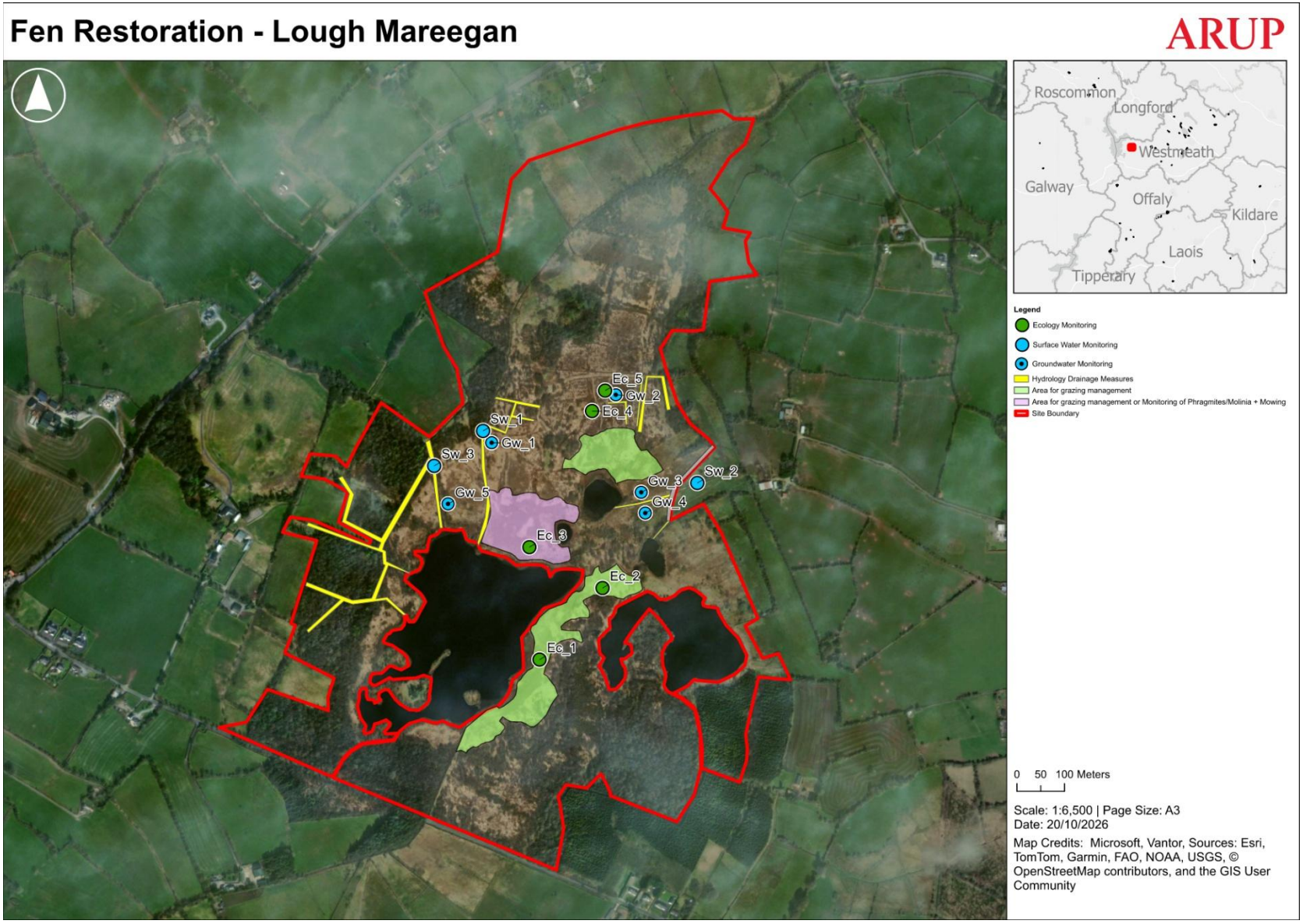


Figure 1-2 Restoration measures and monitoring for Lough Mareegan

Acknowledgements

This Restoration Action Plan was prepared following consultation with a broad range of groups and individuals involved in Peatland restoration, local residents and stakeholders through several workshops.

Thanks to the members of the SAR Directorate, NPWS Regional Staff, Ecological Assessment Unit (EAU), Ecological Guidance and Advisory Unit (EGAU), Wildlife Enforcement and Nature Protection Directorate, Conservation Measures Unit, Conservation Planning Unit and the Tóchar Wetlands Project Team.

Tóchar Wetlands is a wetlands restoration project, co-funded by the Government of Ireland and the European Union through the EU Just Transition Fund Programme. It is managed by the National Parks and Wildlife Service, of the Department of Housing, Local Government and Heritage.

1 Introduction

1.1 Purpose of this Fen Restoration Plan

This Fen Restoration Plan (FRP) report has been developed by Arup on behalf of National Parks and Wildlife Service (NPWS) to set out proposals for restoration of fen habitat. Annex I[1] habitats are those formally listed under Annex I of the EU Habitats Directive and are recognised as qualifying features of a designated site, meaning they have legal protection and must be assessed and managed to meet site-specific conservation objectives. Lough Mareegan is not a designated site however the site supports Annex I habitat. It is referred to here as Annex I quality, meaning it conforms to the Annex I habitat description, but is not a designated Special Area of Conservation (SAC).

Lough Mareegan is located approximately 10 km northeast of Athlone in County Westmeath. The following Annex I quality habitats were recorded within the site as part of the National Fen Survey (NFS) (Brophy et al., In prep) and Westmeath Wetlands Survey (Smith, 2026): 7230 Alkaline fens, 7210 Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* (hereafter referred to as 7210 *Cladium* fens), 3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. (hereafter referred to as 3140 Hard-water lakes) and 91E0 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) (hereafter referred to as 91E0 Alluvial woodland) and 7140 Transition mires and quaking bog (hereafter referred to as 7140 Transition mires).

The main aims of the FRP are to maintain or improve the quality of existing areas of fen habitats and improve the hydrological conditions that will allow an expansion of the measurable area, thus impacting on the favourable condition of the fen. However, in some areas, it must be recognised that restoration to increase areas of existing fen will not be possible due to unsuitable hydrological conditions, and the objective may simply be to ensure no further deterioration.

Although the focus of the FRP is on fen habitat, it is anticipated that restoration actions will also benefit other wetland habitats mapped within the Lough Mareegan site. Restoration actions to raise the water table of peatland habitat will improve the hydrology of adjacent wetlands and fen habitats. The implementation of the actions proposed within this FRP report will also provide wider improvements to biodiversity, reduce carbon emissions and potentially improve water quality, all of which may be demonstrable under eventual post-implementation monitoring.

While full-scale hydrological restoration aimed at re-establishing the site's former lake levels would offer potential ecological gains for aquatic species and waterfowl, this would result in the loss of existing fen areas. Therefore, restoration will be carefully targeted to deliver hydrological and ecological improvements while restoring, expanding and maintaining the extent and quality of existing fen habitat, ensuring a balanced approach that supports favourable conservation outcomes across priority habitats and species.

1.2 Wider benefits of peatland restoration

Fens are vital habitats due to their rich biodiversity, supporting a wide array of flora and fauna, many of which are rare or endangered. They act as natural water filters, purifying water by trapping pollutants and sediments, thus enhancing water quality downstream. Additionally, fens store significant amounts of carbon in their peat soils, contributing to climate change mitigation by reducing atmospheric carbon dioxide levels. Their ability to absorb and gradually release water helps regulate water flow and minimize flood risks. Beyond their ecological importance, fens hold cultural, historical, and recreational value, offering opportunities for education, research, and outdoor activities. Although some fens in Ireland are not protected as SACs or Natural Heritage Areas (NHAs), they remain crucial for biodiversity and climate resilience.

Peatland drainage and extraction transforms a natural peatland, which acts as a modest carbon sink (C-sink), into a carbon source (Waddington & McNeil, 2002; Alm *et al*. 2007; Wilson *et al*. 2015). The EPA- funded Carbon Restore Project (Wilson *et al*. 2012) found that rewetting of drained peatlands can lead to restoration of functional peatland, such as the return of typical plant and animal species, which in turn may lead to the restoration of peat-formation and the C-sink function.

The restoration of fen habitat can lead to improved water quality. Well-functioning fen habitat reduces the risk of dissolved organic carbon passing into water courses and has been shown to attenuate the speed at which water moves downstream thereby also reducing flood risk.

1.3 Key pressures on Fens

The overarching (National) key pressures and threats to Annex I fen habitats been identified in the latest Status of EU Protected Habitats and Species in Ireland (Article 17 report) (NPWS 2025). The overall conservation status is assigned as Bad for 7210 *Cladium* fens, Bad for 7230 Alkaline fens, Bad for 91E0 Alluvial forests and Bad for 3140 Hard-water lakes with further detail in Table 1-1.

Table 1-1: National pressures to fen habitats

Habitat	Importance	Pressure
7210 *Cladium* fens	High	PA05 Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming) PA17 Agricultural activities generating pollution to surface or ground waters (including marine) PL02 Drainage (mixed or unknown drivers)
	Medium	PA06 Mowing or cutting of grasslands PA08 Extensive grazing or under grazing by livestock PB24 Drainage for forestry

Habitat	Importance	Pressure
	Low	PA01 Conversion into agricultural land (excluding drainage and burning) PA07 Intensive grazing or overgrazing by livestock PA22 Drainage for use as agricultural land PB19 Forestry activities generating pollution to surface or ground waters (including marine) PB26 Other forestry activities, excluding those relating to agro-forestry PF05 Sports, tourism and leisure activities PI03 Problematic native species
7230 Alkaline fens	High	PA07 Intensive grazing or overgrazing by livestock PA22 Drainage for use as agricultural land PA23 Physical alteration of water bodies (including dams, channels, etc.) J01 Mixed source pollution to surface and ground waters
	Medium	PA01 Conversion into agricultural land (excluding drainage and burning) PA05 Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming) PA08 Extensive grazing or under grazing by livestock PB24 Drainage for forestry PC06 Dumping/depositing of inert and dredged materials from terrestrial and marine extraction PF06 Deposition and treatment of waste/rubbish from built-up areas PI02 Other invasive alien species (other than species of Union concern) PL02 Drainage (mixed or unknown drivers) to surface or ground waters N02 Droughts and decrease in precipitation due to climate change N03 Increases or changes in precipitation due to climate change
	Low	PF05 Sports, tourism and leisure activities PI03 Problematic native species

Habitat	Importance	Pressure
		PE09 Land, water and air transport activities not referred to above PE01 Roads, paths, railroads and related infrastructure PC05 Peat extraction PA17 Agricultural activities generating pollution to surface or ground waters (including marine) PA20 Livestock farming generating pollution PB19 Forestry activities generating pollution to surface or ground waters (including marine) PB26 Other forestry activities, excluding those relating to agro-forestry
91E0 Alluvial forests	High	PB05 Logging without replanting or natural regrowth PI01 Invasive alien species of Union concern PI04 Plant and animal diseases, pathogens and pests
	Medium	PI02 Other invasive alien species (other than species of Union concern) PI03 Problematic native species PL02 Drainage (mixed or unknown drivers) PL05 Modification of hydrological flow (mixed or unknown drivers)
	Low	PA10 Livestock farming (without grazing) PB06 Logging or thinning (excluding clear cutting) PF03 Creation or development of sports, tourism and leisure infrastructure PF05 Sports, tourism and leisure activities PF06 Deposition and treatment of waste/rubbish from built-up areas
3140 Hard-water lakes	High	PA17 Agricultural activities generating pollution to surface or ground waters (including marine) PA20 Livestock farming generating pollution PA22 Drainage for use as agricultural land PF07 Residential and commercial activities and structures generating pollution to surface or ground waters
	Medium	PB19 Forestry activities generating pollution to surface or ground waters (including marine)

Habitat	Importance	Pressure
		PB24 Drainage for forestry PC05 Peat extraction PC08 Extraction activities generating pollution to surface or ground waters PF17 Active abstraction of water for built-up areas
	Low	PI01 Invasive alien species of Union concern PI02 Other invasive alien species (other than species of Union concern) PJ03 Changes in precipitation regimes due to climate change

1.4 Legislative Context

There is a comprehensive system of legislation, both domestic and international, which aims to protect biodiversity at a landscape, habitat and species level in Ireland. This legislation exists within, and independently of, the planning process.

In Ireland, the most important pieces of legislation underpinning biodiversity and conservation are:

- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, hereafter referred to as the Habitats Directive.
- European Communities (Birds and Natural Habitats) Regulations, 2011 (S.I. No. 477 of 2011), as amended, hereafter referred to as the Birds and Habitats Regulations.
- Regulation (EU) 2024/1991 of the European Parliament and of the Council of June 2024 on nature restoration and amending Regulation (EU) 2022/869.
- Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds, hereafter referred to as the Birds Directive.
- Wildlife Acts 1976 to 2017, hereafter referred to as the Wildlife Acts; and
- Flora (Protection) Order, 2015 (S.I. No. 356 of 2015).

According to the EU Habitats Directive (92/43/EEC) and the EU Birds Directive (79/409/EEC), Member States are required to establish a Natura 2000 network of sites of highest biodiversity importance for rare and threatened habitats and species across the EU. In Ireland, the Natura 2000 network of European sites includes SACs and Special Protection Areas (SPAs).

SACs are selected for the conservation of Annex I habitats (including priority types which are in danger of disappearance) and Annex II species (other than birds). SPAs are selected for the conservation of Annex I birds and all migratory birds and their habitats. The Annex habitats and species, for which each site is selected, are the qualifying interests (QI) of the SAC and special

conservation interest (SCI). Conservation objectives for the site are defined for these qualifying interests.

The EU Nature Restoration Regulation aims to restore damaged ecosystems and improve biodiversity with particular focus on capturing and storing carbon and reducing the impact of natural disasters. Specific targets include improving and re-establishing biodiverse habitats on a large scale and bringing back species populations by improving and enlarging their habitats. EU countries are required to submit National Restoration Plans to the European Commission showing how they will deliver on the targets and monitor their progress.

Ireland is required to manage water resources in an integrated way under the Water Framework Directive (WFD, 2000/60/EC) and the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003). Member States are required to submit River Basin Management Plans to the European Commission showing how they will protect and improve the water environment. Restoring surface and groundwater bodies to the equivalent of 'good status' or better, and to protect water from any further deterioration requires collaboration at a local and national level. Implementing the WFD supports the achievement of site-specific conservation objectives for fen habitats, contributing to their favourable conservation status.

1.5 Outline of this FRP document

- Section 2 of this FRP report outlines details of Lough Mareegan and the conservation objectives for fen habitat.
- Section 3 outlines the findings from the land and water desktop and site monitoring surveys that were carried out to inform the development of this FRP.
- Section 4 outlines the findings from the ecological desktop and site monitoring surveys that were carried out to inform the development of this FRP.
- Section 5 provides a summary of the key pressures identified by this FRP report that are impacting on fen.
- Section 6 outlines the key restoration measures proposed by this FRP.
- Section 7 outlines additional considerations to inform the development of the FRP.
- Section 8 outlines key players in the FRP, summarises restoration actions proposed, habitats that will benefit and further steps required to prepare for implementation.

Restoration actions proposed by this FRP assessment are mapped in GIS format and delivered to NPWS in accordance with NPWS data standards. This includes detailed mapping of the key pressures addressed by this assessment, detailed mapping of proposed restoration actions, ecological survey results and referenced sensitivity areas. Regarding maps presented, and following consultation with NPWS, due to the sensitivity of many of the species recorded or referenced, species names are omitted from Map legends. This is to ensure no confidential or highly sensitive locations are revealed which might result in negative impacts. GIS Shapefiles which accompany this report include all relevant data on referenced species.

2 Site Overview

2.1 Lough Mareegan

Lough Mareegan is located in County Westmeath 10 km north of Athlone town and east of Lough Ree. The large site of 89ha has developed around a series of small lakes in a valley at an altitude range from 60 mOD to 77 mOD. Lough Mareegan is a hard-water lake (corresponding to the Annex I quality 3140 Hard-water lake) surrounded by a complex of fen, woodland and cutover raised bog. The fen is unmanaged and includes stands of Annex I quality 7210 *Cladium* fen, 7230 Alkaline fen and 91E0 Alluvial woodland. The northern section of the site supports pockets of fen which have developed on historically cutover raised bog. The habitat is heterogenous as a result of past turf cutting and is characterised by numerous drains. There is a petrifying spring located within the northern section of the site.

Figure 2-1 outlines the location and extent of Lough Mareegan.

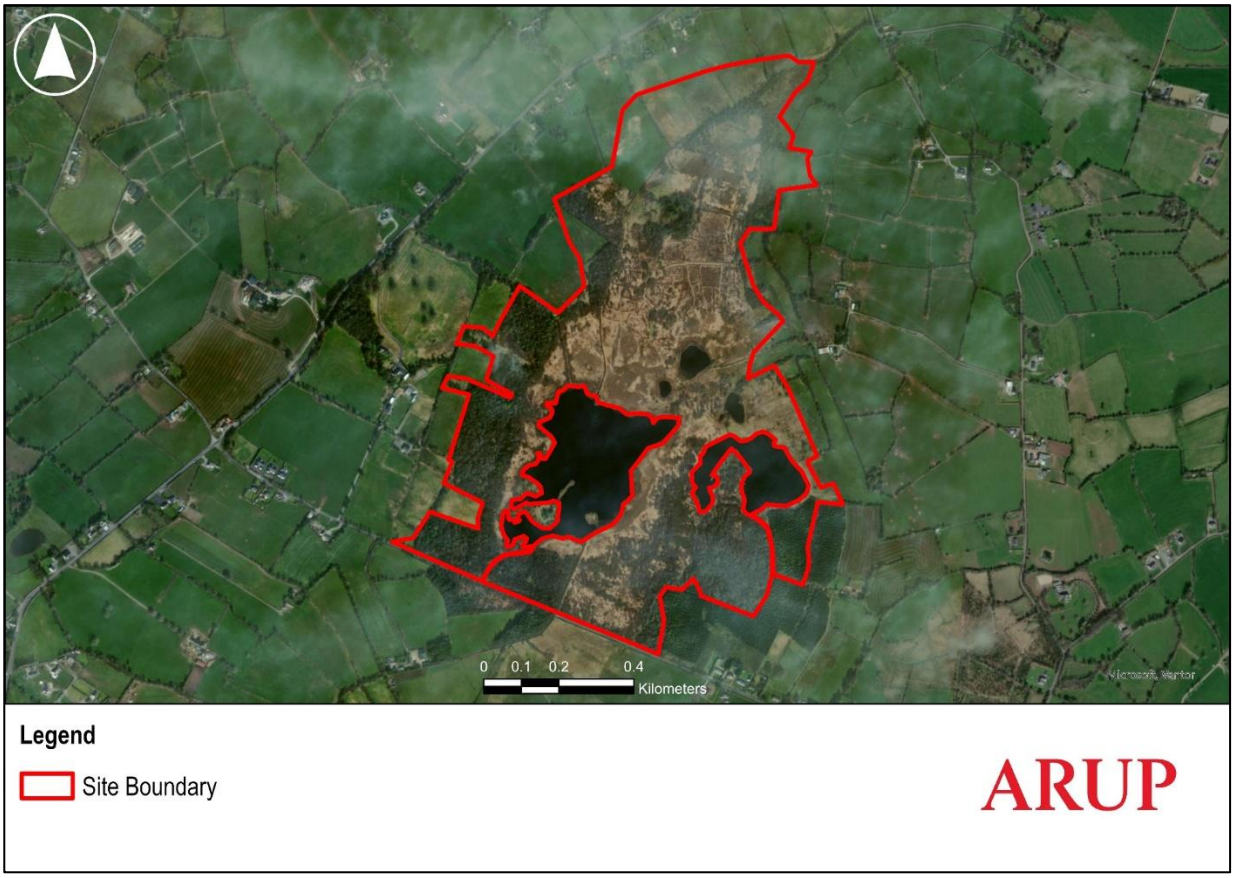


Figure 2-1: Site location map

Lough Mareegan is not a designated site but is surrounded by several including Waterstown Lake pNHA, Lough Ree pNHA, Lough Ree SPA and SAC. Under the Water Framework Directive most of the site is located within the Upper Shannon 26E Catchment, Breensford_SC_010 Sub-Catchment and Glassan_SC_070 River Sub-basin that drains toward Lough Ree at Killinure Lough.

2.2 Fen Condition Assessment

Lough Mareegan was surveyed as part of the NFS between 9th and 10th August 2022 (Brophy et al., In prep). During the NFS, the following notes were recorded:

- Most of the site was unmanaged and rank with extensive cattle grazing in small part.
- The fen is best developed around the lakes and the northern end, with fen development in small turf cutting hollows in the central cutover raised bog area.
- There are numerous drains on site most of which were dry at the time of survey. Drains connecting the lakes were wide, deep and water filled.

The Structure & functions of the following Annex I quality habitats were recorded:

- 7210 *Cladium* fens: Unfavourable-Bad
- 7230 Alkaline fens: Unfavourable-Bad

2.3 Site-specific conservation objectives

As Lough Mareegan is not an SAC, it does not have Site-Specific Conservation Objectives (SSCO). Attributes and targets for Annex I habitats vary and are specific to each site, therefore while they cannot be directly applied to Lough Mareegan, general conservation objectives can be applied as a basis to inform favourable conservation status of the fen habitats. This includes measures such as maintaining appropriate hydrological levels and quality or abundance of vegetation communities and appropriate physical structure relevant to Annex I habitats.

3 Land and Water

3.1 Desktop Study

3.1.1 Meteorological Conditions

Understanding long-term meteorological patterns is key for informing effective fen restoration planning, particularly with respect to hydrological dynamics. To support this, historical precipitation datasets over the past 30 years from the closest Met Éireann weather station, Athlone O.P.W, were reviewed to assess seasonal variability in rainfall at the site and surrounding areas (Met Éireann, 2025).

Two datasets are presented: (1) average monthly precipitation (mm), incorporating a 30-year period to show seasonal distribution patterns (Figure 3-1) and (2) total annual precipitation (mm) for each year within the 30-year record (Figure 3-1), to identify longitudinal trends. This information is important to assess water availability and to evaluate the feasibility and sustainability of restoration actions aimed at restoring or maintaining suitable hydrological conditions.

The average monthly rainfall is highest in the winter months (October to January) and lowest in late spring (April and May). Minimum rainfall follows a similar pattern, while the maximum monthly rainfall shows a notable increase in winter (Figure 3-1).

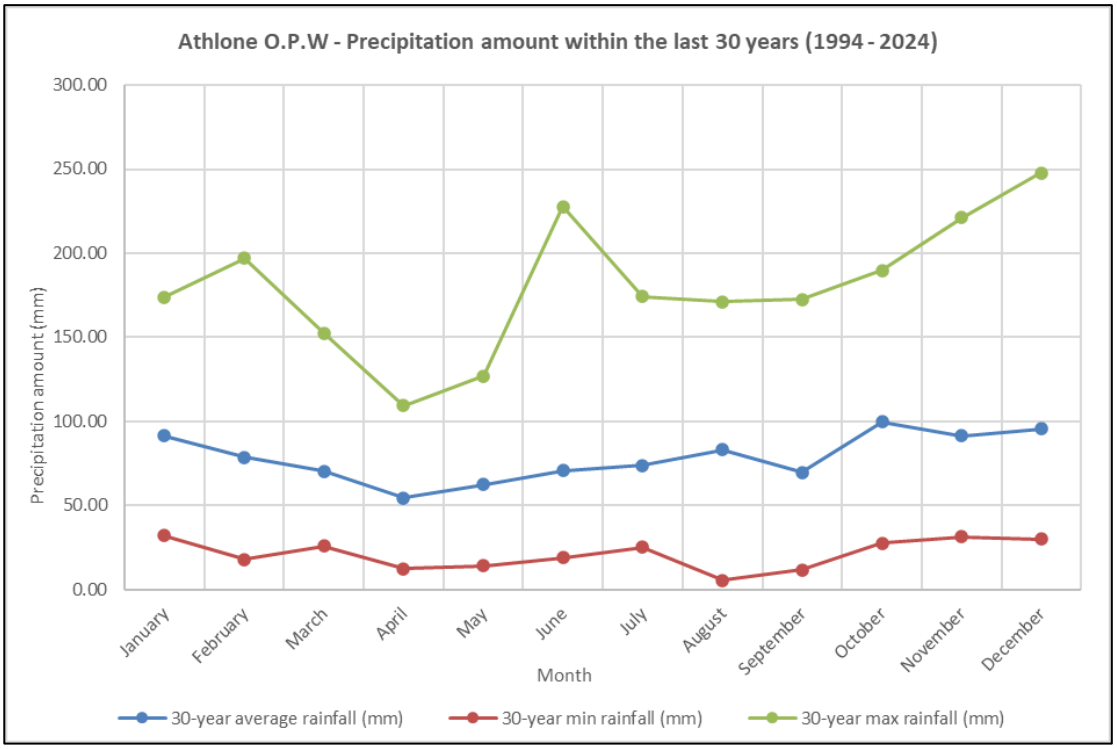


Figure 3-1: Athlone O.P.W-Total annual precipitation within a 30-year period (1954-2024)

3.1.2 Hydrogeological Setting

The majority of the site is underlain by the Lucan Formation, characterised by dark, fine-grained micritic limestones with shale interbeds, while the eastern portion is underlain by the Waulsortian Limestones, comprising pale-grey, massive micritic mud-mound limestones that are commonly karstified, giving rise to locally complex groundwater flow conditions.

The bedrock geology of the site is presented in Figure 3-2.

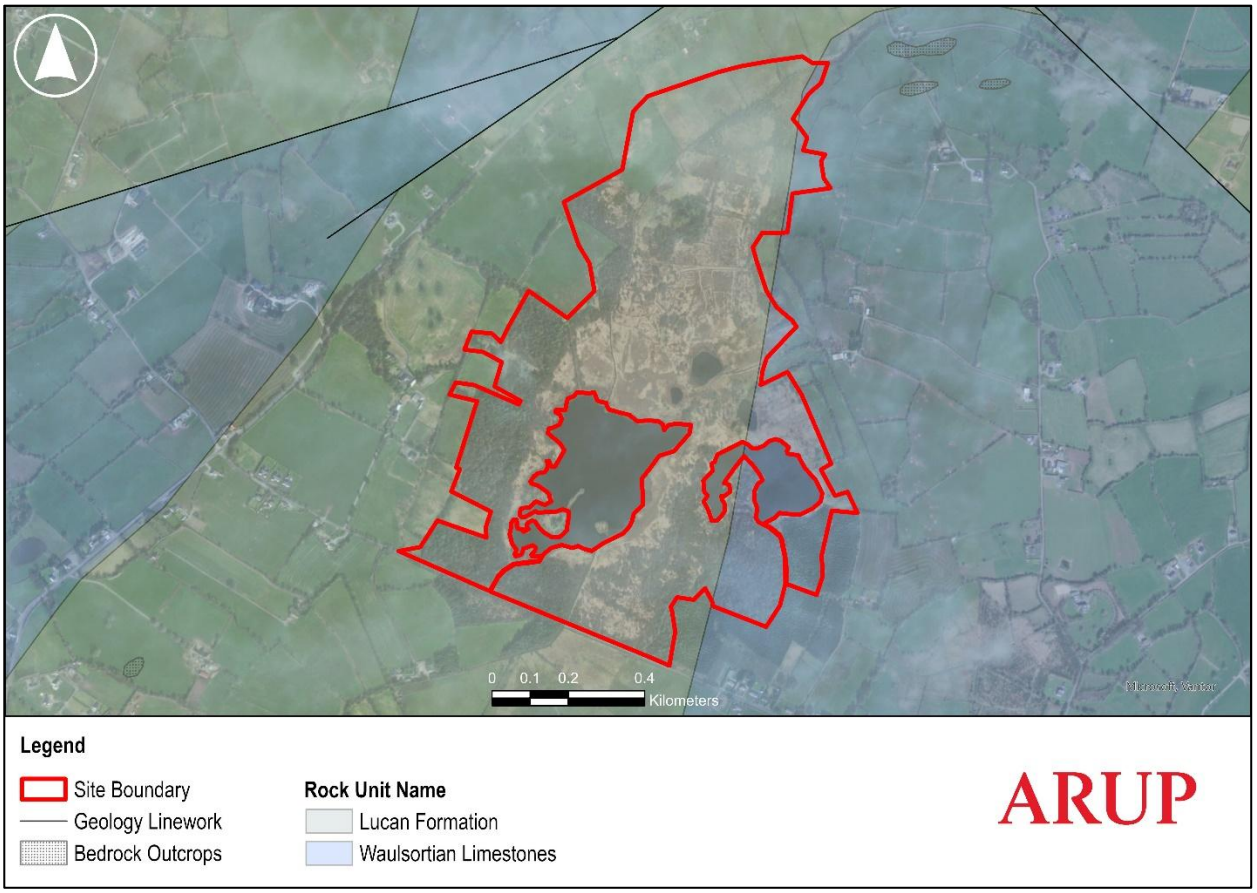


Figure 3-2: Bedrock Geology of Lough Mareegan

The site is underlain by a Locally Important Aquifer (LI), which is moderately productive only in local fractured zones, with groundwater movement largely confined to a shallow weathered bedrock layer and interconnected fissures (Figure 3-3).

Groundwater flow within this karstified zone typically occurs through preferential fracture and dissolution features, remaining largely contained within the local groundwater body. To the east and south, locally important sand/gravel aquifers provide higher-permeability pathways, supporting more uniform and efficient lateral groundwater movement. This combination of karstified limestone to the west with gravel deposits to the east and south leads the site's overall hydrogeological complexity.

The Lough Mareegan groundwater body: Inny, which underlies the site has an overall 'poor' status. The groundwater body's overall status is 'not at risk' of not achieving its WFD objectives (EPA, 2024).

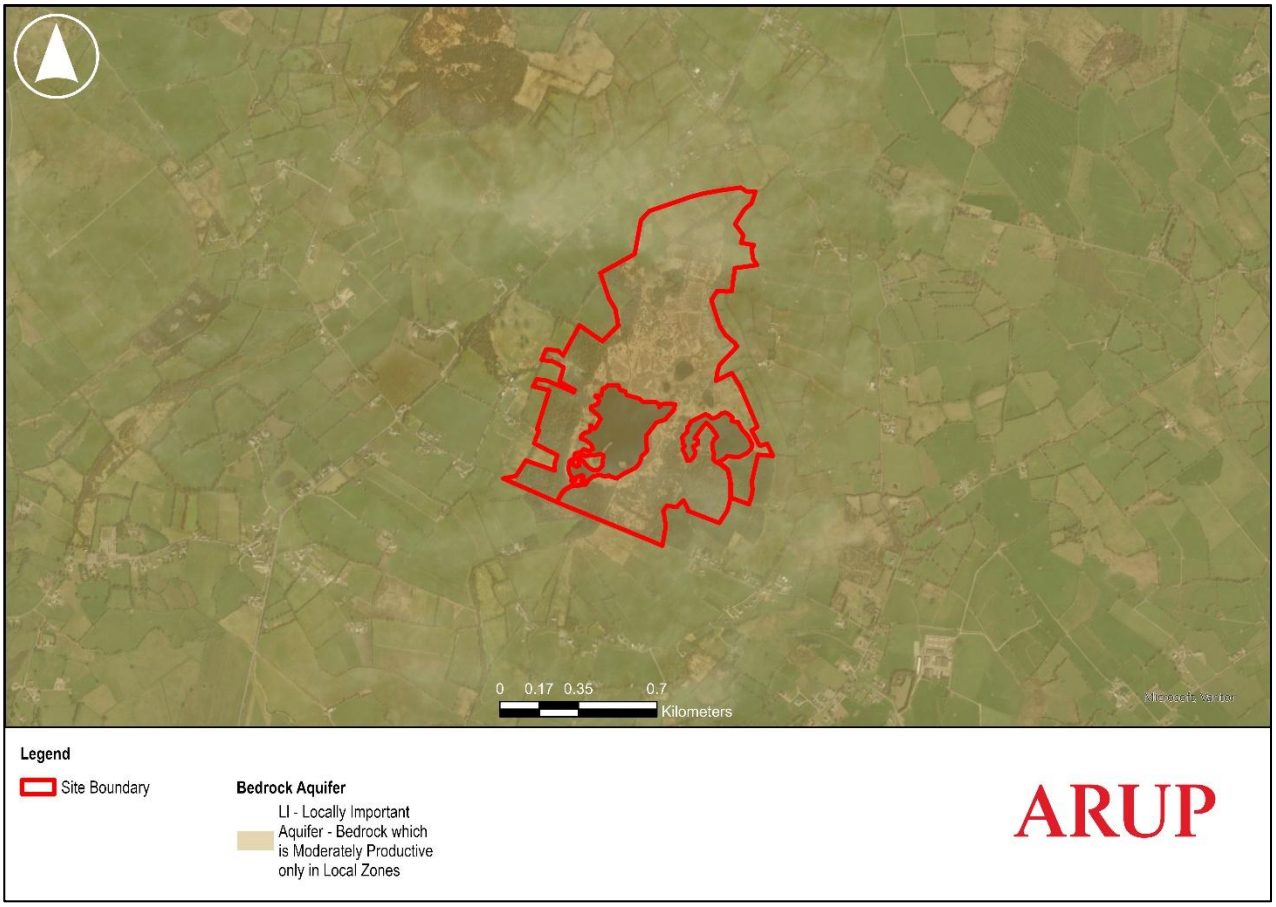


Figure 3-3: Aquifer classification and karst underlying Lough Mareegan

Quaternary sediments within the site boundary comprise fen peat with a body of water, with small areas of limestone-derived till occurring in the north and a localised bedrock outcrop in the northeast. The surrounding area is underlain predominantly by limestone-derived till, with cut-over raised peat and a narrow band of alluvium to the north. Bedrock outcrops are present in the wider landscape, and an area of lacustrine sediments occurs to the southwest. The limestone-derived till predates the peat, having formed during glacial retreat, whereas the peat accumulated during the post-glacial warmer period but has since been modified by turf cutting.

The subsoil types underlying the site are presented in Figure 3-4.

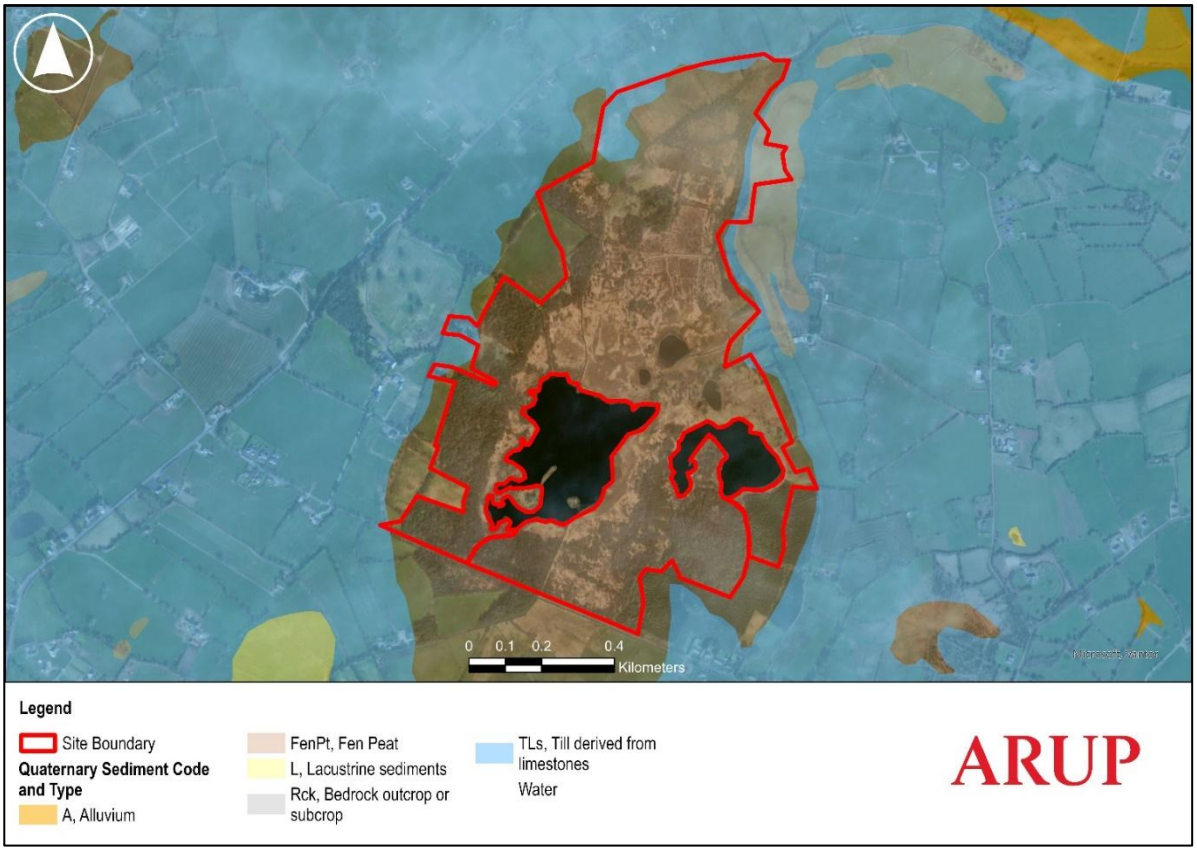


Figure 3-4: Sub-soil type underlying Lough Mareegan (Source: GSI Quaternary map)

Groundwater vulnerability across the site is predominantly moderate. Along the eastern part of the site, this transitions into a band of high vulnerability, followed by a narrower band of extreme vulnerability, with two mapped areas of rock at or near the surface adjacent to the boundary. This pattern is reflected by the recharge rates, with the small north-east area of till is moderate (101 to 150 mm/year), and lower in the fen peat areas across the rest of the site (1 to 50 mm/year).

The groundwater vulnerability for the site is presented in Figure 3-5.

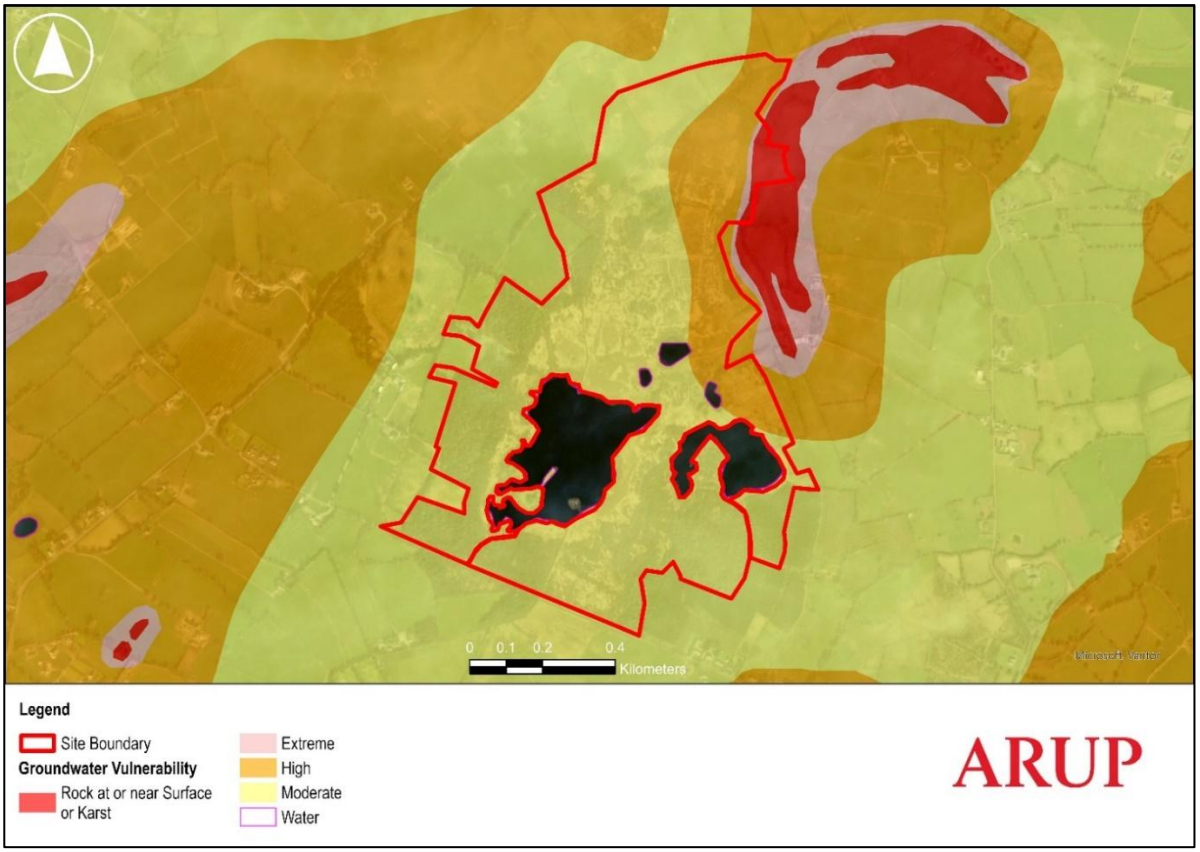


Figure 3-5: Groundwater vulnerability map for Lough Mareegan (Source: GSI)

3.1.3 Topographic and Surface Water Drainage

The site is located within the Upper Shannon Catchment (Catchment ID:26E) and the WFD Catchment sub catchment: Breensford_SC_010 (Catchment ID:26E_4) (Figure 3-6). The Upper Shannon catchments drain towards Kilinure Lough and then to Lough Ree. The outflow of Lough Ree flows towards Lough Derg, to the transitional waterbodies of Limerick Dock and onto Upper Shannon Estuary, then Lower Shannon Estuary and out to the sea at the Mouth of the Shannon.

GLASSAN STREAM_010 WFD River waterbody is classed as ‘moderate’ WFD Status and is being reviewed regarding achieving its WFD objective (EPA, 2024).

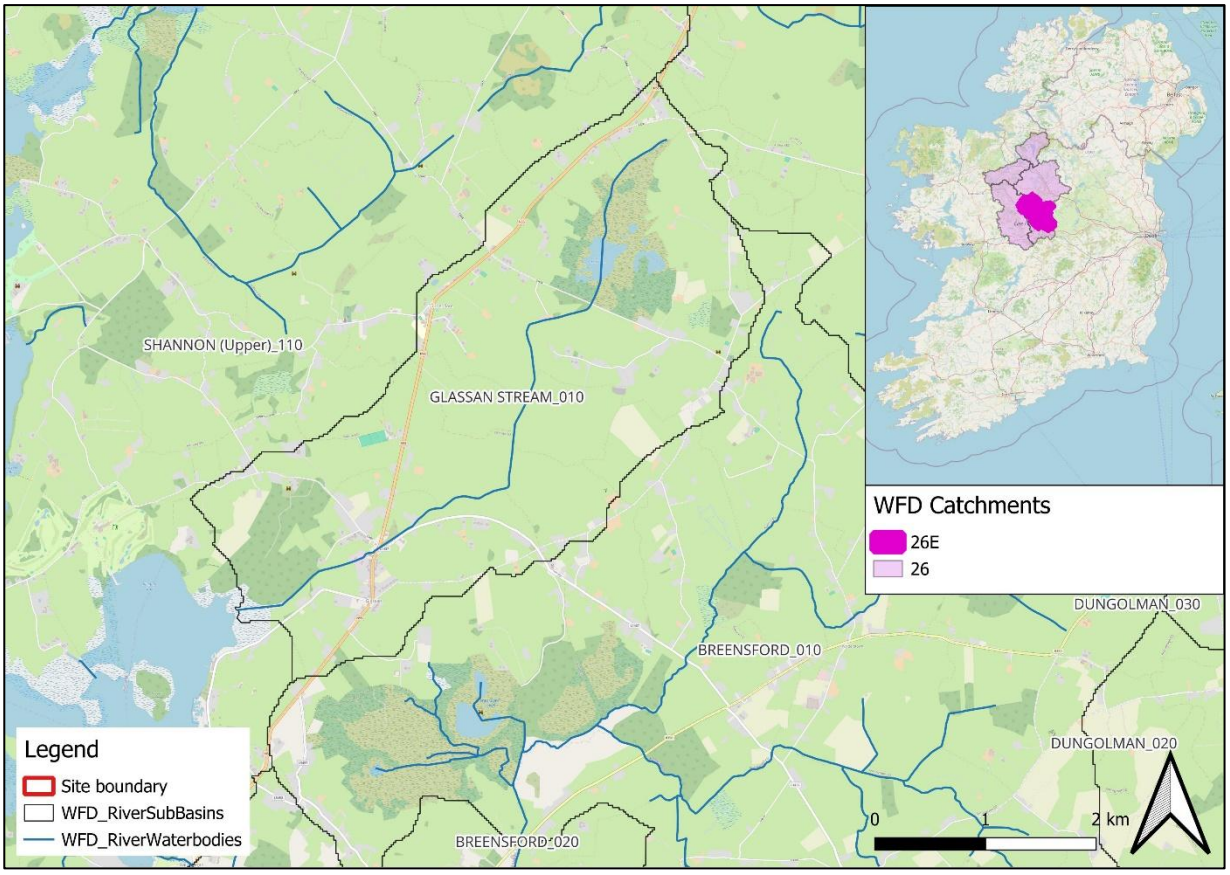


Figure 3-6: WFD Catchment and River sub-basin (EPA, 2024)

An assessment of historical and current hydrological data indicates that the water regime of Lough Mareegan has changed over time, primarily due to drainage for peat extraction activities. There is also evidence of gravel quarrying. Historical maps from the early-1800s show an open water body within the site boundary. The open water is surrounded by springs and wells to the north and east with a large drain passing through the centre of the site from the north to the open water of the lake. The drain then extended from the outlet of the lake in the south. By the 1940s, the larger lake area had reduced, disconnecting from smaller lakes which were likely still fed from upstream seasonal springs and groundwater contributions.

Historical water distribution and retention within wetland is shown in Figure 3-7.

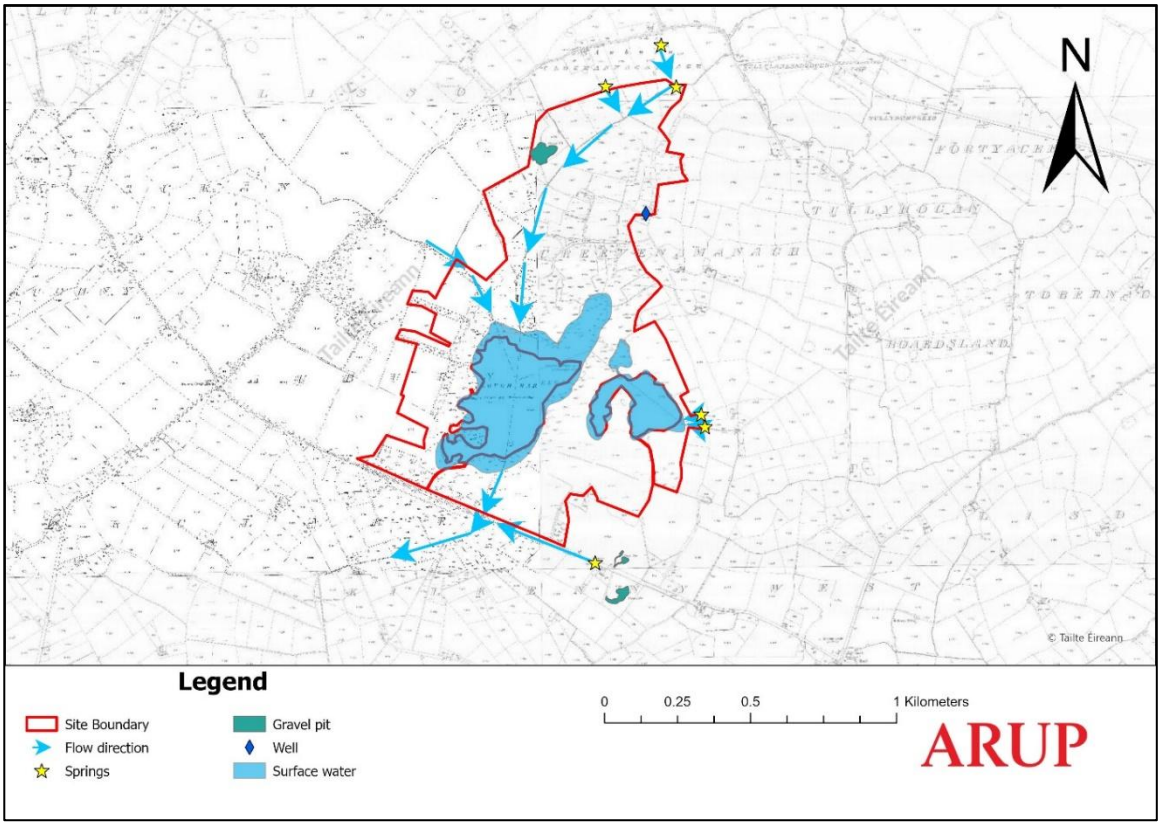


Figure 3-7: Historical water distribution and retention within wetland (Tailte Éireann Historical mapping)

The mapped Wetness Index[1] indicates two core areas of permanent water within the site: one large body in the southwest and a smaller, distinct waterbody in the southeast. Surrounding these, extensive zones of temporary water and temporary wet extend northwards through the central spine of the site, reflecting alternating periods of saturation and drying across 2012–2018.

This pattern indicates a mosaic of variable soil-moisture conditions typical of intermittently inundated peatland surfaces. Areas mapped as temporary wet represent locations with 25–75% wet instances, signalling seasonal or event-driven water presence across the central and northern portions of the site. Three distinct areas are classified as Permanent Wet: a broad saturated zone immediately north and east of the southwestern waterbody, a second concentrated cluster around the southeastern waterbody, and a smaller isolated permanent-wet patch in the northern half of the site. These areas show consistently high moisture levels (>75% wet instances) and represent the hydrological core of the system (Figure 3-8).

[1] Dataset available at 10m resolution indicating the occurrence of water and wet surfaces over the period from 2012 to 2018.

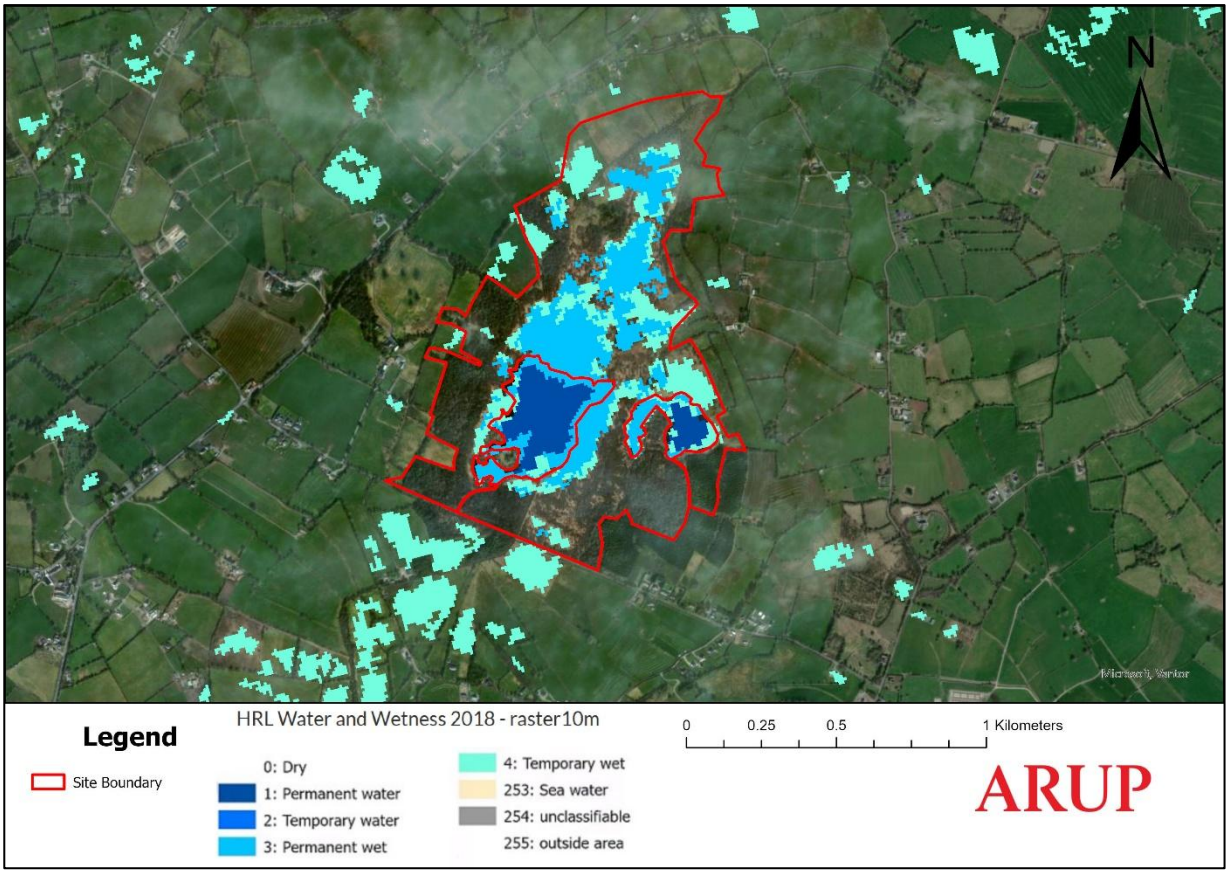


Figure 3-8: HRL Water and Wetness – 2018 of Lough Mareegan (Copernicus, 2025)

Total productivity mapping for the site highlights clear spatial variation in ecosystem condition. Areas of lowest productivity occur in the central and southwestern parts of the site, aligning with locations previously identified as permanently wet. This pattern is characteristic of functioning peatland surfaces where high water levels limit vegetation growth and maintain saturated conditions.

Much of the remaining area within the site displays moderate productivity, forming a broad band across the central and northern sections. These zones typically correspond with semi-degraded peatland habitats where historic drainage, vegetation encroachment, or drying has reduced peat-forming capacity. Moderate productivity along the eastern and southern margins is consistent with edge effects from surrounding agricultural activity and localised artificial drainage influencing the fen's hydrology.

Discrete patches of elevated productivity occur around the margins of the wetter cores, particularly along the western flank, the northeastern edge, and immediately east of the large central wet zone. High productivity within mapped peatland extents is often indicative of disturbance, reflecting lowered water tables, increased aerobic decomposition, and a shift towards more productive, non-peat-forming vegetation communities. These localised hotspots suggest that, although peat remains present, hydrological integrity is partially altered, reducing the resilience and ecological function of affected peatland areas (Figure 3-9).

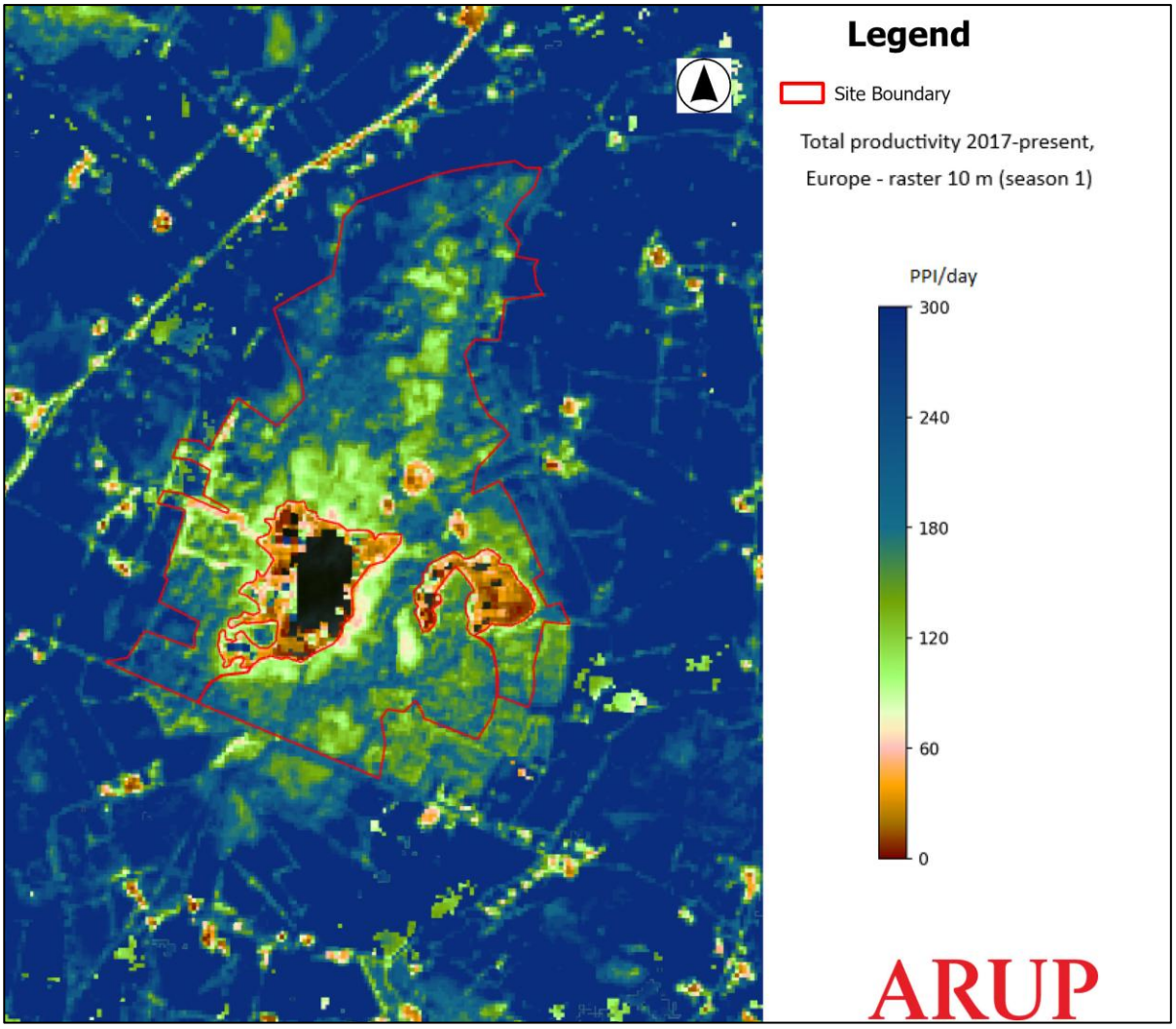


Figure 3-9: Total Productivity 2017 -present, Europe – raster 10m (season 1) of Lough Mareegan (Copernicus, 2025)

The site boundary ranges from 53.7 mOD to the north to 48.8 mOD to the south (Figure 3-10). Outside of the eastern site boundary there is a raised elevation at 83.3 mOD as well as steep slopes. Seasonal springs occur near this area and are directed to the main lake and smaller lakes via deepened drains. Within the site there is a main drainage channel that flows from the northern border of the site at an elevation of 53.7 mOD to the main lake at an elevation of 48.7 mOD. There is a smaller lake to the west of the main lake at an elevation of 48.9 mOD, which seems to be separated from the main lake by raised ground at 50 mOD. There is a bog road at 50 mOD that accesses the raised bog area to the east, which runs towards the central drainage channel. There are drains associated with the turf cutting and drainage along this road. Forest drains on the west are straightened and deepened to 48.8 mOD.

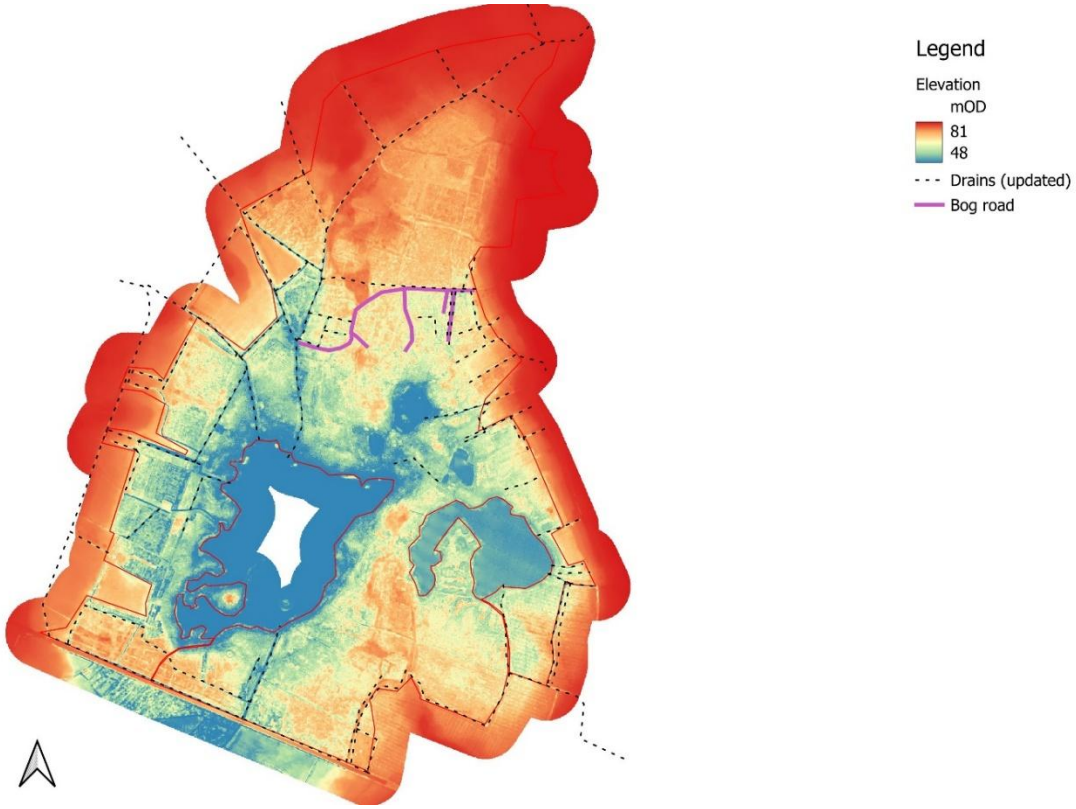


Figure 3-10: Topographic (LiDAR) map of Lough Mareegan with updated drainage

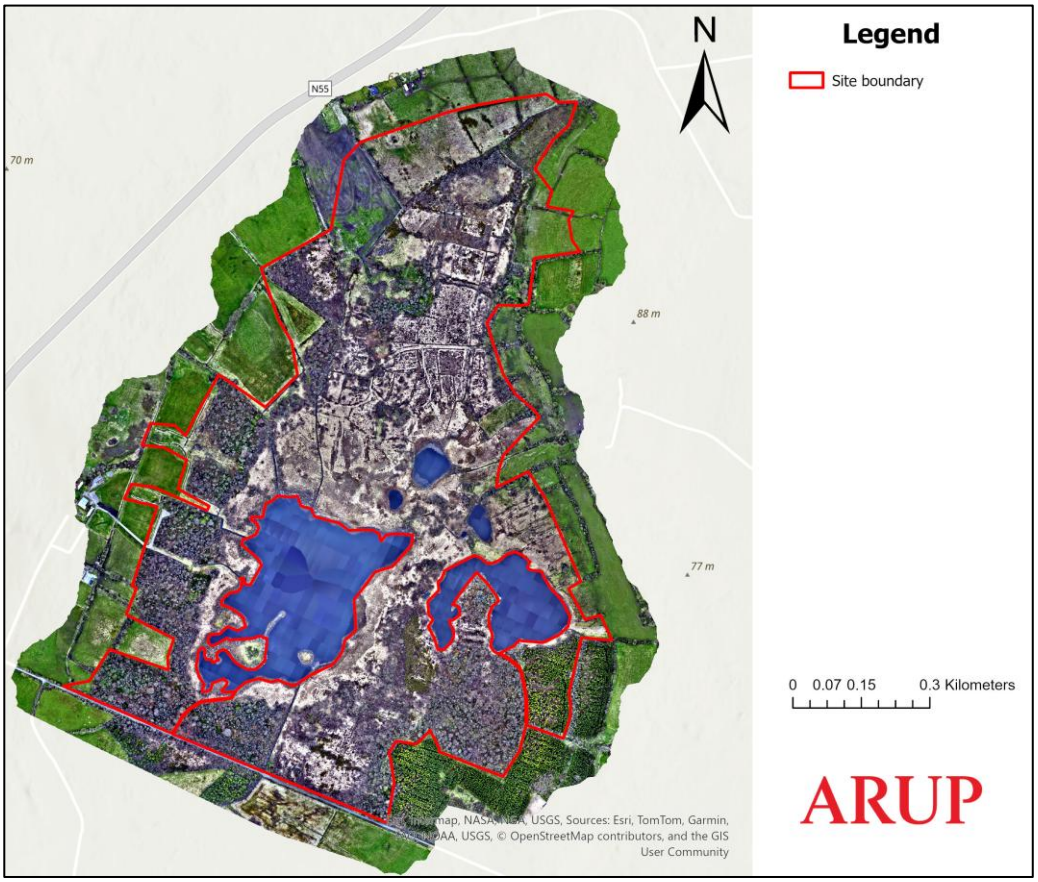


Figure 3-11: Ortho imagery of Lough Mareegan

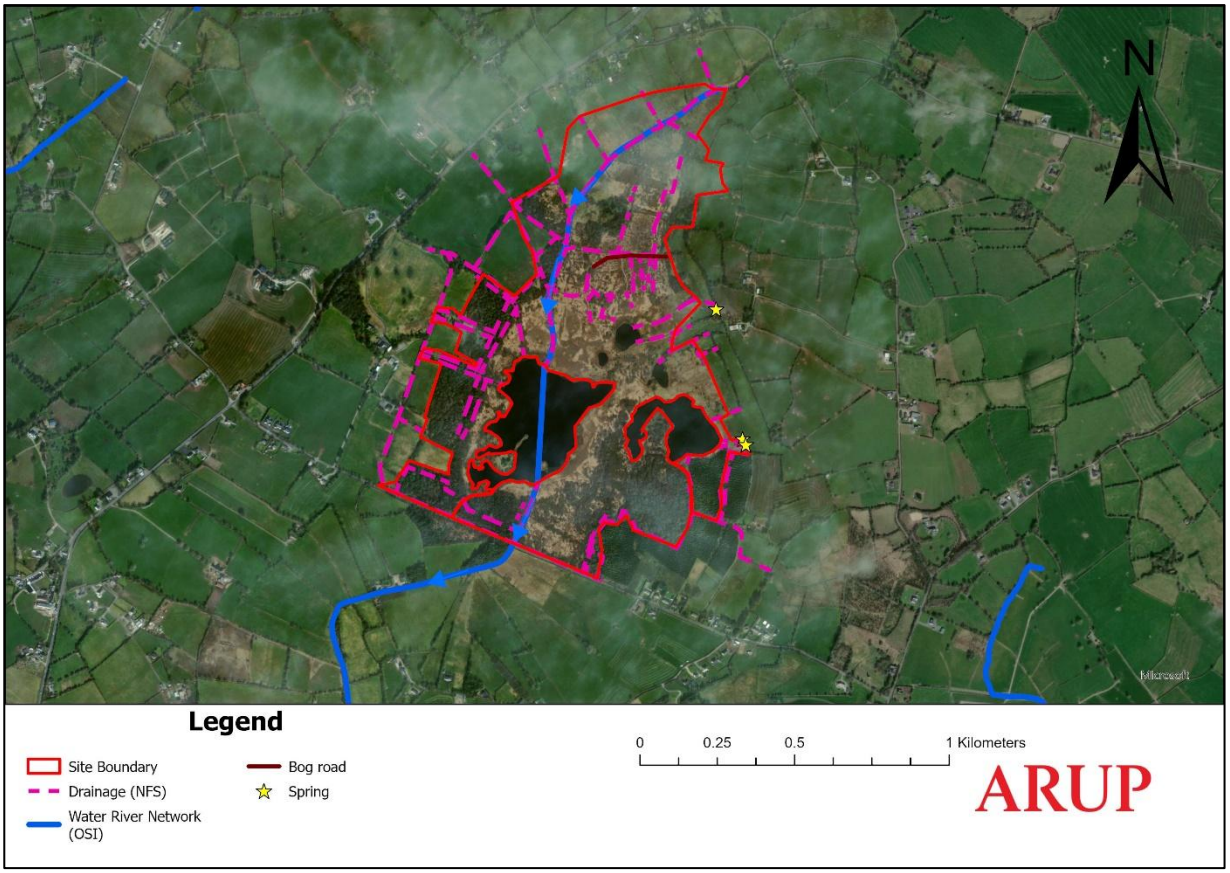


Figure 3-12: Mapped drainage network of Lough Mareegan

3.1.4 Land use Pressures and Water Quality

Pollution Impact Potential (PIP) maps (EPA 2025) show the highest risk areas in the landscape for losses of Nitrate and Phosphorus to waterbodies. The PIP models estimate the annual nutrient losses from agricultural land using spatial data on farm management, soil and hydrogeology. This information is relevant to the SSCO attribute "Water quality – Nutrients" and informs assessment against the SSCO target to maintain nutrient levels and support favourable conservation condition.

High risk areas for phosphorus loss typically have poorly draining soils and dominant overland flow pathways. The site has a high PIP ranking in the north with the land neighbouring the high PIP rank has a moderate PIP rank of 4. This indicates the surrounding agricultural land may be draining into the site boundary or that the site is being used for agricultural purposes. The maps indicate that phosphorus delivery flow paths across the site range from medium to high risk. Pathways were identified across the site. The water draining from the site is high in phosphorus. There are potential preferential pathways identified that locations may be targeted for measures.

Freely draining soils and substantial groundwater pathways are high risk for nitrate losses. The risk of nitrate loss is generally low across the site. The land on the north-east border of the site has a high PIP rank as well land to the north-west border. PIP maps for Phosphorus and Nitrate are presented in Figure 3-13, Figure 3-14 and Figure 3-15 respectively.

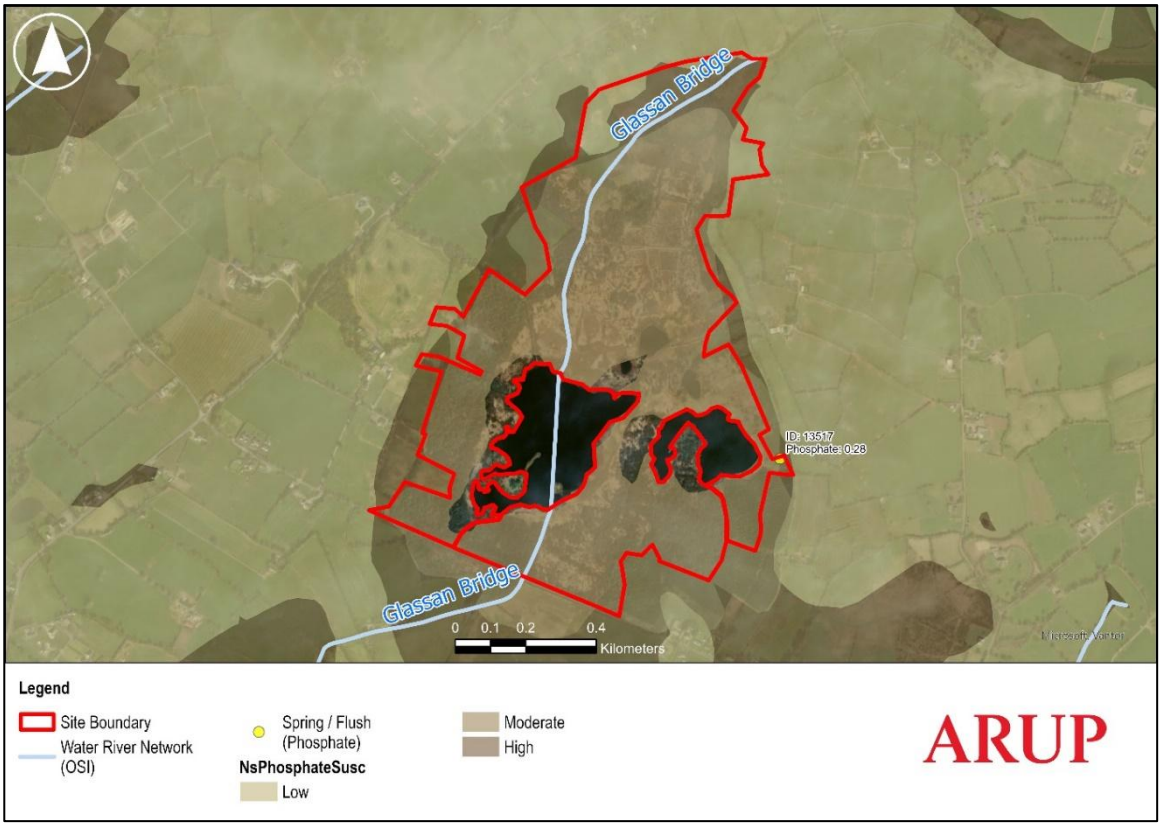


Figure 3-13: PIP maps (Phosphorus) of Lough Mareegan

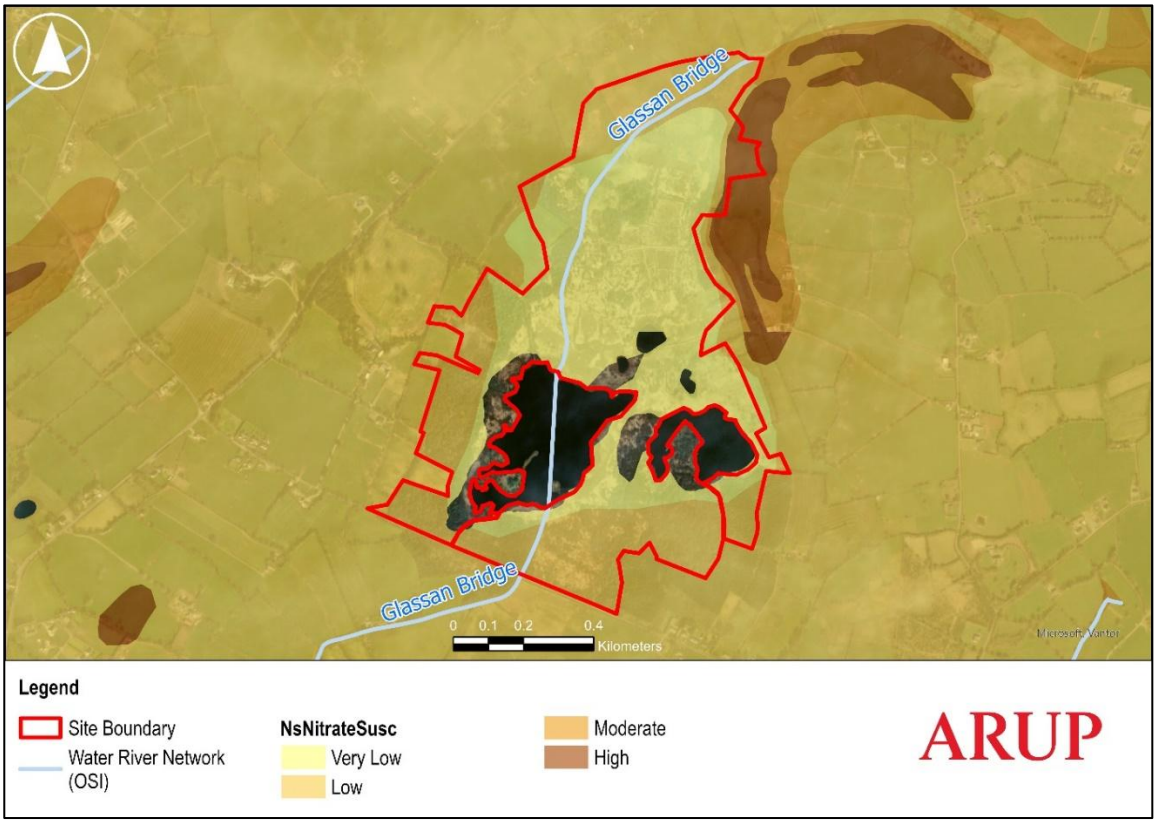


Figure 3-14: PIP maps (Nitrate) near surface pathway of Lough Mareegan

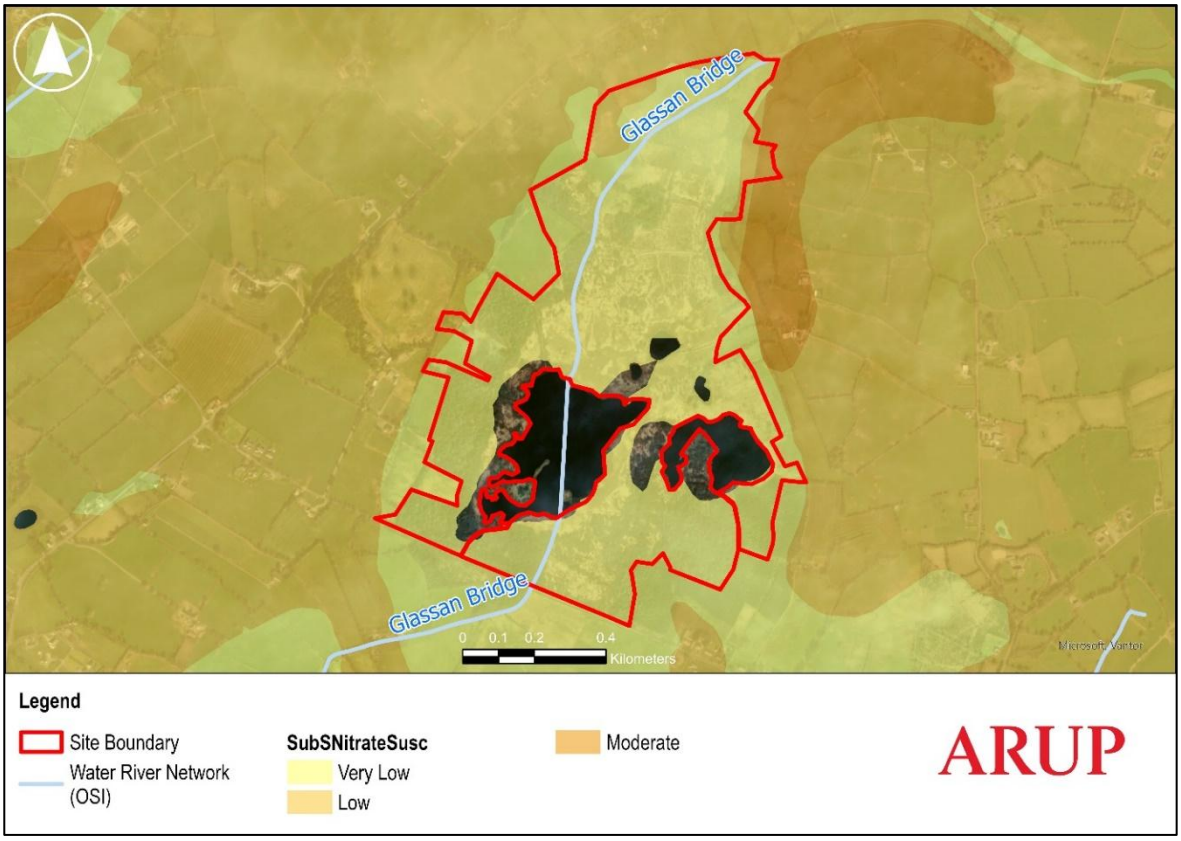


Figure 3-15: PIP maps (Nitrate) subsurface pathway of Lough Mareegan

3.2 Field Survey

Site monitoring was undertaken in February and June 2026, focusing on developing the understanding of the water regime, pressures and implementation of restoration measures within the habitat. The site monitoring included peat depth probing, water quality monitoring and observations of water flow in the drainage network.

Water quality data were collected across multiple areas within and around the site, including fens and associated watercourses. The parameters recorded included pH, EC, temperature, dissolved oxygen (DO), nitrate, and phosphate. Peat depths were probed to assess substrate characteristics.

Locations for water quality monitoring (ID1 to ID11) is presented in Figure 3-16.

Locations for peat monitoring is presented in Figure 3-17.

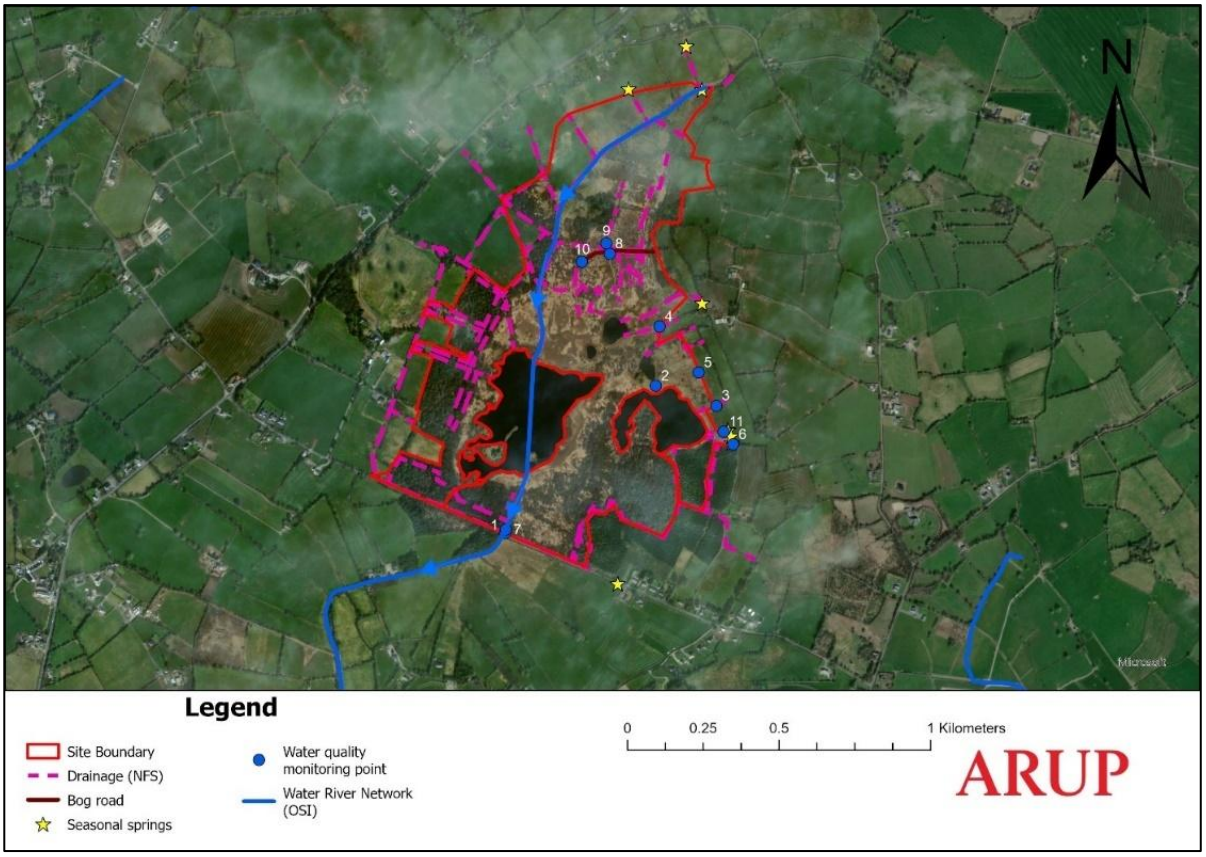


Figure 3-16:Baseline water quality monitoring point locations

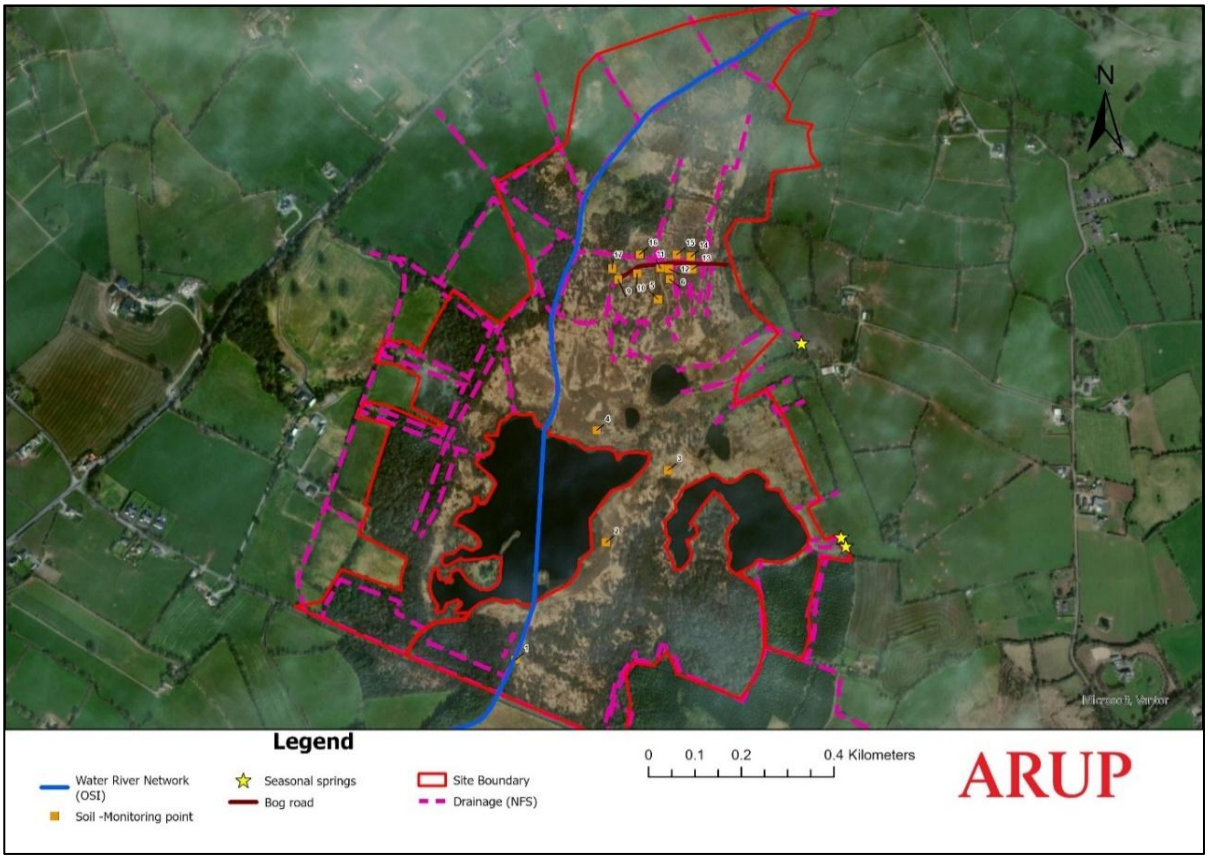


Figure 3-17: Peat probing monitoring locations

3.2.1 Peat Depth Probing and Ground Investigations

Soil type observed during the Scoping Study and Pilot Survey of Fens included peat with a range of the depth from 1 m to 4.1 m.

Peat at the centre of the site, ranged from 1 m to 4 m along the bog road. This is an area of deeper peat which historically would have been cut away. The middle section of the site were noted to be 'shallow fen peat' and to be a 'few cm deep over soft sand'. In the south of the site, peat depth was recorded along the main drain at a depth of 4 m.

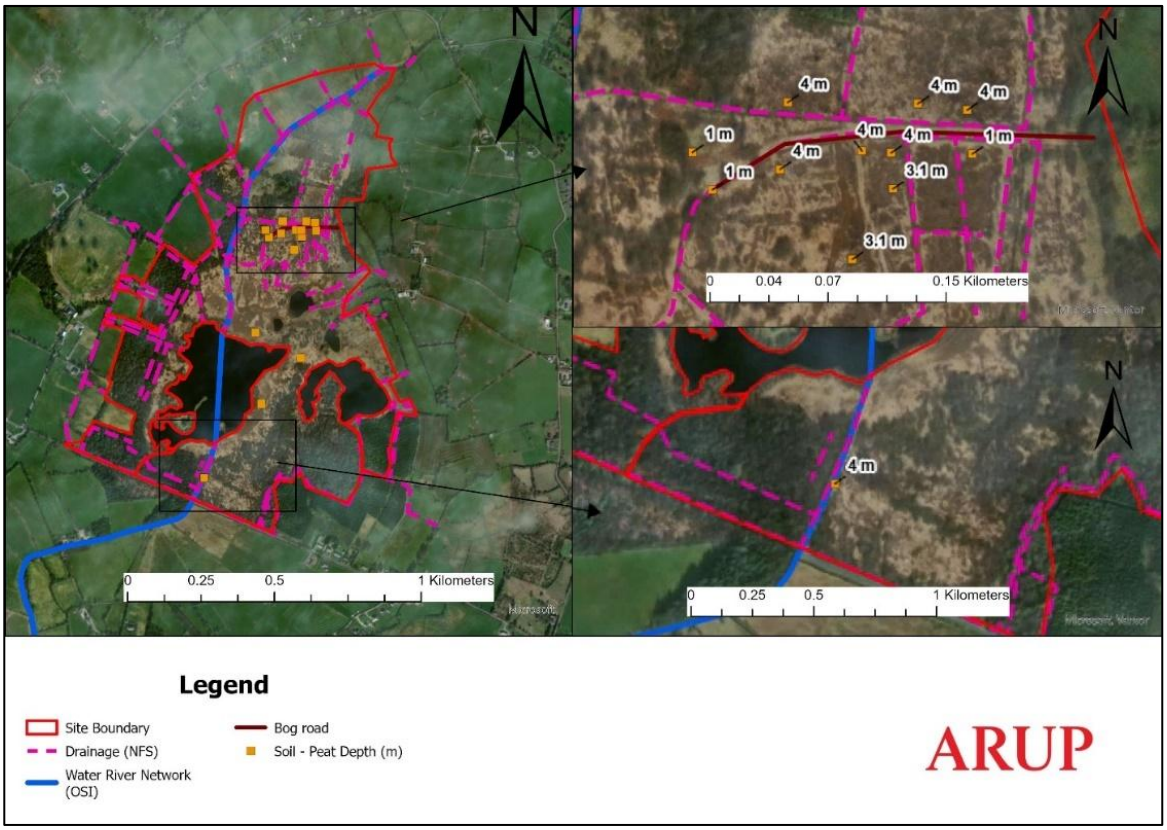


Figure 3-18: Peat depths at monitoring locations

3.2.2 Surface Water levels

Surface water flow direction is from the north to the south, with drainage from the main lake in the south of the site (Figure 3-19). The deeper and wider drainage channels are to the west of the site, with two main drainage channels entering the larger lake from upstream sources.

There are seasonal springs surrounding the site to the north and east, with monitoring points ID 11 and ID 6 being seasonally fed buy upstream springs. Along the eastern boundary of the site, water levels of 0.4 m was recorded in the spring fed drain (ID 4). A drain in the north of the site (ID 9), just north of the bog road, had a low flow with water levels recorded at 0.03 m. The water level (ID 7) was at 1.5 m within the 5m wide outlet drain.

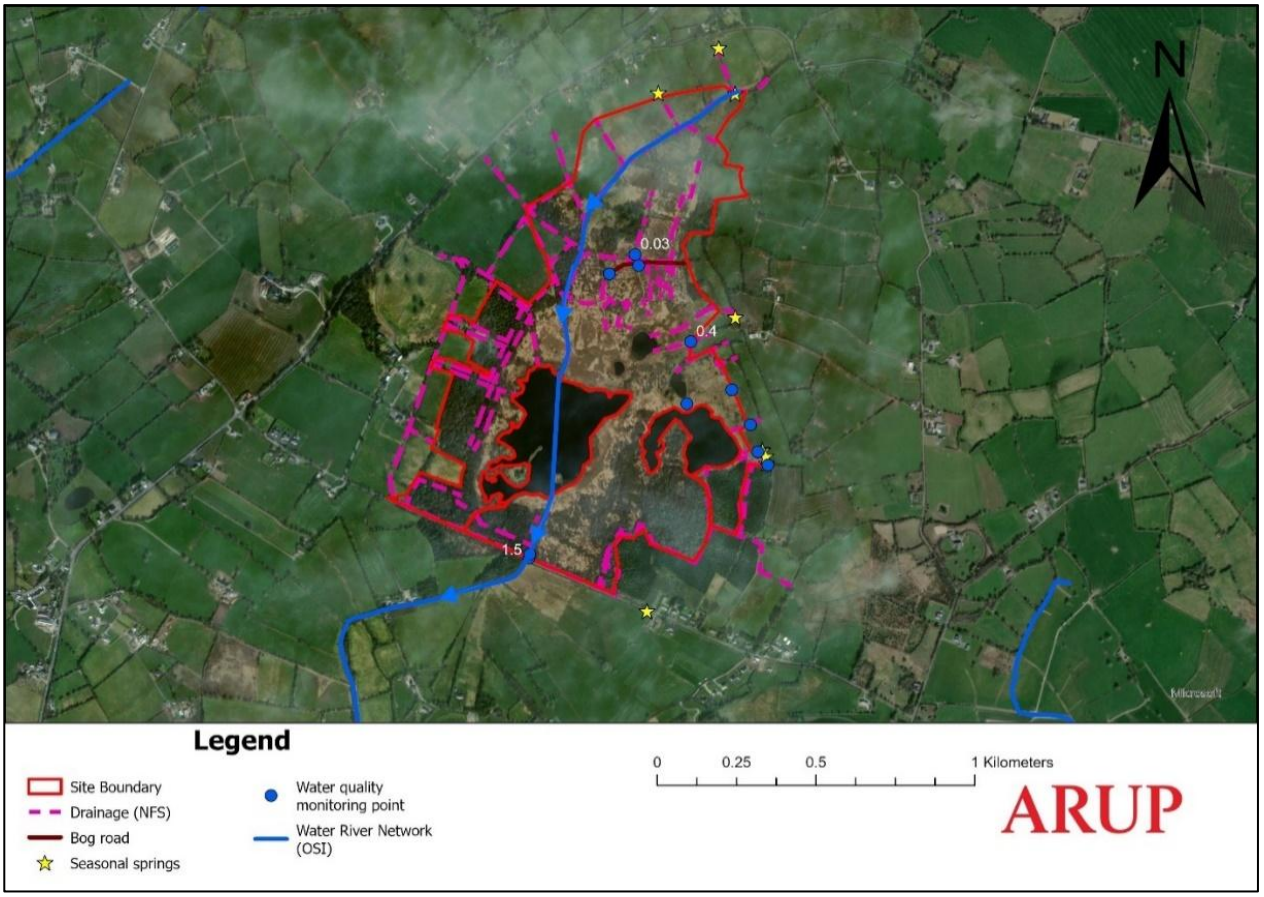


Figure 3-19: Water level (m) of surface water at monitoring points

3.2.3 Water Quality

Water quality monitoring indicates spatial variation in nutrient concentrations across the Lough Mareegan site, with evidence of localised enrichment associated with sections of the drainage network and lake areas.

Phosphate (PO_4) concentrations recorded across the site range from 0.00 mg/L to 2.5 mg/L. Most recorded values exceed the Water Framework Directive (WFD) good status environmental quality standard of 0.107 mg/L PO_4 (0.035 mg/L PO_4-P[2]). The lowest phosphate concentration (0.00 mg/L) was recorded at the drain west of the bog road. Elevated phosphate concentrations were recorded along the eastern boundary, with values of 0.17 mg/L and 0.28 mg/L along the drains. The highest phosphate concentrations were recorded in within the middle section of the bog road with a value of 2.5 mg/L.

Overall, the results indicate elevated values concentrated primarily within the eastern to northeastern area (Figure 3-20).

[2] Government of Ireland, 2015. European Union Environmental Objectives (Surface Waters) Regulations 2009–2015. S.I. No. 272 of 2009, as amended.

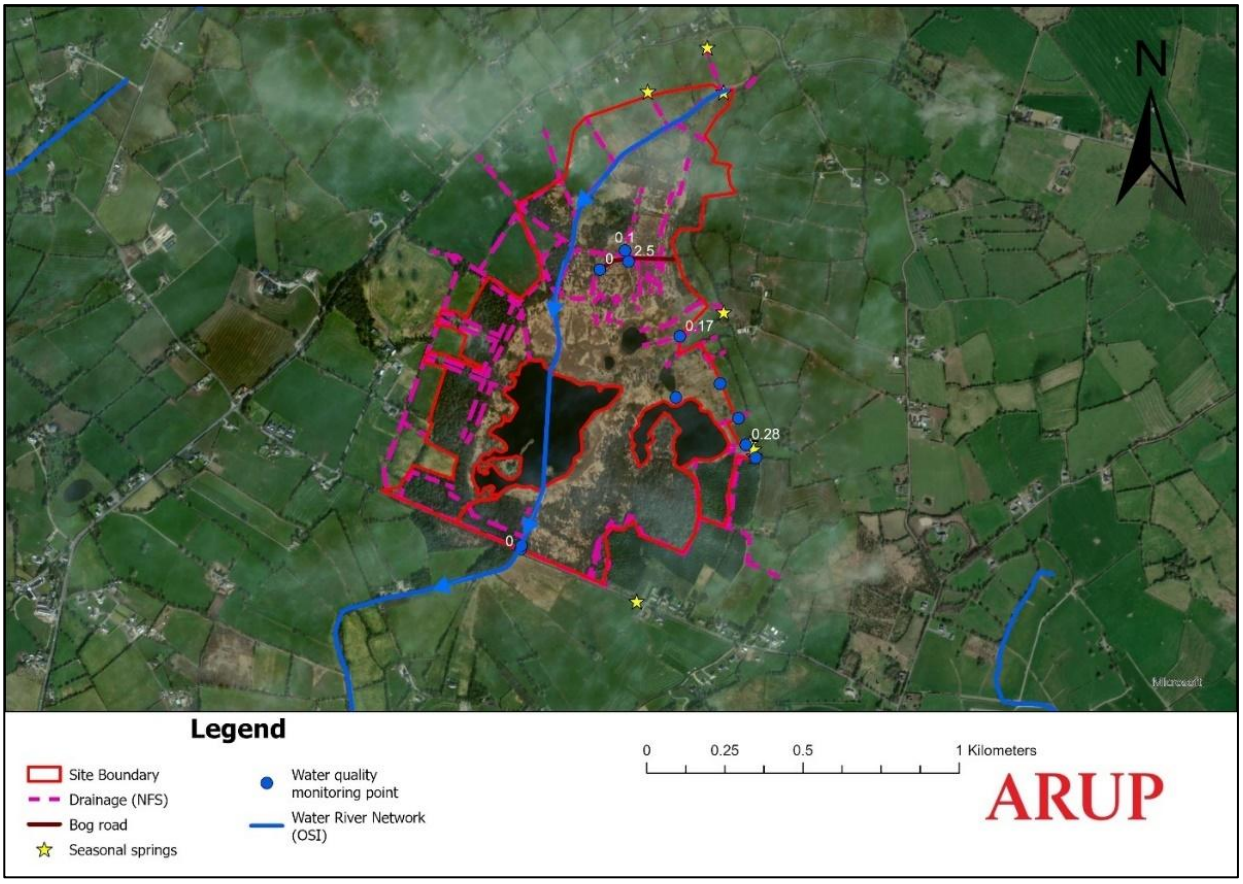


Figure 3-20: Phosphate (mg/l PO4) at Lough Mareegan

Nitrate (NO_3-N) concentrations varied across the site, ranging from 9.7 mg/L to 17.5 mg/L. All recorded values exceed the indicative ecological threshold of 1.8 mg/L NO_3-N (8 mg/L (NO_3^-)) (EPA,2025b), above which impacts on ecological water quality may occur. The highest nitrate concentration (17.5 mg/L) was recorded within a southward flowing drain along the southern boundary. Elevated nitrate concentrations were also recorded along the eastern boundary of (12.1 mg/L) and (14.3 mg/L). Slightly lower nitrate concentrations were recorded along the bog road of (9.7 mg/L), (11 mg/L) and (1.2 mg/L). Overall, the results indicate spatial variability in nitrogen concentrations across the site, with the most elevated values concentrated primarily along the site boundary (Figure 3-21).

The observed nutrient concentrations indicate localised nutrient enrichment within sections of the site. Elevated nitrate and phosphate concentrations are associated primarily with slow-flowing and ponded drainage features, suggesting limited flushing and potential nutrient accumulation. However, concentrations vary notably between monitoring locations, indicating differing hydrological conditions and potential variability in groundwater and surface water inputs across the site.

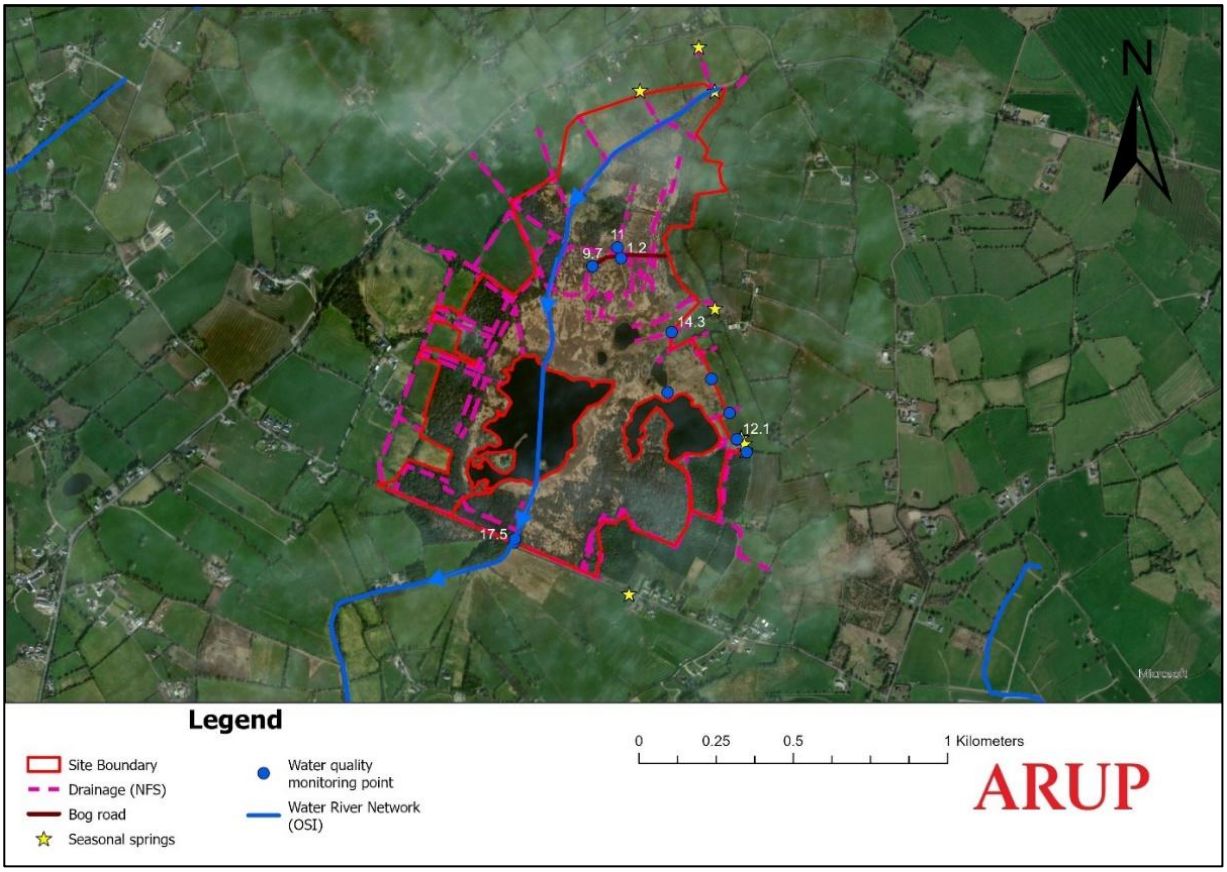


Figure 3-21: Nitrate (mg/l NO_3) at Lough Mareegan

Measurements of pH and electrical conductivity (EC) provide further information into site hydrology and groundwater influence. Recorded pH values ranged from 6.56 to 8.04, indicating neutral to alkaline conditions (Figure 3-22). Electrical conductivity values ranged from 298 µS/cm to 720 µS/cm, with the highest EC values corresponding to areas where elevated nutrient concentrations were also recorded. These EC values may indicate a contribution from mineral-rich groundwater inputs, although variability across the site suggests mixed surface water and groundwater influences (Figure 3-23).

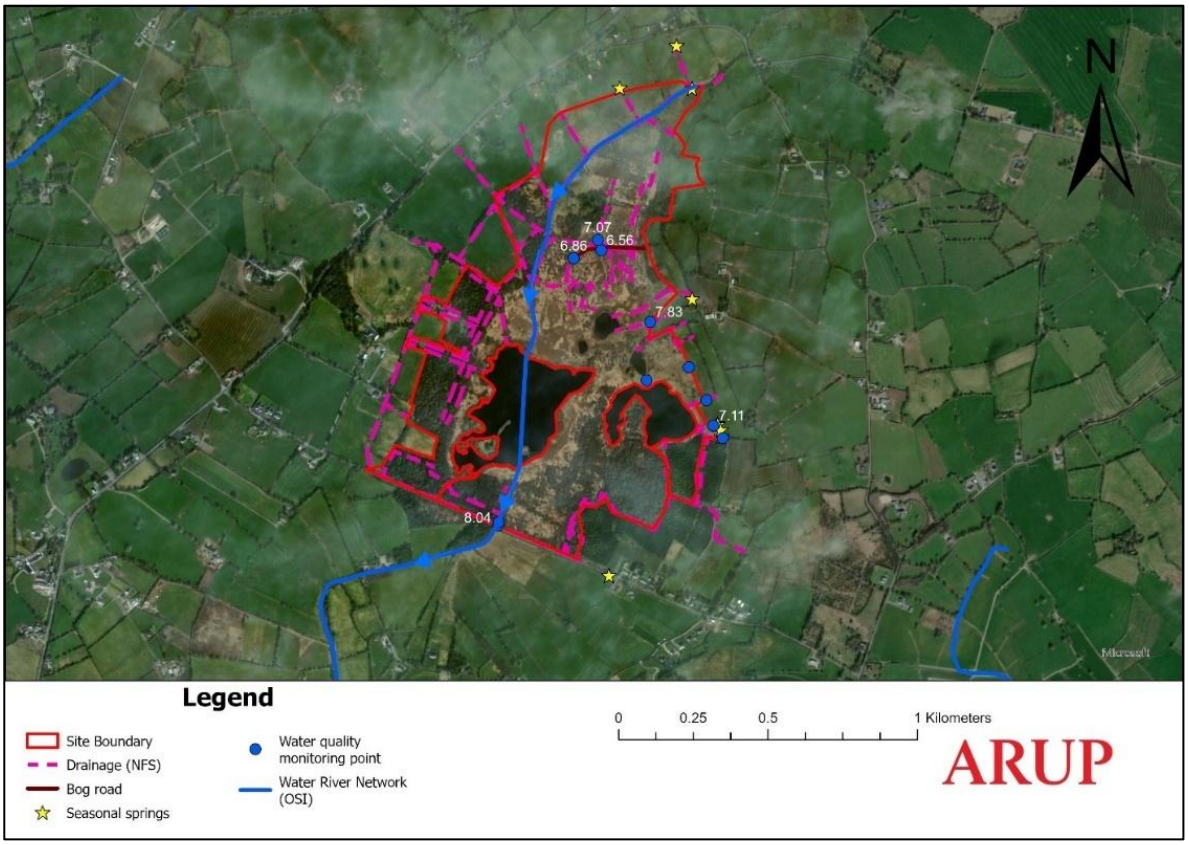


Figure 3-22: pH at Lough Mareegan

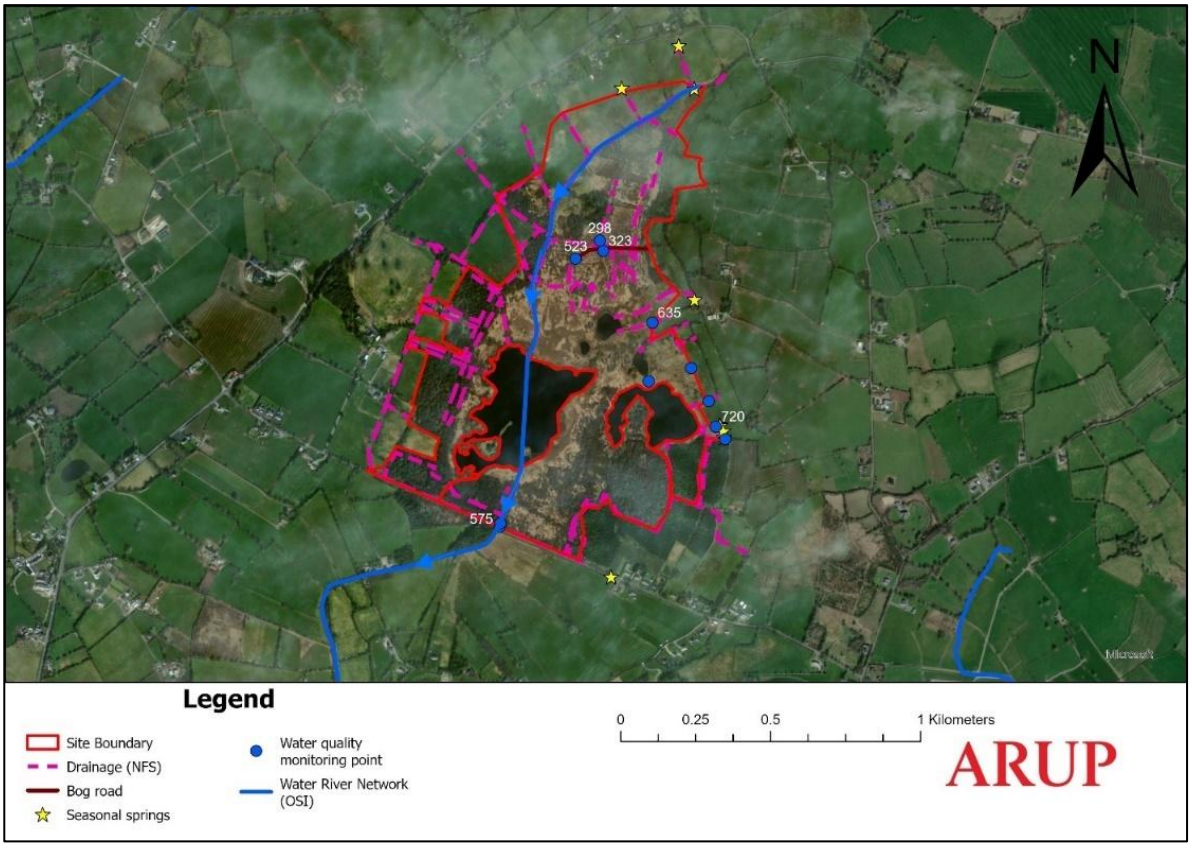


Figure 3-23: Electrical conductivity (EC) (µS/cm) at Lough Mareegan

3.3 Conceptual Site model

The Lough Mareegan site ranges from 53.7 mOD in the north to 48.8 mOD in the south. The profile of the site is sloped from the north to a local depression in the south. Historical springs were identified in the north which are directed towards a central drain to the main lake. A petrifying spring is located in this northern section of the site. The eastern border has rock close to surface which acts as a recharge area for springs. The emerging spring flow is collected in drains which flow towards the smaller eastern lakes. Historical water levels were higher in the central and western area of the site.

The smaller eastern lake is at a higher elevation than the main lake and is separated from the main lake by raised ground. Other areas of raised ground occur along a bog road that connects the eastern hillslope with the central part of the site.

The majority of the site is underlain by the Lucan Formation, characterised by dark, fine grained micritic limestones with shale interbeds, while the eastern portion is underlain by the Waulsortian Limestones, comprising pale grey, massive micritic mud mound limestones that are commonly karstified, giving rise to locally complex groundwater flow conditions. Both formations are classified as Bedrock Aquifers which are moderately productive only in Local Zones (Ll).

The southern section of the site supports the best-developed fen habitats, including Annex I alkaline fen and localised patches of *Cladium* fen vegetation. The electrical conductivity values

(465–686 µS/cm) and neutral to slightly alkaline pH (6.6-7.8) indicate influence from calcium-rich groundwater, which supports the development of these fen habitats.

High nitrate (17.5 mg/L) and phosphate (2.5 mg/L) concentrations were recorded in the drains located in the southern area. The southern outlet drain had the highest nitrate concentration.

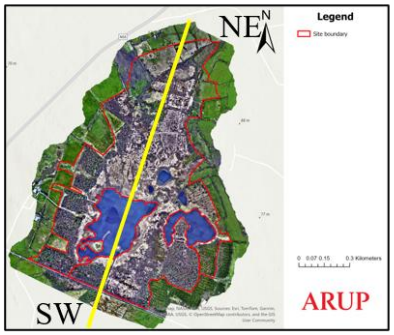
Under the WETMEC framework defined by Wheeler, Shaw & Tanner (2009), Lough Mareegan is consistent with a WETMEC 9b: part-drained groundwater bottom surrounded by WETMEC 16a: groundwater-flushed bottom.

Lough Mareegan
Westmeath County
WFD catchment: 29 Upper Shannon, Breensford_SC_010
WETMEC: 9 (Part-drained Groundwater bottom); 16 (Groundwater flushed bottom)

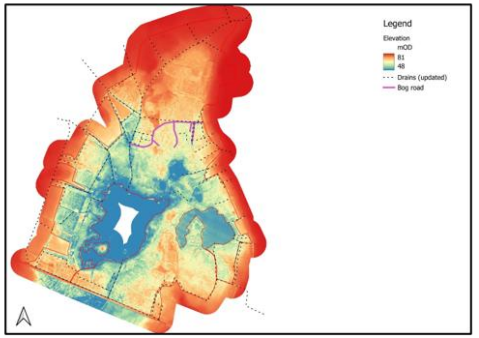
Water key:

Main drain	Seasonal springs
Seasonal drains	Wetland vegetation

Cross section:



Location:



Conceptual site model:

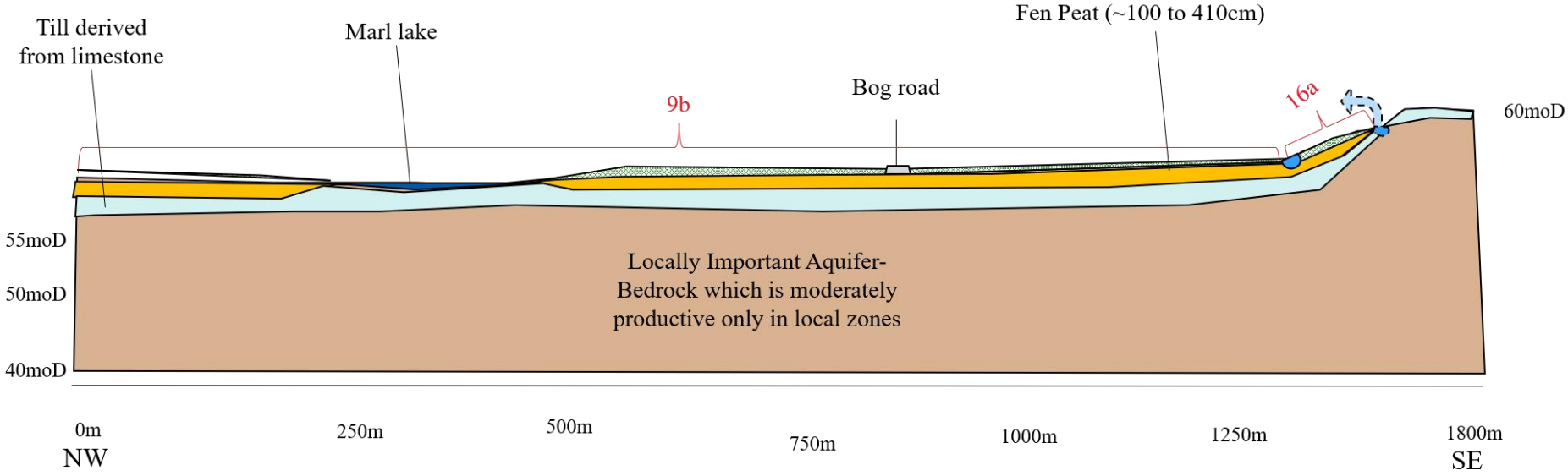


Figure 3-24: Conceptual site model of Lough Mareegan

4 Ecology

4.1 Desk Study

A review of available desktop information on the ecological baseline for Ballymore Fen SAC was reviewed from the below information sources:

- National Fen Survey 2021-25: Final Report. Irish Wildlife Manuals. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland (Brophy et al, In prep).
- The Wetlands of County Westmeath (Smith, 2026);
- Biodiversity Maps - National Biodiversity Data Centre (NBDC);
- Plant Atlas 2020 website - Botanical Society of Britain & Ireland (BSBI);

The NFS was commissioned to develop and test a standardised methodology for assessing the conservation status of fen habitats across Ireland. As part of this study, Lough Mareegan was selected as one of the sites for field survey. The site was surveyed in August 2022, with a focus on Annex I wetland and fen habitats. The survey methodology included:

- Detailed vegetation assessments using quadrats to record species composition and structure.
- Hydrological observations such as water levels and flow.
- Documentation of disturbance indicators including drainage, grazing, and invasive species.

Furthermore, the Westmeath Wetland Survey was commissioned to provide detailed and accurate knowledge of the wetlands in County Westmeath to inform planning policy and prioritise future field work in the wetlands of the county. The key objectives were:

- Gather baseline information on the type, extent and condition of selected wetland sites.
- Identify pressures and threats to conservation condition.
- Recommend conservation actions and priorities.
- Raise awareness of the important of wetlands through liaising with the public and landowners.

GPS mapping and photographic records were also used to support habitat boundary delineation and condition assessment. While the primary emphasis was on habitat quality, vascular plants and bryophytes were recorded as part of the vegetation surveys, contributing to an understanding of species diversity and habitat integrity at the site.

4.1.1 Habitats

As detailed in Section 2.1, Lough Mareegan is a hard-water lake surrounded by a complex of fen, woodland and cutover raised bog. Although the site boundary excludes two of the large lakes (Figure 2-1), they are included within the description given the hydrological connectivity across the site.

4.1.1.1 Annex I Habitats

The following Annex I quality habitats were identified and mapped during the NFS and Westmeath Wetland Survey:

- 7230 Alkaline fen – covering approximately 15.76ha. The fen is best developed around the edges of the lake and at the northern end.
- 7210 *Cladium* fen – covering approximately 3.33ha. Located in the central section of the site, located along the border of the main lake consisting of small, isolated polygons.
- 7140 Transition mires – covering approximately 0.04ha. Located to the north of the site.
- 91E0 Alluvial woodland – predominantly located in the south and along the western border of the site.
- 3140 Hard-water lakes – there are two large lakes and three smaller lakes.

It should be noted that the resulting mapping of Annex I quality habitats from the NFS survey requires suitable interrogation and interpretation as to the extent of these habitats within each polygon i.e. Annex I habitat mapping is represented by the habitat that has the highest percentage attributed to the polygon. Therefore, polygons could be a mosaic or only support a small percentage of Annex I habitat within the overall polygon area and thus must be interpreted appropriately. Figure 1-1 outlines the dominant Annex I quality habitat mapping alongside respective percentage covers within each mapped polygon.

4.1.1.2 Non-Annex/Fossitt habitats

Non-Annex I fen and other habitats were also recorded, with mapping based on Fossitt (2000) classification (Table 4-1). The corresponding habitat map is shown on Figure B 2, Appendix B.

Table 4-1: Fossitt habitats recorded within Lough Mareegan

Habitat Type	Location	Notes
FL3 – Limestone/Marl lakes	East	Located in the east and central section of the site
PF1 – Rich fen and flush	South, east and north	The majority of this habitat is located around the lake to the south and east of the site, with a small section located in the north of the site

Habitat Type	Location	Notes
GS1- Dry Calcareous and Neutral Grassland	Northeast	Small section of both GS1 and WS1 with the grassland the more dominant habitat
GS4 - Wet grassland	North and east	There is a portion of this grassland in the north of the site as well as some isolated polygons along the eastern boundary of the site
GA1 – Improved agricultural grassland	Northwest and west	There are two polygons of this grassland within the northwest of the site close to the site boundary. Another small polygon is located along the western boundary of the site
WS1 – Scrub	Northeast, northwest and south	Small section of both GS1 and WS1 with the grassland the more dominant habitat located in the northeast. There are also polygons of WS1 in the northwest and south of the site
WN6 - Wet Willow-Alder-Ash woodland	Southeast and southwest	Predominantly located surrounding the lake within the central section of the site, located southeast and west
WN7 - Bog woodland	North	Small section located in the north, bordered by PB4 cutover bog
PB4 – Cutover bog	Central and north	Large section located within the central plane of the site and towards the north. It is bordered by GS4 to the east and PF1 to the south

4.1.2 Species

The following subsections outline the presence of species recorded at or within the zone of influence of Lough Mareegan. This includes protected species listed under relevant legislation and conservation frameworks such as the EU Habitats and Birds Directives (Annex I, II, IV, and V), the Irish Red Lists, and the Wildlife Acts (including species protected under the Flora Protection Order. Records are limited to those from the past ten years, reflecting the most plausible timeframe for continued presence and ecological relevance to the site - excepting where invasive species were historically recorded and there has been no indication since of their elimination.

Species Within the Site

The species within Table 4-1 were identified using the NBDC interactive maps service, reviewing the NFS documentation and from the ecological walkover conducted in 2026. Species that are considered notable or indicator species for fen habitat are included.

Table 4-1: Species records within Lough Mareegan

Common name	Latin name	Description	Most recent record
Round-leaved wintergreen	*Pyrola rotundifolia*	A native Irish rare rhizomatous, mycorrhizal evergreen perennial herb	2022
Marsh helleborine	*Epipactis palustris*	Perennial herb of neutral to calcareous fens	2020
Bay willow	*Salix pentandra*	Dioecious multi-stemmed shrub of damp nutrient poor soils	2022
Fibrous tussock sedge	*Carex appropinquata*	Tussock forming perennial sedge mainly occurring in open fenland and mires	2020
Wild angelica	*Angelica sylvestris*	Perennial herb occurring on base-rich soils	2026
Yellow starry feathermoss	*Campylium stellatum*	A native Irish species of brown moss which is an indicator of 7230 Alkaline fen habitat.	2026
Tufted sedge	*Carex elata*	Tussock forming sedge in habitats often with calcareous influence	2026
Glaucous sedge	*Carex flacca*	A native Irish plant species often found in wetland habitats.	2026
Carnation sedge	*Carex panicea*	A native Irish plant species often found in wetland habitats.	2026
Meadow thistle	*Cirsium dissectum*	A native Irish plant species often found in wetland habitats.	2026
Great fen sedge	*Cladium mariscus*	Rhizomatous perennial sedge usually growing on peat	2026
Comb-moss	*Ctenidium molluscum*	Moss of calcareous habitats	2026
Water horsetail	*Equisetum fluviatile*	Deciduous horsetail of aquatic and semi-aquatic habitats	2026
Cross-leaved heath	*Erica tetralix*	Low shrub ubiquitous in wet heath	2026
Maidenhair pocketmoss	*Fissidens adianthoides*	Moss which gros most robustly in wet, basic habitats especially in fens	2026
Fen bedstraw	*Galium uliginosum*	Perennial herb of base-rich marshes and fens	2026
Water mint	*Mentha aquatica*	Perennial herb of permanently wet habitats	2026

Common name	Latin name	Description	Most recent record
Bogbean	*Menyanthes trifoliata*	Rhizomatous perennial herb which grows as an emergent at the shallow edges of lakes, pools or slow-flowing rivers or in swamps, flushes or dune-slacks	2026
Bog-myrtle	*Myrica gale*	Small shrub growing in organise soils	2026
Common twayblade	*Neottia ovata*	Perennial herb found on wide range of calcareous to neutral or mildly acidic soils	2026
Tormentil	*Potentilla etecta*	A native Irish plant species often found in wetland habitats.	2026
Hooked scorpion moss	*Scopidium scorpioides*	A native Irish species of brown moss which is an indicator of 7230 Alkaline fen habitat.	2026
Devil's bit scabious	*Succisa pratensis*	Perennial herb growing in a wide range of moist to moderately free-draining habitats	2026
Black- Bog rush	*Schoneus nigricans*	Tussock forming perennial herb of calcareous and other base-rich fens	2026

4.1.2.1 Species within the Zone of Influence

Table 4-2 outlines the functionally linked species recorded within the 2km distribution zone of influence around Lough Mareegan within the last ten years from NBDC.

Table 4-2: Species records within the Zone of Influence of Lough Mareegan

Legislative Protection	Common Name	Latin Name
Irish Wildlife Act	Short eared owl	*Asio flammeus*

4.2 Field Survey

Following a comprehensive review of available desktop data, a targeted ecological survey was undertaken in June and August 2026. The field surveys concentrated on key areas highlighted during the desk-based assessment, specifically those with potential for restoration activities. These locations were investigated in detail to verify and further assess ecological conditions and parameters, ensuring that any recommended restoration measures would be both appropriate and effective in the identified zones.

Two survey forms were created to collect data relevant to:

- Monitoring data; and
- Pressures and threats

4.2.1 Monitoring Points

To inform the FRP, a targeted walkover survey was undertaken. This was a focused assessment designed to gather site-specific data at pre-identified locations. The walkover was designed to assess ecological condition at eight pre-identified monitoring points, selected based on hydrological features, habitat potential, and restoration feasibility. The locations were determined through expert discussion and review of baseline data and will serve as fixed monitoring stations post-restoration.

These monitoring points now serve a dual purpose:

- Baseline characterisation of current site conditions.
- Long-term monitoring stations to assess ecological change following restoration.

The survey focused on these key components:

- Monitoring points: Presence and absence of positive and negative indicators of fen habitat.
- Target notes: Any qualitative observations capturing for example site condition, vegetation structure, hydrological features, and legacy management.
- Pressures and Threats Identification: Systematic recording of anthropogenic and natural pressures affecting each location.

The survey confirmed the presence of several fen habitat types, notably the Annex I habitat 7230 Alkaline fen and Fossitt habitat PF1 Rich Fen and Flush and PB4 Cutover bog.

4.2.2 Pressure & Threats

This section outlines the historical and current pressures and threats affecting Lough Mareegan, with emphasis on the Annex I quality habitats 7230 Alkaline fen.

4.2.2.1 7230 Alkaline fen

Historical Pressures

The NFS determined the Structure & functions of the 7230 Alkaline fens to be Unfavourable-Bad, with negative pressure being:

- **Inappropriate grazing regime – undergrazing/overgrazing** vegetation was largely rank with a small area subject to extensive cattle grazing
- **Drainage** as a result of historical turf cutting, the cutover bog is heterogenous and characterised by numerous drains

Current Observations

- **Inappropriate grazing regime – undergrazing** recorded at Monitoring point 1,3 and 8. Due to the heterogenous terrain within the area of cutover bog, this makes the area inappropriate for livestock grazing in northern areas of the site i.e. Monitoring point 4 and 5.
- **Drainage** historical drains still present, with deep parallel drains recorded either side of the old bog track near Monitoring point 5
- **High nutrient levels in springs** see Section 3.2.3 regarding nitrate and phosphorous levels

4.2.2.2 7210 *Cladium* fen

No specific pressures or threats on this particular habitat noted.

4.2.2.3 7140 Transition mire

No specific pressures or threats on this particular habitat noted.

4.2.2.4 91E0 Alluvial woodland

Historical Pressures

- **Ash dieback** the woodland canopy comprises mainly of ash *Fraxinus excelsior* and birch *Betula* sp. with some alder *Alnus glutinosa* and is suffering badly from ash dieback disease (Smith, 2026)
- **Drainage** historically turf cut which has resulted in numerous old drains and peaty hollows (Smith, 2026)
- **Invasive species** cherry laurel *Prunus laurocerasus* and rhododendron *Rhododendron ponticum*, were both recorded within the woodland (Smith, 2026)

Current Observations

The woodland was not targeted as part of the survey area for the 2026 ecological walkovers

4.2.2.5 3140 Hard-water lakes

Historical Pressures

- **Eutrophication** minor algae blooms in the lake suggest that eutrophication is a pressure on the lake ecosystem (Smith, 2026)

Current Observations

The lakes were not targeted as part of the survey area for the 2026 ecological walkovers and the two largest lakes are outside the site boundary.

4.2.3 Additional Observations

An otter *Lutra lutra*, was sighted near the lake during the 2026 ecological surveys. Additionally, both marsh fern *Thelypteris palustris* and fibrous tussock sedge *Carex appropinquate* were recorded during the survey. Both species are Red Listed as Near Threatened.

4.3 Site Conservation Priority Matrix for Lough Mareegan Site

The restoration actions proposed (Table 4-4-3) for 7230 Alkaline fen, 7210 *Cladium* fen and 7140 Transition mire are expected to deliver broader ecological benefits beyond their target habitat types i.e. hydrological connectivity with 3140 Hard-water lakes and 91E0 Alluvial woodland. If these measures are successfully implemented and sustained, they may positively influence associated features such as priority species, nationally important species, and locally significant habitats and species. In such cases, the additional restoration interventions outlined for these other features may become unnecessary or only partially required. However, to validate and understand the extent of these mutual benefits, ongoing post-restoration monitoring will be essential. This will ensure that improvements are not limited to fen habitats alone but extend to the wider ecological network within and around the site.

Table 4-4-3: Site Conservation Priority Matrix for Lough Mareegan

Level	Feature Type	Feature Name	Extent/ Population	Pressure/Threat affecting it	Restoration Measure On-Site	Restoration Measure Off- Site
1	SAC Habitat	7230 Alkaline fens	See Section 4.1.1.1	Inappropriate grazing Drainage High nutrient levels	Conservation grazing Drain blocking	Nutrient management
		7210 *Cladium* fen	See Section 4.1.1.1			
		7140 Transition mires	See Section 4.1.1.1			
		91E0 Alluvial woodland	See Section 4.1.1.1	Historical drainage and invasive species recorded	Future measures to be considered: Drain blocking Invasive species removal	N/A
		3140 Hard-water lakes	See Section 4.1.1.1	Historical eutrophication recorded during Westmeath Wetland Survey	N/A	Indirectly benefiting from off-site nutrient management
2	NHA Habitat	N/A	N/A	N/A	N/A	N/A

Level	Feature Type	Feature Name	Extent/ Population	Pressure/Threat affecting it	Restoration Measure On-Site	Restoration Measure Off- Site
3	European Priority Species	N/A	N/A	N/A	N/A	N/A
4	Nationally important species	See Table 4-1 and Table 4-2	See Table 4-1 and Table 4-2	Inappropriate grazing Drainage High nutrient levels	Conservation grazing Drain blocking	Nutrient management
5	Habitats and species of local interest	See Table 4-1 and Table 4-2	See Table 4-1 and Table 4-2	Inappropriate grazing Drainage High nutrient levels	Conservation grazing Drain blocking	Nutrient management

4.4 Impact Assessment Notes

Restoration actions proposed for Lough Mareegan aim to improve the ecological condition of the fen and wetland habitats, particularly the Annex I habitats 7230 Alkaline fens. These actions are designed to support favourable condition of these habitats and enhance habitat resilience. However, potential impacts, both direct and indirect, must be carefully considered to ensure no detrimental impacts to habitats.

Potential impacts

- **Habitat loss** – low risk – restoration actions i.e. drain blocking, is designed to enhance existing habitats rather than remove them. While temporary disturbance will likely occur; it is not anticipated that this would result in habitat loss.
- **Habitat degradation** – moderate risk - potential degradation could occur if restoration measures are poorly implemented or monitored. This could occur where continued ecological and hydrological monitoring is undertaken without due care.
- **Species disturbance** – very low risk – it is not expected that the proposed restoration actions will result in any significant disturbance to species. Works will be timed appropriately so as to avoid disturbing breeding bird species within the site.
- **Accidental pollution release** – very low risk - no chemical inputs are proposed. However, machinery use (if any) could pose a risk of fuel/oil leaks. This is mitigated by avoiding machinery in sensitive areas and using hand tools where possible.
- **Introduction and/or spread of invasive non-native species** – moderate risk - restoration activities (e.g. soil disturbance, water movement) could facilitate dispersal of invasive species. Monitoring and biosecurity protocols will be embedded into the site plan to avoid such risks.

4.5 Good Practice Recommendations

Several good practice measures are recommended based on the requirement for compliance with legislation but also the occurrence of sensitive receptors and possible pathways for negative effects during preparation for or implementation of restoration actions. These are summarised in Table 4-4-4 and should be taken as generally applicable in the planning of FRP.

Consultation with relevant NPWS staff should be undertaken prior to implementation to obtain more recent or up to date information on the locations of sensitive receptors, and buffers revised accordingly. Any further requirements outlined by NPWS at pre implementation stage should also be adhered to.

Table 4-4-4: Good Practice Recommendations

Receptor	Measure
Ground nesting birds	No vegetation clearance or activity which might contravene Section 40 of the Wildlife Act (consolidated) should be undertaken.
Invasive Alien Species (IAS)	All vehicles should undergo stream cleaning before site entry. Identified buffers on IAS should be avoided during site preparation and restoration implementation
Protection of European Sites	Any required mitigation measures to avoid potentially adverse effects on European Sites should be incorporated into an Environmental Management Plan or Checklist of Environmental Commitments. Implementation should be overseen by a suitably qualified ecologist.
Protection of Sensitive Habitats	High sensitivity habitats should be protected from long term damage by the use of low-pressure vehicles. Extensive repeated tracking over fen habitat or any other identified priority habitat should be avoided. The storage locations of any materials should avoid high & medium sensitivity habitats.

5 Key Pressures – Field Validation and Evaluation

The FRP considers pressures on Lough Mareegan through an initial desktop assessment of existing information on the site (including previous NPWS commissioned surveys), assessment of land, water and topographic data and aerial imagery, followed by field surveys to characterise and confirm key pressures mapped through desktop assessment. Consultation with NPWS Regional Staff was also undertaken, including a visit with the Conservation Ranger for the area to inform identification of pressures.

The NFS (Brophy et al., In prep) undertook a site evaluation and ranking which determined the conservation value of the site. This evaluation considered 15 criteria as outlined which included naturalness, non-recreatability, potential value, typicality, educational value, size, diversity, fen value, rarity of species, rarity of habitats, viability, recorded history, management needs, intrinsic appeal and expert opinion. These criteria then informed the conservation status assessment (structure & functions) which are detailed in Section 2.2.

5.1 Field surveys of key pressures

Following completion of desktop mapping of key pressure, field surveys were carried out by personnel to verify the findings of the desktop assessment and characterise conditions of the pressures to inform selection of appropriate restoration actions required. The site surveys are discussed in Sections 3.2 and 4.2. These surveys aimed to capture information on the land and water environment such as drainage features, peat depth and water quality and the ecology.

As part of the ecology monitoring surveys, pressures and threats associated with the monitoring point were recorded. A summary is provided within Section 5.2.

5.2 Key Pressures

An overview of the key pressures identified on site, following desktop review and site visits are summarised in this section.

5.2.1 Flora and Fauna Pressures

The key pressures affecting the ecological receptors of Lough Mareegan were identified through a review of historical information and data captured during the 2026 ecological walkover, including the assessment of condition and identification of pressures and threats. These pressures are ranked below based on their relative intensity, spatial extent, and ecological impact (Figure 5-1)

- **Absence of grazing** – the absence of grazing represents the most significant pressure on areas of 7230 Alkaline fen within the site. Data collected during the 2026 ecological walkover indicates that this pressure is present across all monitoring points within the fen and is associated with unmanaged, rank and tussocky vegetation structure. The lack of grazing reduces disturbance and biomass removal, allowing dominant species such as purple moor-grass *Molinia caerula* to proliferate. This results in reduced structural diversity, suppression of characteristic fen species, and

a decline in habitat quality across Annex I 7230 Alkaline fen and associated non-Annex habitats.

- **Drainage and hydrological modification** – drainage was identified as both a historical and ongoing pressure. While its intensity varies spatially, it represents a significant but spatially variable pressure, particularly affecting parts of the site where historical drainage and local drainage schemes have altered hydrological conditions. Drainage lowers water tables, disrupts groundwater-fed systems, and reduces the extent of saturated conditions required for fen habitats. This results in shifts in species composition, reduced peat formation, and increased susceptibility to secondary pressures such as scrub development, nutrient enrichment as well as carbon dioxide release from peat. This pressure affects Annex I 7230 Alkaline fen, 7210 *Cladium* fen, 7140 Transition mires and associated non-Annex habitats. It will also affect the Annex I 91E0 Alluvial woodland and 3140 Hard-water lake.
- **Nutrient enrichment (eutrophication)** – nutrient enrichment of the lake was previously recorded including the presence of algal growth (Smith, 2026) and high levels of nitrate and phosphorous levels were recorded during the 2026 water quality surveys (Section 3.2.3). In the context of surrounding land use, it is considered likely that adjacent agricultural land contributes to diffuse nutrient inputs via surface and/or groundwater pathways. Elevated nutrient availability leads to competitive dominance of fast-growing species, resulting in reduced species richness and the loss of characteristic fen vegetation. This pressure affects Annex I 7230 Alkaline fen, 7210 *Cladium* fen, 7140 Transition mires and associated non-Annex habitats. It will also affect the Annex I 91E0 Alluvial woodland and 3140 Hard-water lake.
- **Invasive species** – rhododendron and cherry laurel have both been recorded within the 91E0 Alluvial woodland. These invasive species form dense evergreen stands which outcompete native ground flora and prevent natural regeneration of native tree species. The woodland was not targeted as a survey area for the 2026 ecological walkovers and the mapped extent of these areas is therefore not included in Figure 5-1. Restoration measures associated with the woodland are included for completeness and should be targeted as a measure that is implemented in the future should appropriate opportunity/funding arise.

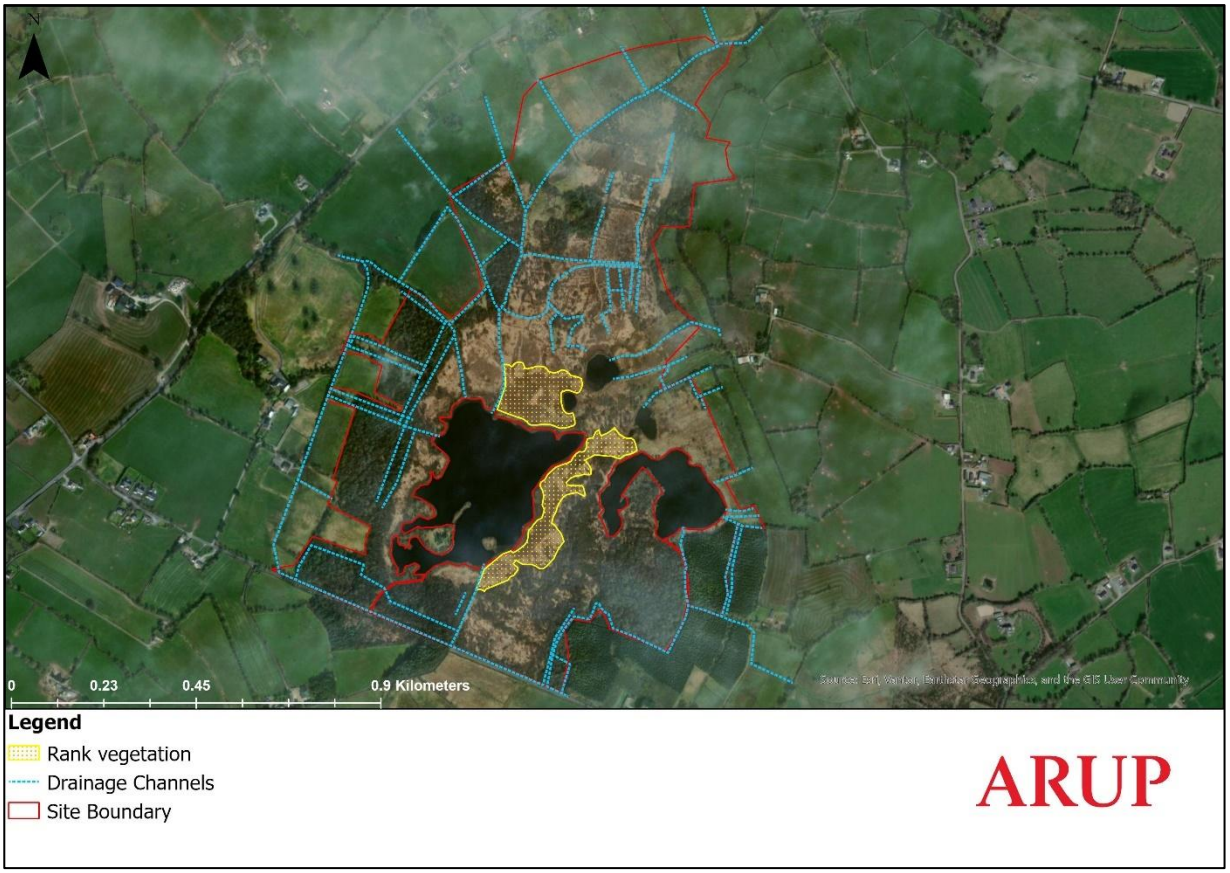


Figure 5-1: Pressures and threats recorded as present at Lough Mareegan. Pressures and threats were compiled from desktop review and 2026 ecological walkover

5.2.2 Fen Hydrology Pressures

The key pressures affecting the hydrology for fen habitat of Lough Mareegan were identified through a review of historical information and data captured during the 2026 field surveys. The main hydrology pressures are as follows:

- Localised hydrology pressure near the bog road where drainage is variable and associated with previous turf cutting.
- Localised hydrology pressure where drains connect surrounding spring/surface water from surrounding lands into the site.
- Site-wide hydrology pressure where there are deeper drains associated with the western woodland and the larger central drainage channels.

5.2.3 Fen Nutrient Pressures

The key pressures affecting the nutrients pressure for fen habitat of Lough Mareegan were identified through a review of historical information and data captured during the 2026 field surveys. The main fen nutrient pressures are as follows:

- High nutrients in spring and surface water from the surrounding surface water and groundwater catchment.

6 Restoration Measures

6.1 Introduction

The restoration actions proposed by the FRP will help to maintain or improve the quality of existing areas of fens and improve the conditions that will allow an expansion of the area of fen. In some areas it must be recognised that restoration to fen habitat will not be possible, and the objective may simply be to improve the habitat condition.

Selection of the most appropriate restoration action depends on a range of factors including peat depth, hydrological conditions (flow rates, existing and expected flow paths after restoration), substrate type, existing ecological conditions, potential ecological constraints and practicality of access for machinery.

Each of the factors was considered based on a combination of desktop analysis combined with site-specific field surveys to select the most appropriate restoration technique to address each pressure considered by the FRP. The restoration measures proposed are outlined in Section 6.2 to Section 6.4, with detailed mapping of proposed measures illustrated in the maps provided in Appendix C.

6.2 Hydrology Measures

The hydrological restoration objective for Lough Mareegan is to improve parts of the site from WETMEC 9b: Part-Drained Groundwater-Fed Bottom to **WETMEC 9a: Wet Groundwater-Fed Bottom**. Full achievement of WETMEC 9a will require blocking of drains. The site is also fed by springs associated with the exposed rock to the west/north. This represents WETMEC 16b: Groundwater flushed bottom. Maintaining the connection to these groundwater sources will be important, but the hydrological objective will be to slow down the flow from springs towards the main lakes.

6.2.1 On-site Fen Hydrology Measures

Drainage measures at bog road

In the northeastern part of the site there is a defined bog road which was used for turf cutting in the past and may be used by livestock to access the smaller lakes. This area is classed as having a mosaic of 7230 Alkaline fen habitat. There are various smaller drains and hollows that have collected water over time, and according to the Wetness Index it is an area of permanent wetness. The road cuts across the site from the east to the main drain in the centre. This road may have been built to access the historical higher lakeshore. There are no clear surface water connections to the smaller eastern downstream lakes but there are deeper drains present along the edge of the track visible in the digital terrain model and orthophoto in Figure 6-1. There are drains connecting to the main channel above the bog road to the west.

Reprofiling some of the road surfaces will contribute to improved drainage. Where drains are less than 2 m peat dams are proposed to slow the water flow and to increase the water levels

optimal for fen habitat. Lateral water flow would be beneficial for the peat conditions as well as for filtration of agriculture run off prior to inputting to the lake.



Figure 6-1: Drainage along bog road in northeast of Lough Mareegan

Drainage measures at spring fed drains

There are drains on the eastern site boundary that directs surface water or spring-fed water towards the downstream lakes. Capturing this flow prior to discharge into the lakes will be beneficial to surrounding vegetation and restore more natural water levels. This will also allow for filtration of the water. A drain flowing east to west is present at the east of the site (Figure 6-2). The drain is fed from a spring, east of the drain. This flow is directed from the spring to a small lake feature. Drains directing the flow of spring water will be proposed to be blocked by peat dams, allowing for higher water levels for 7230 Alkaline Fen..

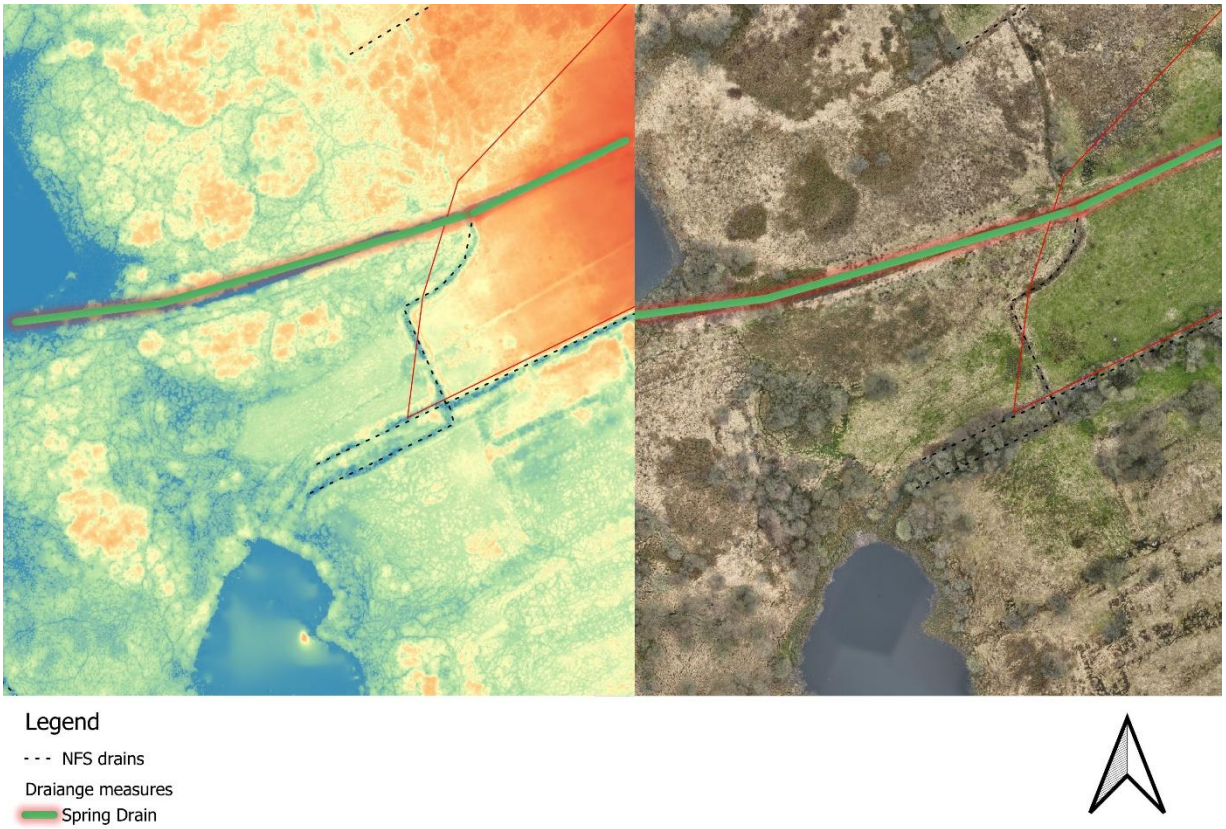


Figure 6-2: Spring fed drains in southeast of Lough Mareegan

Drainage measures at the centre

There is a deep north to south flowing drain, beginning at the northern boundary of the site (likely spring fed) through to the main lake water body. This drain is about 4m wide closer to the lake. At the point of the bog road the elevation changes, which was historically to where the lake levels may have reached and the bog road would have acted as the access point to the edge of the lake. This drain is enhancing drainage at the centre of the site. There is also a western drain that is draining the north-western part of the site. This drain is also about 4 m near the lake.

Wider hydrological benefits are possible if these drains are blocked to maintain a higher water table within the central section of the site.



Figure 6-3: Drainage measures at the centre of Lough Mareegan

Drainage measures on the west

The western side of the site has the deeper drains connected to the managed woodland and historical turf cutting in the area. Restoring the full functioning of the site will require the western part of the site to also have drainage measures. This will benefit 91EO Alluvial woodland habitat. In the longer-term drains should be blocked following monitoring. This may be possible as part of agroforestry/natural woodland under the afforestation grant scheme.



Figure 6-4: Drainage measures at the western part of Lough Mareegan

6.2.2 Off-site Hydrology Measures

Engagement with adjacent landowners is needed to avoid the introduction of new drainage works or the deepening of existing drains where hydrological connectivity to Lough Mareegan may be affected.

6.3 Nutrient Measures

The primary aim of the nutrient measures is to maintain appropriate water quality, particularly nutrient levels, to support the natural structure and functioning of the habitats. For water quality the target is to maintain, or where necessary restore, appropriate water quality, particularly pH and nutrient levels, to support the natural structure and functioning of fen habitat. This will also have benefits for the lake, which has experienced eutrophication.

6.3.1 On-site Nutrient Measures

On-site nutrient measures will focus on the monitoring of water quality to improve understanding of nutrient dynamics within the site and to assess the effectiveness of any future off-site measures. This will be targeted at drain and lake sites. Water quality monitoring will include nitrate, phosphate, electrical conductivity (EC), pH and temperature.

Monitoring locations will include water monitoring at areas across the site where the objectives are to:

- Identify spatial and temporal trends in nutrient concentrations in groundwater and surface water bodies;
- Improve understanding of nutrient sources and pathways (surface water vs groundwater).

The results of monitoring will be used to determine whether further interventions are required and to guide the selection of appropriate nutrient management measures, if needed.

6.3.2 Off-site Nutrient Measures

Elevated nutrient concentrations are likely indicative of inputs from the surrounding agricultural farmland, which are promoting nutrient enrichment via both surface and groundwater pathways. Nitrate is likely to enter the site through groundwater pathways, primarily via the exposed rock to the east of the site which provides flow to the springs along the eastern/northern boundary. Measures proposed to address excess nitrate entering the habitat should focus on the groundwater catchment providing flow to the east/north of the site.

Catchment-scale measures should target both phosphorus and nitrogen pathways based on observed spatial patterns. Measures should include source control through nutrient management planning, pathway interception to reduce nutrient transport. Novel approaches under NPWS Farm Plans[3] can provide support to landowners in reducing nutrient loads to reduce the mobilisation and transport of nitrogen (N) and phosphorus (P) from agricultural land to the fen habitat.

Suitable measures for Lough Mereegan may include source control measures (Farming for Water EIP, 2023):

- **Farmer Training Course for farmers** in the fen catchment.
- **Nutrient Management Plan**. Such a plan will enable farmers in the catchment to achieve optimum slurry application and nutrient uptake and avoid overapplication of nutrients.

6.4 Vegetation Measures

[3] The NPWS Farm Plan Scheme trials novel approaches to farming for the environment, to safeguard particular sites, habitats and species, and to work towards meeting conservation measures required under the EU Birds and Habitats Directives. Role players are the NPWS through the Agri-Ecology Unit, the regional staff of the NPWS and the farm participant.

6.4.1 On-site Vegetation Measures

Proposed measures to address rank vegetation and invasive species include the on-site measures detailed in Table 6-6-1 and shown in Figure 6-5.

Table 6-6-1: On-site vegetation measures proposed for Lough Mareegan

Priority	Measure	Description	Responsibility
1	Conservation grazing	Following discussions with relevant landowners, the implementation of a conservation grazing regime with appropriate stocking levels is recommended in the areas highlighted in Figure 6-5. The purpose of this is to reduce the pressures of rank vegetation with regard to 7230 Alkaline fen. These areas are deemed suitable for livestock grazing. It should be noted that in areas of cutover bog to the north of the site, the heterogenous terrain makes it unsuitable for grazers and therefore is not recommended in these areas. The reintroduction of appropriate grazing is the principal restoration measure for the site, addressing the high influence of grazing absence recorded across monitoring points near the lake. Grazing will aim to reduce sward dominance by purple moor-grass, improve structural diversity, and maintain open fen conditions. Stocking levels and grazing timing should be carefully managed to avoid localised overgrazing or damage to sensitive areas, particularly in wetter zones. Furthermore, fishers access the largest lake for recreational use and should be considered when choosing and implementing grazing measures. The area directly north of the largest lake should also be targeted for conservation grazing. However, due to water table levels, access may be restricted for appropriate livestock to access. After confirmation that this is not possible, it is recommended that small scale mowing and removal of rank vegetation, in particular common reed *Phragmites australis* and purple moor-grass is considered within this area.	NPWS (post-Tóchar)
2	Drain blocking	Details on measures relating to drain blocking are included in Section 6.2.1. Drain blocking aims to raise the water table locally reducing the release of carbon dioxide as a result of drying peat and improving the hydrology for the formation of fen habitat in hollows.	Tóchar
3	Vegetation monitoring	Monitoring points are proposed which overlap with (where suitable) the existing NFS points. The purpose of these points is to monitor species composition within the habitat. This serves to monitor any vegetation change and inform future restoration measures. Monitoring will be used to	Tóchar & NPWS (post-Tóchar)

Priority	Measure	Description	Responsibility
		directly inform adaptive management, including the spatial targeting and intensity of grazing and scrub management, based on observed changes in sward structure, species composition and evidence of recovery or further degradation.	
4	Invasive species	Further surveys confirming the location and extent of rhododendron and cherry laurel are recommended in the 91E0 Alluvial woodland to inform an invasive species removal management plan informed by good practice guidance (Higgins, 2008).	NPWS (post-Tóchar)

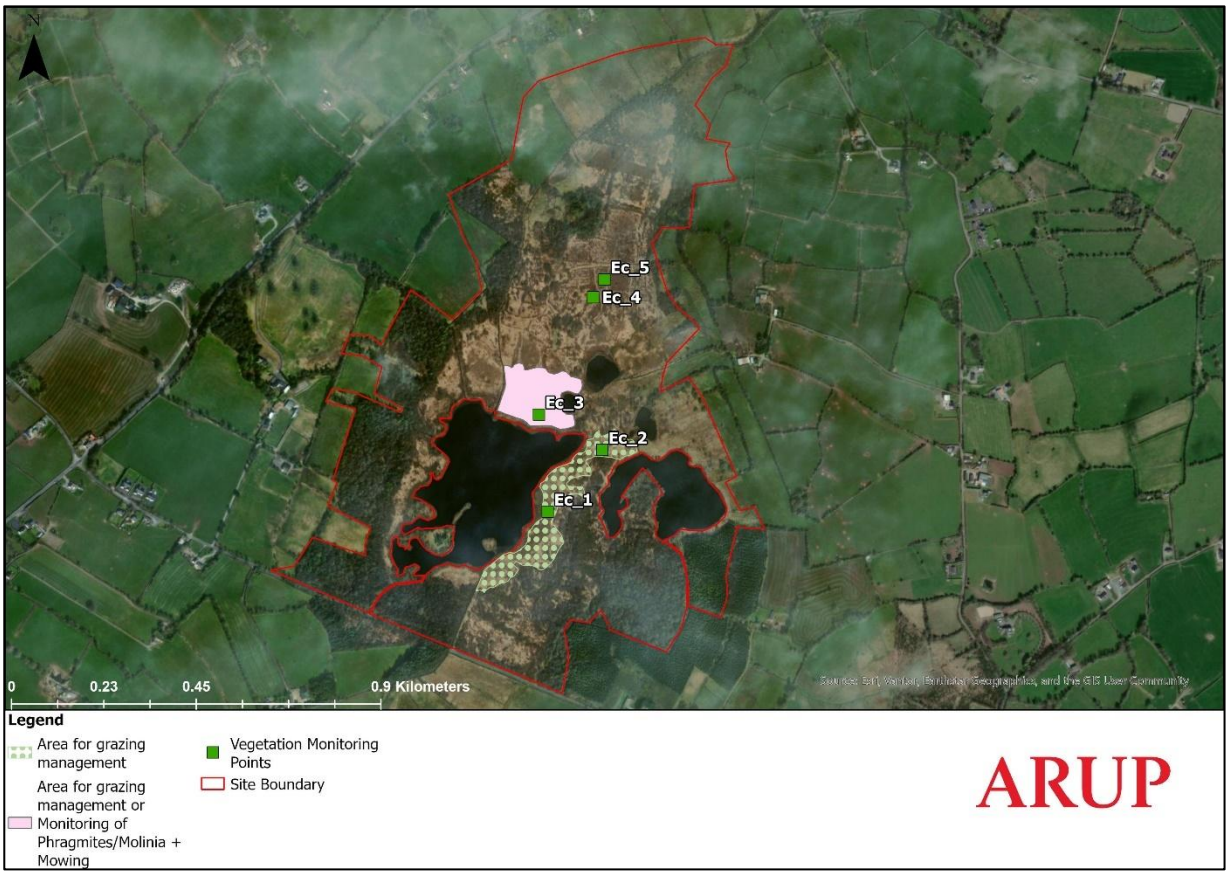


Figure 6-5: Proposed vegetation management measures and monitoring for Lough Mareegan

6.4.2 Off-site Vegetation Measures

As detailed in Section 6.3.2, engagement with landowners surrounding the site regarding farming practices within and adjacent to the site in relation to nutrient measures, with particular consideration for fens.

7 Additional Considerations

7.1 Drainage Management Plan

Lough Mareegan is not part of a Drainage District/Arterial Drainage Area. The preliminary drainage management plan for Lough Mareegan is presented in Appendix D.

7.2 Peat Stability Assessment

The northeast region of moderately high landslide susceptibility will be avoided during restoration access routes while most of the site has low susceptibility.

The GSI landslide susceptibility map for Fin Lough is presented in Figure 7-1.

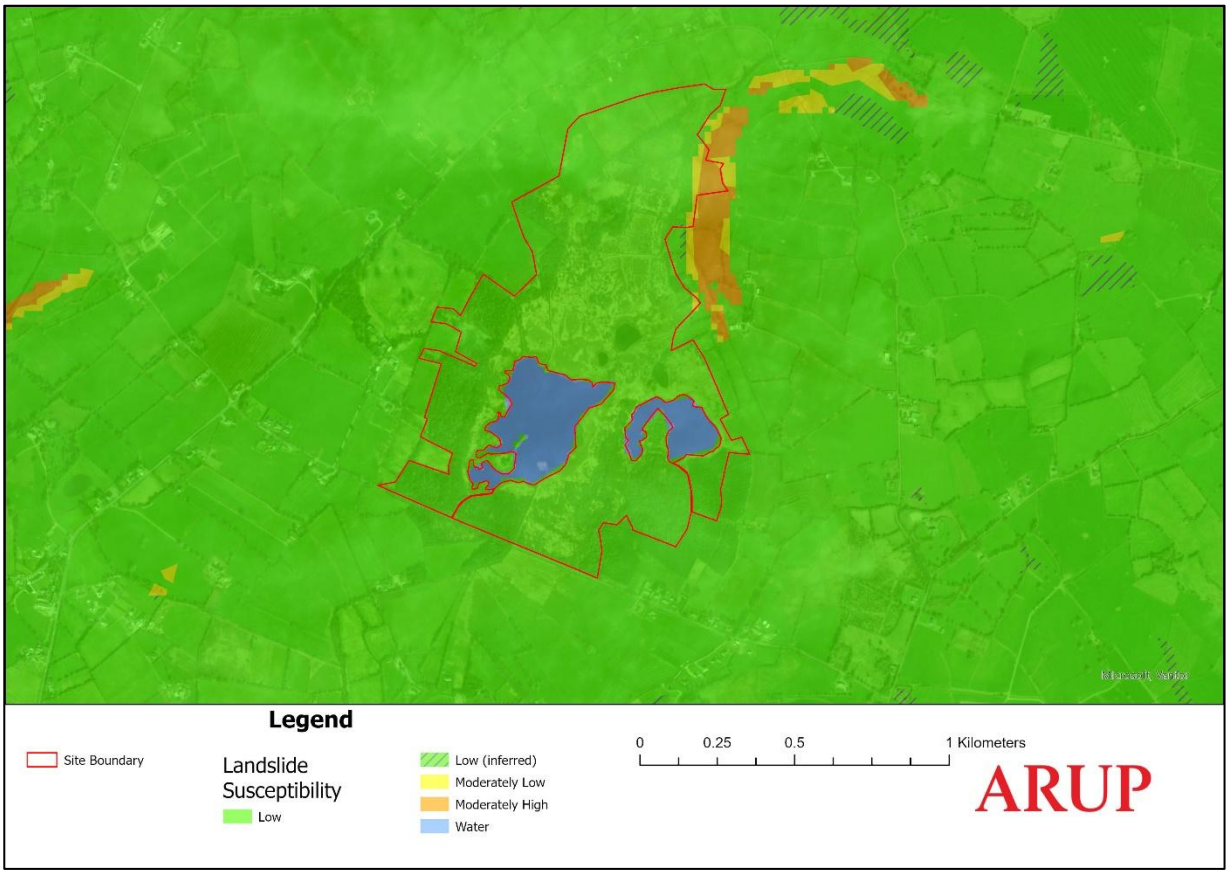


Figure 7-1: Geological Survey of Ireland Landslide Susceptibility mapping for Lough Mareegan

7.3 Archaeology

The site has three historic points of interest within the boundary, with one being within the open water of the site. In the northwest of the site there is a ringfort according to records in 1976 (NMR,2026). The ringfort, is visible on the map as point WM01700.

There are Crannóg sites at point WM01667 and WM04508. The national monuments services note that previous NMI finds, noted that 'bones' had been previously recovered from a crannóg (NMR,2026).

The assessment confirmed that there are no recorded archaeological monuments, protected heritage features, or statutory "zones of notification" overlapping with or situated within a relevant proximity to the proposed restoration footprint.

Consequently, statutory requirements under the National Monuments Acts are determined to be not applicable to this project as follows:

- Section 12 Notification: Not required, as no works will take place at, or in the immediate vicinity of, an RMP-listed site.
- Section 14 Consent / Licensing: Not required, as the project does not impact any designated National Monument or site subject to a Preservation Order.

While no recorded features exist, the waterlogged and anaerobic conditions of fen environments possess a high potential for preserving previously unrecorded organic archaeological materials (e.g., wooden trackways, ancient implements, or environmental deposits).

To ensure complete compliance with the spirit of the National Monuments Acts, a standard "Chance Finds" Protocol will be maintained throughout the duration of the restoration works. In the highly unlikely event that any sub-surface archaeological features or artefacts are exposed during ground disturbance or rewetting activities, works in the immediate area will cease immediately, and the National Monuments Service and the National Museum of Ireland will be notified within the statutory 72-hour window.”

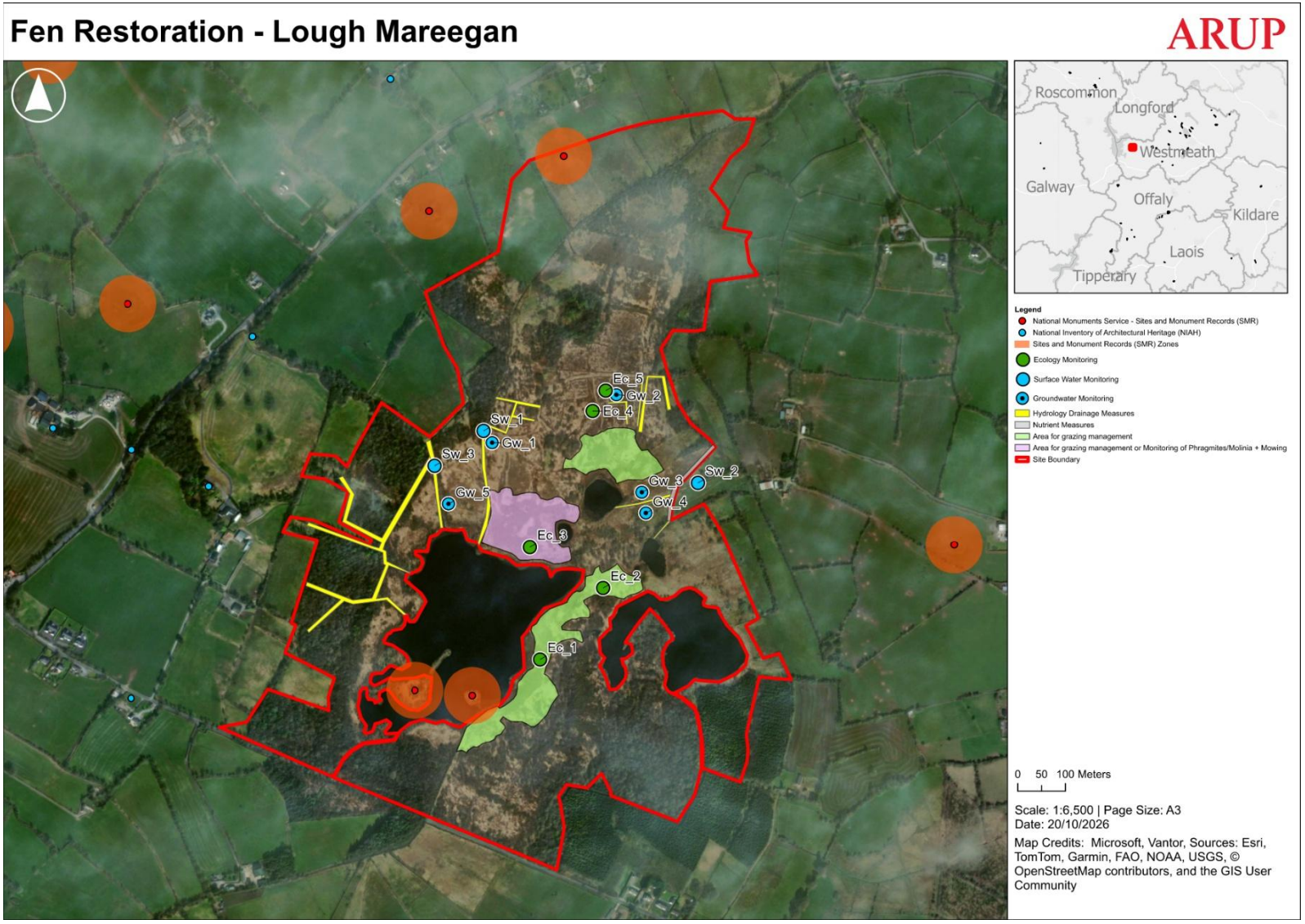


Figure 7-2: Archaeological Sites for Lough Mareegan (NMS, 2025)

8 Summary of Fen Restoration Plan Actions

Prior to proceeding with the implementation of the restoration measures outlined in the FRP, consultation with landowners and key stakeholders with an interest in the site is essential (Table 8-1). While this FRP identifies the key pressures and actions to be implemented, consultation with landowners and stakeholders may identify the need to amend or alter restoration actions. There may also be opportunities to provide additional benefits to the wider community. Consultation with local NPWS staff will be crucial to informing implementation planning.

Table 8-1: Role players in fen restoration plan

Measures	Stakeholder	Description
On-site	National Monument Services / County Council	Archaeological sites were identified from the desk study. The planned restoration measures are not targeted at the points of these archaeological sites. Further consultation with National Monument services will be needed prior to commencing of Restoration works
	Landowners	Parts of Lough Mareegan are under Commonage ownership by private individuals.
	NPWS	The fen is upstream of Lough Ree SAC and SPA.
Off-site	Landowners & farmers	Engagement for uptake of catchment measures.
Capacity building	NPWS	NPWS engaging in community education and events

Table 8-2 provides the summary of the FRP Actions for Lough Mareegan.

Table 8-2: Implementation plan for Lough Mareegan Fen Restoration

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
1	**Required preliminary actions**							
1.1	**Screening for Appropriate Assessment report.**							
	N/A							
1.2	**Archaeological assessment**							
	Consultation with Westmeath County Council on the archaeology is required to ensure compliance with legislation and local authority objectives.	Sitewide	Archaeological assessment report	Pre-restoration	NPWS	Westmeath County Council	Arup	Within Tóchar project scope
2	**Enabling Works**							
2.1	**Pre-restoration Works Surveys**							
	Pre-site walkover with Ecologist/Ecological Clerk of Works (ECoW) to ensure proposed measures are appropriate and whether alterations are required.	Sitewide	ECoW report	Pre-restoration			Arup	Within Tóchar project scope
2.2	**Implementation of Mitigation Measures**							
	Ecological Impact Assessment Considerations – identification of necessary mitigation measures. Such measures may include, but are not limited to, the utilisation of hand machinery to avoid impact on sensitive habitats	Sitewide	ECoW report	Pre-restoration			Arup	Within Tóchar project scope
2.3	**Breeding Bird Considerations**							

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Prior to restoration works, where any restoration measures are identified to have the potential to interfere with breeding birds e.g. drain blocking, these works shall occur outside the breeding bird season (1 March – 31 August inclusive) or if necessary during the breeding bird season, a nesting bird survey will be undertaken by a suitably qualified ecologist immediately prior to works to confirm the likely absence of breeding birds	Sitewide	ECoW report	Pre-restoration			Arup	Within Tóchar project scope
2.4	**Good Practice Recommendations and CEMP**							
	Good Practice Recommendations – Includes, but not limited to, avoidance of sensitive ecological receptors, pollution prevention procedures, biosecurity measures etc. The preparation and provision of a Construction Environmental Management Plan (CEMP).	Sitewide	ECoW report	Pre-restoration			Arup / Contractor	Within Tóchar project scope
3	**On-Site Restoration measures**							
3.1	**Hydrology measures**							
	Drainage measures in the east near the bog road	East near the bog road	Water level monitoring	Restoration in 2027	NPWS to facilitate		Arup/ Contractor	Within Tóchar project scope
	Drainage measures at spring fed drain in the east	at spring fed drain in the east	Water level monitoring	Restoration in 2027	NPWS to facilitate		Arup/ Contractor	Within Tóchar project scope

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Drainage measures at main drain channel through site	main drain channel through site	Water level monitoring	Long-term	NPWS to facilitate		Contractor	NPWS Farm Plan Scheme
	Drainage measures site wide	Sitewide	Water level monitoring	Long-term	NPWS/DAFM		Contractor	Agroforestry programme
3.2	**Nutrient measures**							
	Source control within site boundary Engage landowners to reduce nutrient application within site boundary through farmer training and nutrient management plan specific to fen.	Sitewide	Nutrients (Nitrate and phosphate), EC, pH	Restoration in 2026	NPWS to facilitate site access		Arup / Contractor	Within Tóchar project scope
	Pathway interception within site boundary Initial priority will be the spring drains. Ensure hedgerows along the border and drain are sufficient. In the long-term ensure all drains have a riparian buffer along the farm side.	Sitewide		Restoration in 2026	NPWS to facilitate site access		Arup / Contractor	Within Tóchar project scope
3.2	**Vegetation measures**							
	Conservation grazing	7230 Alkaline fens	Regular monitoring of vegetation to review the stocking density and suitability of grazers	Seasonal grazing regime	NPWS working with landowner			NPWS Farm Plan Scheme

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
4	**Off-Site Restoration measures**							
4.1	**Hydrology measures**							
	Landowner engagement is required due to the farmland activities surrounding site that may be affecting the water balance of the site.	Surrounding farms	Landowner awareness	Long-term	NPWS, LAWPRO, Farming for Water EIP		Landowners	Catchment measures to be funded through Farming for Water EIP/other similar
4.2	**Nutrient measures**							
	Targeted nutrient control measures should be implemented across the catchment to address both phosphate and nitrogen pathways. Farmers should be included in the NPWS Farm Plans. Suitable measures include farmer training. Nutrient management plans and nitrogen surplus, where applicable.	Surrounding landowners	Uptake of measures by landowners	Long-term	NPWS, LAWPRO, Farming for Water EIP		Landowners	Catchment measures to be funded through Farming for Water EIP/other similar
5	**Monitoring progress**							
5.1	**Hydrology monitoring**							
	Monitoring groundwater and surface water at key site locations using piezometers and standpipes	Sitewide	Water level	Long term	NPWS to facilitate access	Westmeath County Council		Within Tóchar project scope
5.2	**Nutrient monitoring**							

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Ongoing monitoring of habitats, drainage channels and piezometers for water quality parameters is proposed within the northern and southern sections of the site.	Various locations within the site	Nutrients (Nitrate and phosphate), electrical conductivity and pH	Long term	NPWS to facilitate	Westmeath County Council		Within Tóchar project scope
5.3	**Vegetation monitoring**							
	Habitat condition assessments will be included to track restoration progress.	Sitewide	Habitat condition	Long-term	NPWS	Westmeath County Council		Within Tóchar project scope
6	**Capacity building and training**							
	Public meeting: To engage stakeholders on developments and results from the restoration measures.			Long-term	NPWS			NPWS
	Farmer training: Training such as that provided by the Farming for Water EIP will provide farmers with knowledge of alternative and habitat sensitive measures			Long-term	NPWS/ Farming for Water EIP / LAWPRO / Teagasc			Farming for Water EIP / other similar

8.1 Habitats Benefiting from Implementation of Restoration Actions

7230 Alkaline fen, 7210 Cladium fen and 7140 Transition mires

The proposed restoration measures will benefit 7230 Alkaline fens, 7210 *Cladium* fen and 7140 Transition mires by addressing key pressures including grazing absence, hydrological modification and nutrient enrichment. The implementation of conservation grazing, in combination with hydrological restoration measures and targeted vegetation management, will improve sward structure, reduce the dominance of coarse species and maintain open, species-rich fen conditions. These measures will support the restoration of habitat structure and function.

91E0 Alluvial forests and 3140 Hard-water lakes

The proposed restoration measures will benefit 91E0 Alluvial forests and 3140 Hard-water lakes through the retention of wet woodland areas and lakes as part of the wider site mosaic. While active intervention is limited within the Tóchar project, the management of surrounding fen habitats will ensure that woodland expansion does not adversely affect adjacent Annex I Alkaline fen habitats. Maintaining the woodland areas will support their role in hydrological buffering and nutrient interception contributing to overall site resilience.

Non Annex Habitats/ Fossitt classified habitats

A range of non-Annex habitats within the site, including PF1 Rich fen and flush, PB4 cutover bog and WN6 wet willow-alder-ash woodland will also benefit from the implementation of the proposed restoration measures. These habitats are functionally connected to the Annex I fen system and form part of the wider ecological mosaic. Measures such as conservation grazing, vegetation management and hydrological restoration will improve habitat condition and structural diversity across these areas, while supporting habitat connectivity and overall ecological stability within the site.

8.2 Species Benefiting from Implementation of Restoration Actions

Species typical of fen, wet woodland and hard-water lakes will benefit from the improving condition of habitats outlined in Section 0. Notably, this includes species such as round-leaved wintergreen and fibrous tussock sedge previously recorded on site. These are rare species in Ireland with records restricted to the midlands area, which favour wetland habitats

9 References

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Appendix A – Non-Technical Summary

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan Non-Technical Summary			
Site Name	Lough Mareegan	**NFS site no.**	104012
County	Westmeath	**Designation**	*Not designated*
Fen habitats present (area)	7230 Alkaline fen 7210 Cladium fen 7140 Transition mires		

Site Description

Lough Mareegan is located approximately 10 km northeast of Athlone in County Westmeath. The site is not a formally designated habitat, however, it is important for supporting the following range of important Annex I quality habitats: 7230 Alkaline fens, 7210 Cladium fens, 3140 Hard-water lakes, 91E0 Alluvial woodland and 7140 Transition mires. Although not formally designated, the site is of high ecological value.

Conceptual Site Model (CSM)

The Lough Mareegan site ranges from 53.7 mOD in the north to 48.8 mOD in the south. The profile of the site is sloped from the north to a local depression in the south. Historical springs were identified in the north which are directed towards a central drain to the main lake. A petrifying spring is located in this northern section of the site. The eastern border has rock close to surface which acts as a recharge area for springs. The emerging spring flow is collected in drains which flow towards the smaller eastern lakes. Historical water levels were higher in the central and western area of the site.

The smaller eastern lake is at a higher elevation than the main lake and is separated from the main lake by raised ground. Other areas of raised ground occur along a bog road that connects the eastern hillslope with the central part of the site.

The majority of the site is underlain by the Lucan Formation, characterised by dark, fine grained micritic limestones with shale interbeds, while the eastern portion is underlain by the Waulsortian Limestones, comprising pale grey, massive micritic mud mound limestones that are commonly karstified, giving rise to locally complex groundwater flow conditions. Both formations are classified as Bedrock Aquifers which are moderately productive only in Local Zones (Ll).

The southern section of the site supports the best-developed fen habitats, including Annex I alkaline fen and localised patches of *Cladium* fen vegetation. The electrical conductivity values (465–686 µS/cm) and neutral to slightly alkaline pH (6.6-7.8) indicate influence from calcium-rich groundwater, which supports the development of these fen habitats.

High nitrate (17.5 mg/L) and phosphate (2.5 mg/L) concentrations were recorded in the drains located in the southern area. The southern outlet drain had the highest nitrate concentration.

Under the WETMEC framework defined by Wheeler, Shaw & Tanner (2009), Lough Mareegan is consistent with a WETMEC 9b: part-drained groundwater bottom surrounded by WETMEC 16a: groundwater-flushed bottom.

Key Pressures	
Hydrology Pressures	•Localised hydrology pressure near the bog road where drainage is variable and associated with previous turf cutting. •Localised hydrology pressure where drains connect surrounding spring/surface water from surrounding lands into the site. •Site-wide hydrology pressure where there are deeper drains associated with the western woodland and the larger central drainage channels
Nutrient Pressures	• High nutrients in spring and surface water from the surrounding surface water and groundwater catchment.
Ecology Pressures	Absence of grazing – the absence of grazing represents the most significant pressure on areas of 7230 Alkaline fen within the site. The lack of grazing reduces disturbance and biomass removal, allowing dominant species such as purple moor-grass Molinia caerula to proliferate. This results in reduced structural diversity, suppression of characteristic fen species, and a decline in habitat quality across Annex I 7230 Alkaline fen and associated non-Annex habitats. Drainage and hydrological modification – drainage was identified as both a historical and ongoing pressure. This pressure affects Annex I 7230 Alkaline fen, 7210 Cladium fen, 7140 Transition mires and associated non-Annex habitats. It will also affect the Annex I 91E0 Alluvial woodland and 3140 Hard-water lake. Nutrient enrichment (eutrophication) – nutrient enrichment of the lake was previously recorded including the presence of algal growth (Smith, 2026) and high levels of nitrate and phosphorous levels were recorded during the 2026 water quality surveys. In the context of surrounding land use, it is considered likely that adjacent agricultural land contributes to diffuse nutrient inputs via surface and/or groundwater pathways. Elevated nutrient availability leads to competitive dominance of fast-growing species, resulting in reduced species richness and the loss of characteristic fen vegetation. This pressure affects Annex I 7230 Alkaline fen, 7210 Cladium fen, 7140 Transition mires and associated non-Annex habitats. It will also affect the Annex I 91E0 Alluvial woodland and 3140 Hard-water lake. Invasive species – rhododendron and cherry laurel have both been recorded within the 91E0 Alluvial woodland. These invasive species form dense evergreen stands which outcompete native ground flora and prevent natural

	regeneration of native tree species. The woodland was not targeted as a survey area for the 2026 ecological walkovers and this pressure is therefore not considered. Restoration measures associated with the woodland are included for completeness and should be targeted as a measure that is implemented in the future should appropriate opportunity/funding arise.
Objective of Restoration Plan	
The main aims of the FRP are to maintain or improve the quality of existing areas of fen habitats and improve the hydrological conditions that will allow an expansion of the measurable area, thus impacting on the favourable condition of the fen. However, in some areas, it must be recognised that restoration to increase areas of existing fen will not be possible due to unsuitable hydrological conditions, and the objective may simply be to ensure no further deterioration	
Restoration Measures	
Hydrology Measures	**Drainage On-Site Measures measures ;** • in the east near the bog road • at spring fed drain in the east • at main drain channel through site **Off-Site Measures**: Landowner engagement is required due to the farmland activities surrounding site that may be affecting the water balance of the site.
Nutrient Measures	**On-Site Measures:** On-site nutrient measures will focus on the monitoring of water quality to improve understanding of nutrient dynamics within the site and to assess the effectiveness of any future off-site measures. This will be completed within the piezometers to be installed where nitrate, phosphate, electrical conductivity (EC), pH and temperature will be monitored. Springs, drains and lakes will also be monitored to understand nutrient pathways. **Off-Site Measures:** Targeted nutrient control measures should be implemented across the catchment to address both phosphate and nitrogen pathways. Farmers should be included in the NPWS Farm Plans. Suitable measures include farmer training. Nutrient management plans and nitrogen surplus, where applicable.
Ecology Measures	**On-Site Measures:** Conservation grazing

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan Non-Technical Summary	
Monitoring	
Hydrology Monitoring	Groundwater and surface water monitoring within the fen as well as rainfall and evaporation monitoring.
Nutrient Monitoring	Ongoing monitoring of groundwater and surface water for water quality parameters within the fen
Ecology Monitoring	Habitat condition assessments to monitor the rate, if any, of succession and/or general scrub encroachment which in turn will inform the need for further works
More information	
Fen Restoration Plan Report (provide url) Tóchar website: https://www.tocharwetlands.ie/fen-restoration/	

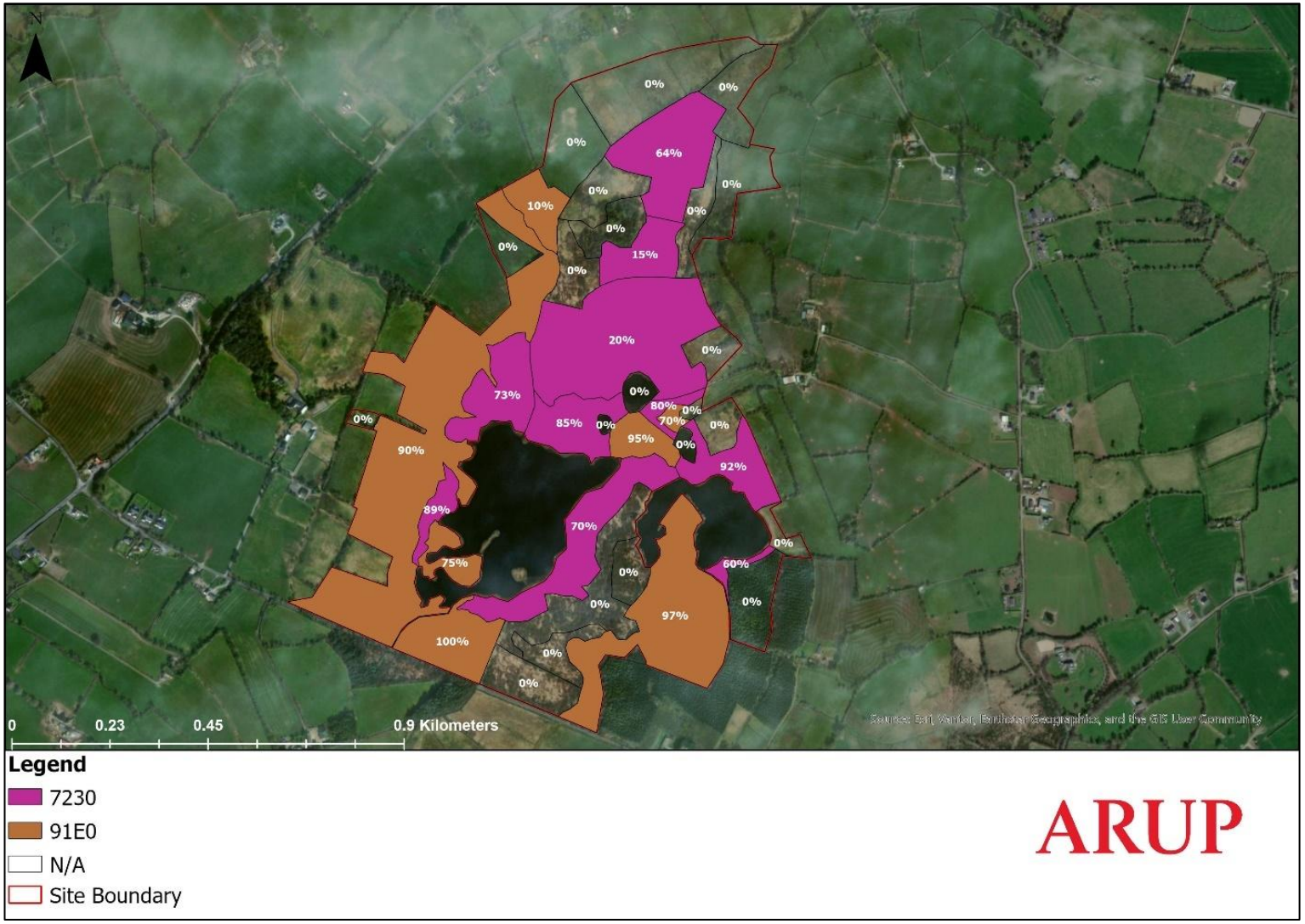
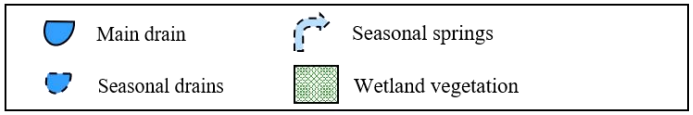


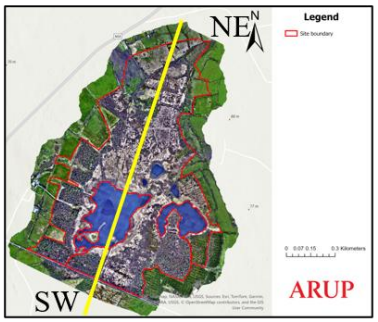
Figure 1: Site Habitat Map

Lough Mareegan
Westmeath County
WFD catchment: 29 Upper Shannon, Breensford_SC_010
WETMEC: 9 (Part-drained Groundwater bottom); 16 (Groundwater flushed bottom)

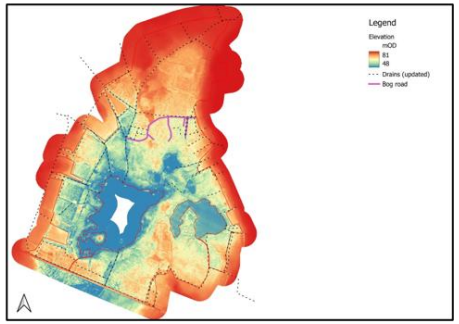
Water key:



Cross section:



Location:



Conceptual site model:

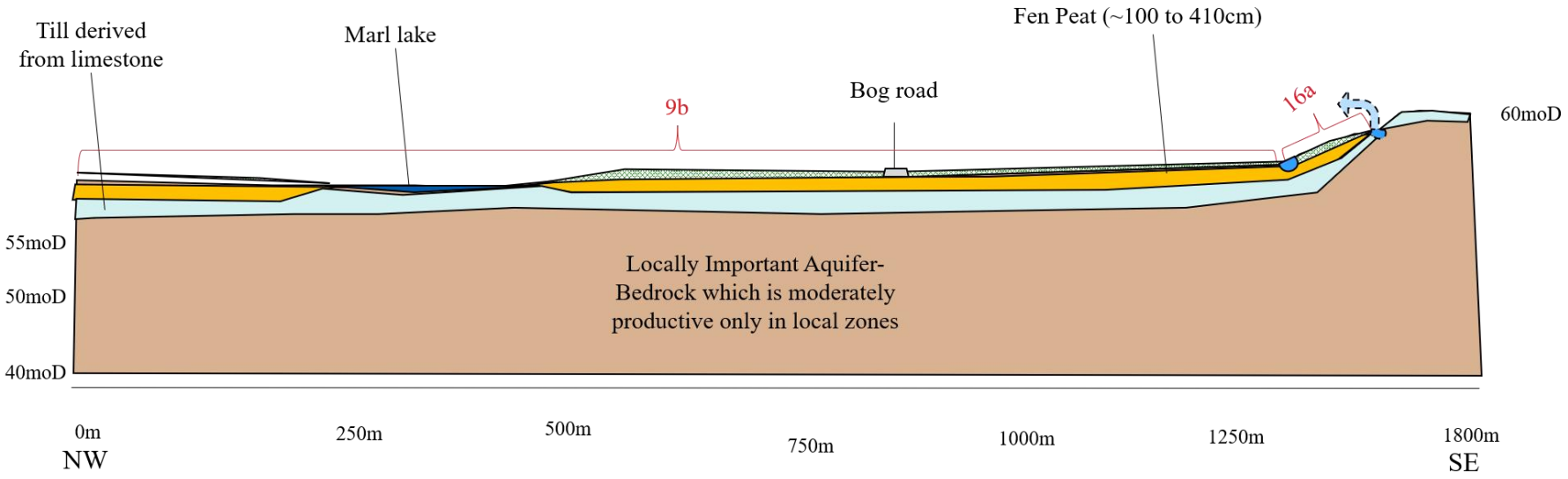


Figure 2: Conceptual Site Model

Appendix B – Ecological Survey Maps

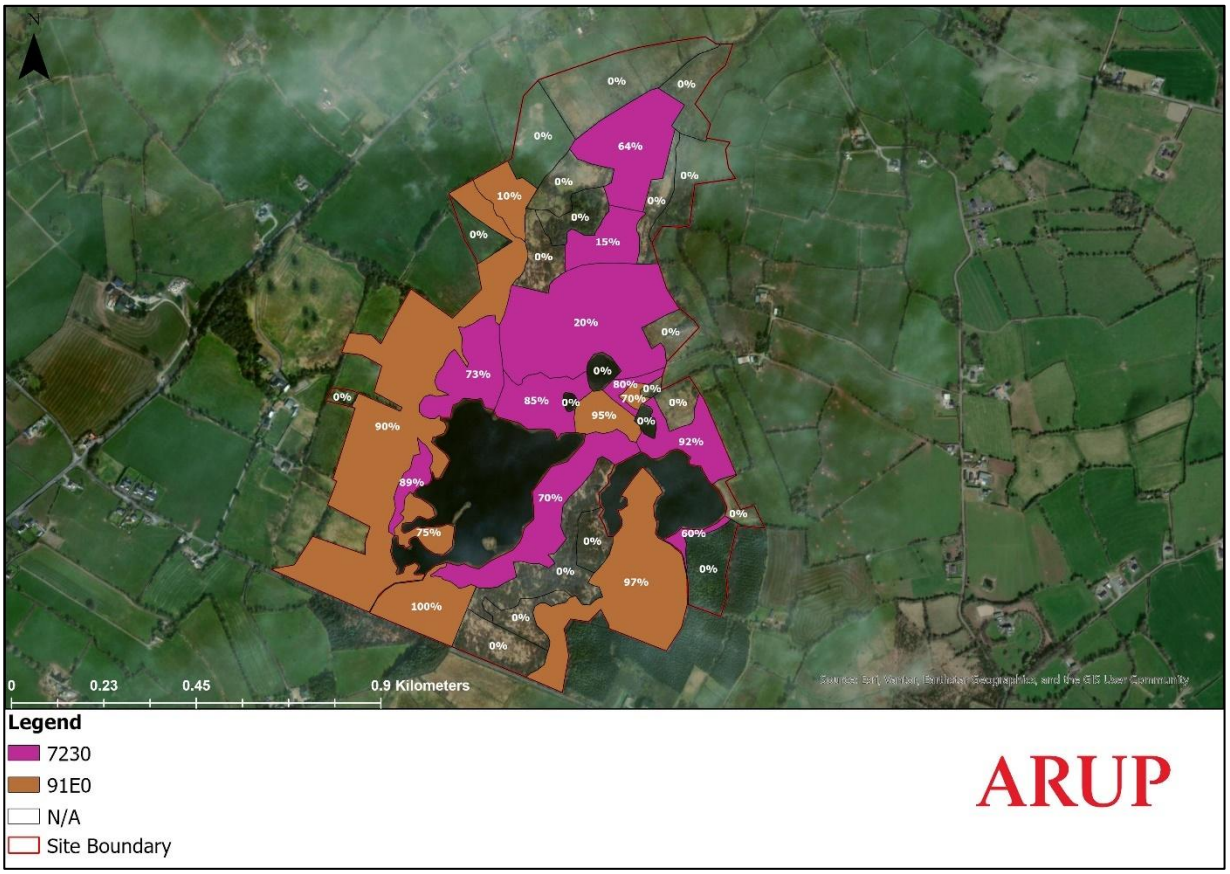


Figure B 1: Annex I quality habitats recorded and mapped as part of the 2022 NFS. Note the % value indicates the % cover of the dominant Annex I quality habitat recorded in the polygon

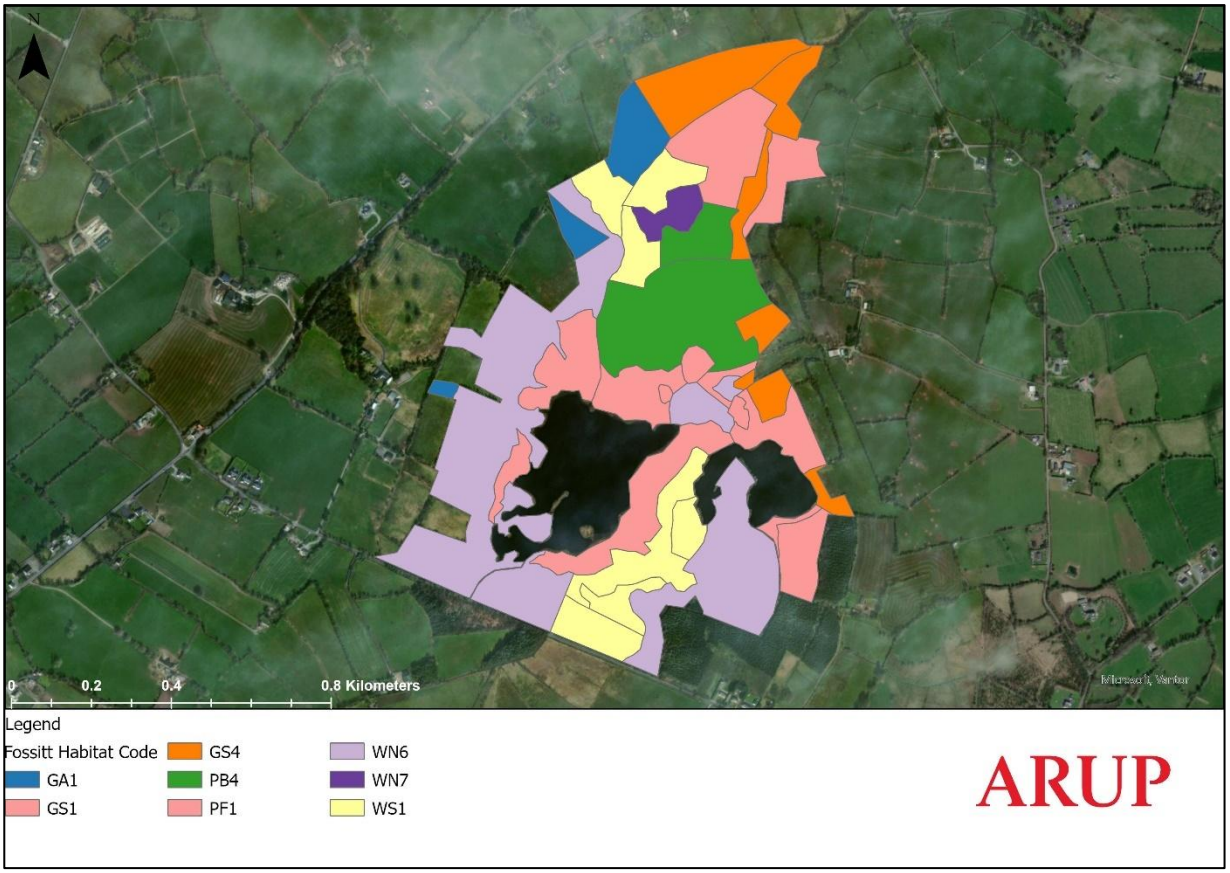


Figure B 2: Habitats recorded during the 2022 NFS and classified according to the Fossitt Habitat Classification System

Appendix C – Restoration Plan and Monitoring

Table C1: Long-term monitoring points for fen restoration at Lough Mareegan

Point	Measure	Objective	Timeframe	Frequency of monitoring	Monitoring indicator
Gw_1	Hydrological	Monitoring groundwater levels and quality	Long-term	Seasonal[4] for year 1 Annual for year 2-5	Groundwater level near main central drain
Gw_2					Groundwater level near bog road
Gw_3					Groundwater level near spring drain
Gw_4					Groundwater level near spring drain
Gw_5					Groundwater level near secondary main drain
Sw_1		Monitoring of surface water levels and quality	Long-term	Seasonal for year 1 Annual for year 2-5	Water level and quality at main central drain
Sw_2					Water level and quality at spring-fed drain

[4] Seasonal: once in winter and once in summer to represent a hydrological year

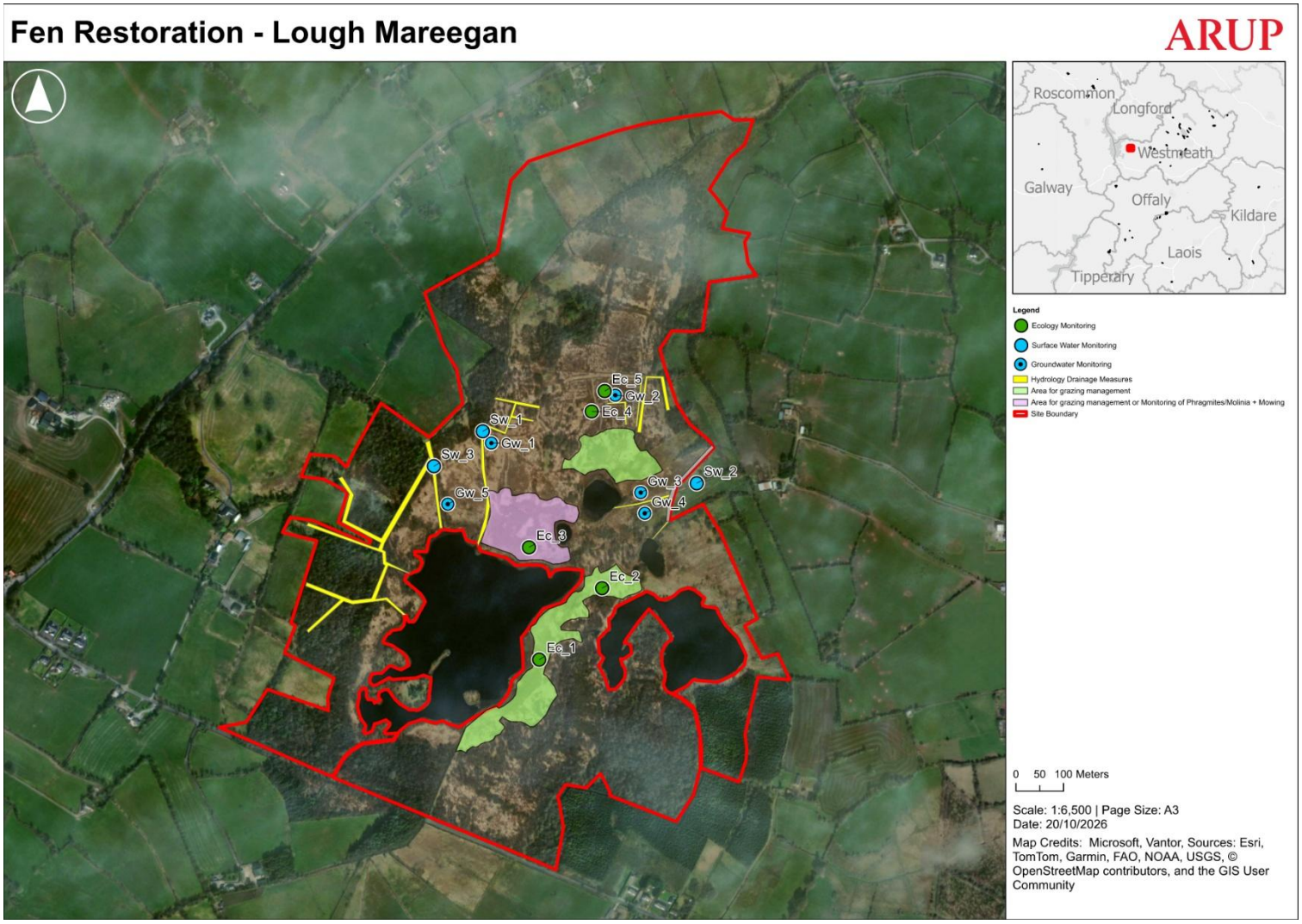


Figure C 1: Restoration measures and monitoring for Lough Mareegan

Appendix D – Drainage Management Plan

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan: Drainage Management Plan			
Site name	Lough Mareegan		
County	Westmeath	NFS site No.	104012
Catchment overview:			
Lough Mareegan is located approximately 10 km northeast of Athlone in County Westmeath. The site is not a formally designated habitat, however, it is important for supporting the following range of important Annex I quality habitats: 7230 Alkaline fens, 7210 Cladium fens, 3140 Hard-water lakes, 91E0 Alluvial woodland and 7140 Transition mires. Although not formally designated, the site is of high ecological value.			
WFD catchment	Upper Shannon 26E	WFD Sub-catchment	Breensford_SC_010
Drainage Area	N/A	Drainage District	N/A
Responsible authority	N/A	Maintenance date	N/A
Surrounding landowners	Private		
Wetland drainage			
Historical maps from the early-1800s show an open water body within the site boundary. The open water is surrounded by springs and wells to the north and east with a large drain passing through the centre of the site from the north to the open water of the lake. The drain then extended from the outlet of the lake in the south, which drains towards Lough Ree. By the 1940s, the larger lake in the site boundary had reduced, disconnecting from smaller lakes which were likely still fed from upstream seasonal springs and groundwater contributions.			
Surface water inflow	Spring fed drains	Surface water outflow	Drain
Groundwater inflow	Springs		
Internal drains	Multiple	Perimeter drains	Multiple
On site hydrology measures			
• Drainage measures in the east near the bog road to include reprofiling and peat dams • Drainage measures at spring fed drain in the east to include peat dams or plastic piling • Drainage measures at main drain channel through site			

<table>
<tr><th colspan="6">NPWS Tóchar Midlands Wetland Restoration Scheme
Fen Restoration Plan: Drainage Management Plan</th></tr>
<tr><td colspan="6">• Drainage measures site wide</td></tr>
<tr><td colspan="6">Off-site hydrology measures</td></tr>
<tr><td>Off-site measure 1</td><td colspan="2">Avoid creating new drainage channels</td><td>Role player</td><td colspan="2">NPWS/Surrounding landowners</td></tr>
<tr><td colspan="6">Engagement with landowners to not create new drainage channels.</td></tr>
<tr><td colspan="6">On-site nutrient measures</td></tr>
<tr><td colspan="6">Monitoring to identify nutrient pathways in fen habitat. Monitoring targeted at springs and lakes.</td></tr>
<tr><td>On-site measure 1</td><td colspan="2">Catchment nutrient measures as part of a farm plan</td><td>Role player</td><td colspan="2">Landowners within catchment/NPWS</td></tr>
<tr><td colspan="6">Water Monitoring</td></tr>
<tr><td colspan="6">Groundwater and surface water monitoring in a network of piezometers and standpipes at key locations within the site to monitor changes to water in order to establish if onsite measures area required such as drain blocking.</td></tr>
<tr><td>Indicator</td><td>Water level</td><td>Location</td><td>Various locations across site</td><td>Role players</td><td>NPWS</td></tr>
<tr><td colspan="6">A hydrological monitoring programme will be implemented, including the installation of piezometers and the use of existing piezometers. Rainfall and evaporation monitoring is proposed using the nearby Met Eireann weather station.</td></tr>
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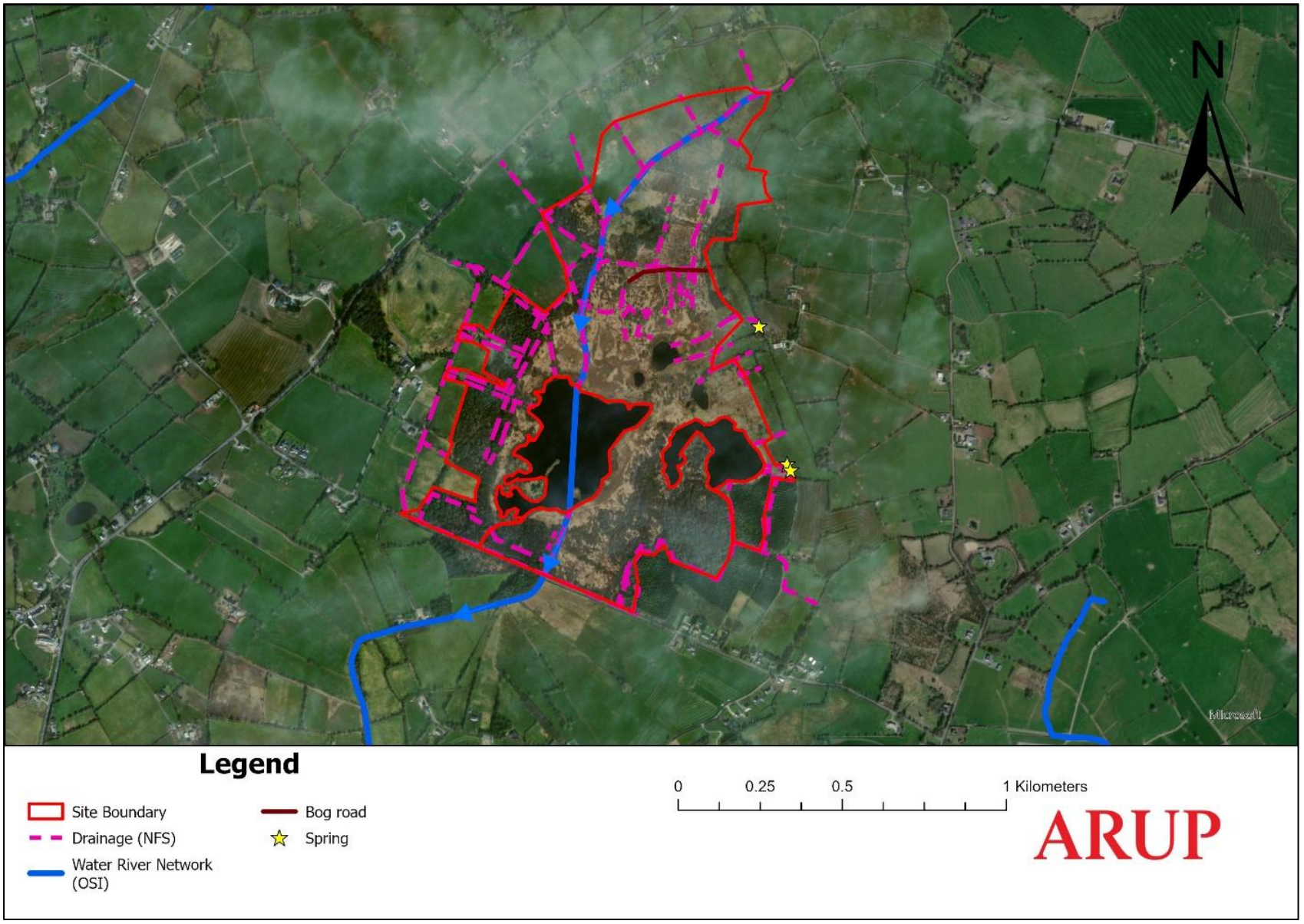


Figure 1: Mapped drainage network at Lough Mareegan