National Parks & Wildlife Service

Tóchar Midlands Wetland Restoration Scheme

Annaghmore Lough SAC (Roscommon)

NFS site No. 304001

SAC 001626

pNHA 001626

Fen Restoration Plan

July 2026

Tóchar
Athchóiriú Bogach Lár na Tíre
Midlands Wetland Restoration

ARUP

Rialtas na hÉireann
Government of Ireland

Arna chomhchistiú ag an Aontas Eorpach
Co-funded by the European Union

Tionól Réigiúnach an Oirthir agus Lár Tíre
Eastern and Midland Regional Assembly

NPWS
An tSeirbhís Páirceanna Náisiúnta agus Fiadhúlra
National Parks and Wildlife Service

Fen Restoration Plan

Annaghmore Lough SAC (Roscommon)

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Arup

Citation:

Lodenkemper, L., Lau, Y-Y, O'Shea, N, Ryan, J. Baker, G. & Smith, G. (2026) Fen Restoration Plan. Annaghmore Lough SAC (Roscommon) (304001). The National Parks and Wildlife Service.

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

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Executive Summary

Annaghmore Lough SAC (Roscommon) is located 5km north-west of Strokestown, Co. Roscommon and is designated as a Special Area of Conservation (SAC) for the presence of 7230 Alkaline fens as well as 1013 Geyer's Whorl Snail (*Vertigo geyeri*) - listed under Annex I and II of the EU Habitats Directive. It is also nationally designated as a Proposed National Heritage Area (pNHA).

This Fen Restoration Plan (FRP) identifies restoration measures for the Annex I habitats within the SAC, as well as other wetland habitats supported within the site. The proposed measures aim to contribute to the achievement of site-specific conservation objectives and to support the attainment of favourable conservation condition of the fen habitat.

This site-level plan provides a framework for restoration, which will be refined further prior to implementation at site. The assessment primarily considers the following pressures that may be impacting on the hydrological function and/or favourable condition of the fen habitat:

- Drainage
- Grazing
- Agricultural intensification
- Nutrient enrichment

Factors such as landownership and management will dictate the ability of addressing such pressures as part of this FRP.

Restoration Plan

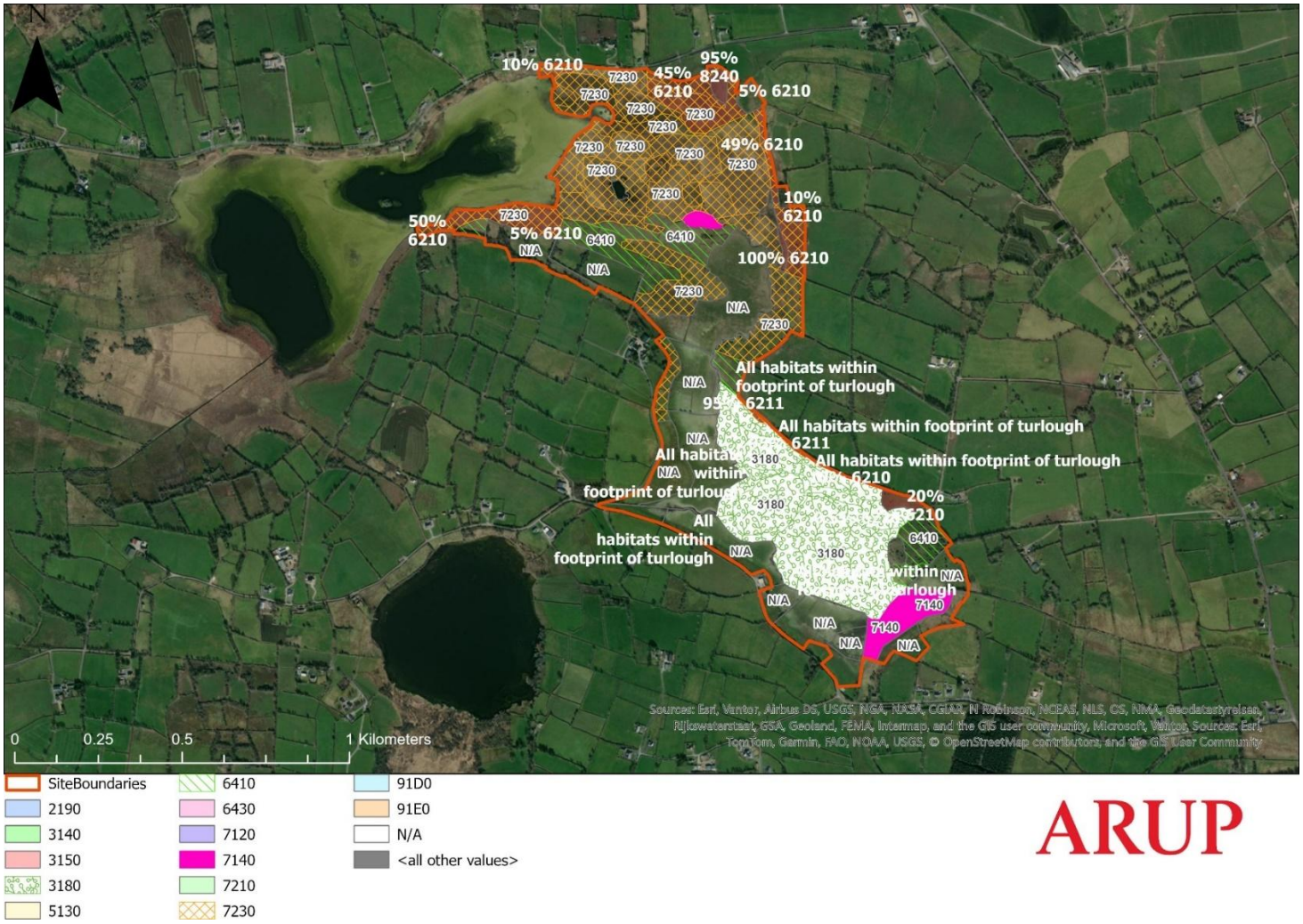
The FRP proposes a targeted programme of hydrological and vegetation management to address the key pressures affecting the site and support the recovery of 7230 Alkaline fen and associated fen which will in turn support the recovery of 1013 Geyer's whorl snail which is dependent on fen habitats in favourable condition to survive.

- Hydrological measures will focus on drain blocking to raise water levels locally and allow for seasonal flooding. Hydrological monitoring and wider hydrogeological assessments will inform the regional controls to spring and turlough functioning prior to drainage measures to improve site-wide water levels.
- Water quality monitoring to maintain low nutrient, calcium-rich conditions in the fen.
- Vegetation measures focus on the recovery and long-term maintenance of 7230 Alkaline fens through the implementation of various levels of conservation grazing across the site. Grazing levels should be maintained within fen areas of good condition and increase grazing in areas which are deemed more tussocky or in rank condition.

Habitat and Restoration Map

The Annex I and Annex I quality habitats recorded and mapped as part of the 2022 NFS is presented in Figure 1.1. The habitats recorded during the 2022 NFS and classified according to the Fossitt Habitat Classification system is presented in Appendix B.

The proposed restoration measures and monitoring points are presented in Figure 1.2.



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Figure 1.1: Annex I and Annex I quality habitats recorded and mapped as part of the 2022 NFS. Note the % value indicates the % cover of the dominant Annex I and Annex I quality habitat recorded in the polygon for Annaghmore Lough SAC (Roscommon)

Figure 1.2: Restoration measures and monitoring for Annaghmore Lough SAC (Roscommon)

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, Conservations 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.

Annaghmore Lough SAC (Roscommon) is located approximately 5km northwest of Strokestown in County Roscommon. The qualifying interests (QI) features of the SAC are 7230 Alkaline fens and 1013 Geyer's whorl snail *(Vertigo geyeri*).

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 site. Restoration actions to raise the water table of peatland habitat will improve the hydrology of adjacent turlough, lake, wetland 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,

[1] Each habitat and species type protected under the EU Habitats Directive (Council Directive 92/43/EEC of 21 May 1992) is given a unique numeric code so that all.
Member States use the same reference in legislation, reporting and monitoring. Each habitat and species code is an index in the Annex lists with codes grouped by habitat family.

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 minimise flood risks. Beyond their ecological importance, fens hold cultural, historical and recreation 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 transform a natural peatland which acts as a modest carbon 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 the fen habitat at Annaghmore Lough SAC (Roscommon) is likely to lead to improved hydrological aspects (water quality and distribution). 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 reducing flood risk.

1.3 Key pressures on Fens

The overarching (National) key pressures and threats to Annex I fen habitats and Annex II species Geyer's whorl snail have been identified in the latest Status of EU Protected Habitats and Species in Ireland (Article 17 report) (NPWS 2025) in Table 1-1. The overall conservation status is assigned as Bad for 7230 Alkaline fens and Bad for Geyer's whorl snail in the Article 17 report.

Table 1-1: National pressures to fen habitats and QI Species

Habitat	Importance	Pressure
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

Habitat	Importance	Pressure
		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 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
Geryer's whorl snail	High	PA08 Extensive grazing or under grazing by livestock PA22 Drainage for use as agricultural land PL05 Modification of hydrological flow (mixed or unknown drivers)

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).

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. Member States are required to implement restoration measures for specific habitats and species, including marine ecosystems, forests, wetlands, and pollinators.

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 QI of the SAC and special conservation interest (SCI). Conservation objectives for the site are defined for these qualifying interests.

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 Annaghmore Lough SAC (Roscommon) and the conservation objectives for 7230 Alkaline fens and Geyer's whorl snail.
- 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 Annaghmore Lough SAC (Roscommon)

Annaghmore Lough SAC (Roscommon) (Figure 2-1) is located northwest of Strokestown, Co. Roscommon. The FRP boundary encompasses part of the SAC, including an extensive area of predominantly 7230 Alkaline fens to the east of Annaghmore Lough SAC (Roscommon) and a broad shallow basin with a swallow hole to the south that functions as a turlough system. The site comprises a complex mosaic of wetland habitats, including Annex I quality 7140 Transition mires and quaking bog (hereafter referred to as 7140 Transition mires), 6410 Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) (hereafter referred to as 6410 Molinia meadows),7210 Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* (hereafter referred to as 7210 *Cladium* fens), 7220 Petrifying springs with tufa formation (Cratoneurion) (hereafter referred to as 7220 Petrifying springs) and 3180 Turloughs*with large areas subject to seasonal winter inundation. Additional Annex I quality habitats recorded within the site include 8240 Limestone pavements and 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites) (hereafter referred to as 6210 Orchid-rich calcareous grassland).

The northern section is dominated by 7230 Alkaline fens, although some areas are degraded, with reduced sedge and brown moss cover. The northern shore of the lough that supports 7230 Alkaline fens is the location where Geyer's whorl snail had been recorded (NPWS, 2013) as well as 7220 Petrifying springs.

In the south, the turlough system creates a gradient of habitats influenced by subtle topographic variation, ranging from Annex I quality 6210 Orchid-rich calcareous grassland on higher, drier ground to species-rich 7230 Alkaline fens, 6410 Molinia meadows, and extensive rich fen communities within the turlough basin.

Large areas are dominated by purple moor-grass (*Molinia caerulea*), representing species-rich but generally degraded fen meadow. Wetter areas support high-quality rich fen communities characterised by sedges, rushes, brown mosses, and a wide range of wetland herbs. Approximately 2ha of 7140 Transition mire occurs in the southern part of the site, supporting communities dominated by bottle sedge (*Carex rostrata*) and lesser tussock-sedge (*Carex diandra*).

At the time of the National Fen Survey (NFS), grazing management varies across the site. Much of the central area is lightly grazed, with cattle grazing in the northern section and horses grazing in the southern section. In contrast, fields around the site margins, particularly in the southwest, are more intensively grazed by cattle. Some of these marginal fields also contain deep, well-maintained drainage channels, which may influence habitat condition and site hydrology. (Brophy et al., In prep).

Overall, the site supports a valuable complex of alkaline fen, calcareous grassland, wet grassland, transition mire, and turlough-associated habitats, maintained under a mixed grazing regime and influenced by seasonal flooding patterns.



Figure 2-1: Site Location Map

2.2 Fen Condition Assessment

Annaghmore Lough SAC (Roscommon) was surveyed as part of the National Fen Survey (NFS) on the 13th to the 15th of June 2022 (Brophy et al., In prep). The survey identified a number of pressures influencing the condition of the fen habitat including drainage, grazing, agricultural intensification at site boundaries and nutrient enrichment (See Section 4.2.2). During these surveys, the negative pressures outlined in Table 2-1were identified.

The NFS assessment of Annex I habitats recorded contrasting conservation between habitat types. Both the 7230 Alkaline fens were assessed as 'Unfavourable-inadequate' and 7140 Transition mire as 'Unfavourable-bad' indicating that the structure and functions of the habitat are significantly impacted. In contrast 7210 *Cladium* fen were assessed as 'Favourable', reflecting more intact ecological functioning in these locations across the site.

Although the 7210 *Cladium* fen recorded within the site was assessed as being in favourable condition, it occurred only as a minor component of a habitat mosaic, covering ≤10% of the relevant polygons (and around 1% in one polygon). The result should therefore be considered in the context of its limited extent. In addition, the 7210 *Cladium* fen occurs within a wider

habitat complex where 7230 Alkaline fens was assessed as being in poor condition, highlighting the need for caution when interpreting the favourable assessment.

Table 2-1: Assessment of impacts of pressures on 7230 Alkaline fens at Annaghmore Lough SAC (Roscommon)

Pressure Code	Pressure	Influence
PA07	Intensive grazing or overgrazing by livestock. The level of grazing varies across the site with the central section of the site lightly grazed by cattle and horses in the south, much of the site remains open fen and grassland structure. Areas in the southwest is more intensively grazed allowing for the decline in alkaline fen.	Depending on intensity can be considered positive or negative
PA17	Agricultural activities generating pollution to surface or ground waters (including marine). There is evidence of green algae recorded onsite even within Annex I fen habitats.	Negative
PA22	Drainage for use as agricultural lands. Multiple deep, well-maintained agricultural drains were noted along the south and south-west of the site.	Negative
PL05	Modification of hydrological flow. Multiple deep, well-maintained agricultural drains were noted along the south and south-west of the site.	Negative
PA09	Burning for agriculture. The site synopsis notes that burning was evident onsite.	Negative

2.3 Site-specific conservation

Detailed SSCOs aim to define the conditions necessary to maintain or achieve the favourable conservation condition of a habitat or species at site level. The maintenance of habitats and species within sites at favourable condition will contribute to the maintenance of favourable conservation status of those habitats and species at a national level.

A conservation objective was set for Annaghmore Lough SAC (Roscommon) for 7230 Alkaline fens and 1013 Geyer's whorl snail using attributes and targets based on the parameters set out in the Habitats Directive. The restoration actions outlined by this restoration plan aim to contribute towards achieving these targets.

The attributes and targets for 7230 Alkaline fen and 1013 Geyer's whorl snail along with how the FRP will contribute to achieving set targets set out in Table 2-2.

This document does not present the full suite of attributes, targets, and measures for the Annex I habitats and QI species within Annaghmore Lough SAC (Roscommon).
The selection provided below reflects a conscious decision to focus on those with clear, direct benefits from the FRP measures. While these are listed below, it is anticipated that the remaining attributes, targets and measures will also experience positive outcomes as restoration measures are implemented.

Table 2-2: Attributes and targets for 7230 Alkaline fens (NPWS, 2019)

Attribute	Measure	Target	Addressed by FRP?	Will restoration actions contribution to achieving target?
Habitat area	Hectares	Area stable or increasing, subject to natural processes	Yes	Yes. FRP actions will ensure the area remains stable or increases allowing natural processes to continue to influence the site.
Habitat distribution	Occurrence	No decline, subject to natural processes	Yes	Yes. FRP actions will not result in a decline in distribution of fen habitat within the SAC as actions are set to improve the condition.
Ecosystem function: soil nutrients	Soil pH and appropriate nutrient levels at a representative number of monitoring stops	Maintain soil pH and nutrient status within natural ranges	Yes	Yes. FPR actions will address nutrient input from surrounding land which will assist in the restoration of more natural nutrient conditions.
Ecosystem function: peat formation	Percentage cover of peat-forming vegetation and water table levels	Maintain active peat formation, where appropriate	Yes	Yes. Improvement in the hydrology of fen habitat will improve conditions for ecosystem functioning. Furthermore, appropriate grazing levels will improve/maintain the structure and composition of vegetation communities associated with fen habitat.

Attribute	Measure	Target	Addressed by FRP?	Will restoration actions contribution to achieving target?
Ecosystem function: hydrology – groundwater levels	Water levels (centimetres); duration of levels; hydraulic gradients	Maintain appropriate natural hydrological regimes necessary to support the natural structure and functioning of the habitat	Yes	
Ecosystem function: hydrology - surface water flow	Flow direction	Maintain as close as possible to natural or semi- natural drainage conditions	Yes	
Ecosystem function: water quality	Water chemistry measures	Maintain appropriate water quality, to support the natural structure and functioning of the habitats	Yes	
Community diversity	Abundance of variety of vegetation communities	Maintain variety of vegetation communities, subject to natural processes	Yes	
Vegetation composition: brown mosses	Percentage cover at a representative number of 2m x 2m monitoring	Maintain adequate cover of typical brown moss species	Yes	

Attribute	Measure	Target	Addressed by FRP?	Will restoration actions contribution to achieving target?
Vegetation composition: typical vascular plants	Percentage cover at a representative number of 2m x 2m monitoring stops	Maintain adequate cover of typical vascular plant species	Yes	
Vegetation composition: native negative indicator species	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of native negative indicator species at insignificant levels	Yes	
Vegetation composition: nonnative species	Percentage cover at, and in local vicinity of, a representative number of 2m x 2m monitoring stops	Cover of non-native species at insignificant levels	Yes	
Vegetation composition: native trees and shrubs	Percentage cover in local vicinity of a representative number of monitoring stops	Cover of scattered native trees and shrubs at insignificant levels	Yes	
Physical structure: disturbed bare ground	Percentage cover in local vicinity of a representative number of monitoring stops	Cover of disturbed bare ground not more than 10%	Indirectly	

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 data over the past 30 years from the closest Met Éireann weather station, Strokestown (Carrowclogher), which was opened in 1987, has been reviewed to assess seasonal variability in rainfall at the site and surrounding areas (Met Eireann, 2025).

Two datasets have been visualised: (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 3-2), 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.

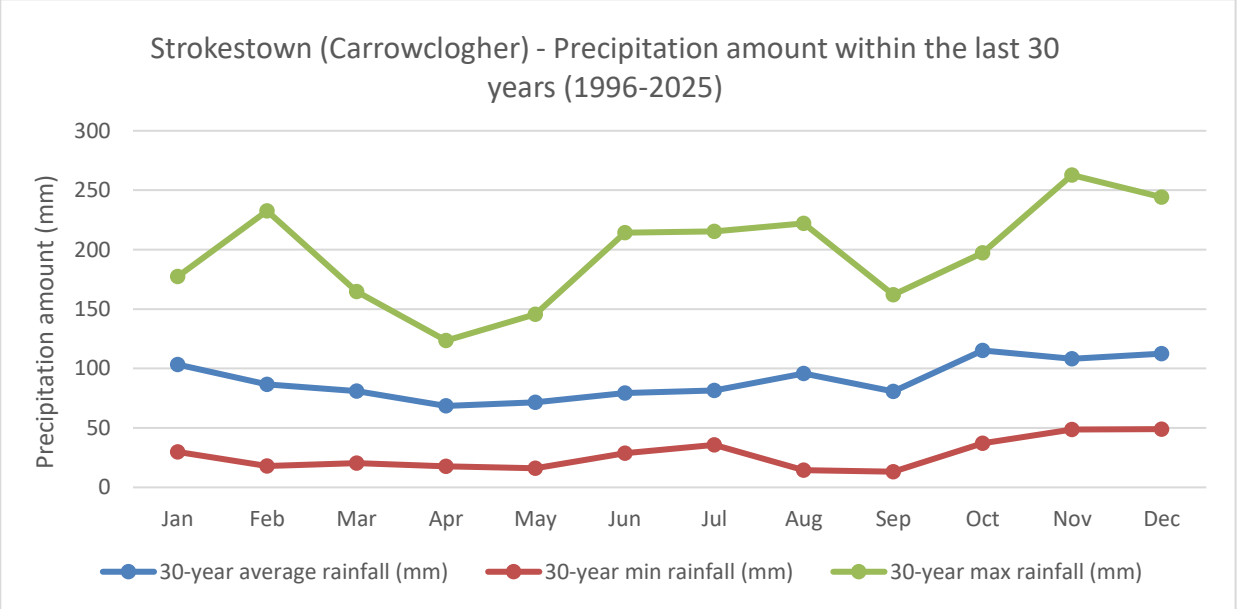


Figure 3-1: Strokestown (Carrowclogher) Weather station - Precipitation amount within the last 30 years (1996-2025)

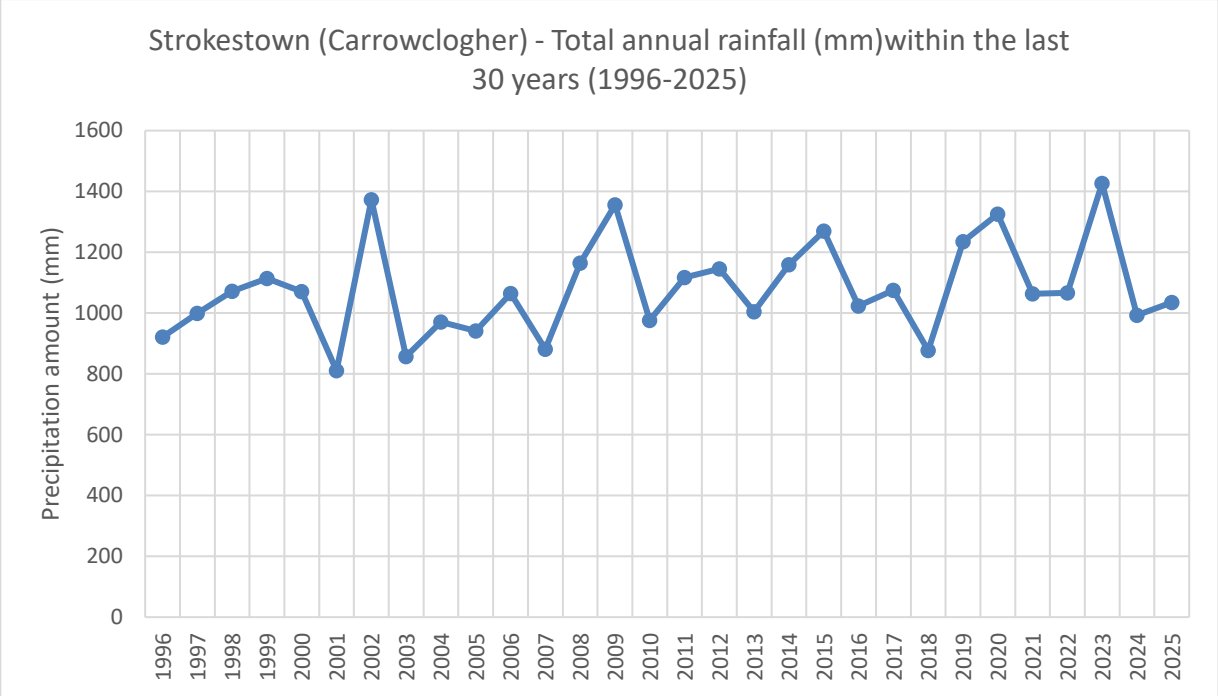


Figure 3-2: Strokestown (Carrowclogher) Weather station - Total annual precipitation within the last 30 years (1996-2025)

The 30-year monthly rainfall data show clear seasonal variation, indicating that the rainfall is typically highest in late autumn and winter, and lowest in spring (notably in April and May). The maximum monthly precipitation can be notably higher in winter, during the wettest times of year.

The total annual precipitation chart also shows seasonal rainfall variation, indicating inter-annual variability that is relevant when considering baseline hydrological conditions and the application of the restoration measures under both wetter and drier climate conditions.

3.1.2 Hydrogeological Setting

Annaghmore Lough SAC (Roscommon) is underlain by the Ballymore Limestone formation (BLF), which are well bedded limestones known for being prone to karstification. The bedrock geology of the site is shown in Figure 3-3. The contact boundary between the BLF and the Oakport Limestone Formation (OLF) outcrops 500 east of the site. The upper ~20m of the OLF is heavily fractured and is known regionally for a significant amount of karst features.

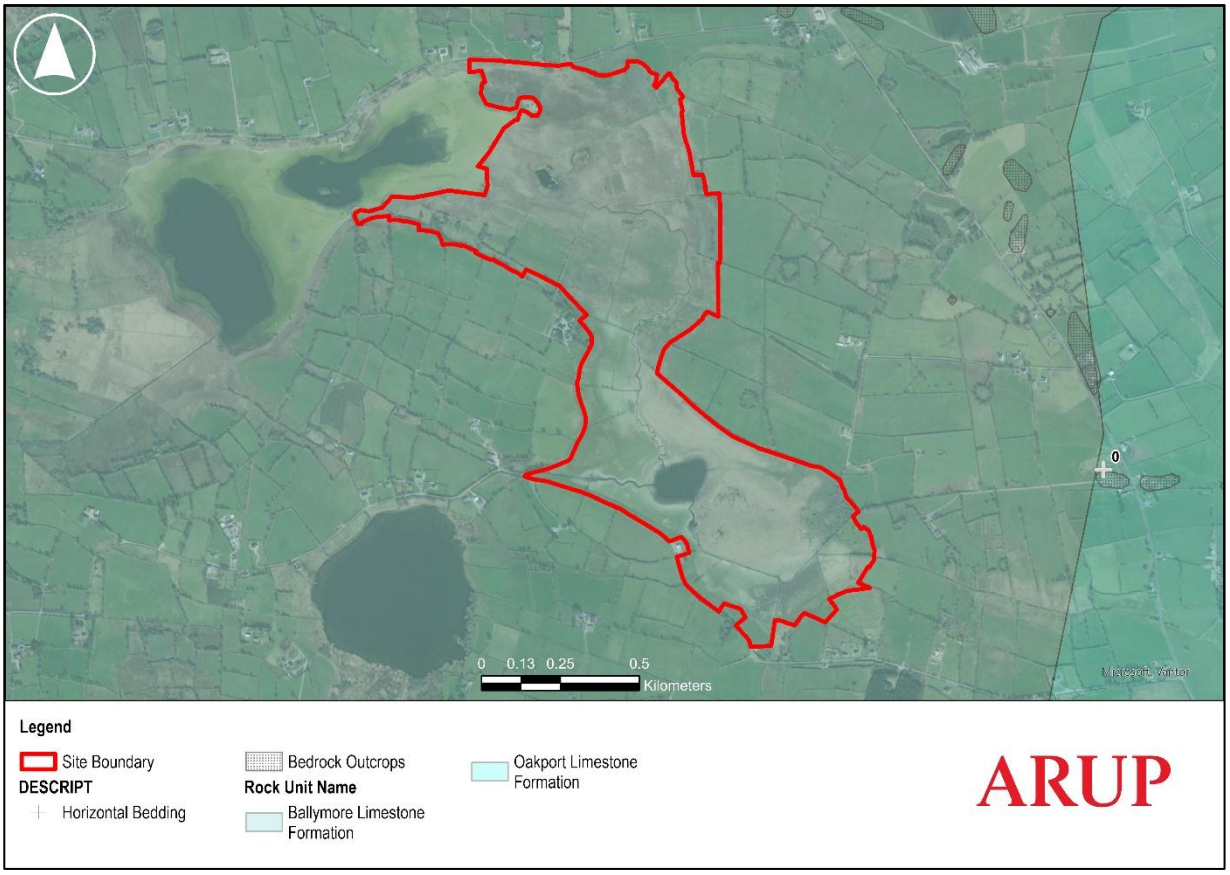


Figure 3-3: Bedrock Geology of Annaghmore Lough SAC (Roscommon) (Source: GSI)

Both the BLF and OLF are classed by the GSI as a Regionally Important Aquifer, that is karstified and dominated by conduit flow (classification abbreviation: RKc). Figure 3-4 shows the bedrock aquifer classification, as well as mapped karst features. A mapped swallow hole within the site boundary directs surface water flow and funnels it underground. The OLF formation 500m east of the site shows many characteristic karst features, including springs and enclosed depressions. A karst spring is mapped 1km east of the site, marking a point where groundwater reaches the surface. Within 2km east of the site boundary there are at least 10 mapped enclosed depressions. Enclosed depressions are known locally as "sinkholes", which funnel groundwater underground. Sinkholes are smaller features than swallow holes.

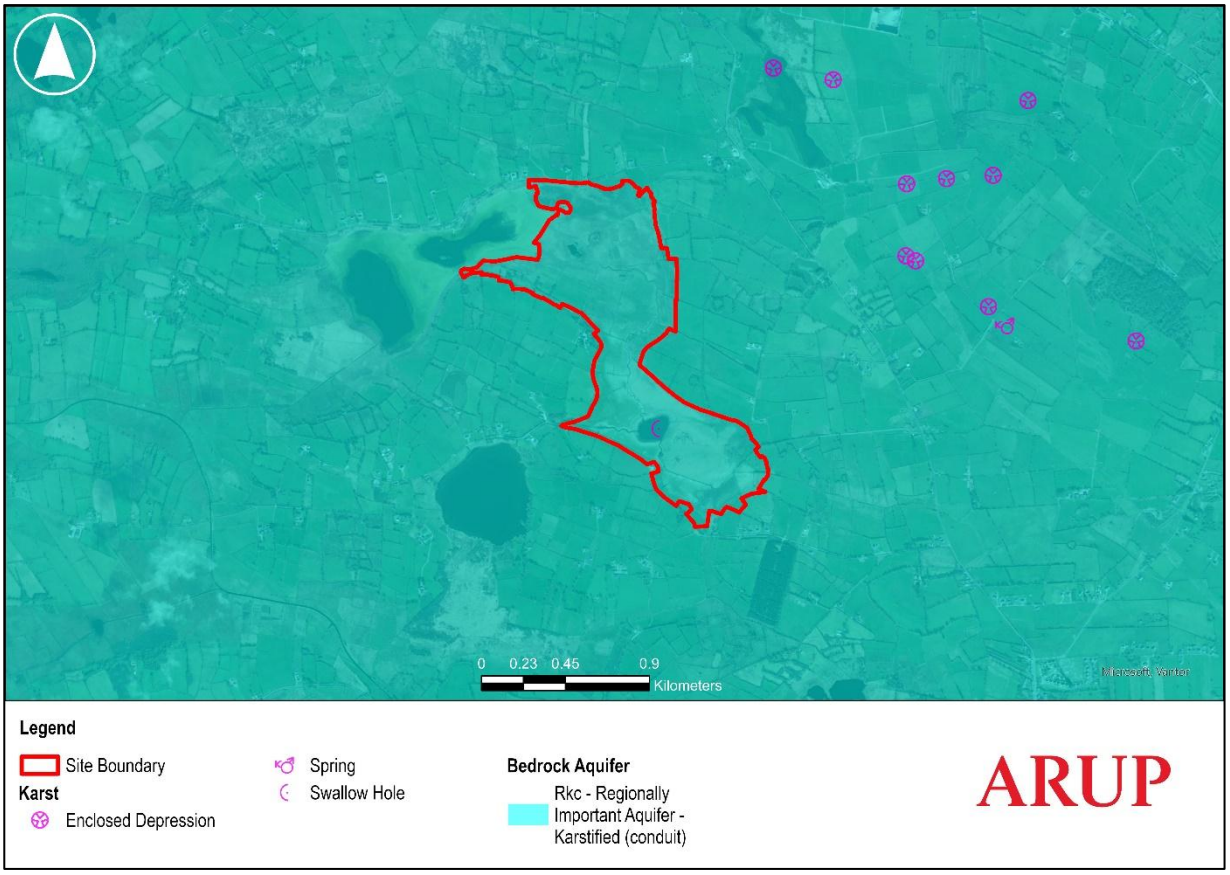


Figure 3-4: Aquifer classification and karst underlying Annaghmore Lough SAC (Roscommon) (Source: GSI)

Figure 3-5 shows the subsoils underlying the site. The subsoil map of the sites dominated primarily by cut over raised peat. Lacustrine sediments to the north of the site are associated with the lake northwest of the site boundary. Till derived from limestones immediate to the site boundary correspond to areas of higher elevation.

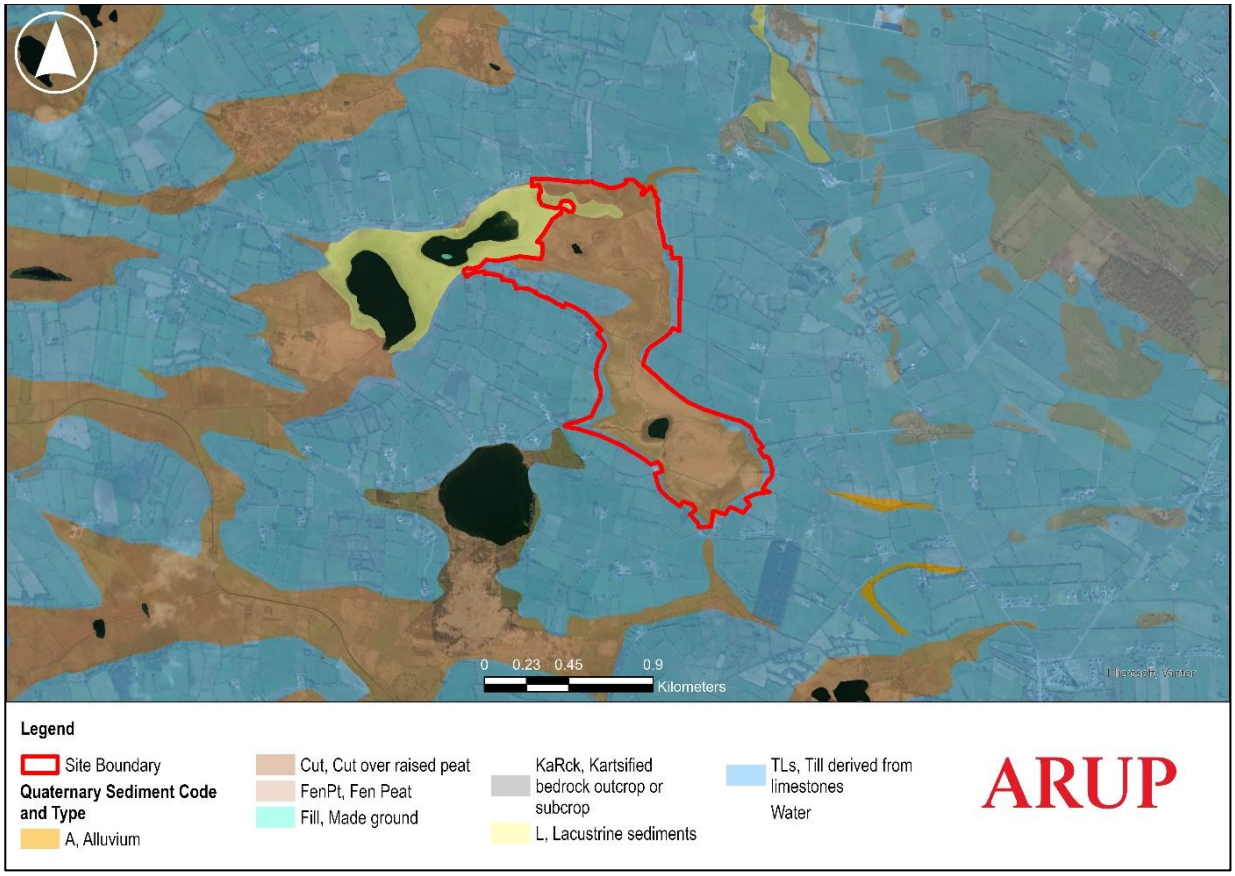


Figure 3-5: Sub-soil type underlying Annaghmore Lough SAC (Roscommon) (Source: GSI)

Spatial variability in groundwater vulnerability is shown in Figure 3-6 below. Groundwater vulnerability corresponds to the depth of the soils and subsoils overlying the aquifer, generally decreasing with increasing soil depth, and is highest in areas of outcropping bedrock. Vulnerability within the site boundary is moderate in the north, increasing to high in the south. This area of high vulnerability is associated with the mapped swallow hole. Areas mapped as low vulnerability correspond to the areas mapped as limestone till. Outside the site boundary, areas of highest vulnerability are associated with bedrock outcrop and mapped karst features. Karstified aquifers are regionally recognised as having increased vulnerability due to the rapid and often unpredictable movement of groundwater.

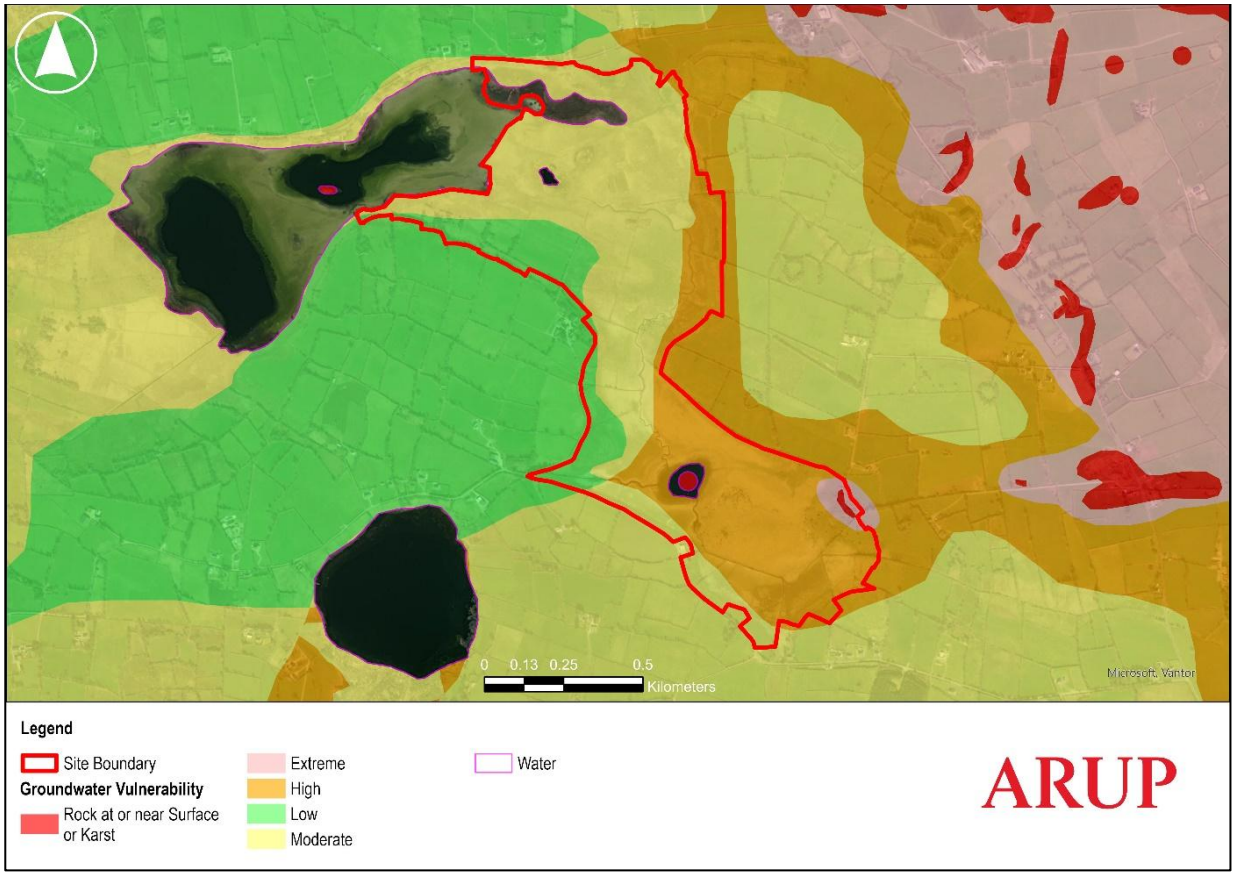


Figure 3-6: Groundwater vulnerability map for Annaghmore Lough SAC (Roscommon) (Source: GSI)

Subsoil permeability reflects the mapped vulnerability zones in Figure 3-6 above. The area of moderate vulnerability in the northern half of the site corresponds to low permeability, while the area of high vulnerability to the south corresponds to moderate permeability.

This pattern is reflected in groundwater recharge zones. Groundwater under the northern half of the site has an average annual recharge of 1-50 mm, compared to 51-100 mm in the south.

3.1.2.1 Seasonal Variation in Groundwater Levels

Water level monitoring has taken place at the northern area of the site. . The piezometers were installed where tufa formation was previously recorded (Figure 3-7;

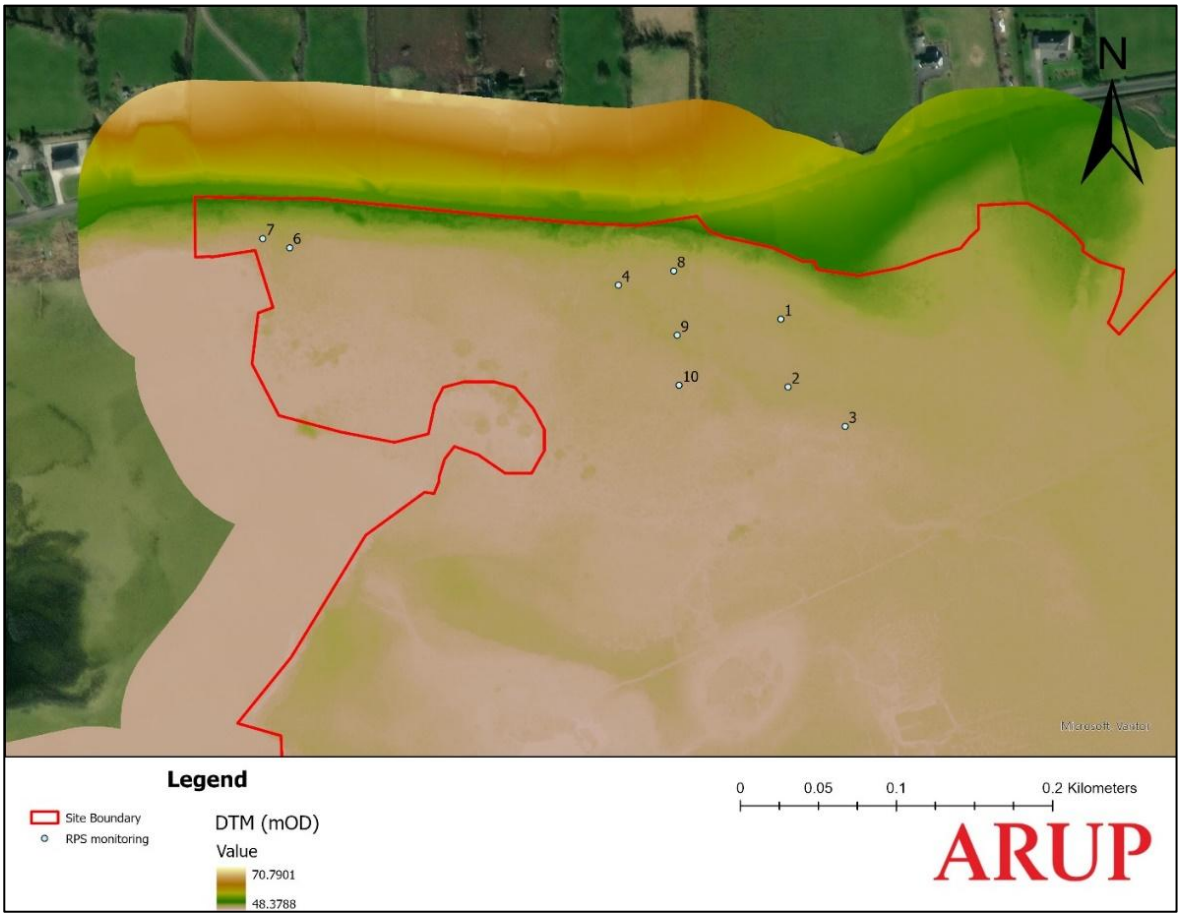


Figure 3-8). The hydrograph of water levels for this area , shows seasonal variability in a general downward trend suggesting a decline in water level over time (Figure 3-9). The graph shows the highest water level during winter noted at 50.2 mOD in October 2023 which declines in the summer period dropping to 49.3 mOD in July 2024, with a further decline to 49.1 in August 2025.



Figure 3-7: Location of site Piezometers at Annaghmore Lough SAC (Roscommon) (Source: RPS, 2025)

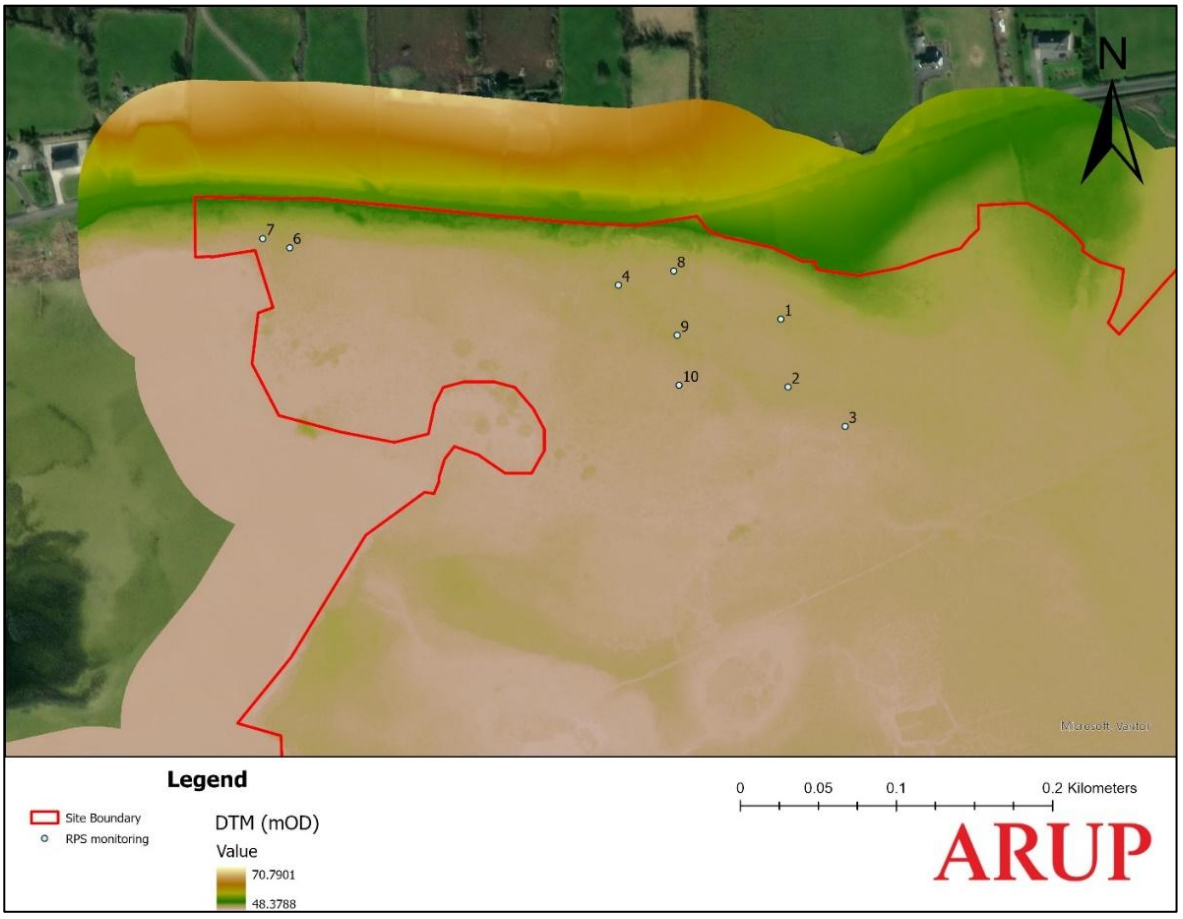


Figure 3-8: Elevation at Piezometer location at Annaghmore Lough SAC (Roscommon) (Source: RPS, 2025)

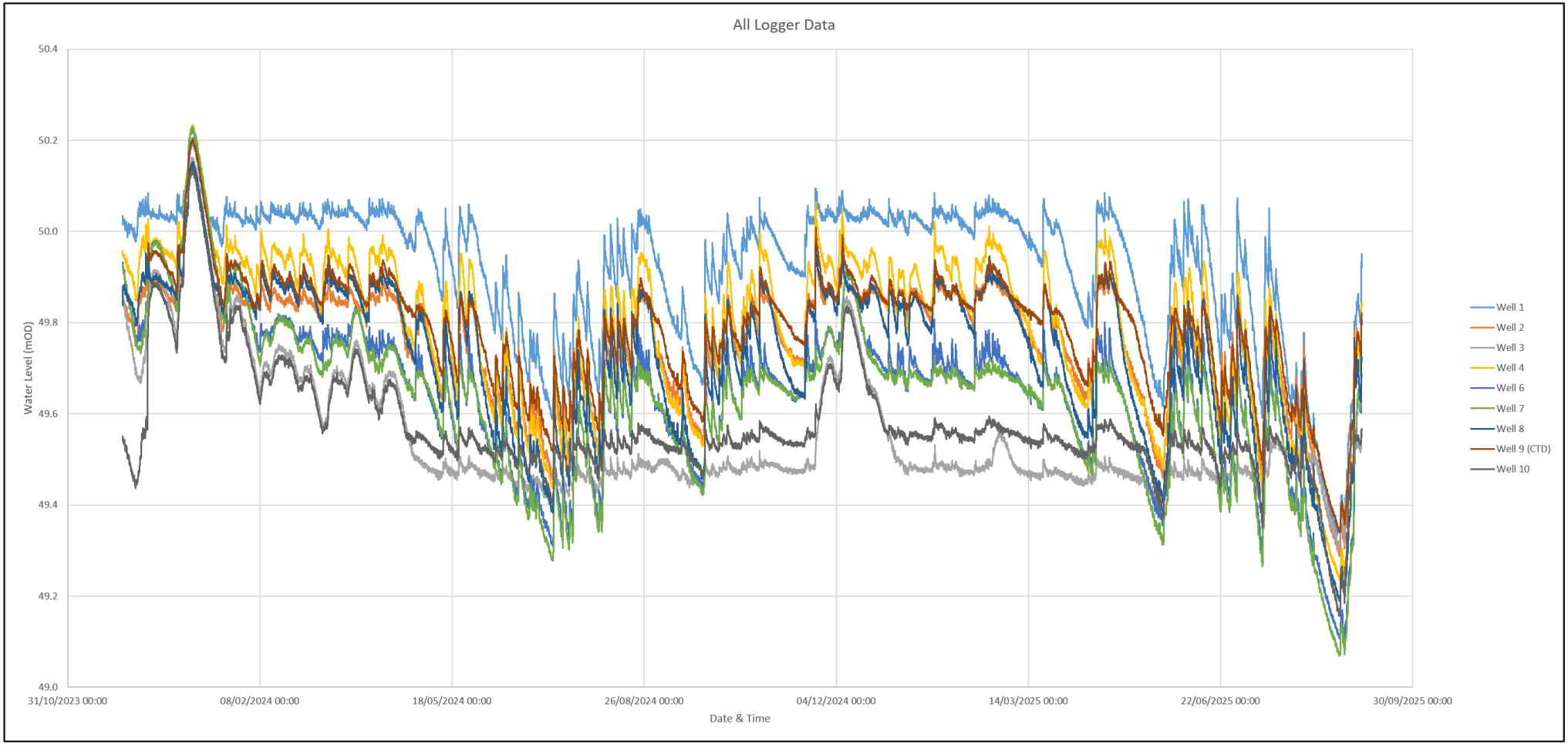


Figure 3-9: Water logger graph from piezometers in northern area, over a period of 24 Months (Source: RPS, 2025)

Groundwater elevations along Transect 1-2-3 and 8-9-10 suggests groundwater flow south towards Well 3 and Well 10, the lowest point above ground level along the transect, as seen in Figure 3-10, Figure 3-11 and Figure 3-12. The groundwater level is close to or at surface level through the monitoring period. Seasonal variation is limited across the transect, with the greatest difference observed at Well 3. Well 3 groundwater levels were at or above surface level during the winter period, dropping to 0.1m below surface level during the summer period. Little to no variation is seen along Transect 6-7 (Figure 3-12).

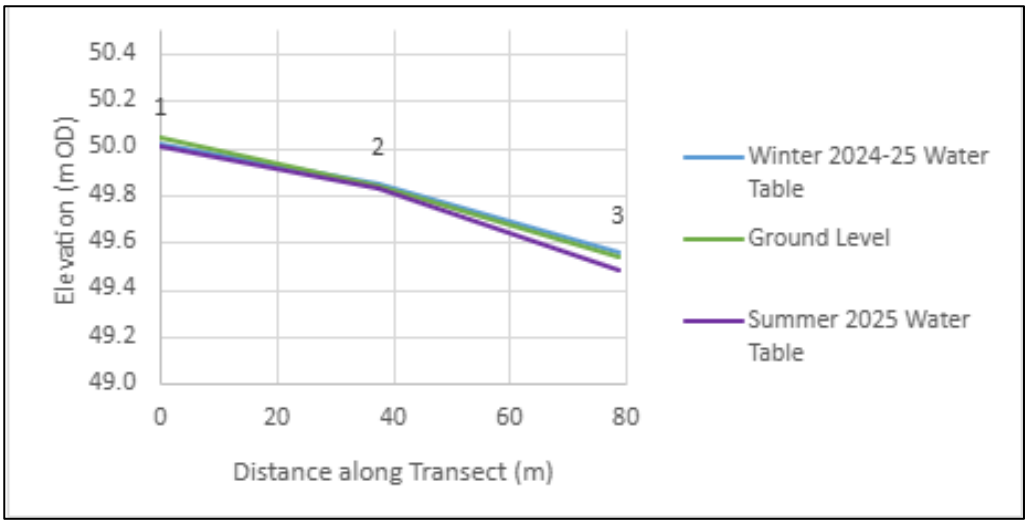


Figure 3-10: Transect of wells 1-2-3 at northern area of site (Source: RPS, 2025)

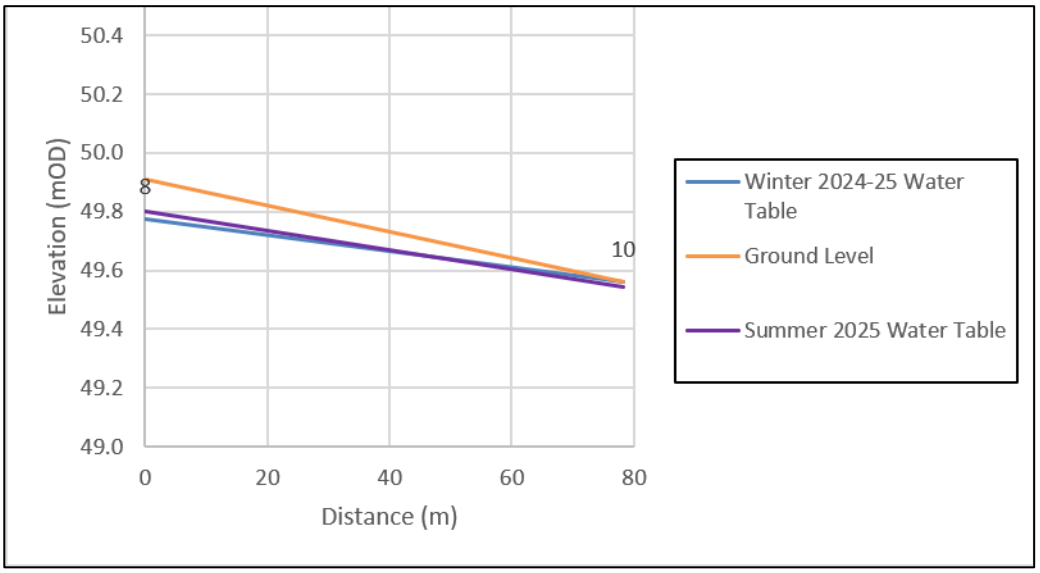


Figure 3-11: Transect of wells 8-10 at northern area of site (Source: RPS, 2025)

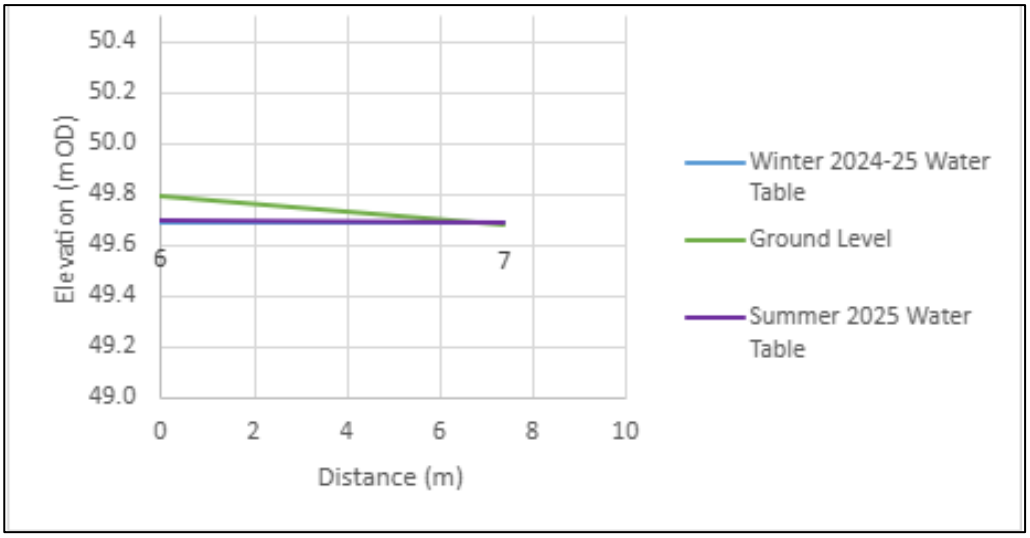


Figure 3-12: Transect of wells 6-7 at northern area of site (Source: RPS,2025)

3.1.3 Topography and Surface Water Drainage

The site is situated within the Upper Shannon (WFD) Catchment and specifically falls under the Scramoge_SC_010 WFD sub-catchment, as illustrated in Figure 3-13, which drains towards Lough Ree.

- Annaghmore Lough is a WFD Lake waterbody currently assessed as having a 'good' status. Surveillance monitoring by the EPA indicates that there is a downward trend for Ammonia-Total (as N) and Total Phosphorus (as P), and an upward trend for Chloropyll[2].
- The WFD Groundwater body associated with the site is the Carrick on Shannon, which is currently assessed as having a 'good' status.
- The WFD River waterbody (Doon_010) associated with the site is currently assessed as having 'moderate' status and it is considered 'at risk' of failing to achieve its WFD objectives. Identified pressures of the WFD sub-catchment are Urban wastewater and Agriculture, within the pressure subcategories of Agglomeration PE < 500 and Farmyards. Annual monitoring by the EPA indicates that there is a downward trend for Ammonia-Total (as N) and an upward trend for Total Phosphorus (as P) and ortho-Phosphate (as P)-unspecified[3].

Annaghmore Lough (WFD lake) and Doon_010 have included the 'Tulsk' area for action under the River Basin Management Plan for Ireland 2022-2027 (third cycle). This area comprises nine waterbodies, including the Doon_10 and Annaghmore Lough. LAWPRO is the lead organisation and Roscommon County Council is the responsible authority.

[2] As indicated in catchments.ie for the 2019-2024 monitoring period

[3] As indicated in catchments.ie for the 2019-2024 monitoring period

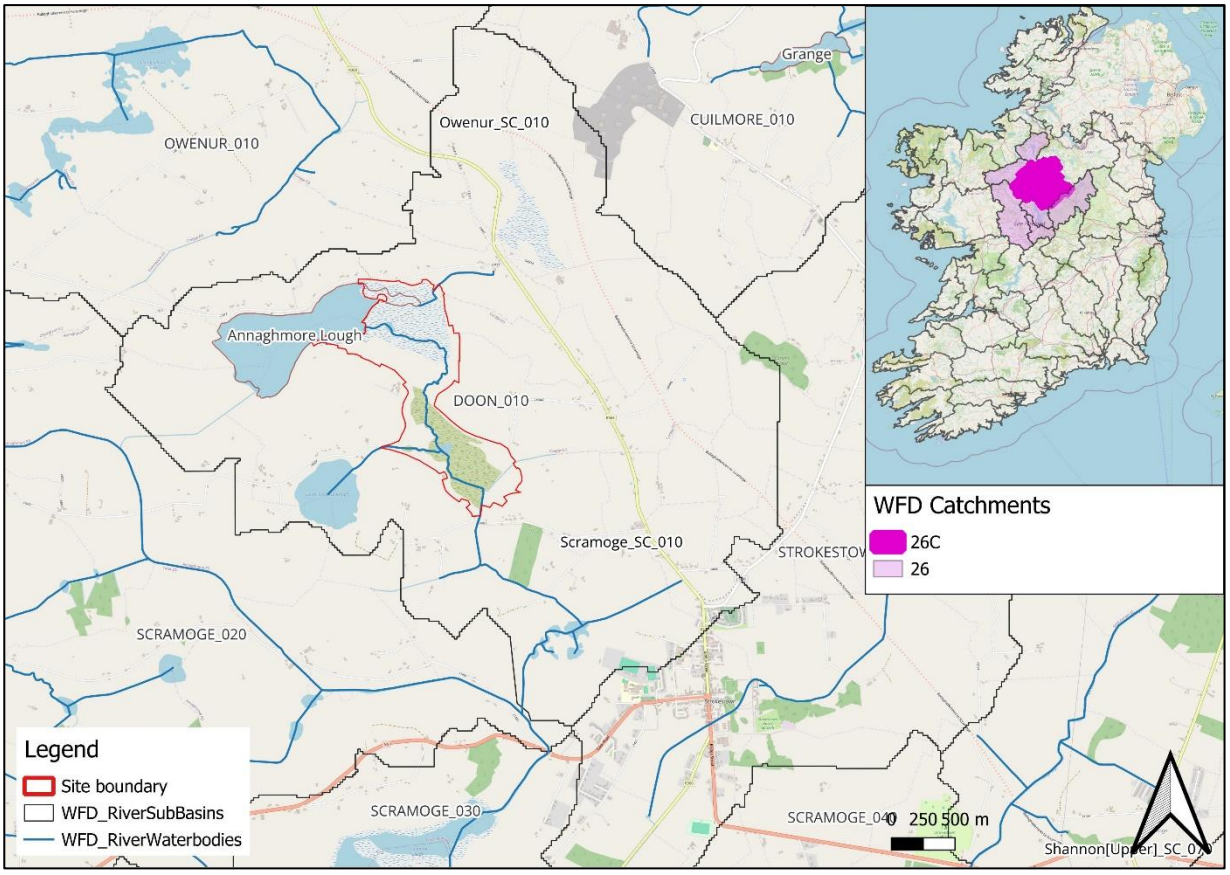


Figure 3-13: WFD Catchment and River sub-basin (EPA, 2025)

An assessment of historical and current hydrological data indicates that the water regime of Annaghmore Lough SAC (Roscommon) has changed over time, primarily due to drainage changes. Historical maps from the early-1800s show an open water body within the site boundary (Figure 3-14). An assessment of both historical and current mapping has indicated that the site has significantly less water than it did historically. In the 1829-1842, 6 inch First edition maps, the northern area of the site was covered by the marl lake with a meandering watercourse flowing to the swallow hole in the south of the site with an additional small lake to the east of the swallow hole. The site had multiple watercourses and field drains leading to the turlough, with one draining from Lough Narlasbarnagh. Historically, there were wells and springs at about 50 mOD which were directed towards downstream waterbodies.

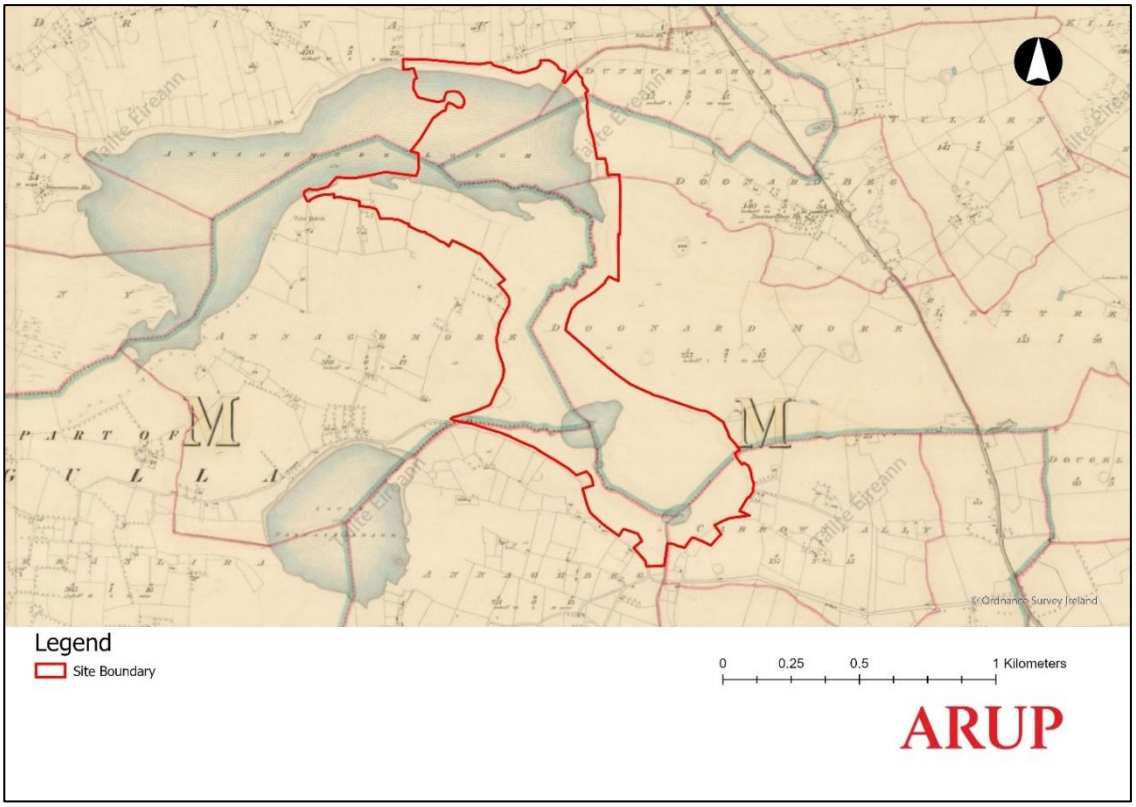


Figure 3-14: Historical water distribution and retention within Annaghmore Lough SAC (Roscommon) (Tailte Éireann Historical mapping, surveyed between 1829 and 1842)

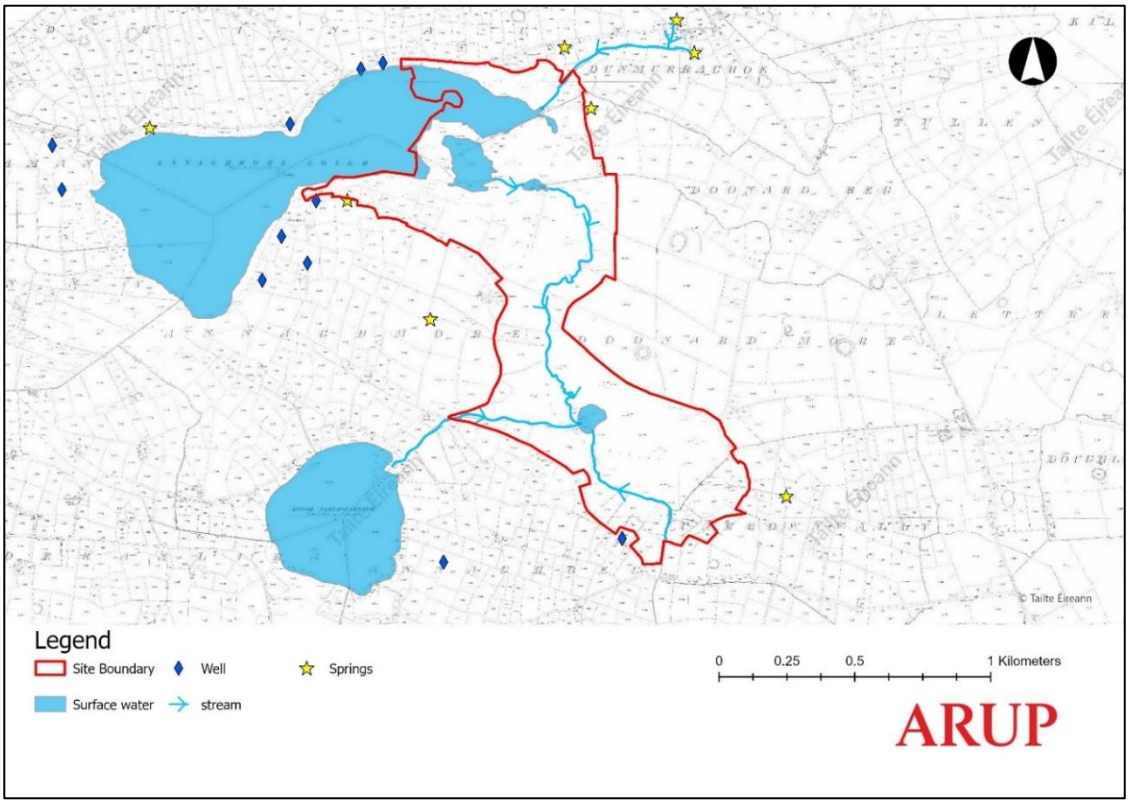


Figure 3-15: Historical water distribution and retention within Annaghmore Lough SAC (Roscommon) (Tailte Éireann Historical mapping, surveyed between 1863 and 1924)

According to the NFS (Pilot) (2022), the site has many drains bisecting the site. Although some were dry at the time of survey, most of them were wide and deep. Some drains remained stagnant, while others were hydraulically connected to neighbouring land parcels, facilitating water movement beyond the site boundary. The northern area of the site was defined as being spring fed. The site had drains entering the site from springs in the east which flowed to the smaller lake, draining towards the swallow hole at the south of the site. The main watercourse was identified as flowing through the centre of the site to a turlough. The main watercourse had many field drains directed towards it. In the south of the site there is a closed basin with surface water being redirected towards the swallow hole. The main output from the site is the swallow hole, where water in this karst region can flow to the regionally important aquifer underlaying the site.

The mapped Wetness Index for the site indicates that it is classified as temporarily wet, with patches of permanent wet in the north and of the turlough area being classified as permanent water. This classification reflects alternating periods of saturation and dryness between 2012 and 2018. Such variability in soil moisture conditions creates a mosaic across the landscape, which supports intermittent wetland characteristics throughout the site (Figure 3-16).

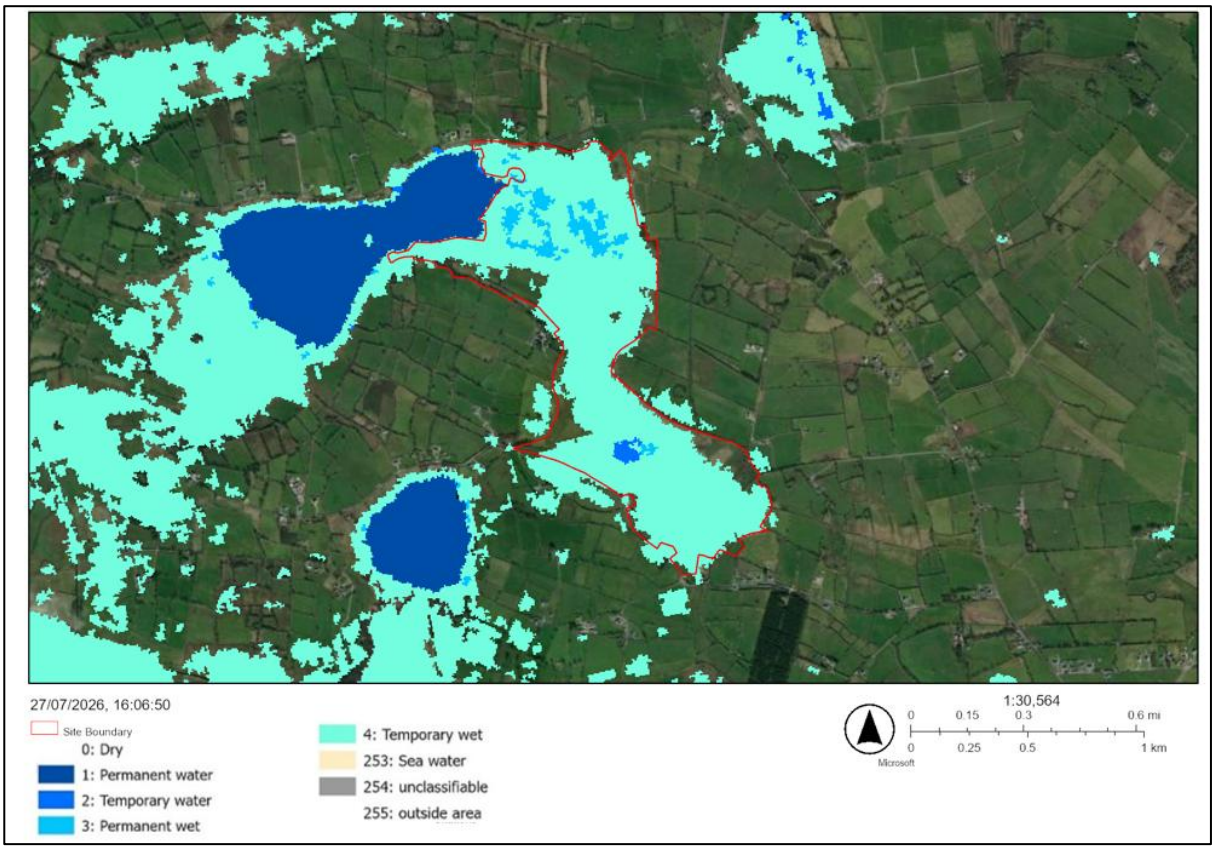


Figure 3-16: HRL Water and Wetness – 2018 of Annaghmore Lough SAC (Roscommon) (Copernicus, 2025)

An analysis of total productivity from 2017 to the present indicates that Annaghmore Lough SAC (Roscommon) shows moderate productivity levels in the north of the site, and in portions

of the south. This status is commonly associated with semi-degraded peatland habitats that have been affected by drainage and increasing vegetation encroachment (Figure 3-17). This drying has facilitated further encroachment of vegetation.

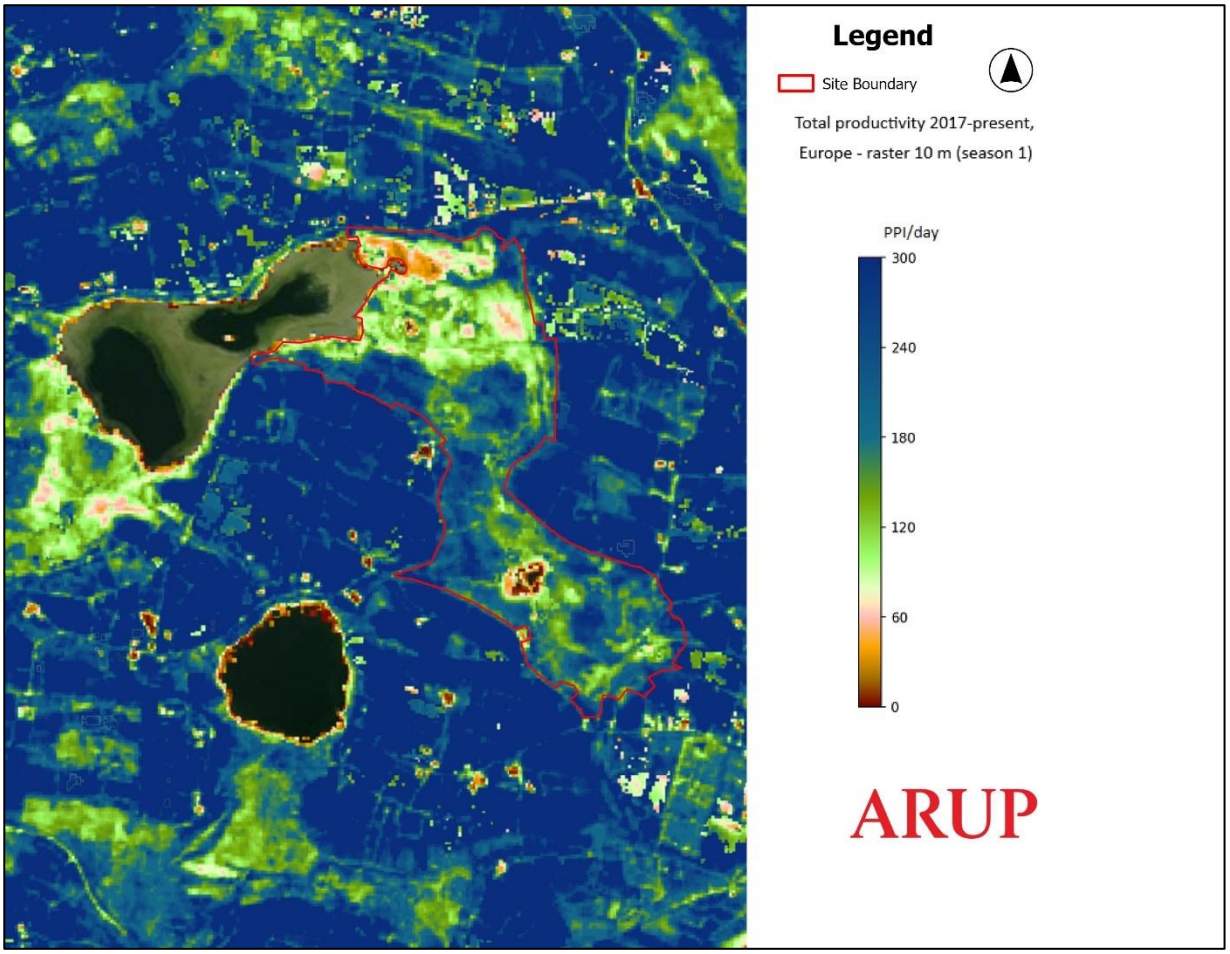


Figure 3-17: Total Productivity 2017 -present, Europe – raster 10m (season 1) of Annaghmore Lough SAC (Copernicus, 2025)

The site is within a depression with the boundary of the site being approximately 70 mOD and the central area being mainly flat at around 49 mOD. From north to south the lowest topography is the swallow hole at 47.27 mOD. Small drains through the site occur at 49.6 mOD and the main watercourse occurs at 49.15 mOD. The site has spring fed drains around the boundary at about 50 mOD. The main watercourse flows in southern direction to the groundwater connected swallow hole in the South.

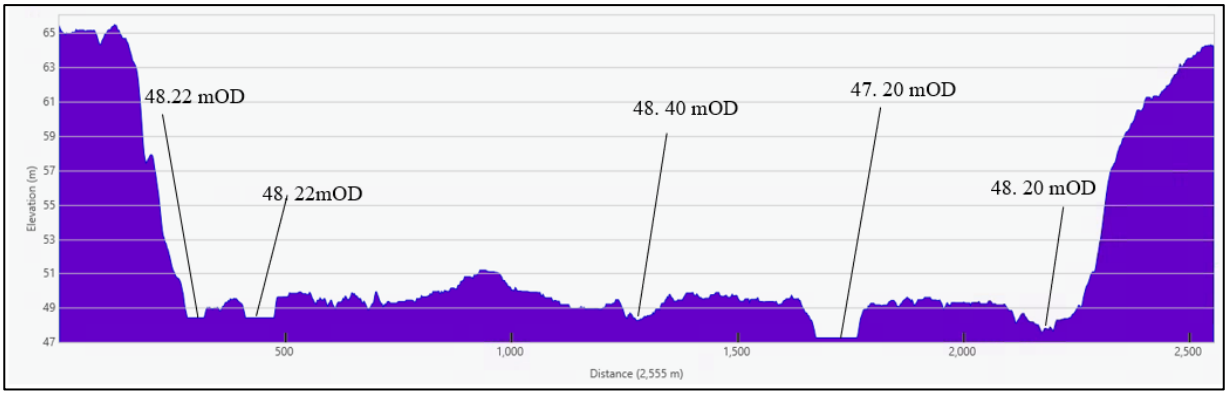


Figure 3-18: Elevation profile, from Northwest to Southeast of Annaghmore Lough SAC (Roscommon)

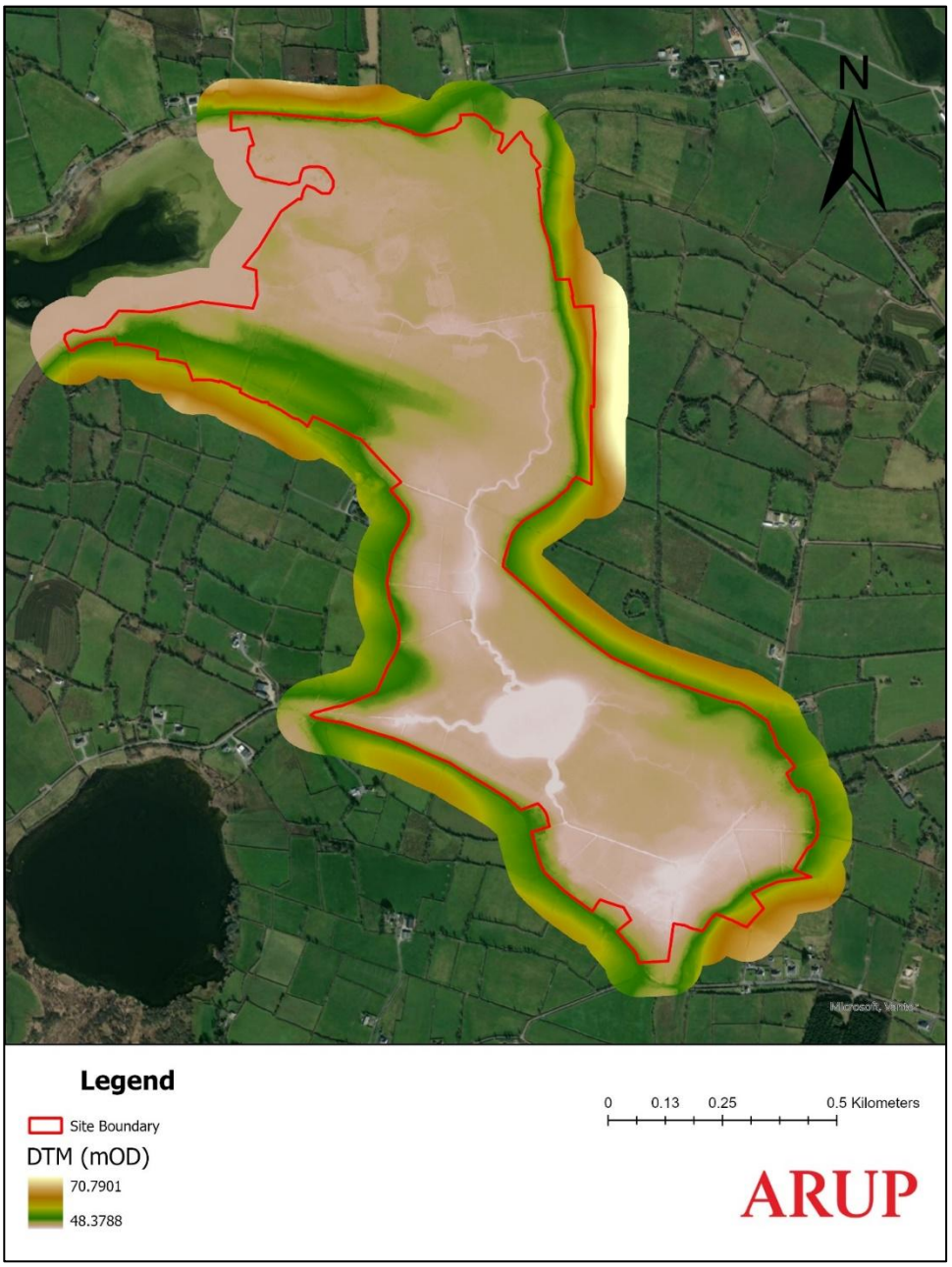


Figure 3-19: Topographic (LiDAR) map of Annaghmore Lough SAC (Roscommon)

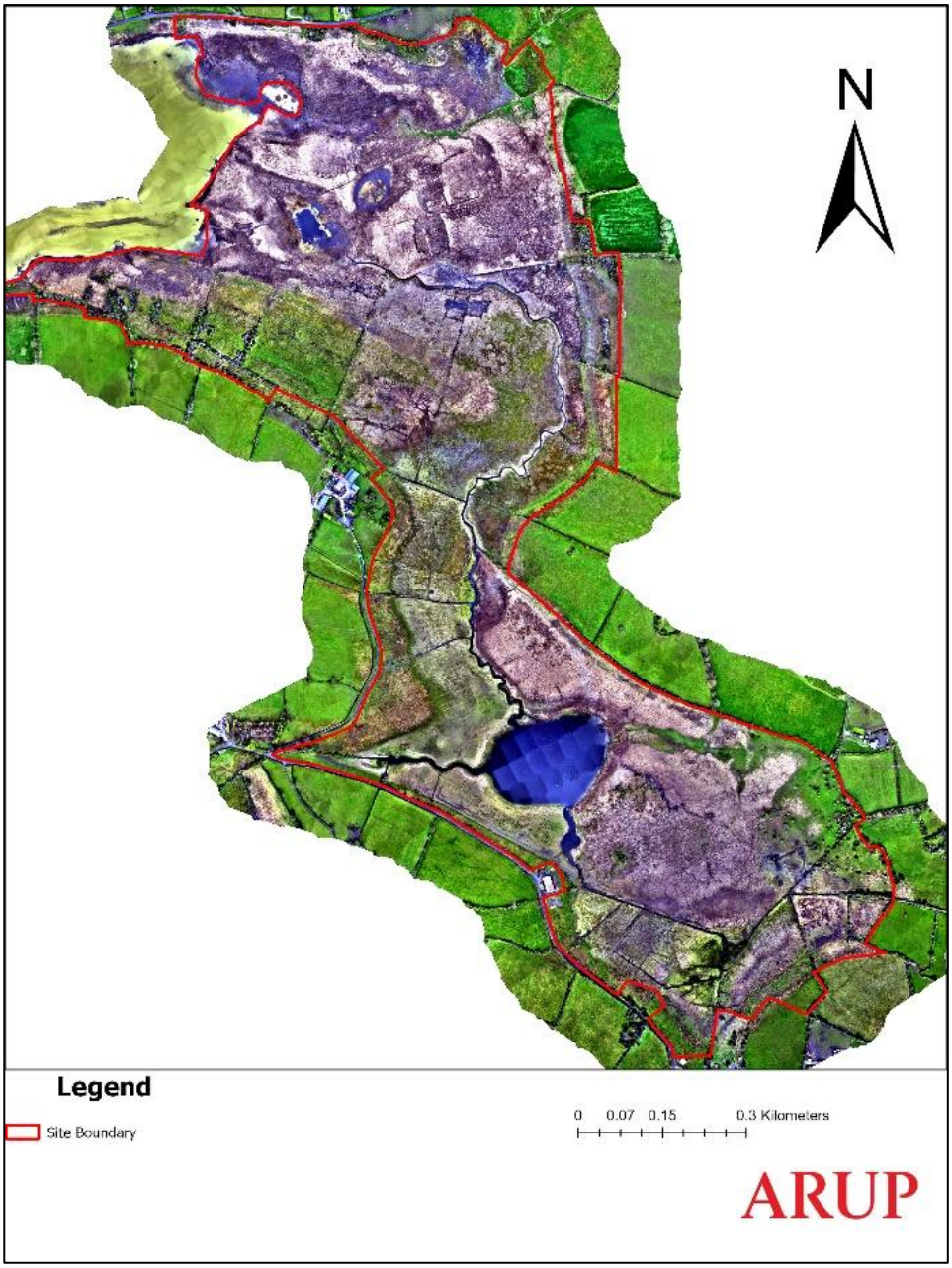


Figure 3-20: Orthophoto of Annaghmore Lough SAC (Roscommon)

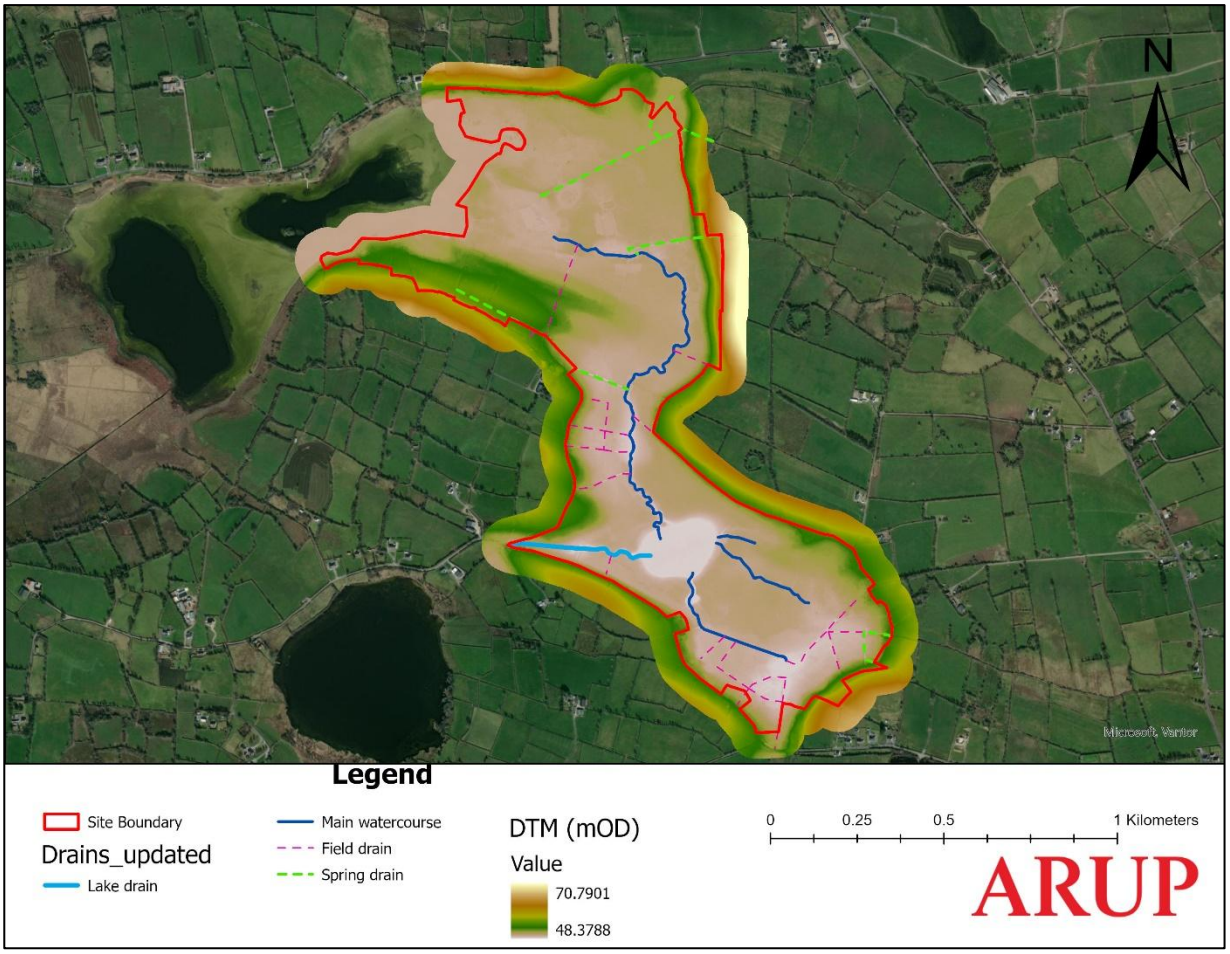


Figure 3-21: Mapped drainage network of Annaghmore Lough SAC (Roscommon)

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.

Areas identified as high risk for Phosphorus loss are typically characterised by poorly draining soils and dominant overland flow pathways. Such conditions facilitate the movement of phosphorus from the land surface into nearby waterbodies. Mapping of phosphorus delivery flow paths across the site shows that the majority are of medium risk, with areas of higher risk situated on the eastern side. Additionally, potential preferential pathways have been identified in the eastern portion of the site. These pathways may provide direct routes for Phosphorus movement towards the fen, highlighting specific locations that could be targeted for measures.

Areas characterised by freely draining soils and significant groundwater pathways are recognised as high-risk zones for nitrate losses. Within the context of Annaghmore Fen and its surroundings, the overall risk of nitrate loss is generally assessed as medium with the central area having a low risk. According to the Targeting Agricultural Measures map, Annagh

more is designated as a white Flag area. PIP maps for Phosphorus and Nitrate are presented in Figure 3-23, Figure 3-23, Figure 3-24 , respectively.

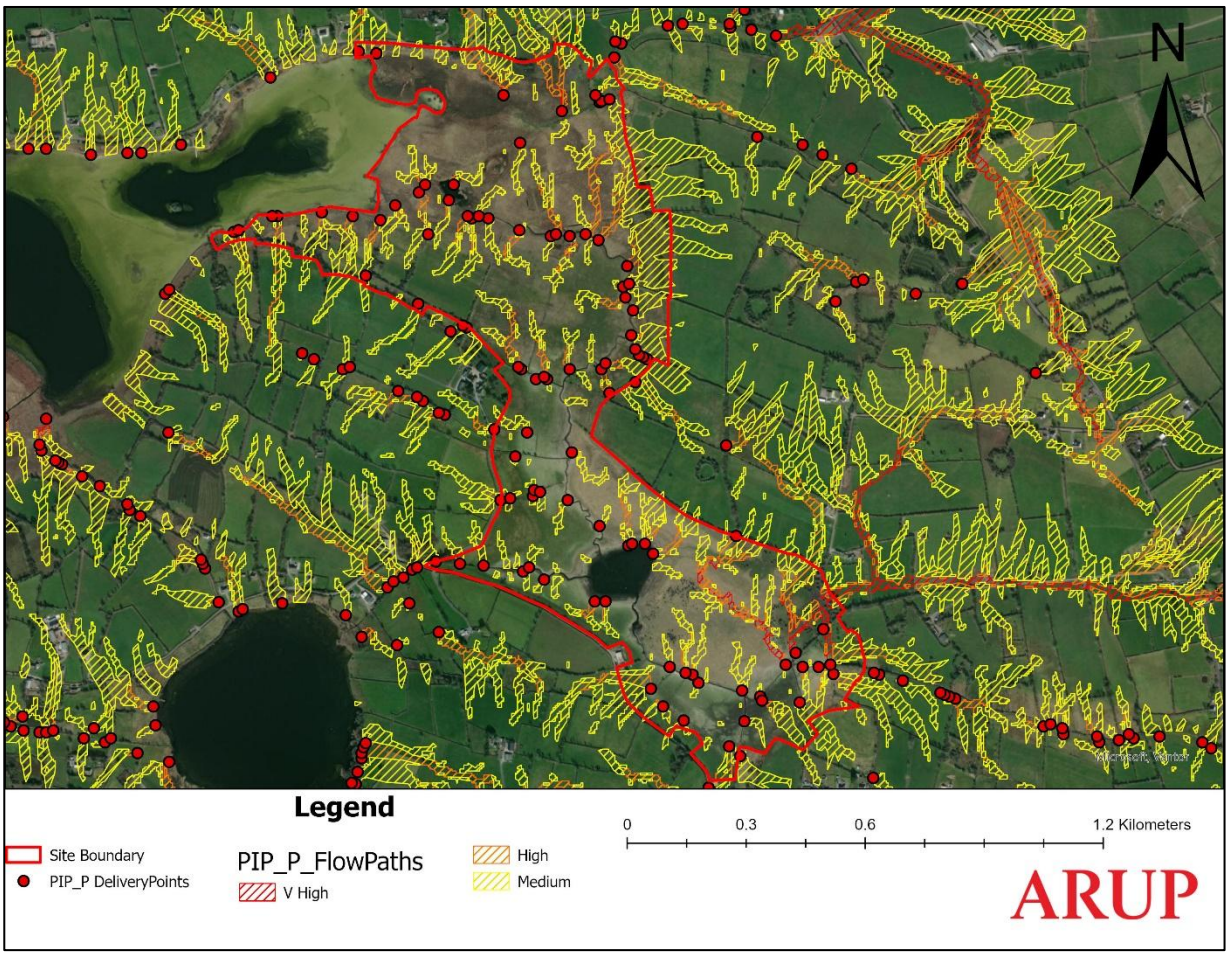


Figure 3-22: PIP- P - Flow delivery paths and points for Phosphorus at Annaghmore Lough SAC (Roscommon) (EPA, 2026)

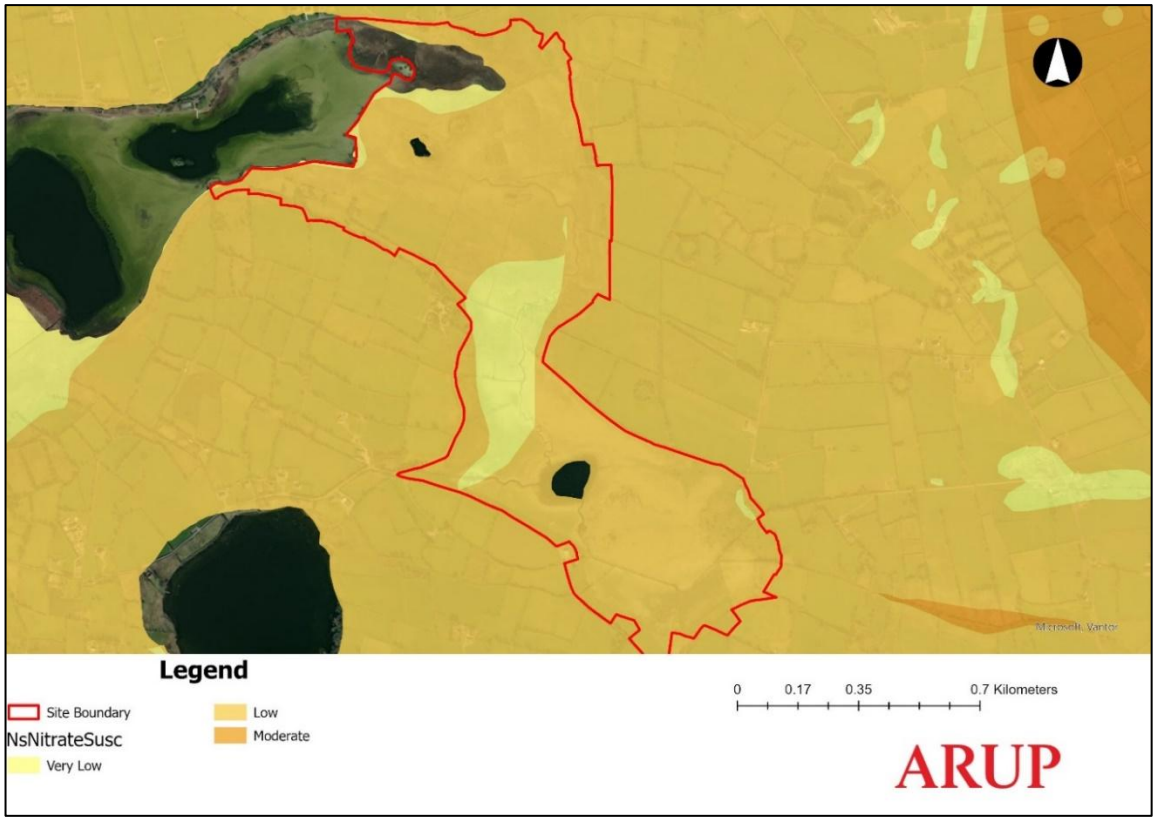


Figure 3-23: PIP maps (near surface Nitrate) of Annaghmore Lough SAC (Roscommon) (EPA, 2025)

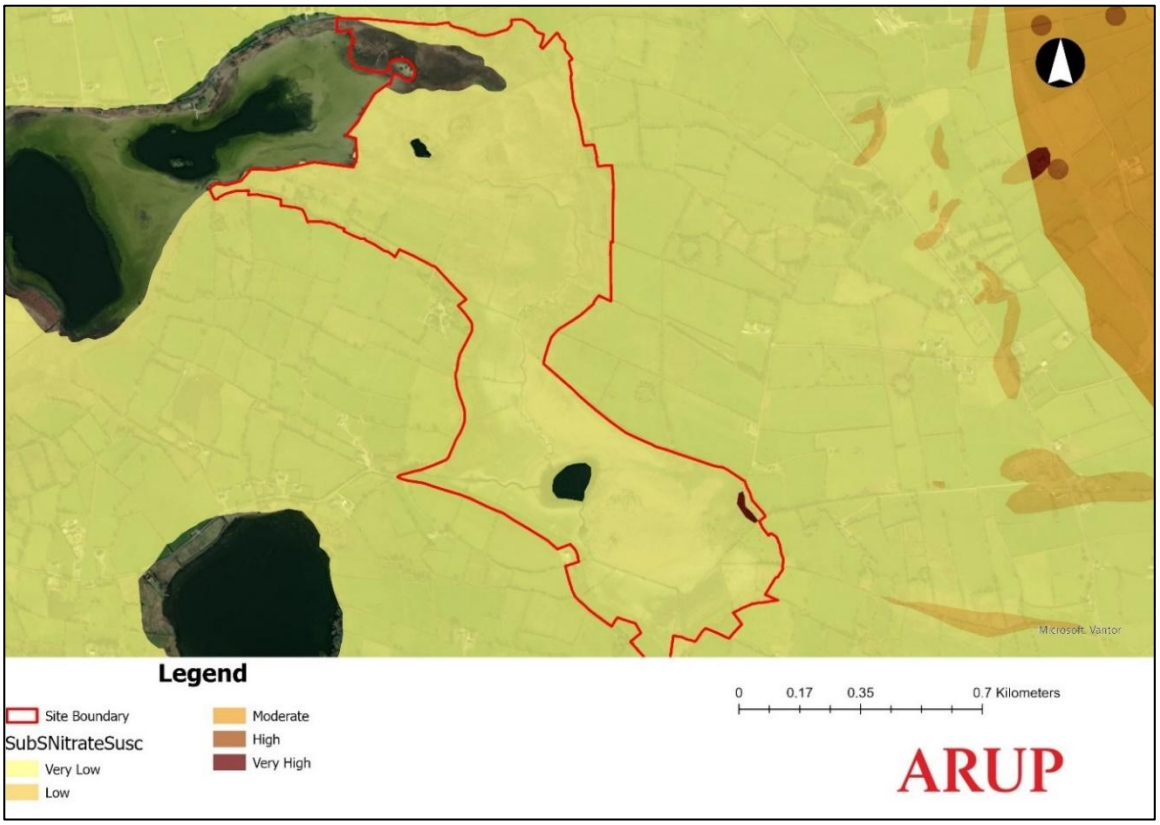


Figure 3-24: PIP maps (subsurface Nitrate) of Annaghmore Lough SAC (Roscommon) (EPA, 2025)

3.2 Field Survey

Electrical Conductivity, pH, and peat depth data was recorded as part of the NFS (pilot) carried out in 2022. EC was recorded at 600 µS/cm and the pH at 6.03 in one location. Peat depth was also recorded at one location with a depth of 310m. However, the spatial location of these measurements was not provided.

Site monitoring was undertaken during wet conditions in March 2026 and drought conditions in August of 2026, focusing on developing the understanding of the water regime, pressures and implementation of restoration measures within the site. The site monitoring included peat depth probing, water quality monitoring, and observations of water flow in the drainage network.

Water quality data was collected from multiple areas both within the site and its immediate surroundings. Specific focus was placed on the fields drain connecting to the main watercourse. Parameters recorded during the monitoring included pH, electrical conductivity (EC), temperature, dissolved oxygen (DO), nitrate, and phosphate. Observations of water flow were made throughout the site's drainage network to further understand hydrological dynamics. Peat depths were measured at various locations across the site to assess substrate characteristics.

Monitoring locations for the field survey are presented in

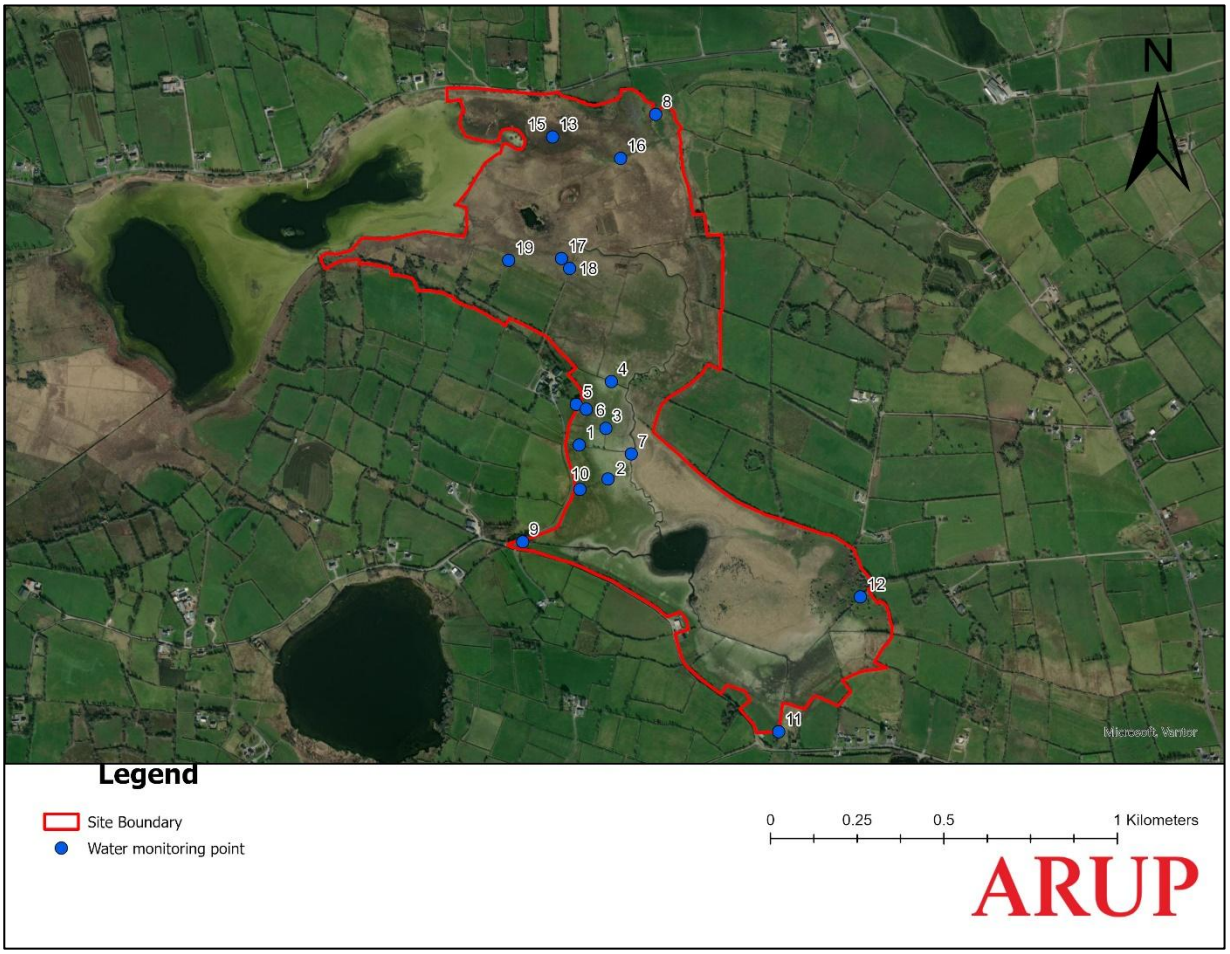


Figure 3-25, providing spatial context for the peat depth probing and water sampling undertaken during the site visits.

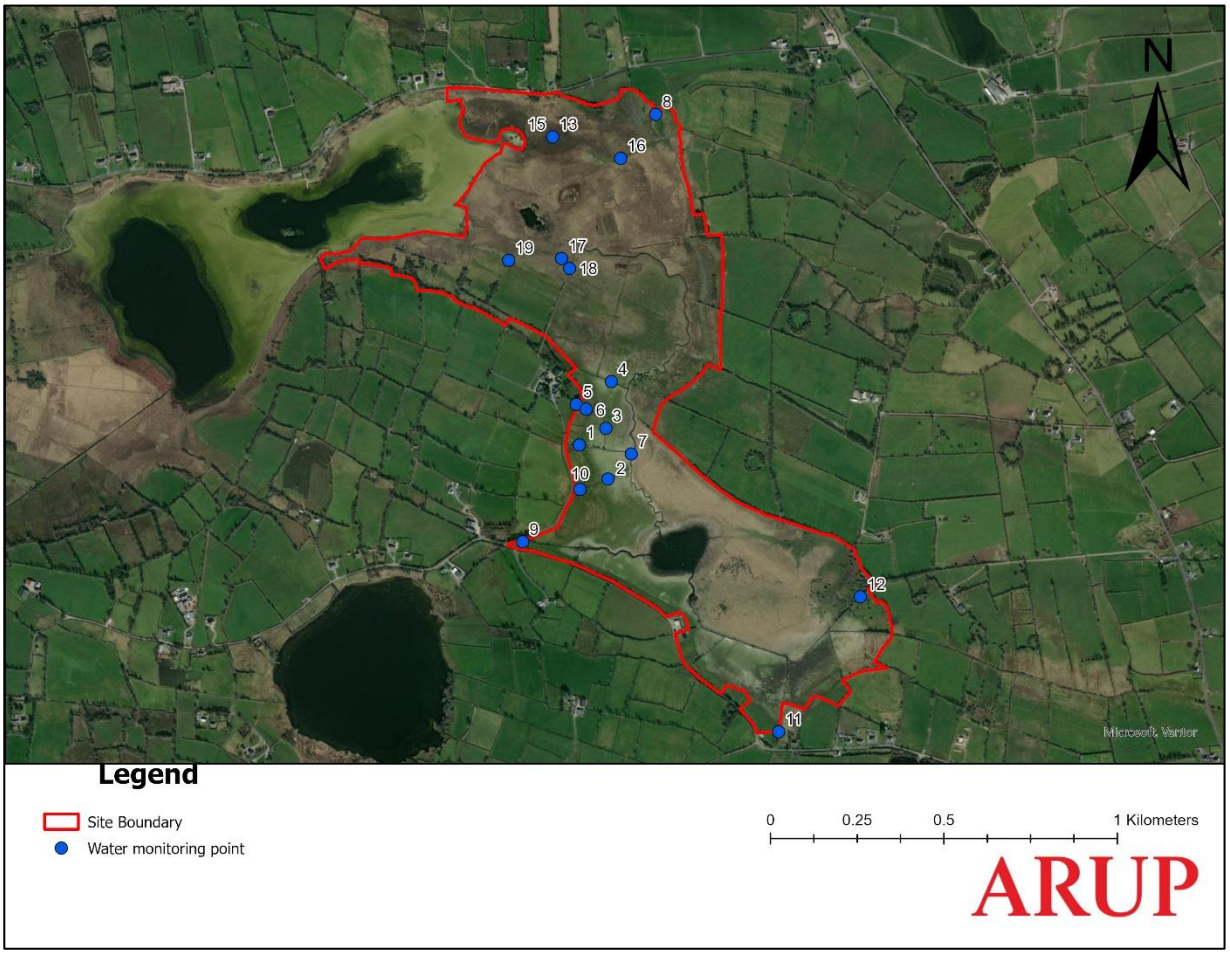


Figure 3-25: Baseline water monitoring point locations

3.2.1 Peat Depth Probing and Ground Investigations

Peat depth probing was undertaken in the northern section and the central section of the site to evaluate substrate characteristics. Measurements indicated a transition from shallow to deeper peat. Specifically, deep peat was recorded in the northern section of the site (2.9 m) and at the central section of the site near the main watercourse (3.1 m). Shallow peat samples of 0.8 m were present in the north and 0.2 m in the centre of the site. This is indicative of a dynamic fluvial system, with areas of shallow peat being influenced by changes to landuse, drainage and seasonal flooding. The northern region is influenced by the surrounding springs, tufa springs and drainage towards the smaller lake/open water. The central region is prone to seasonal fluvial flooding and sediment deposition by the central watercourse. The southern region is influenced by the surrounding springs, extensive drainage and swallow hole.



Figure 3-26: Peat probing monitoring locations

3.2.2 Surface Water levels

Surface water conditions across the site exhibited seasonal variation during the site visits, particularly in relation to flow regimes and drain type. The main watercourse runs through the site, flowing in a southern direction towards a swallow hole, with field drains having seasonal flow.

Surface water is distributed in shallow, natural depressions, rather than in defined channels within the northern area. This is reflective of the historical coverage of the northern region by higher lake levels. There may be high connecting to groundwater inputs.

Spring fed drains (about 2m wide) feed the northern region with water from the east, but by the time the wide (up to 3m) spring fed drain enters the site boundary the flow reduces, and the banks are fully vegetated. Lidar analysis indicates that this spring fed drain is not deeper than the southern lake or main watercourse. The main watercourse flowing through the site is about 2 m wide. There are smaller field drains entering the main watercourse as it flows from the north-west to south-east. A large spring fed drain discharges to the main watercourse as it turns towards the south. This drain is 2 m wide and up to 1.75 m wide. Smaller field drains discharge to the main watercourse in the central region. The main watercourse then discharges to the swallow hole in the south.

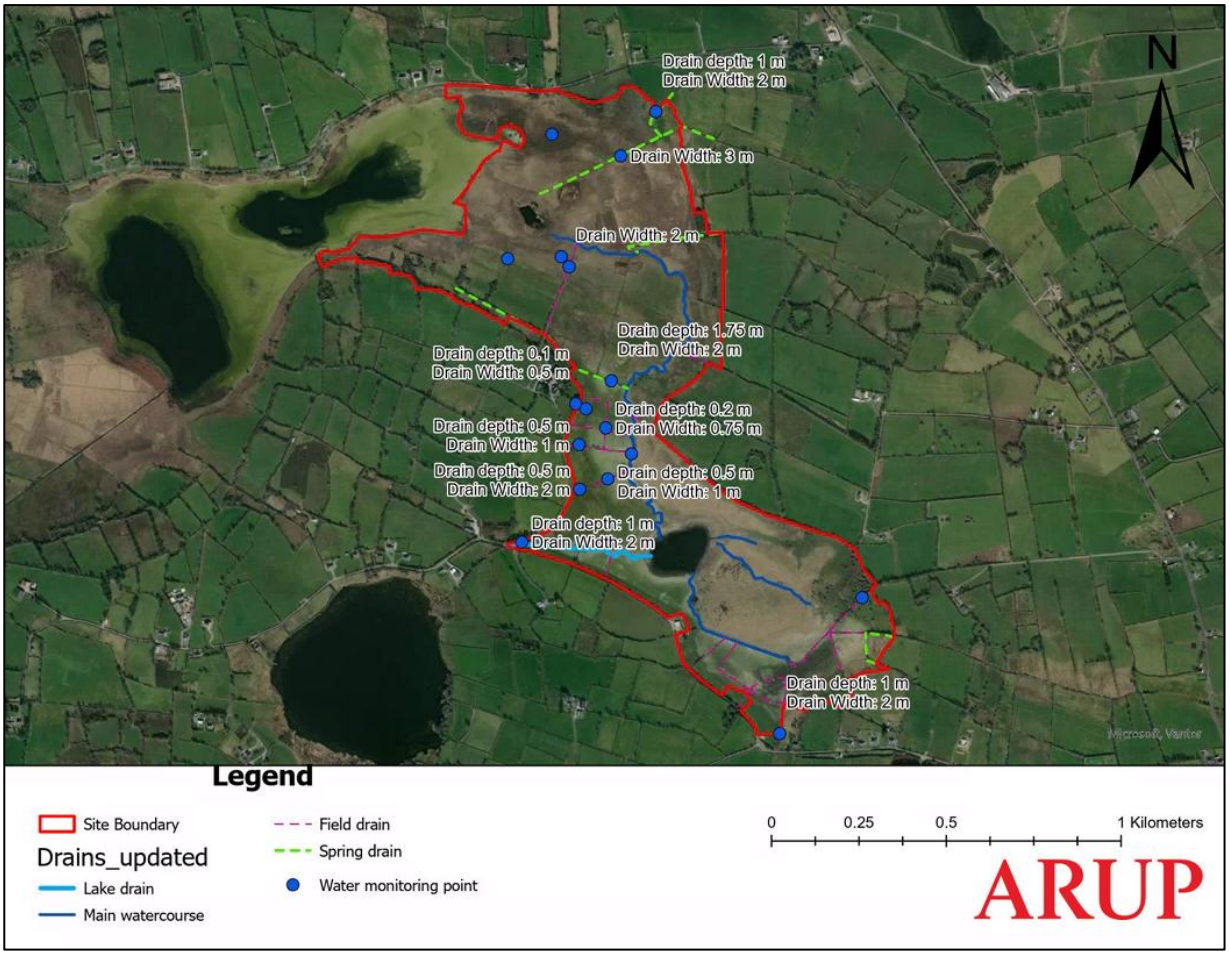


Figure 3-27: Baseline surface water monitoring locations of Annaghmore Lough SAC

3.2.3 Water Quality

Water quality monitoring shows spatial variation in nutrient concentrations across the site, with potential sources of enrichment evident in the northeast of the site.

Phosphate (PO4) concentrations measured throughout the site consistently exceed the Water Framework Directive (WFD) good status environmental quality standard of 0.107 mg/l PO4 (0.035 mg/l PO4-P). The southern sampling point registered the highest phosphate concentration at the main watercourse of 1.43 mg/l.

Nitrate (NO3-N) concentrations also vary across the site, with some measurements exceeding the regulatory groundwater threshold of 8.5 mg/l NO3-N (37.5 mg/l NO3) within the central area. Although there is no regulatory surface water threshold for nitrate, mean concentrations above 1.8 mg/l NO3-N (8 mg/l NO3) may adversely affect river ecological health (EPA, 2025b). All recorded nitrate levels exceed this concentration, with the highest value recorded in the 13.4 mg/l, specifically at the field drains west of the main watercourse.

Fens are generally characterised by low nutrient levels, particularly with respect to nitrogen and phosphorus. The observed concentrations indicate potential nutrient enrichment within the site.



Figure 3-28: Phosphorus (PO_4) Concentrations (mg/L) in Annaghmore Lough SAC (Roscommon)



Figure 3-29: Nitrate (NO_3) Concentrations (mg/L) in Annaghmore Lough SAC (Roscommon)

Previous water quality surveys of the tufa springs by NPWS indicated ranges of temperature of 10.7-12.3 °C; pH of 7.12-7.41 and Electrical conductivity (EC) of 784-971 µS/cm. Nutrients were not sampled as part of this survey.

Site surveys reflected similar results, with pH of 6.93-7.69 and EC of 372 to 1,157 µS/cm (Figure 3-30). The highest EC value, 1157 µS/cm, was measured in the main watercourse where there was sediment. The drains to the west of the main watercourse were not sampled as they were dry at the time of sampling (August 2026).



Figure 3-30: pH locations of Annaghmore Lough SAC (Roscommon)



Figure 3-31: EC locations of Annaghmore Lough SAC (Roscommon)

3.3 Conceptual Site Model

Annaghmore Lough SAC (Roscommon) represents a complex hydrological system, with the topography of the site being a basin with higher elevations of 65-70 mOD along the site borders and about 49 mOD within the centre. Within the site the topography is generally flat with springs at about 50 mOD and a central watercourse draining towards a swallow hole at about 47.2 mOD. Both the springs and swallow hole are influenced by regional groundwater controls as the site is underlain by Regionally Important Aquifer (Lk) with the potential for deeper, preferential flow paths due to karstification. Water from rainfall or surface streams flow into these depressions, infiltrating into the underground karst system. The presence of these karst landforms may indicate a subterranean network where water collects in depressions, travels underground, and then discharge in the site area.

Geologically, the site is underlain by the Ballymore Limestone Formation, comprising of dark, fine-grained, argillaceous limestones interbedded with calcareous shales layers. Within the site boundary, quaternary sediments comprise of Cut over raised peat present in majority of the site and a small band of lacustrine sediments in the north associated with the marl lake. The surrounding area comprises of Till derived from Limestones.

Historically the marl lakeshore extended further to the east, with a smaller open water body being present at 48.22 mOD. In recent times the marl lakeshore has moved westwards and the smaller open water body has become increasingly isolated from the main marl lake. During this

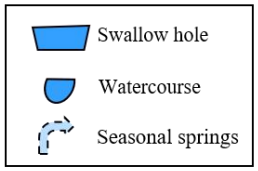
time the main watercourse has connected to the eastern open water to the swallow hole in the south. There are two types of drains present in the site - ephemeral drains that are wide and deep bring in seasonal spring flow to the main watercourse and; smaller drains within the site are historical or more recent farm drains which act to control seasonal flooding on grazing land.

Annaghmore Lough SAC (Roscommon) currently supports a degraded rich fen. The primary cause of degradation appears to be hydrological alteration, specifically changes in drainage and groundwater drawdown. The site's hydrological characteristics results from the combination of groundwater discharge, rainwater, and catchment runoff. However, modifications to site drainage and regional groundwater drawdown have altered these dynamics, leading to drier conditions within the fen. Additionally, evidence of drainage and the presence of peat hags are attributed to historical peat cutting activity, although there has been no recent cutover extraction. These impacts further contribute to the semi-degraded state of the fen, allowing the encroachment of woodland and scrub species.

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

Annaghmore Lough SAC (Roscommon)
Roscommon County
WFD catchment: 26C Upper Shannon; Scramoge_SC_010
WETMEC 9 (Part-drained Groundwater bottom); 16 (Groundwater flushed bottom)

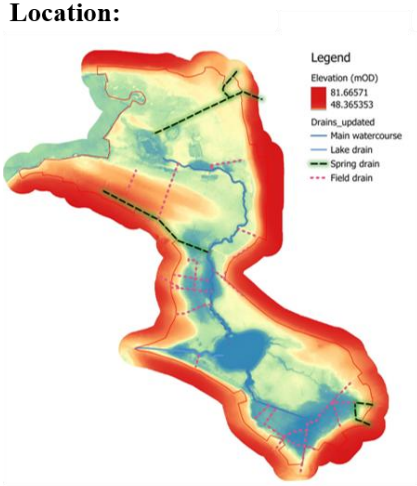
Water key:



Cross section:



Location:



Conceptual site model:

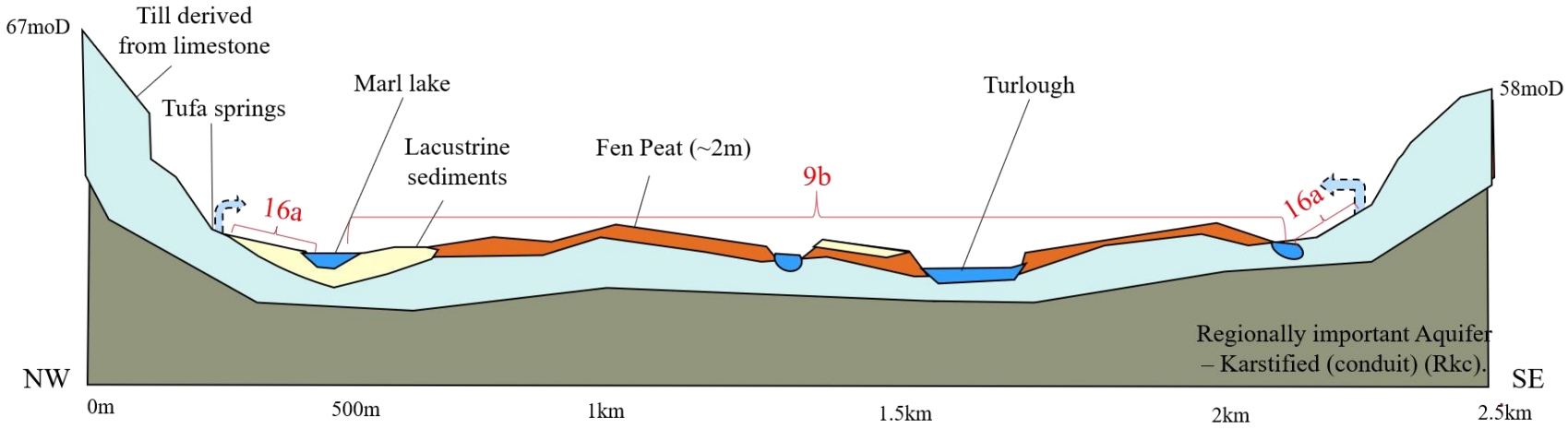


Figure 3-32: Conceptual site model of Annaghmore Lough SAC (Roscommon)

4 Ecology

4.1 Desk Study

A desk-based review of available ecological information for Annaghmore Lough (Roscommon) SAC was undertaken to establish the baseline ecological conditions of the site. The following sources were consulted:

- NPWS Protected Sites – SAC – Annaghmore Lough (Roscommon);
- NPWS Article 17 habitats distribution datasets;
- National Fen Survey (Brophy et al., in prep);
- National Biodiversity Data Centre (NBDC) mapping;
- World Imagery Wayback - ArcGIS;
- Botanical Society of Britain & Ireland (BSBI) Plant Atlas 2020;
- Long, M.P. & Brophy, J.T. (2019) Monitoring of sites and habitat for three Annex II Species of whorl snail *(Vertigo)* – Irish Wildlife Manuals 104;
- Brophy, J.T. et al (2025) Monitoring of three Annex II species of Vertigo snail on Irish sites (2022-2024). Appendices I & II – Irish Wildlife Manuals 159;
- Denyer, J. (2025). Monitoring and Assessment of EU Habitats Directive Annex I Priority Habitat Petrifying Springs, 2025. Irish Wildlife Manuals, No. 160. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland; and
- NPWS Site Synopsis for Annaghmore lough SAC.

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, Annaghmore Lough (Roscommon) SAC was selected as one of the sites for field survey. The site was surveyed in June 2022, with a focus on Annex I and Annex I quality 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.

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

4.1.1.1 Annex Habitats

The following Annex I and Annex I quality habitat was identified and mapped during the NFS (**Error! Reference source not found.**):

- **7230 Alkaline fens** covering approximately 30.17ha located predominantly in the North and central section of the site.
- **7140 Transition mires and quaking bogs** covering approximately 3.38ha in three distinct sections of the site, one in the central section of the site adjacent to the 7230 Alkaline fens with the remaining being located in the south on the edge of the site boundary.
- **6410 Molinia meadows** the exact area of this habitat is not recorded, however three separate areas of this habitat are mapped and located in the northeast, central and southern sections of the site.
- **3180 Turloughs*** this priority habitat is located in the southeastern section of the site with the exact area not recorded.
- **7210 Calcareous fens** covering approximately 0.22ha. This forms a mosaic with other Annex I quality habitats covering a greater percentage of area and consequently does not appear as a dominant habitat on **Error! Reference source not found.**.

It should be noted that NFS habitat mapping is based on the dominant habitat within each polygon. As such, mapped polygons may represent mosaics of habitats, and the extent of Annex I/Annex I quality habitat within each polygon may vary. Interpretation of habitat extent should therefore consider the potential of mixed habitat composition within mapped areas.

4.1.1.2 Non-Annex/Fossitt habitats

In addition to Annex I habitats, a range of non-Annex I habitats were recorded and classified according to the Fossitt (2000) habitat classification system. These habitats form part of the wider wetland mosaic and are summarised in Table 4-1.

Table 4-1: Fossitt habitats recorded within Annaghmore Lough (Roscommon) SAC

Habitat Type	Location	Notes
FS1 – Reed and large sedge swamps	Northwest	A small section is located in the northwest of the site, this polygon is predominantly FS1.
GS1 – Dry calcareous and neutral grassland	Borders of the site	There are seven distinct areas of GS1 mapped along the borders of the site mostly in the north, west and southeast.
PF1 – Rich fen and flush	North, central section and south	Majority of this habitat is located in the northern section of the site with a large section within the central plane of the site with smaller separate areas in the south.
GS4 – Wet grassland	North, central plane and south	Predominantly located in the northern section of the site across the central plane with
GS2 – Dry meadows and grassy verges	South	Two distinct sections located in the southern section of site along the site border.
WS1 – Scrub	Northeast	A small section of WS1 was mapped in the northeast of the site located at the border of the site.
FL6 – Turloughs	South and southeast	Large Turlough system located in the southern section of the site.
PF3 – Transition mire and quaking bog	Southeast	A small section is located in the southeast of the section on the border of the site.

4.1.2 Species

The following subsections outline the presence of species recorded at or within the zone of influence of the Annaghmore Lough SAC. 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). Where available, maps of recorded sightings will be provided to

support spatial understanding of species distribution. 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 have been historically recorded and there has been no indication since of their elimination.

4.1.2.1 Qualifying Interest Species: Geyer's Whorl Snail

Monitoring of Vertigo species across Irish SACs was undertaken by NPWS over three monitoring cycles: 2007-2012, 2013-2018 and 2019-2024 (Brophy et al. 2025 and Long & Brophy 2019). Results from these monitoring programmes were reviewed to inform this FRP with Annaghmore Lough SAC surveyed during each cycle with important information such as species presence data, observations on habitat condition and site management recommendations from these reports provide an important ecological baseline for this assessment.

The qualifying species Geyer's whorl snail is associated with base-rich, groundwater-fed fen habitats characterised by stable hydrological conditions and consistently high soil moisture. The species requires saturated, calcium-rich substrates and structurally open vegetation supporting a suitable microclimate.

At Annaghmore Lough SAC, the population, habitat and future prospects assessments all returned a result of Favourable for the monitoring cycle from the 2007-2012 monitoring period. However, the results observed within the 2013-2018 monitoring period showed a decline into Unfavourable-Bad across the overall assessments regarding the population with no snails found, Unfavourable-Inadequate habitat with overgrazing and flooding impacting snail populations with future prospects also considered Unfavourable-Inadequate. This trend continued in the 2019-2024 monitoring period with the overall assessment considered Unfavourable-Bad across population, habitat and future prospects with no snails found again. The persistent drier conditions were suggested the main cause. This survey concluded that all previously suitable habitat polygons are now too dry due to climate related issues such as changing precipitation, grazing pressure and spread of invasive species with a small occurrence of Wall cotoneaster (*Cotoneaster horizontalis*) identified onsite.

Management recommendations for Annaghmore Lough SAC have consistently focused on maintaining suitable alkaline fen habitat for Geyer's whorl snail through careful grazing management and protection of site hydrology. Earlier surveys recommended low-intensity summer cattle grazing, avoidance of drainage, fertiliser application and supplementary feeding, and occasional cutting of dense black bog-rush where undergrazing reduced habitat quality. Later surveys identified both overgrazing and undergrazing issues, recommending reduction of grazing by horses and donkeys in sensitive areas, restoration of appropriate grazing in rank fen habitats, scrub control, prevention of habitat infilling and garden-waste dumping, and hydrological monitoring to investigate changes in water levels.

The most recent survey concluded that widespread drying of the fen is now the principal threat and recommends restricting excessive grazing in shoreline fen areas, maintaining light

conservation grazing where beneficial, engaging with local landowners to identify any drainage or water abstraction impacts, investigating changes in lake and groundwater levels, and continuing regular monitoring to track habitat condition and any potential recovery.

These measures, if successfully implemented, are expected to restore suitable habitat conditions for Geyer's whorl snail and contribute to achieving favourable conservation status for this qualifying species in line with the SSCOs.

4.1.2.2 Species Within the Site

The species within Table 4-2were identified using the NBDC interactive maps service and reviewing the NFS documentation.

Predominant species in the fen habitat are black bog rush (*Schoenus nigricans*), common cottongrass (*Eriophorum angustifolium)*, yellow starry Feathermoss (*Campylium stellatum*), intermediate Hook-moss (*Drepanocladus cossonii)*, and hooked scorpion moss (*Scorpidium scorpioides*), pondweed (*Potamogeton*sp.) and bottle sedge (*Carex rostrata*).

Table 4-2: Species records within Annaghmore Lough (Roscommon) SAC

Common Name	Latin name	Description	Most recent record
Black bog-rush	*Schoenus nigricans*	Native and widespread species characteristic of base-rich fens, flushes, dune slacks, calcareous wetlands and wet peatlands especially where groundwater supplies calcium-rich, nutrient-poor water.	2007
Devil's-bit scabious	*Succisa pratensis*	Found in damp unimproved grasslands, fens, cutover bogs, heaths and wet meadows, principal larval foodplant of the Marsh Fritillary butterfly (*Euphydryas aurinia*), one of Ireland's most important protected butterfly species.	2007
Lesser spearwort	*Rannunculus flammula*	A native buttercup of wet mud, marshes, lake margins, ditches, wet grassland and fens, thrives in shallow water and periodically inundated habitats.	2017
Snipe	*Gallinago sp.*	Widespread breeding and wintering wading bird in Ireland, occurring in bogs, marshes, wet grasslands, fens and other wetlands. Although Ireland supports both resident and migrant populations, breeding numbers have declined significantly due to habitat loss, drainage, afforestation and agricultural intensification, and the species is currently	2021

Common Name	Latin name	Description	Most recent record
		Red-listed in Ireland because of severe declines in its breeding and wintering populations.	
Irish hare	*Lepus timidus hibernicus*	Occurring across a wide range of habitats including farmland, grasslands, bogs, heathlands and coastal areas. The population is widespread across Ireland and the most recent national conservation assessments have found its range, population, habitat and future prospects to be favourable and stable, although local fluctuations occur and threats include agricultural intensification, habitat change.	2021
Common butterwort	*Pinguicula vulgaris*	A carnivorous plant occurring in wet flushes, bogs, fens, seepages, wet rocks and upland wetlands. Obtains nitrogen by trapping insects on sticky leaves, an adaptation to nutrient poor conditions.	2022
Slender-leaved pondweed	*Potamogeton filiformis*	Submerged aquatic macrophyte of clear lakes, ponds and slow-flowing water, associated particularly with hard-water, calcareous lakes and low nutrient conditions.	2007
Canadian waterweed	*Elodea canadensis*	An aquatic submerged plant growing in ponds, lakes, canals and slow-moving rivers. Forms dense stands and reproduces very effectively by fragmentation Non-native invasive species, introduced from North America which now outcompetes native aquatic vegetation and alters habitat structure	2011
Yellow starry fen moss	*Campylium stellatum*	Most characteristic bryophytes of alkaline fens and calcareous flushes where it forms extensive carpets in permanently moist, calcium-rich peat. Highly sensitive to hydrological alteration and nutrient enrichment and is considered widespread within suitable fen habitats but dependent on high-quality groundwater-fed systems.	2022

4.1.2.3 Species within the Zone of Influence

Table 4-3 outlines the functionally linked species recorded within the 2km distribution zone of influence around Annaghmore Lough (Roscommon) SAC within the last ten years from NBDC. The records are from within the grid reference: M98B.

Table 4-3: Species records within the Zone of Influence of Annaghmore Lough (Roscommon) SAC

Legislative Protection	Common name	Latin name
Irish Wildlife Act	Great crested grebe	*Podiceps cristatus*
Irish Wildlife Act	Lesser black-backed gull	*Larus fuscus*
EU Birds Directive	Lapwing	*Vanellus vanellus*
EU Birds Directive	Whimbrel	*Numenius phaeopus*
No legal protection	Small tortoiseshell	*Aglais urticae*
No legal protection	Caddis fly	*Limnephilus lunatus*
No legal protection	Brown hawker	*Aeshna grandis*
No legal protection	Black-tailed skimmer	*Orthetrum cancellatum*
No legal protection	Blue-tailed damselfly	*Ischnura elegans*
No legal protection	Common darter	*Sympetrum stroilatum*
No legal protection	Mother shipton	*Callistege mi*
No legal protection	Stonewort	*Chara*
EU Habitats Directive	Soprano pipistrelle	*Pipistrellus pygmaeus*
EU Habitats Directive	Pipistrelle	*Pipistrellus pipistrellus sensu lato*
EU Habitats Directive	Common pipistrelle	*Pipistrellus pipistrellus sensu stricto*

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 appropriate and effective in the identified zones.

Two surveys forms were created to collect data relevant to:

- Monitoring data; and
- Pressures and threats

4.2.1 Monitoring Points

The targeted walkover survey in June and August 2026 was a focused assessment designed to gather site-specific ecological data at pre-identified locations within the site. The walkover was designed to assess ecological condition at seven pre-identified monitoring points (Monitoring Points 1 to 7). The monitoring points were selected based on hydrological features, habitat potential and restoration feasibility and LiDAR data. These locations were determined through expert discussion and review of baseline data and will serve as fixed monitoring stations for post-restoration monitoring. A map of survey points is provided in **Error! Reference source not found.**.

These monitoring points serve a dual purpose:

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

The survey focuses on two key components:

- Target notes: qualitative observations at each monitoring point, capturing vegetation structure, habitat condition, hydrological context and legacy management; and
- Pressures and threats identification: systematic recording of anthropogenic and natural pressures affecting each location.

There were a total of seven monitoring points surveyed across the site with 7230 Alkaline fens and PF1 Rich fen confirmed at Monitoring Points 1,3, 5 and 6. Monitoring Point 2 supported 7140 Transition mire and PF3 Transition mire and quaking bog habitat and Monitoring Point 4 and 7 supported GS4 Wet grassland.

4.2.2 Pressure & Threats

This section outlines the historical and current pressures and threats affecting fen habitats at Annaghmore Lough SAC including 7230 Alkaline fens and associated fen habitat recorded during the NFS and 2026 ecological walkover.

4.2.2.1 7230 Alkaline fen

Historical Pressures

The NFS determined that the structure and functions of the Annex I 7230 Alkaline fen habitat were ‘Unfavourable-Inadequate’, with negative pressures relating to drainage, agricultural intensification, grazing and nutrient enrichment (Section 2.3).

- Drainage has been affecting the site with multiple deep, well-maintained agricultural drains entering the site from the south and south-west.

- Grazing intensity varied across the site with the central site receiving only very light grazing, while peripheral fields, especially in the south-west, experienced more intensive grazing. Horses also grazed parts of the southern area.
- Agricultural intensification along the site boundaries particularly along the southwestern edge with this area more intensely grazed with drains created here also.
- Nutrient enrichment has been observed onsite including within Annex I fen, particularly in deep modified drain located in the south of the site.

Current Observations

Recent walkover surveys indicate that the historical pressures identified through the NFS remain relevant to the site, with evidence of ongoing vegetation change and hydrological pressure in parts of the monitored fen habitat. Current observations recorded during the 2026 walkover indicate the following:

- **Water pollution** there were large areas of algae observed across the site suggesting groundwater pollution.
- **Abandonment of pastoral systems** is contributing to rank vegetation in areas of 7230 Alkaline fens in the north of the site.

4.2.3 Additional Observations

Several additional observations were noted across the site:

- The NFS notes green algae was recorded frequently across the site, including within Annex I fen habitats. In the south green algae is primarily evident in deep modified drain.
- 7220 Petrifying springs were previously recorded within the north of the site as part of the petrifying springs survey undertaken in 2023-2024 (Denyer, J. 2025). A lack of appropriate grazing has led to rank and unmanaged fen vegetation which is negatively impacting the 7220 Petrifying springs.

Table 4-4: Site Conservation Priority Matrix for Annaghmore Lough SAC

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	30.17ha	Drainage Abandonment of pastoral systems	Conservation grazing Vegetation monitoring	Community/landowner engagement
		7140 Transition mires and quaking bogs	3.38ha	Drainage Abandonment of pastoral systems	Conservation grazing Vegetation monitoring	Community/landowner engagement
		6410 Molinia meadows	Not recorded	Drainage Abandonment of pastoral systems	Conservation grazing Vegetation monitoring	Community/landowner engagement
		3180 Turloughs*	Not recorded	Drainage Abandonment of pastoral systems	Conservation grazing Vegetation monitoring	Community/landowner engagement
		7210 Calcareous fens	0.22ha	Drainage Abandonment of pastoral systems	Conservation grazing Vegetation monitoring	Community/landowner engagement
	SAC Species	Geyer's whorl snail	See section 4.2.2.1	Drainage	Conservation grazing Vegetation monitoring	Community/landowner engagement

Level	Feature Type	Feature Name	Extent/ Population	Pressure/Threat affecting it	Restoration Measure On-Site	Restoration Measure Off-Site
				Abandonment of pastoral systems		
2	NHA Habitat	N/A	N/A	N/A	N/A	N/A
3	European Priority Habitats	FL6 Turloughs	**Error! Reference source not found.**	Drainage Water pollution	Hydrological monitoring	N/A
4	Nationally important species	See Table 4-2 and Table 4-3	See Table 4-2 and Table 4-3	Drainage Abandonment of pastoral systems	Conservation grazing Vegetation monitoring	Community/landowner engagement
5	Habitats and species of local interest	See Appendix B	See Appendix B	Drainage Abandonment of pastoral systems	Conservation grazing Vegetation monitoring	Community/landowner engagement

4.3 Impact Assessment Notes

Proposed restoration actions aim to improve the ecological conditions of the fen and wetland habitats. 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 e.g. drain blocking and appropriate grazing levels are designed to enhance and expand habitats rather than remove them.
- **Habitat degradation** – moderate risk – potential degradation could occur if restoration measures are poorly implemented or monitored. This could occur through poor biosecurity and spread of invasive species or drain blocking altering hydrology in unintended ways if not based on robust baseline data. Should restoration measures be actioned, monitoring protocols will be embedded into the site plan to monitor change following implementation of the restoration measures.
- **Species disturbance** – low risk – potential for species disturbance if works are undertaken during breeding bird season. Should works be required, these will be undertaken outside the breeding bird season (March to August inclusive). Should works be required during the breeding season, confirmation from an Ecological Clerk of Works that no nesting birds are present in the working area will be undertaken ahead of any works proceeding.
- **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.

4.4 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 **Error! Reference source not found.** below 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 4-5: 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 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 Annaghmore Lough SAC 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 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 overall conservation status assessment was applied based (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 following pressures are listed in order of their intensity and impact on the ecological receptors of Annaghmore Lough (Roscommon) SAC. These were determined from the review of historical information and gathered from observations made along the monitoring points carried out as part of this project (**Figure** 5-1**: Flora & Fauna Pressures mapped within Annaghmore Lough SAC**).

- Abandonment of pastoral systems – insufficient levels of grazing in areas within the site is facilitating the spread of rank vegetation. This ongoing pressure is leading to shifts in species composition and a decline in characteristic 7230 Alkaline fens. The implementation of a conservation grazing regime is expected to remediate this issue.
- Drainage

- Agricultural intensification
- Water pollution

All identified pressures and threats are fully considered within the FRP to guide appropriate remediation. The proposed suite of restoration measures, encompassing both hydrological and vegetation interventions, is designed to maintain and improve the condition of Annex I and Annex I quality habitats present within Annaghmore Lough (Roscommon) SAC, while delivering co-benefits to associated non-Annex habitats and protected species. The prioritisation of pressures (grazing, drainage, agricultural intensification and nutrient enrichment) was informed by a review of historical data (including the NFS) and detailed observations recorded at monitoring points during this project. These measures, supported by ongoing vegetation and hydrological monitoring, will ensure that habitat structure and function are preserved, threats are addressed promptly, and the ecological integrity of the site is safeguarded into the future.



Figure 5-1: Flora & Fauna Pressures mapped within Annaghmore Lough SAC (Roscommon)

5.2.2 Fen Hydrology Pressures

The following hydrological pressures were identified within Annaghmore Lough SAC (Roscommon):

- Seasonal variation of water level, leaving the site overly dry at summer periods.
- Modified drainage system draining water away from the main watercourse.

- Regionally drawdown of groundwater

Fen habitat requires water level to be at or slightly above ground level for optimal fen conditions.

5.2.3 Fen Nutrient Pressures

The following nutrient pressures were identified within Annaghmore Lough (Roscommon) SAC:

- Elevated nutrients
- Livestock animal crossings over field drains.

6 Restoration Measures

6.1 Introduction

The restoration actions proposed by the Fen Restoration Plan 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 6.3 to 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 Annaghmore Lough SAC (Roscommon) 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 the main watercourse, but local level improvements can be achieved by blocking seasonally active drains on the site border. The site is also fed by springs and tufa springs. This represents **WETMEC 16a: 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 watercourse and downstream open water. Due to the complexity of the site there needs to be a wider understanding of the regional controls on groundwater, and how this impacts seasonal groundwater levels at the springs, lake and turlough.

All restoration maps are presented in Appendix C.

6.2.1 On-site Fen Hydrology Measures

Drainage measures associated with the central springs

In the central area of the site, tufa formation has been noted along the western boundary. This area has field drains bringing water from upstream and there is a road with a stormwater drain directing flow towards the south (Figure 6-1). Within the site boundary the area has wide drains as well as less deep field drains. These drains seem to be ephemeral as during the NPS survey and the recent field survey the drains had no flow in the summer. Field drains at the center of the site should be blocked to control local water levels and extend seasonal flooding.

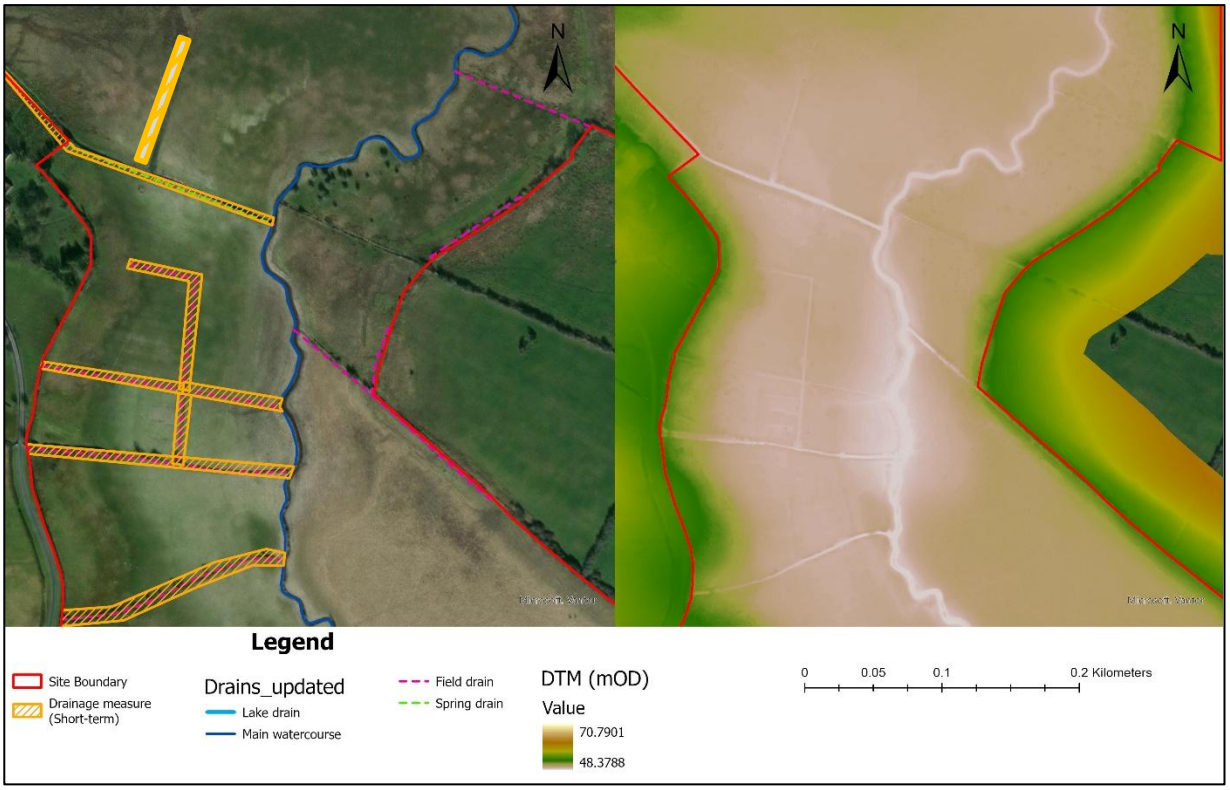


Figure 6-1: Spring drain and field drains at centre of Annaghmore Lough SAC (Roscommon)

Drainage measures associated with the southern turlough

The main watercourse that flows to the swallow hole from the south has many field drains (Figure 6-2). The blocking of these drains will allow for seasonal flooding. As this is closely connected to the turlough there will need to be additional monitoring prior to drain blocking. The drains are also part of the RCC Drainage District which will require engagement to ensure that there are no downstream impacts.

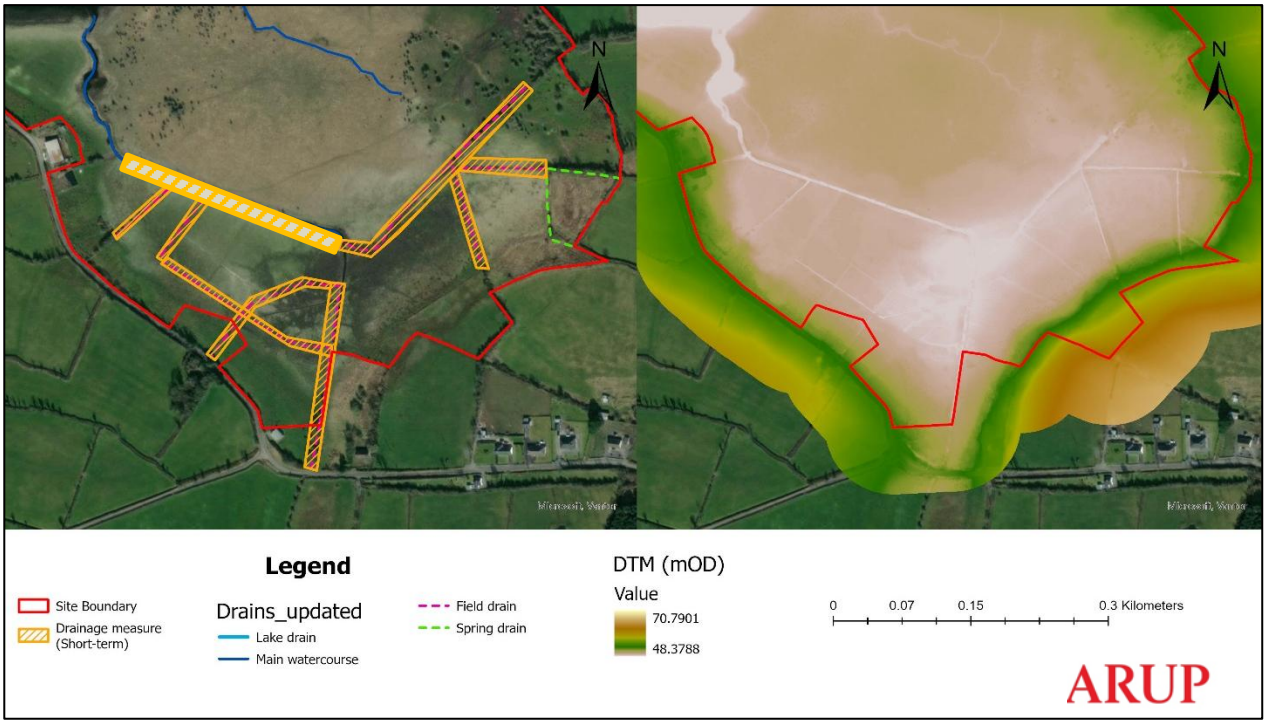


Figure 6-2: Drainage measures associated with southern turlough at Annaghmore Lough SAC (Roscommon)

Drainage measures associated with the main watercourse

The main watercourse that flows to the swallow hole from the north seems to be an important hydraulic control between the north and south of the site. The watercourse is also responsive to seasonal water levels, which may indicate close connection to regional hydrogeology. Further monitoring of the groundwater levels will allow for an improved understanding of the functioning of the watercourse. Drainage measures are proposed at the northern and central region of the site.

6.2.2 Off-site Hydrology Measures

Input to Roscommon maintenance plan

Engagement with Roscommon County Council (RCC) to ensure Annaghmore Lough SAC (Roscommon) fen restoration objectives considered as part of the Drainage District annual maintenance planning.

6.3 Nutrient Measures

Site surveys for both hydrology and ecology indicate excessive nutrients may be an issue for 7230 Alkaline fens and associated fen habitat. Nutrient enrichment was observed during previous ecology site visits particularly in the deep modified drain located in the south of the site. More recent site visits indicated that there were large areas of algae observed across the site. The recent water survey also observed potential nutrient enrichment within the site.

6.3.1 On-site Nutrient Measures

Within SACs landowners must get consent from NPWS to undertake certain actions. The "activities requiring consent" related to nutrient measures include:

- Reclamation, including infilling.
- Cutting, uprooting or otherwise removing plants[4].
- Introduction, or re-introduction, of plants or animals not found in the area[6].
- Digging, ploughing, harrowing or otherwise disturbing soil or substrate[5].
- Applying inorganic or organic fertiliser, including slurry and farmyard manure[6].
- Application of pesticides, including herbicides[6].

Existing agri-environment frameworks such as Farming for Water EIP[6] or novel approaches under NPWS Farm Plans[7] 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.

The drains surrounding the site are bringing nutrients into the site. This will be considered as part of the drainage hydrology measures. For the northern drain there is an opportunity to create leaky barriers or embankments to allow for infiltration of nutrients prior to discharge into the fen habitat.

Monitoring is proposed for habitats and drainage channels, including key water quality parameters such as nutrients (nitrate and phosphate), electrical conductivity, and pH. Monitoring locations will encompass the main surface water inputs, both upstream and downstream of the sites.

6.3.2 Off-site Nutrient Measures

[4] Consent is not required for harvesting of cultivated crops, or for grazing or mowing.

[5] Consent is not required for these activities on established reseeded grassland or cultivated land provided it is greater than 20m from a river, stream or floodplain; or greater than 50m from a wetland, lake, turlough or pond.

[6] The "Farming for Water" project provides funding to help farmers implement 43 measures designed to protect water quality by reducing pollution from nitrates, phosphorus, sediment, and pesticides. The project is a major initiative to reduce pollution from farming practices in Ireland and ensure that the country's rivers and other waterbodies are kept clean and healthy for the future and that we meet our obligations under the Water Framework Directive.

[7] 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.

Catchment nutrient management

Targeted nutrient control measures should be implemented across the catchment to address both phosphate and nitrogen pathways.

All restoration maps are presented in Appendix C.

6.4 Vegetation Measures

6.4.1 On-site Vegetation Measures

Proposed measures to address vegetation succession includes conservation grazing and vegetation monitoring as on-site measures which are described in order of priority in Table 6-1..

Table 6-1: On site vegetation measures proposed for Annaghmore Lough (Roscommon) SAC

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. The purpose of this is to control/reduce the pressures of scrub encroachment and rank vegetation with regard to 7230 Alkaline fens. The reintroduction and assessment of appropriate grazing is the principal restoration measure for this site, addressing the pressure of rank vegetation. Grazing will aim to reduce sward dominance, particularly by black bog rush, improve structural diversity and maintain open fen conditions. Stocking levels and grazing timing should be carefully managed to avoid localised overgrazing, poaching between tussocks of black bog rush or damage to wetter zones. This improvement in habitat condition aligns with improving habitat for Geyer's whorls snail. It should be noted that piezometers are currently installed in the northern area of the site. Appropriate measures e.g. fencing, may be required to ensure that livestock do not negatively impact on these devices.	NPWS (post-Tóchar)
4	Removal of Invasive Species	A small stand of *Cotoneaster* was identified within the northern section of the site measuring approximately 4mx4m with this planned for removal to avoid spreading into the wider environment.	Tóchar & NPWS
2	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 directly inform adaptive management,	Tóchar & NPWS (post-Tóchar)

Priority	Measure	Description	Responsibility
		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.	

6.4.2 Off-site Vegetation Measures

As agricultural intensification on lands adjoining Annaghmore Lough SAC (Roscommon) has the potential to contribute to adverse effects on qualifying interests through nutrient enrichment, changes in hydrology, habitat degradation and reduced ecological connectivity, the implementation of a targeted NPWS Farm Plan Scheme on agricultural lands surrounding the SAC could provide an effective off-site vegetation and habitat management measure.

7 Additional Considerations

7.1 Drainage Management Plan

The Annaghmore Lough SAC (Roscommon) is part of a Drainage District managed by Roscommon County Council (RCC). RCC is responsible for the maintenance and function of the channels associated with the Drainage District.

The preliminary drainage management plan for Annaghmore Lough SAC (Roscommon) is presented in Appendix D.

7.2 Peat Stability Assessment

The GSI landslide susceptibility map for Annaghmore Lough SAC (Roscommon) is presented in **Figure 7-1: Geological Survey of Ireland Landslide Susceptibility mapping for Annaghmore Lough SAC (Roscommon)**

. There is low risk within the site close to the main watercourse, but moderately low risk near the tufa springs in the north and to the east of the swallow hole.

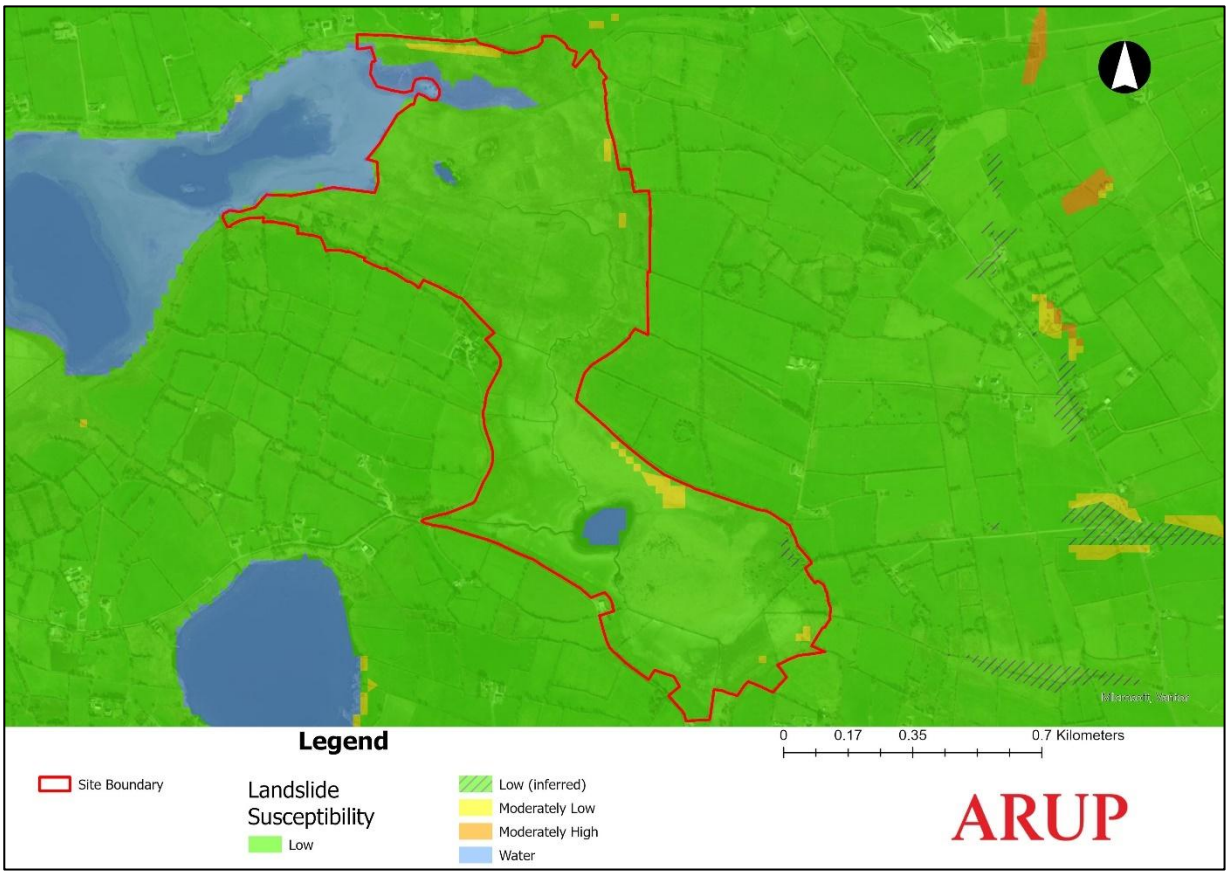


Figure 7-1: Geological Survey of Ireland Landslide Susceptibility mapping for Annaghmore Lough SAC (Roscommon)

7.3 Archaeology

There are no NIAH monuments within the site boundary (Figure 7-2) but there is one SMR site (ID: RO02717: earthwork) within the site boundary and multiple sites outside of the site

boundary. There is a crannog on the marl lakes, a holy well along the western border and multiple ring forts around the east/west site border.

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 not be 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.”

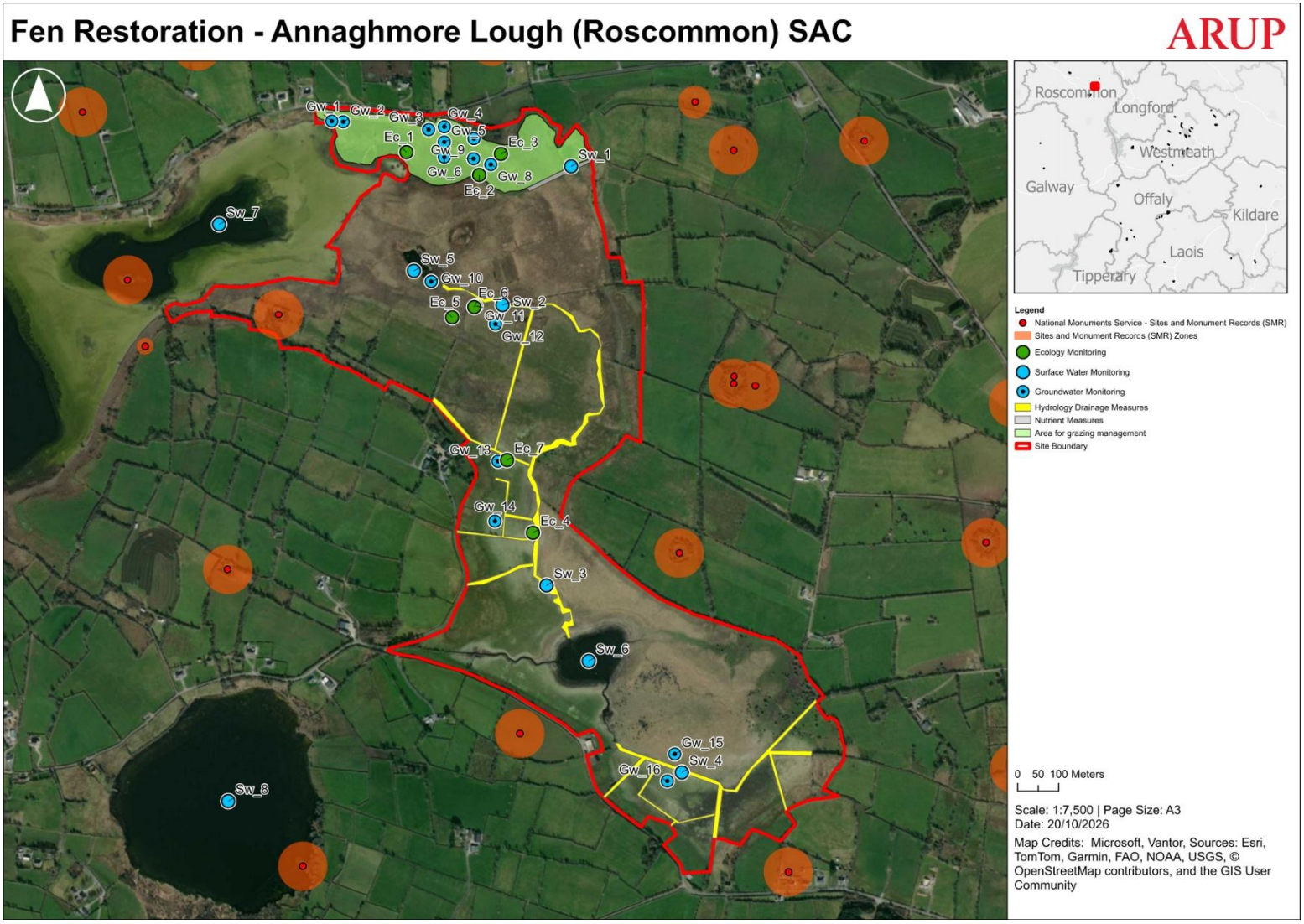


Figure 7-2: Archaeological Sites for Annaghmore Lough SAC (Roscommon) (NMS, 2025)

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	Landowners	Grazing onsite undertaken by various private landowners.
	Roscommon County Council	Management of Drainage District channels on site
	NMS	Monuments on site
Off-site	Roscommon County Council	Management of off-site Drainage District channels
	Landowners & farmers	Engagement for uptake of catchment measures.
Capacity building	NPWS	NPWS engaging in community education and events

This section provides the summary of the Fen Restoration Plan Actions for Annaghmore Lough SAC (Roscommon) (Table 8-2).

Table 8-2: Implementation plan for Annaghmore Lough SAC (Roscommon) 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.**							
	This report must outline all restoration measures that shall be undertaken as part of the project at Annaghmore Lough SAC (Roscommon). The Screening for AA must conclude whether a likely significant effect is anticipated to arise from the implementation of the project.	Sitewide	Screening report	Pre-restoration	NPWS			Within Tóchar project scope
1.2	**Drainage management plan**							
	Consultation with RCC on the drainage management plan is required to ensure compliance with legislation and local authority objectives.	Sitewide	Drainage management plan	Pre-restoration	NPWS	RCC	Arup	Within Tóchar project scope
1.3	**Archaeological assessment**							
	Consultation with RCC on the archaeology is required to ensure compliance with legislation and local authority objectives.	Sitewide	Archaeological assessment report	Pre-restoration	NPWS	RCC	Arup	Within Tóchar project scope
2	**Enabling Works**							
2.1	**Pre-restoration Works Surveys**							

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Pre-site walkover with Ecologist/Ecological Clerk of Works (ECoW) to ensure proposed measures are appropriate and whether alterations are required. The walkover will include identifying habitats for Geyer's whorl snail which were historically recorded within the areas for restoration measures. The purpose of the restoration measures is to improve habitat condition in the long-term. Their presence and consideration in the design of access routes will be included in a Construction Environmental Management Plan (CEMP) (discussed below) to ensure minimal disturbance during proposed works.	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**							
	Prior to restoration works, where any restoration measures are identified to have the potential to interfere with breeding birds e.g. scrub removal, these works shall occur outside the breeding bird season (1 March – 31 August inclusive).	Sitewide	ECoW report	Pre-restoration			Arup	Within Tóchar project scope
2.4	**Good Practice Recommendations and CEMP**							

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	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 CEMP.	Sitewide	ECoW report	Pre-restoration			Arup / Contractor	Within Tóchar project scope
3	**On-Site Restoration measures**							
3.1	**Hydrology measures**							
	Drainage measures associated near the central springs Install drain blocking measures on the drains west of the main watercourse to allow for seasonal flooding and locally raise water table.	Central area of the site.	Site installation records	Short-term	NPWS to facilitate site access		Landowner	Within Tóchar project scope
	Drainage measures associated with the southern turlough Install drain blocking measures on the field drains in the south of the site to allow for seasonal flooding and locally raise water table.	Southern area of the site.	Site installation records	Long-term	NPWS to facilitate site access		Landowner	Farming for Water EIP
	Drainage measures associated with the main watercourse Install drain blocking measures on the main watercourse that leads to the turlough to allow for seasonal flooding and raising of water table across site. This requires a wider understanding of the regional hydrogeological controls	Central drain-flows north to south.	Site installation records	Long-term	NPWS to facilitate site access	RCC	Landowner	Farming for Water EIP
3.2	**Vegetation measures**							

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	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
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	NPWS Farm Plan Scheme
	Engagement with RCC to ensure Annaghmore Lough SAC (Roscommon) fen restoration objectives considered as part of annual maintenance planning.	Drainage district	RCC awareness	Long-term		RCC		RCC
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	NPWS Farm Plan Scheme
5	**Monitoring progress**							
5.1	**Hydrology monitoring**							

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Monitoring groundwater and surface water at key site locations using piezometers and standpipes.	Sitewide (lake, open water, channels)	Water level	Long term	NPWS	RCC	Landowners	Within Tóchar project scope
5.2	**Nutrient monitoring**							
	Ongoing monitoring of habitats, lake, open water, 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	RCC	Landowners	Within Tóchar project scope
5.3	**Vegetation monitoring**							
	Habitat condition assessments will be included to track restoration progress.	Sitewide	Habitat condition	Long-term	NPWS	RCC	Landowners	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 fens/6410 Molinia meadows/7140 Transition mires/7220 Petrifying springs/7210 Cladium fens/3180 Turloughs***

Restoration measures will focus on improving the hydrology of the fen habitat and conservation-oriented grazing and land management. Together, these measures will protect the fen's structure and function, prevent vegetation succession and supporting its long-term conservation value.

- **Non-Annex Habitats/ Fossitt classified habitats**

A range of non-Annex habitats within the site, including PF1 Rich fen and flush, GS4 Wet grassland and PF3 Transition mire and quaking bog, 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

The proposed restoration measures will benefit the SAC's QI species, Geyer's whorl snail, by increasing both quality and quantity of available habitat within the SAC. Although the snail has not been recorded within the site since 2007, the proposed restoration measures create the potential for a recovery of the site's population. Together, the proposed restoration efforts offer mutual benefits for broader fen ecosystem function and the long-term viability of Annaghmore Lough SAC (Roscommon)'s QI species alongside other wetland species that were recorded within the site, such as marsh fritillary.

9 References

Alm, J., Shurpali, N. J., Minkkinen, K., Aro, L., Hytönen, J., Laurila, T., ... & Laine, J. (2007). Emission factors and their uncertainty for the exchange of CO2, CH4 and N2O in Finnish managed peatlands.

Bord na Móna and RPS (2024). WP4 Restoration Planning Assessment of Forestry on Peat Within and Adjacent to Blanket Bogs SACs/ NHAs - Overarching Report. Unpublished.

Brophy, J.T., Daly, O.H., Hamilton, J.J., O'Neill, F.H. and Martin, J.R. (2025) *Monitoring of three Annex II species of Vertigo snail on Irish sites (2022–2024). Appendix III. Vertigo geyeri site reports*. Irish Wildlife Manuals No. 159. Dublin: National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.

CIEEM (2021). Good Practice Guidance for Habitats and Species. Version 3 May 2021. Chartered Institute of Ecology and Environmental Management

Denyer, J. (2025). Monitoring and Assessment of EU Habitats Directive Annex I Priority Habitat Petrifying Springs, 2025. Irish Wildlife Manuals, No. 160. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.

Fossitt, J.A. (2000). A guide to habitats in Ireland. The Heritage Council, Kilkenny.

Gilbert G, Stanbury A and Lewis L (2021). Birds of Conservation Concern in Ireland 2020 –2026. Irish Birds 9: 523—544.

Goodship, N. M., & Furness, R. W. (2022, October). NatureScot Research Report 1283-Disturbance Distances Review: An updated literature review of disturbance distances of selected bird species.

Higgins, G.T. (2008) *Rhododendron ponticum*: A guide to management on nature conservation sites. Irish Wildlife Manuals, No. 33. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

Lusby, J., O'Brien, I., Lauder, A., Wilson-Parr, R., Breen, D., Cummins, S. & Tierney, D. (2022). Survey of breeding Merlin in the Special Protection Area network 2018. Irish Wildlife Manuals, No. 139. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.

Mills, A.J. and Rushton, D. 2023. A risk-based approach to peatland restoration and peat instability. NatureScot Research Report 1259.

National Parks and Wildlife Service (NPWS) (2013). *Site Synopsis: Annaghmore Lough (Roscommon) SAC (Site Code 001626)*. Department of Arts, Heritage and the Gaeltacht, Dublin.

National Parks and Wildlife Service (NPWS), 2025. *The Status of EU Protected Habitats and Species in Ireland. Volume 2: Habitat Assessments. Habitat 7230 Alkaline Fens*. Department of Housing, Local Government and Heritage, Dublin.

NatureScot (accessed 2024). Disturbance Distances in selected Scottish Bird Species – NatureScot Guidance. Available online at: https://www.nature.scot/doc/disturbance-distances-selected-scottish- bird-species-naturescot-guidance.

NatureScot 2022. Peatland ACTION - Technical Compendium. Peatland ACTION sharing good practice for peatland restoration techniques. Available online at: https://www.nature.scot/doc/peatland- action-technical-compendium. Accessed November 2024.

NRA (2008a). Guidelines For the Treatment of Otters Prior to the Construction of National Road Schemes. National Roads Authority.

NRA (2008b). Guidelines For the Treatment of Badgers Prior to the Construction of National Road Schemes. National Roads Authority.

NRA (2010). Guidelines on The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads. Revision 1, December 2010. National Roads Authority.

Perrin, P.M., Barron, S.J., Roche, J.R. & O'Hanrahan, B. (2014). Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0. Irish Wildlife Manuals, No. 79. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Ruddock, M. (2016). The 2015 National Survey of breeding hen harrier in Ireland. Department of Arts, Heritage and the Gaeltacht.

Ruddock, M., Wilson-Parr, R., Lusby, J., Connolly, F., J. Bailey, & O'Toole, L. (2024). The 2022 National Survey of breeding Hen Harrier in Ireland. Report prepared by Irish Raptor Study Group (IRSG), BirdWatch Ireland (BWI), Golden Eagle Trust (GET) for National Parks & Wildlife Service (NPWS). Irish Wildlife Manuals, No. 147.

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

National Parks and Wildlife Service (NPWS) (2013). *Site Synopsis: Annaghmore Lough (Roscommon) SAC (Site Code 001626)*. Department of Arts, Heritage and the Gaeltacht, Dublin.

Waddington, J. M., & McNeil, P. (2002). Peat oxidation in an abandoned cutover peatland. Canadian Journal of Soil Science, 82(3), 279-286.

Wilson, D., Renou-Wilson, F., Farrell, C., Bullock, C. and Muller, C. (2012). Carbon Restore – the potential of restored Irish peatlands for carbon uptake and storage; CCRP Report. EPA Wexford.

Wilson, D., Dixon, S.D., Artz, R.R., Smith, T.E.L., Evans, C.D., Owen, H.J.F., Archer, E., & Renou-Wilson,

Brophy, J.T., Daly, O.H., Hamilton, J.J., O'Neill, F.H. and Martin, J.R. (2025) *Monitoring of three Annex II species of Vertigo snail on Irish sites (2022–2024). Appendix III. Vertigo geyeri site*

reports. Irish Wildlife Manuals No. 159. Dublin: National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.

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Appendix A – Non-Technical Summary

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan Non-Technical Summary			
Site Name	Annaghmore Lough SAC (Roscommon)	**NFS site no.**	304001
County	Roscommon	**Designation**	*SAC* 001626 pNHA 001626
Fen habitats present (area)	7230 Alkaline fens (30.17ha) 7140 Transition mires and quaking bogs (3.38ha) 7210 *Cladium* fens (0.22ha)	**Species of note**	1013 Geyer's whorl snail *(Vertigo geyeri*).

Site Description

Annaghmore Lough SAC (Roscommon) is located northwest of Strokestown, Co. Roscommon. The FRP boundary encompasses part of the SAC, including an extensive area of predominantly 7230 Alkaline fens to the east of Annaghmore Lough SAC (Roscommon) and a broad shallow basin with a swallow hole to the south that functions as a turlough system. Overall, the site supports a valuable complex of alkaline fen, calcareous grassland, wet grassland, transition mire, and turlough-associated habitats, maintained under a mixed grazing regime and influenced by seasonal flooding patterns.

Conceptual Site Model (CSM)

Annaghmore Lough SAC (Roscommon) represents a complex hydrological system, with the topography of the site being a basin with higher elevations of 65-70 mOD along the site borders and about 49 mOD within the center. Within the site the topography is generally flat with springs at about 50 mOD and a central watercourse draining towards a swallow hole at about 47.2 mOD. Both the springs and swallow hole are influenced by regional groundwater controls as the site is underlain by Regionally Important Aquifer (Lk) with the potential for deeper, preferential flow paths due to karstification.

Annaghmore Lough SAC (Roscommon) currently supports a degraded rich fen. The primary cause of degradation appears to be hydrological alteration, specifically changes in drainage and groundwater drawdown. The site's hydrological characteristics results from the combination of groundwater discharge, rainwater, and catchment runoff. However, modifications to site drainage and groundwater drawdown have altered these dynamics, leading to drier conditions within the fen.

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

Key Pressures

<table>
<tr><th colspan="2">NPWS Tóchar Midlands Wetland Restoration Scheme
Fen Restoration Plan Non-Technical Summary</th></tr>
<tr><td>Hydrology Pressures</td><td>• Seasonal variation of water level, leaving the site overly dry at summer periods.
• Modified drainage system draining water away from the main watercourse.
• Regionally drawdown of groundwater</td></tr>
<tr><td>Nutrient Pressures</td><td>• Elevated nutrients
• Livestock animal crossings over field drains.</td></tr>
<tr><td>Ecology Pressures</td><td>• Abandonment of pastoral systems – insufficient levels of grazing in areas within the site is facilitating the spread of rank vegetation.
• Agricultural intensification</td></tr>
<tr><td colspan="2">Objective of Restoration Plan</td></tr>
<tr><td colspan="2">The hydrological restoration objective for Annaghmore Lough SAC (Roscommon) 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 the main watercourse, but local level improvements can be achieved by blocking seasonally active drains on the site border. This Fen Restoration Plan (FRP) identifies restoration measures for the Annex I habitats within the SAC, as well as other wetland habitats supported within the site. The proposed measures aim to contribute to the achievement of site-specific conservation objectives and to support the attainment of favourable conservation condition of the fen habitat.</td></tr>
<tr><td colspan="2">Restoration Measures</td></tr>
<tr><td>Hydrology Measures</td><td>On-Site measures:
• associated near the central springs
• associated with the southern turlough
• associated with the main watercourse
Off-Site Measures:
Landowner engagement is required due to the farmland activities surrounding site that may be affecting the water balance of the site. Engagement with RCC to ensure Annaghmore Lough SAC (Roscommon) fen restoration objectives considered as part of annual maintenance planning.</td></tr>
<tr><td>Nutrient Measures</td><td>On-Site measures:
• northern drain to have nutrient measures</td></tr>
</table>

	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
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 Tóchar website: https://www.tocharwetlands.ie/fen-restoration/	

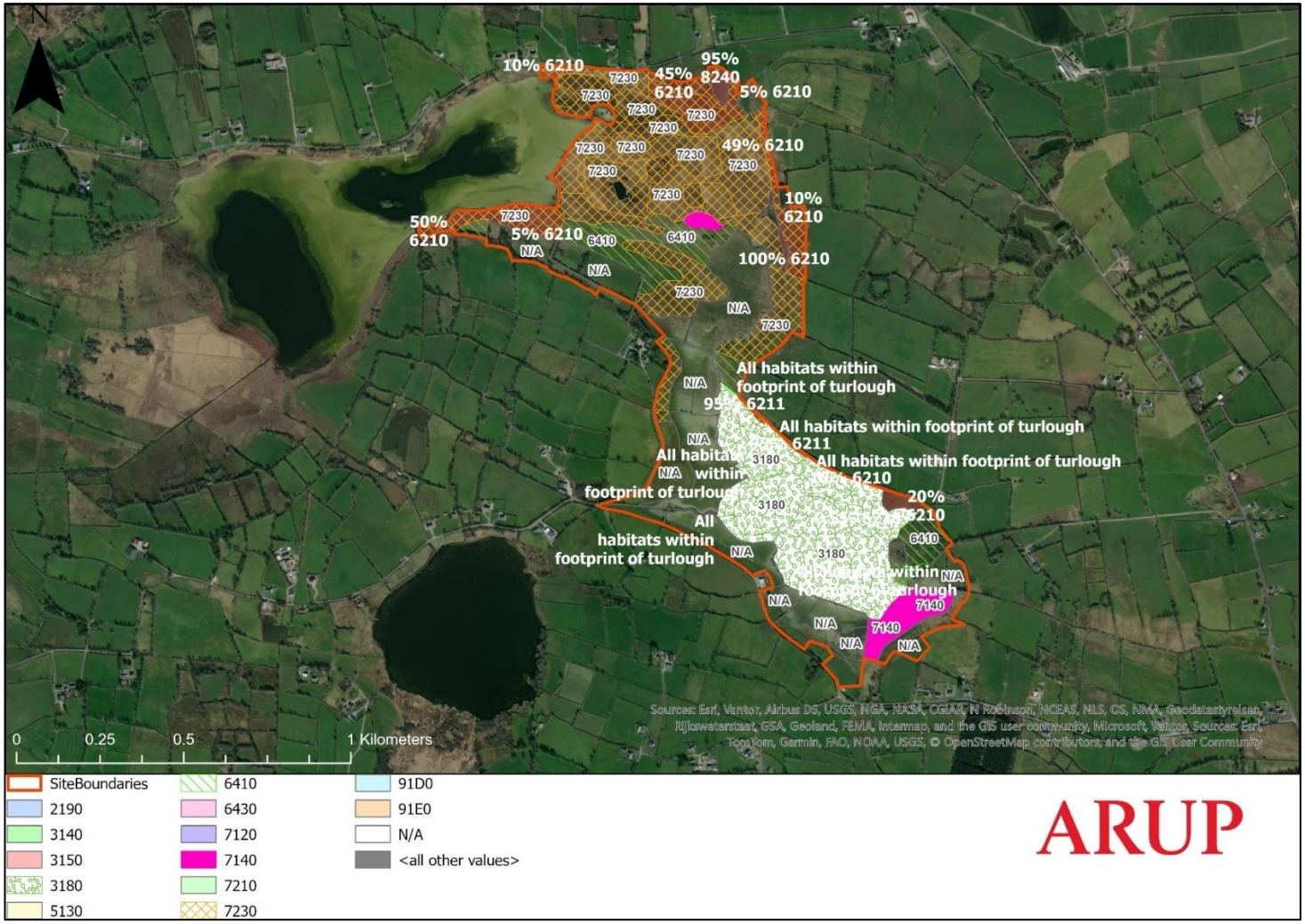
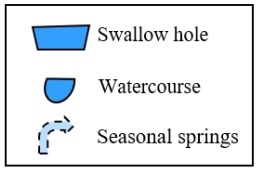


Figure 1: Site Habitat Map

Annaghmore Lough SAC (Roscommon)
Roscommon County
WFD catchment: 26C Upper Shannon; Scramoge_SC_010
WETMEC 9 (Part-drained Groundwater bottom); 16 (Groundwater flushed bottom)

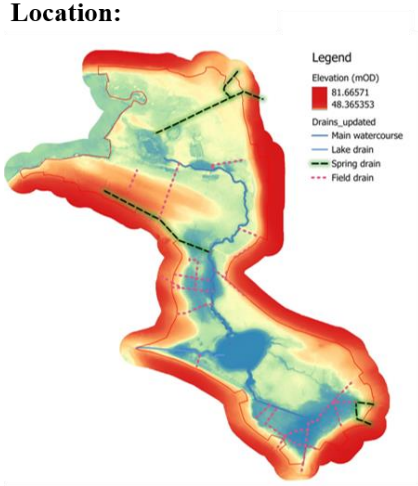
Water key:



Cross section:



Location:



Conceptual site model:

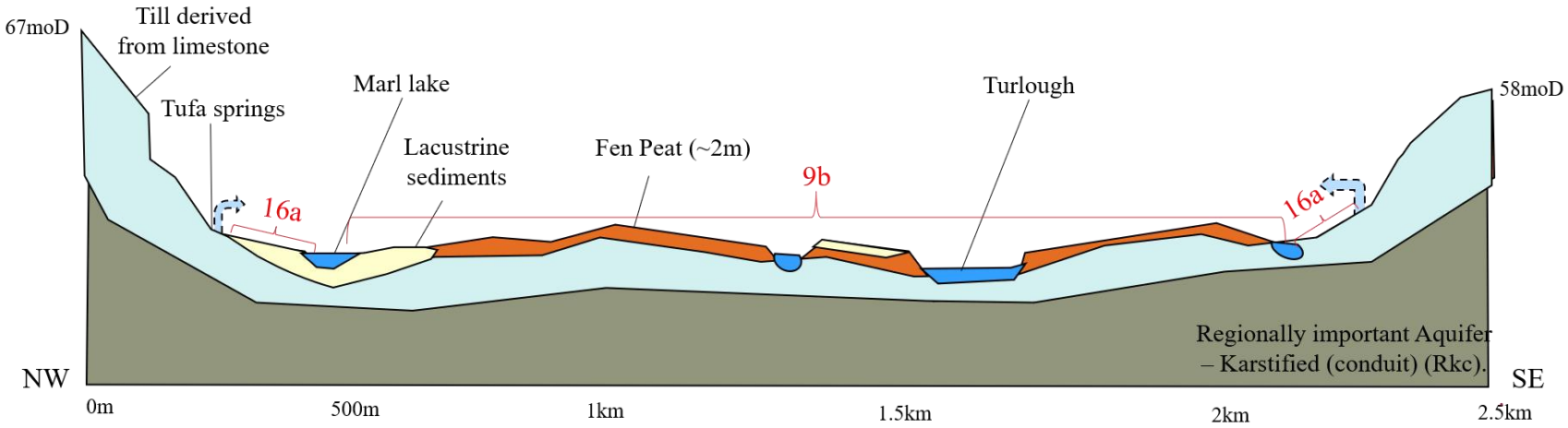


Figure 2: Conceptual Site Model

Appendix B – Ecological Survey Maps

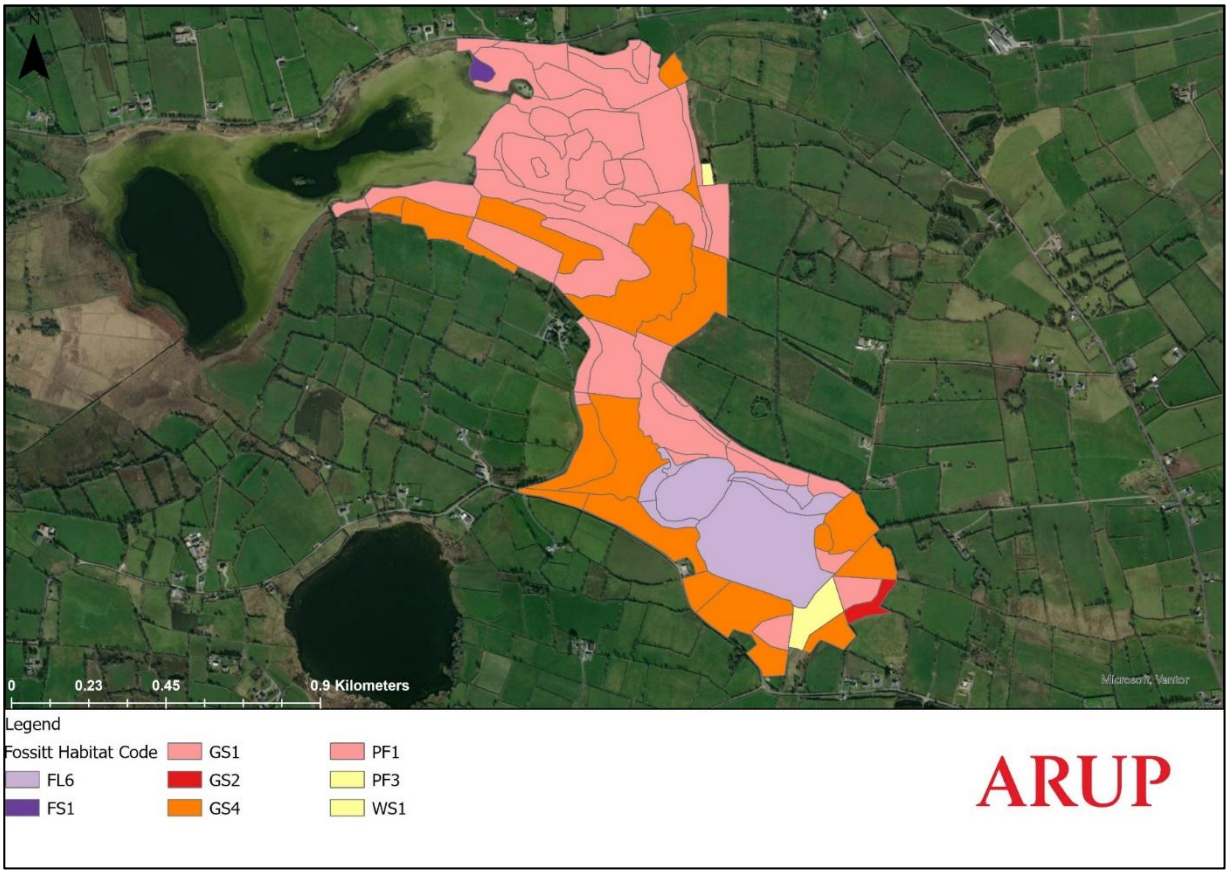


Figure B-1: Habitats recorded during the 2022 NFS and classified according to the Fossitt Habitat Classification system

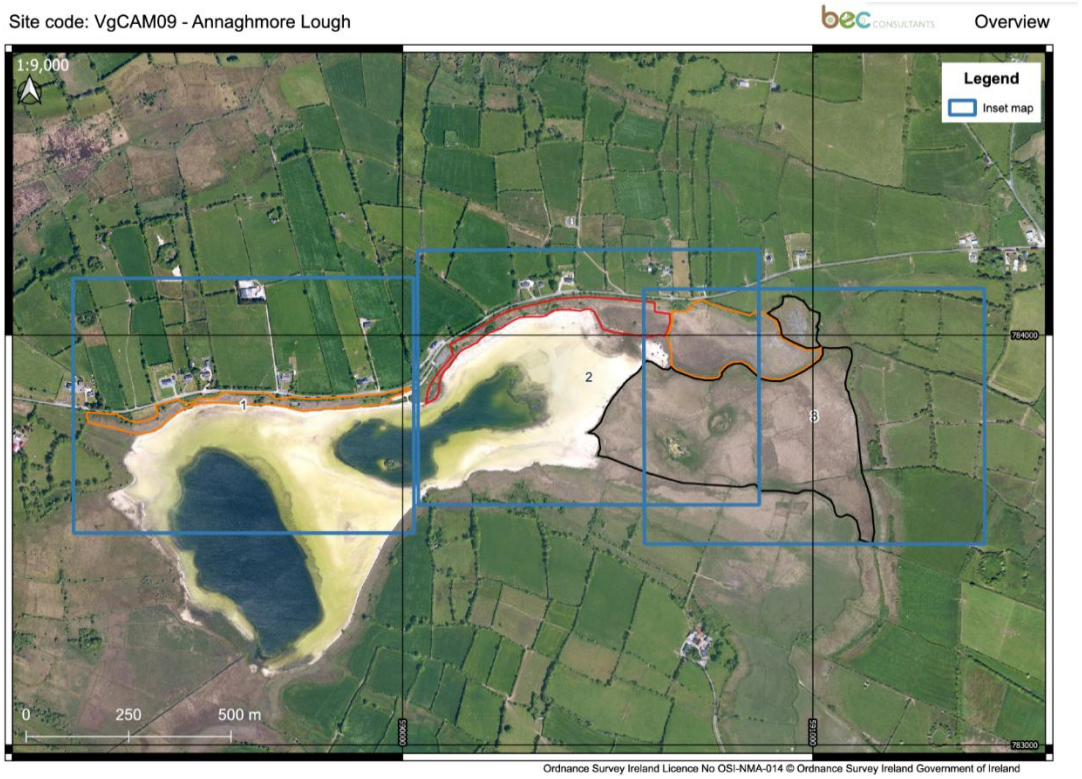


Figure B-1: Overview map of the suitability for Geyer's whorl snail in Annaghmore Lough SAC (Roscommon)



Figure B-3: Habitat Suitability for Geyer's whorl snail in Annaghmore Lough SAC (Roscommon)Figure B 1-9-1: Habitat Suitability for Geyer's whorl snail in Annaghmore Lough SAC (Roscommon)

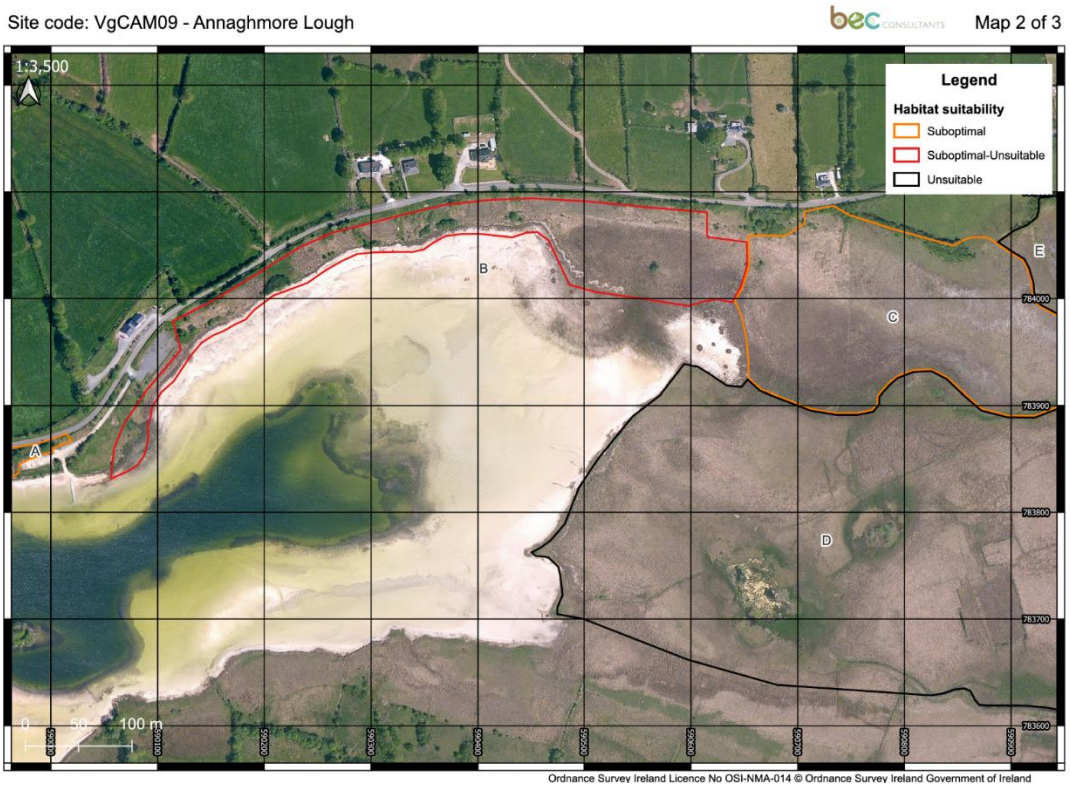


Figure B-4: Habitat Suitability for Geyer's whorl snail in Annaghmore Lough SAC (Roscommon)

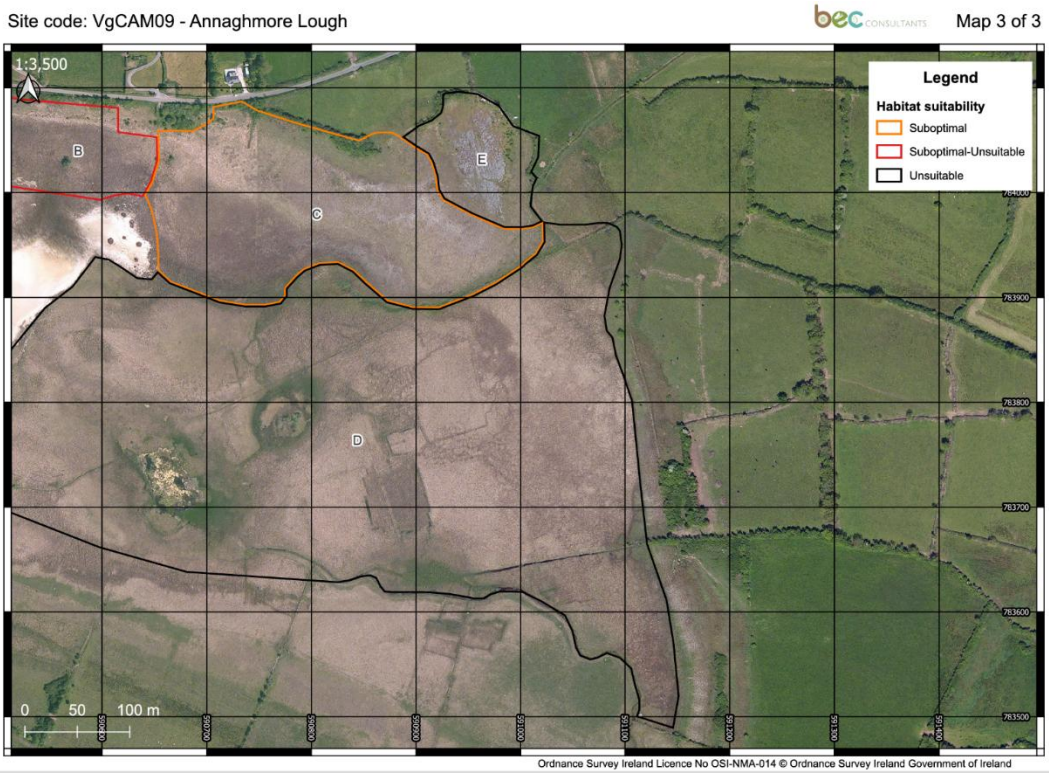


Figure B-5: Habitat Suitability for Geyer's whorl snail in Annaghmore Lough SAC (Roscommon)

Appendix C – Restoration and Monitoring Map

Table C1: Long-term monitoring points for fen restoration at Annaghmore Lough SAC (Roscommon)

Point	Measure	Description	Timeframe	Frequency of monitoring	Monitoring indicator
Gw_1	Hydrological	Monitoring groundwater levels and quality	Short-term	Seasonal for year 1 Annual for year 2-5	Groundwater level and quality of northern tufa (Continued monitoring of RPS piezometers)
Gw_2					
Gw_3					
Gw_4					
Gw_5					
Gw_6					
Gw_7					
Gw_8					
Gw_9					
Gw_10					Groundwater level and quality near main watercourse
Gw_11					
Gw_12					Groundwater level and quality near central tufa
Gw_13					
Gw_14					Groundwater level and quality near western field drains
Gw_15					
Gw_16					Groundwater level and quality near eastern open water (confirm hydraulic gradient)
Sw_1	Hydrological	Monitoring of surface water levels and quality	Short-term	Seasonal for year 1 Annual for year 2-5	Water level and quality at spring-fed drain
Sw_2					Water level and quality at main watercourse
Sw_3					
Sw_4					
Sw_5					Water quality at eastern open water
Sw_6					Water quality at swallow hole

Point	Measure	Description	Timeframe	Frequency of monitoring	Monitoring indicator
Sw_7					Water quality at marl lake
Sw_8					Water level and quality at Lake south of the site

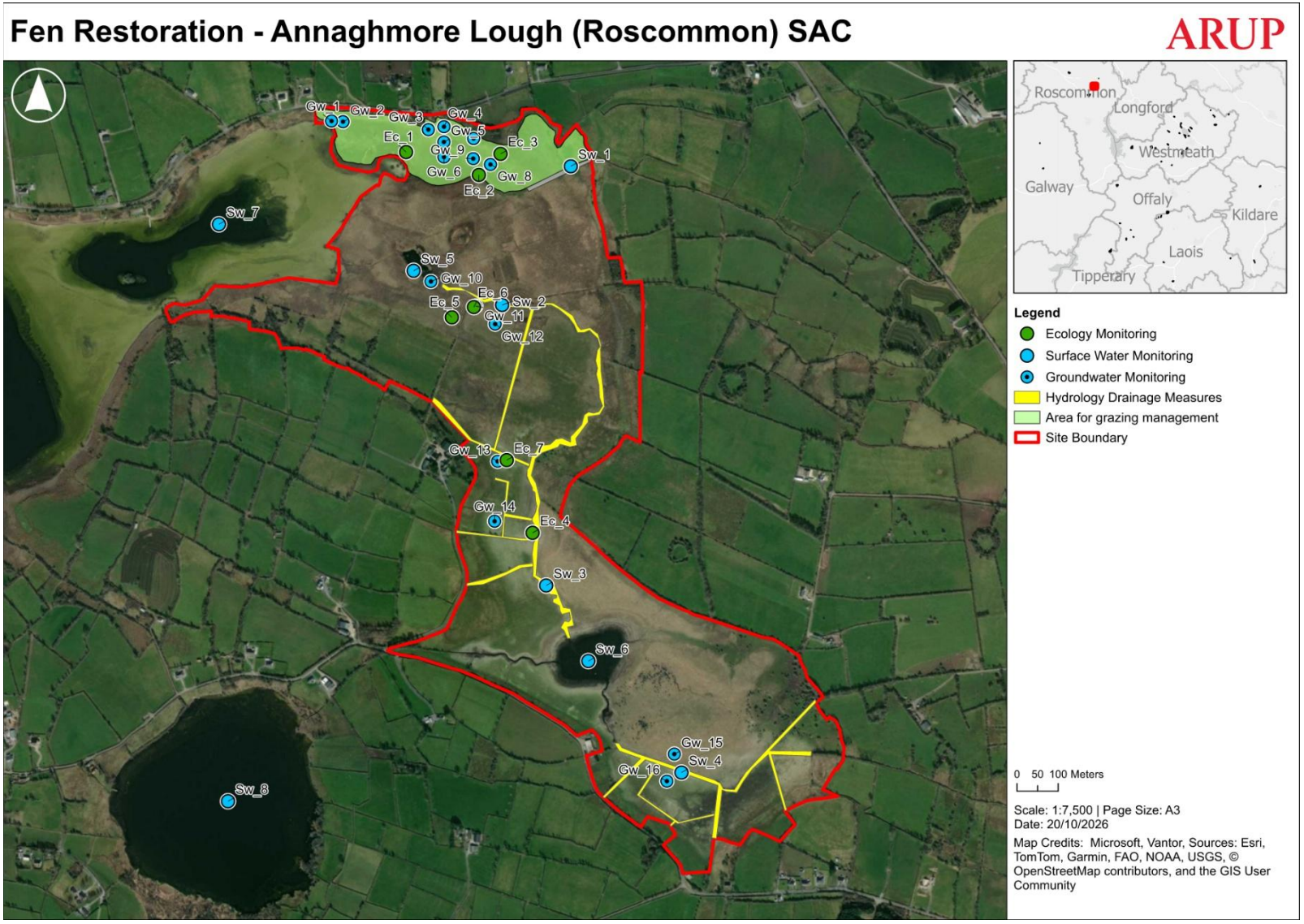


Figure 9-2: Restoration measures and monitoring for Annaghmore Lough SAC (Roscommon)

Appendix D – Drainage Management Plan

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan: Drainage Management Plan			
Site name	Annaghmore Lough SAC (Roscommon)		
County	Roscommon	NFS site No.	304001

Catchment overview:

Annaghmore Lough is a WFD Lake waterbody currently assessed as having a 'good' status. Surveillance monitoring by the EPA indicates that there is a downward trend for Ammonia-Total (as N) and Total Phosphorus (as P), and an upward trend for Chloropyll[1]. The WFD Groundwater body associated with the site is the Carrick on Shannon, which is currently assessed as having a 'good' status.

The WFD River waterbody (Doon_010) associated with the site is currently assessed as having 'moderate' status and it is considered 'at risk' of failing to achieve its WFD objectives. Identified pressures of the WFD sub-catchment are Urban wastewater and Agriculture, within the pressure subcategories of Agglomeration PE < 500 and Farmyards. Annual monitoring by the EPA indicates that there is a downward trend for Ammonia-Total (as N) and an upward trend for Total Phosphorus (as P) and ortho-Phosphate (as P)-unspecified[2].

Overall, the site supports a valuable complex of alkaline fen, calcareous grassland, wet grassland, transition mire, and turlough-associated habitats, maintained under a mixed grazing regime and influenced by seasonal flooding patterns.

WFD catchment	Upper Shannon 26E	WFD Sub-catchment	Scramoge_SC_010
Drainage Area	N/A	Drainage District	Yes
Responsible authority	Roscommon CC	Maintenance date	To be confirmed
Surrounding landowners	Private		

Wetland drainage

An assessment of historical and current hydrological data indicates that the water regime of Annaghmore Lough SAC (Roscommon) has changed over time, primarily due to drainage changes. Historical maps from the early-1800s show an open water body within the site boundary. An assessment of both historical and current mapping has indicated that the site has significantly less water than it did historically. In the 1829-1842, 6 inch First edition maps, the northern area of the site was covered by the marl lake with a meandering watercourse flowing to the swallow hole in the south of the site with an additional small lake to the right of the swallow hole. The site had multiple watercourses and field drains leading to the turlough, with one draining from Lough Narlasbarnagh. Historically, there

[1] As indicated in catchments.ie for the 2019-2024 monitoring period

[2] As indicated in catchments.ie for the 2019-2024 monitoring period

were wells and springs at about 50 mOD which were directed towards downstream waterbodies.

Surface water inflow	Spring fed drains	Surface water outflow	Drains, turlough
Groundwater inflow	Springs/turlough		
Internal drains	Multiple	Perimeter drains	Multiple

On site hydrology measures

Drainage measures;

- associated near the central springs
- associated with the southern turlough
- associated with the main watercourse

Drainage measures to include peat dams or plastic piling.

Off-site hydrology measures

Off-site measure 1	Engagement with Roscommon County Council (RCC) to ensure Annaghmore Lough SAC (Roscommon) fen restoration objectives considered as part of the Drainage District annual maintenance planning	Role player	NPWS/RCC

Engagement with landowners to not create new drainage channels.

On-site nutrient measures

Northern drain to have nutrient measures.

Off-site nutrient measures

Off-site measure 1	Catchment nutrient measures	Role player	Landowners within catchment/NPWS	Role players	NPWS

	as part of a farm plan				

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.

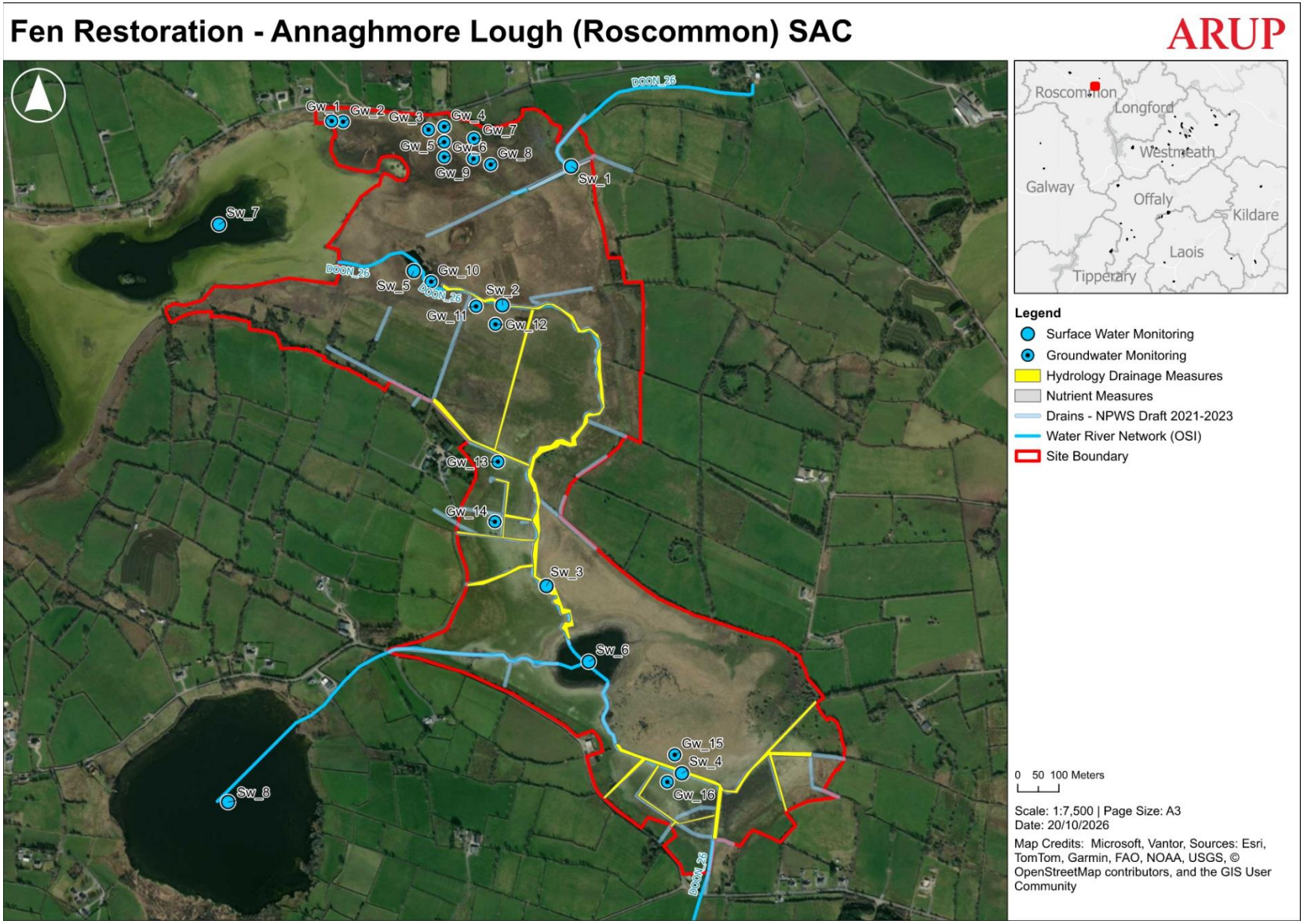


Figure D1: Mapped drainage network and restoration measures at Annaghmore Lough SAC (Roscommon)