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Tóchar Midlands Wetland Restoration Scheme

Lisduff Fen SAC

NFS site

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SAC 002147

Fen Restoration Plan

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ARUP

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Fen Restoration Plan

Lisduff Fen (Offaly) SAC (002147)

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Executive Summary

Lisduff Fen SAC is located 4km southeast of Birr, Co. Offaly and is designated as a Special Area of Conservation for the presence of 7220 Petrifying Springs, 7230 Alkaline fen, and 1013 Geyer's whorl snail *(Vertigo geyeri)*, all of which are listed under Annex I and II of the EU Habitats Directive.

This assessment of Fen Restoration Plan (referred to hereafter as FRP) was developed to set out proposals for the restoration of Annex I 7230 Alkaline fen and 7220 Petrifying springs alongside Annex I quality 7140 Transition mire, which contribute to the achievement of site-specific conservation objectives for the SAC and the favourable conservation condition of fen habitat. In parallel, the conservation objectives include the maintenance of the condition of Geyer's whorl snail, acknowledging their ecological significance and vulnerability within the landscape.

This is a site-level plan that will be subject to refinement prior to implementation of restoration actions in each subsite. The assessment primarily considers the following pressures that may be impacting on the hydrological function and/or favourable condition of the fen habitat:

- Drainage
- Scrub encroachment
- Changes to water quality, e.g. nutrient enrichment
- Over or under grazing
- Invasive species e.g. scattered self-seeding conifers

This assessment included a review of previous studies of Lisduff Fen SAC commissioned by NPWS including the surveys carried out in 2022 as part of the National Fen Survey (NFS). Detailed aerial imagery and topographic datasets were then used to map all drainage features within the site. Hydrological and ecological field surveys were then undertaken to collect additional information to validate the findings from desktop assessment and inform the selection of suitable restoration actions, considering the conditions found on site and possible constraints.

Actions of the Fen Restoration Plan

The restoration plan for Lisduff Fen SAC sets out a coordinated series of measures to address the key pressures affecting the site and to support the recovery of its wetland habitats.

A phased approach is recommended. The initial phase should focus on implementing a hydrological monitoring programme to improve the understanding of groundwater and surface water interactions, and to assess the influence of the drainage network on water levels within the fen. The monitoring results will be used to determine whether drain blocking is required and to identify the most appropriate locations.

Based on the findings of the monitoring programme, targeted hydrological restoration measures, including drain blocking, may be implemented to raise water levels and enhance fen habitat condition. If hydrological restoration measures are progressed, scrub encroachment monitoring and targeted scrub removal should also be undertaken to support the maintenance of fen vegetation.

Recommended vegetation measures focus on addressing the primary pressure of grazing absence, which is driving scrub encroachment, dominance of rank species (notably *Molinia caerulea* and *Phragmites australis*), and declining habitat structure across Annex I and Annex I quality habitats (7230 Alkaline fens, 7220 Petrifying springs and 7140 Transition mires). The reintroduction of conservation grazing is identified as the principal restoration measure to reduce sward dominance, maintain open fen conditions, and restore structural diversity. Grazing regimes must be carefully controlled in terms of stocking density and timing to avoid localised overgrazing or damage to sensitive, wetter areas.

Targeted, evidence-led scrub management is recommended where woody encroachment is contributing to habitat degradation, with control (rather than complete removal) applied within transition mire areas and exclusion of Annex I quality 91E0 Alluvial forests. These measures must be implemented in conjunction with grazing to ensure long-term effectiveness. Ongoing vegetation monitoring will inform adaptive management by tracking changes in species composition and sward structure, allowing refinement of grazing and scrub control measures. In addition, manual removal of fly-tipped material is required to prevent localised nutrient enrichment and physical smothering, supporting recovery of vegetation communities and progress towards favourable condition in line with site-specific conservation objectives.

The plan recognises the importance of stakeholder engagement and compliance. Active engagement with landowners, statutory bodies, and other local stakeholders will help ensure that restoration actions are practical, widely supported, and compliant with relevant legislation.

Drainage features, water quality and ecology were assessed, and a recommendation made for suitable restoration actions. A prioritisation exercise was completed to identify restoration measures that should be targeted first in progressing the implementation of these restoration requirements. Consultation with stakeholders, and further site investigations, will be the next key steps required to refine this assessment prior to proceeding to the implementation phase(s). The key measures proposed by this assessment are:

- Implementation of a hydrological monitoring programme to improve understanding of groundwater and surface water interactions and inform restoration design.
- Targeted hydrological restoration measures, including drain blocking where supported by monitoring results.
- Reintroduction of conservation grazing to address rank vegetation and maintain open fen conditions.

- Targeted scrub management where woody encroachment is contributing to habitat degradation.
- Ongoing vegetation monitoring to inform adaptive management.
- Removal of fly-tipped material to prevent localised nutrient enrichment and physical smothering of vegetation.

Benefits of the Fen Restoration Plan

The restoration plan is expected to deliver measurable benefits for fen habitats and associated species at Lisduff Fen SAC. Improved understanding of hydrological conditions will support the identification of appropriate management actions to maintain or restore suitable wet conditions across the site.

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

The monitoring data indicate that the highest quality fen vegetation occurs in the wettest areas of the site, confirming that hydrological conditions are the primary control on habitat condition at Lisduff Fen SAC.

Habitat and Restoration Map

The habitats recorded during the 2022 NFS and classified according to the Fossitt Habitat Classification system is presented in Figure 1-1

The Restoration and Monitoring Map including both hydrological and ecological measures is presented in Figure 1-2.

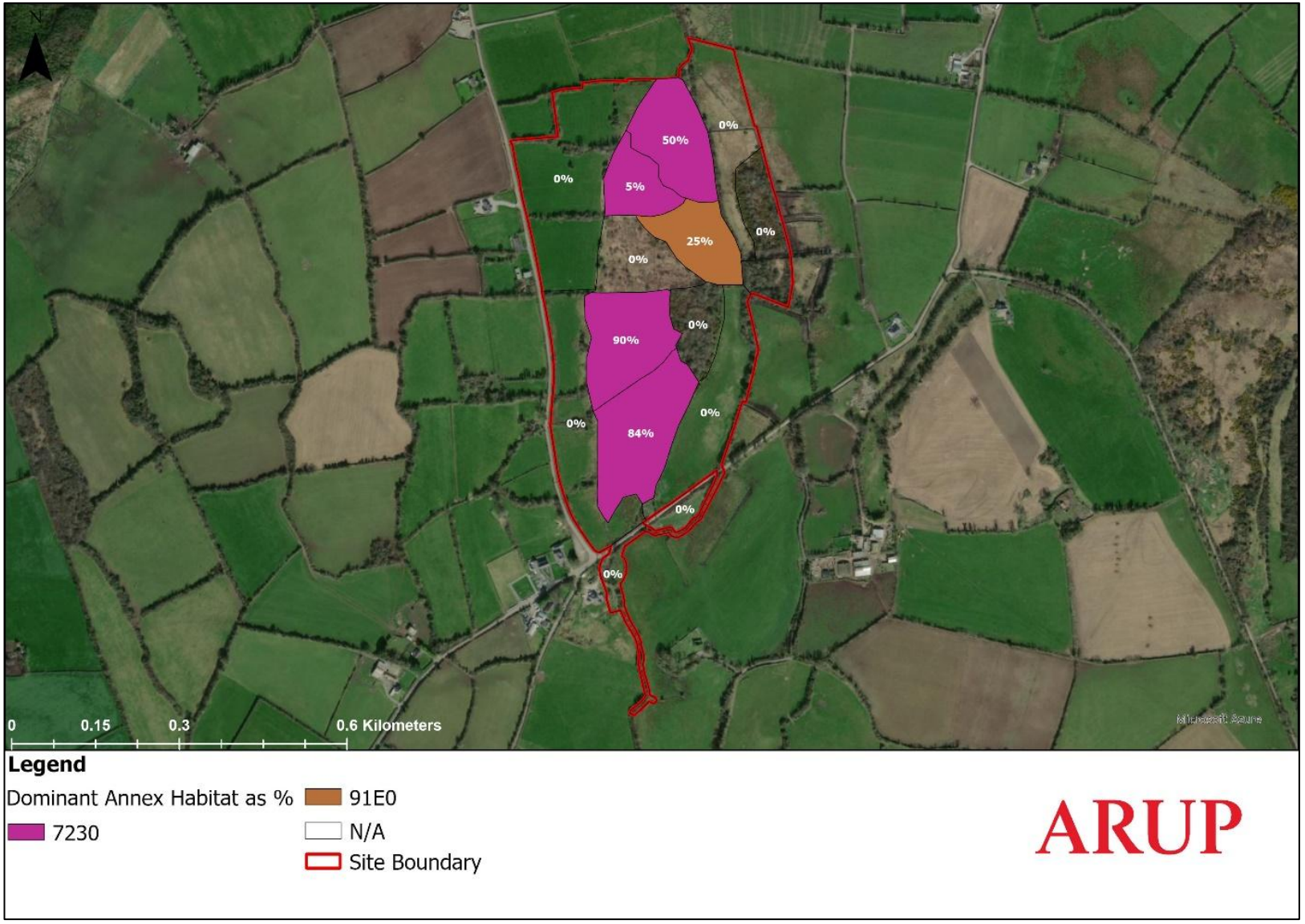


Figure 1-1 Annex I habitats recorded during the 2022 NFS (see Table 9-1 for full list of habitat names and corresponding codes) Note the % value indicates the % cover of the Annex I and Annex I quality habitat recorded in the polygon

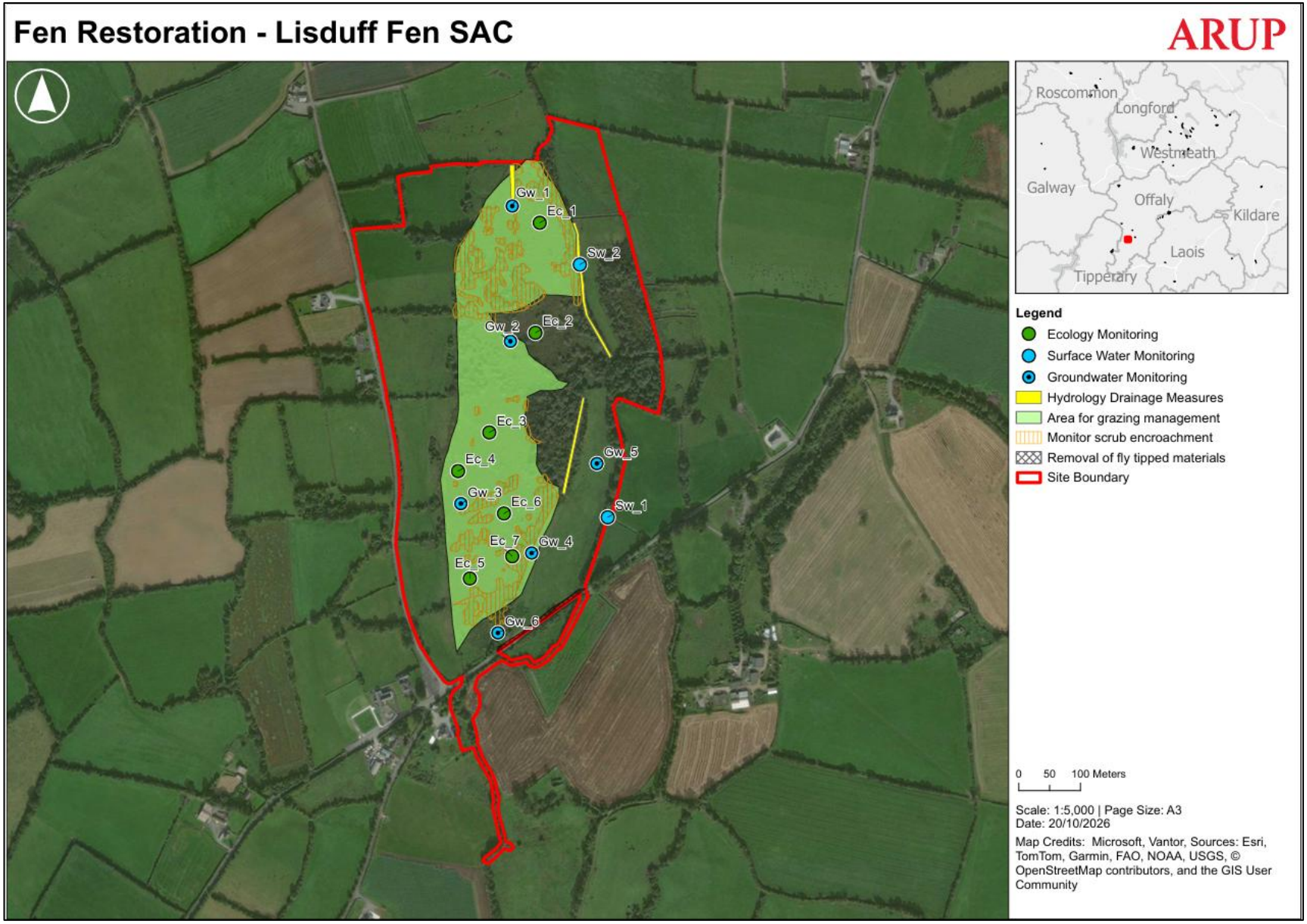


Figure 1-2 Restoration and Monitoring Map including both hydrological and ecological measures

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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.

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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 was developed by Arup on behalf of National Parks and Wildlife Service (NPWS) to set out proposals for the restoration of Annex I habitats of 7230 Alkaline fen and 7220 Petrifying springs alongside Annex I quality 7140 Transition mire and quaking bog (hereafter referred to as 7140 Transition mire) habitat within the site which contributes to favourable conservation condition of the site's fen habitat and the achievement of SAC (Special Area of Conservation) site-specific conservation objective (SSCO) targets.

Lisduff Fen SAC (site code: 002147) is located approximately 4 km southeast of Birr in Co. Offaly. The SAC covers a total area of 31.37 ha and is dominated by fen habitat although several other associated wetland habitats are also present as identified by the National Fen Survey (NFS) (Brophy et al, In prep). The qualifying interests (QI) of the SAC consist of Annex I 7230 Alkaline fen and 7220 Petrifying springs habitat and the Annex II species Geyer's whorl snail (*Vertigo geyeri*) [1013]. Annex I quality 7140 Transition mire and 91E0 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) (hereafter referred to as 91E0 Alluvial forests) habitats are also present within the site. According to the NFS, the total extent of 7230 Alkaline fen and 7140 Transition mire within Lisduff Fen SAC is estimated at 6.46 ha and 1.03 ha, respectively.

The main aim of the restoration actions proposed as part of this FRP is to maintain or improve the quality of existing areas of fen or improve the hydrological conditions that will allow an expansion of the measurable area of fen thus impacting on SSCOs/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.

1.2 Wider benefits of fen restoration

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

Peatland drainage and extraction 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 fen habitat within Lisduff Fen SAC is likely to lead to improve 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 have been identified in the latest Status of EU Protected Habitats and Species in Ireland (Article 17 report) (NPWS 2025). The overall conservation status is assigned as 'Bad' for 7140 Transition mire, 7230 Alkaline fen and 1013 Geyer's whorl snail, and Inadequate for 7220 Petrifying springs.

Table 1-1: National pressures to fen habitats

Habitat	Importance	Pressure
7230 Alkaline fen	High	PL02 Drainage (mixed or unknown drivers) to surface or ground waters PL05 Modification of hydrological flow (mixed or unknown drivers) 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 J01 Mixed source pollution to surface and ground waters
	Medium	PI03 Problematic native species PA17 Agricultural activities generating pollution to surface or ground waters (including marine) PA20 Livestock farming generating pollution
7220 Petrifying springs	Medium	PK01 Mixed source pollution to surface and ground waters (limnic and terrestrial) PA05 Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming) PL05 Modification of hydrological flow (mixed or unknown drivers) PI03 Problematic native species
	Low	PL02 Drainage (mixed or unknown drivers)
7140 Transition mire	High	PL02 Drainage (mixed or unknown drivers) PL05 Modification of hydrological flow (mixed or unknown drivers)
	Medium	PA08 Extensive grazing or undergrazing by livestock PA05 Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming)

Habitat	Importance	Pressure
		PI03 Problematic native species
	Low	PA17 Agricultural activities generating pollution to surface or ground waters (including marine)

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.
- 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.
- 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.
- 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 Special Areas of Conservation (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 QIs of the SAC and special conservation interest (SCI). Conservation objectives for the site are defined for these QIs.

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 Lisduff Fen SAC and the conservation objectives for 7230 Alkaline fen habitats.
- Section 3 outlines the findings from the land and water desktop and site monitoring surveys that were carried out to inform the development of these FRP.
- Section 4 outlines the findings from the ecological desktop and site monitoring surveys that were carried out to inform the development of these 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 were mapped in GIS format and delivered to NPWS in accordance with NPWS data standards (see Appendix D for details of GIS layers provided). 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. GIS shapefiles which accompany this report include all relevant data on referenced species.

2 Site Overview

2.1 Lisduff Fen SAC

Lisduff Fen SAC is located 4 km southeast of Birr, Co. Offaly (Figure 2-1). The site occupies a local basin and has minor differences in elevations, with the western boundary at 70 mOD and the central area at 69 mOD. The site is designated due to the presence of 7230 Alkaline fen, 7220 Petrifying springs and Geyer's whorl snail.

A local road is located to the west of the site at an elevation of approximately 77 mOD. This road connects to a second local road in the southern part of the site, which passes through a small section of the site boundary. An important water course identified as Rock Birr (IE_SH_25R020200) is located along the eastern perimeter of the site, flowing from south to north. Other multiple drains are identified within the site.

The site occupies a lowland setting within a predominantly agricultural landscape characterised by improved pasture, with adjacent land uses including conifer forestry and areas of wet grassland.

The site is dominated by fen habitat, principally rich fen, including extensive areas of 7230 Alkaline fen in the north and south of the site, as well as an area of Annex I quality 91E0 Alluvial forests and 7140 Transition mire. In addition, areas of non-Annex rich fen occur, some of which are rank in structure. Other habitats recorded within the site include scrub, wet grassland, wet woodland, wet heath, broadleaved forest, cut over bog, transition mire hollow raised bog and wet heath.

Management across much of the site is limited. Light cattle grazing occurs intermittently in the site contained by an electric fence in the west of the site, leaving some portions of the site overgrazed and others under grazed. There is scrub encroachment in the centre of the site that encroaches onto the 7230 Alkaline fen.

The site is located within the 26F Upper Catchment and is primarily drained by tributaries of the Shannon River. For the purposes of the Water Framework Directive most of the site is located within the Inn [Shannon]_040 sub-catchment.



Figure 2-1 Site Location Map

2.1.1 Fen Condition Assessment

Lisduff Fen SAC was surveyed as part of the NFS on the 16th of August 2022 (Brophy et al, In prep) and again as part of the 2025 Petrifying springs monitoring report (Denyer, 2025) on the 14th of September 2024. During these surveys, the pressures outlined in Table 2-1 were identified.

Table 2-1: Assessment of impacts of pressures on 7220 Petrifying springs and 7230 Alkaline fen at Lisduff Fen SAC

Pressure Code	Pressure [sub-category]	Influence
PA05	Abandonment of management/use of grasslands and other agricultural agroforestry systems (e.g. cessation of grazing, mowing or traditional farming). This pressure was impacting both 7220 Petrifying springs and 7230 Alkaline fen habitat due to insufficient levels of grazing.	Negative
PI03	Problematic native species in the form of encroaching scrub was noted as impacting 7230 Alkaline fen habitat.	Negative

Pressure Code	Pressure [sub-category]	Influence
PK01	Mixed source pollution to surface and ground waters (limnic and terrestrial). This pressure was recorded as impacting 7220 Petrifying springs habitat.	Negative
PL05	Modification of hydrological flow. The site contains a series of old drains and a dredged, canalised watercourse. This pressure was impacting both 7220 Petrifying springs and 7230 Alkaline fen habitats.	Negative

The results of a field evaluation (2026) of the above pressures to inform the restoration planning process is detailed in Section 5 of this report.

The structure and functions of the Annex I 7230 Alkaline fen habitat was recorded as Unfavourable-Bad. In the latest assessment for 7220 Petrifying springs (Denyer, 2025), the overall status was Unfavourable-Bad and. However, the area was assessed as Favourable, while structure and functions and future prospects were assessed as Unfavourable-Bad and Unfavourable-Inadequate, respectively.

2.1.2 Site-specific conservation objectives

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.

Conservation objectives are defined for Lisduff Fen SAC for 7230 Alkaline fen using attributes and targets based on parameters set out in the Habitats Directive. The restoration actions outlined by this restoration plan aim to contribute towards achieving these targets. The conservation objective is ‘to maintain the favourable conservation condition of 7230 Alkaline fen in Lisduff Fen SAC. The attributes and targets for 7230 Alkaline fen, along with how the FRP will contribute to achieving set targets, are 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 Lisduff Fen SAC. 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 fen at Lisduff Fen SAC (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	FRP actions will not result in a decline in the area of fen habitat within the SAC and are expected to contribute to an increase in 7230 habitat extent.
Habitat distribution	Occurrence	No decline, subject to natural processes	Yes	FRP actions will not result in a decline in distribution of fen habitat within the SAC and are expected to contribute to an increase in 7230 distributions.
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. FRP actions will address nutrient inputs from surrounding land and assist in restoring 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. Improvements in site hydrology will support conditions required for peat formation.

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, or where necessary restore, appropriate natural hydrological regimes necessary to support the natural structure and functioning of the habitat	Yes	Yes. FRP actions (e.g. drain blocking/weirs) will improve groundwater conditions and restore natural hydrological regimes.
Ecosystem function: hydrology – surface water flow	Drain density and form	Maintain, or where necessary restore, as close as possible to natural or semi-natural drainage conditions	Yes	Yes. FRP actions (e.g. drain blocking/weirs) will reduce artificial drainage and improve surface water flow conditions.
Ecosystem function: water quality	Water chemistry measures	Maintain appropriate water quality, particularly pH and nutrient levels, to support the natural structure and functioning of the habitat	Yes	Yes. FRP actions include engagement with landowners and monitoring to reduce nutrient inputs and improve water quality.
Community diversity	Abundance of variety of vegetation communities	Maintain variety of vegetation communities, subject to natural processes	Yes	Restoration measures will improve vegetation structure and composition, resulting in a positive shift across all attributes towards their targets.
Vegetation composition: brown mosses	Percentage cover at a representative number of 2m × 2m monitoring stops	Maintain adequate cover of typical brown moss species	Yes	Yes. Improvements in hydrology and nutrient conditions will support typical brown moss communities.

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 × 2m monitoring stops	Maintain adequate cover of typical vascular plant species	Yes	Yes. Restoration of hydrology and nutrient balance will support recovery of characteristic vascular plant assemblages.
Vegetation composition: native negative indicator species	Percentage cover at a representative number of 2m × 2m monitoring stops	Cover of native negative indicator species at insignificant levels	Yes	Yes. Vegetation management and hydrological restoration will limit expansion of negative indicator species.
Vegetation composition: non-native species	Percentage cover at, and in local vicinity of, a representative number of 2m × 2m monitoring stops	Cover of non-native species less than 1%	Yes	Yes. Monitoring and site management will ensure non-native species remain below target thresholds.
Vegetation composition: native trees and shrubs	Percentage cover in local vicinity of a representative number of monitoring stops	Cover of scattered native trees and shrubs less than 10%	Yes	Yes. Scrub management (supported by hydrological restoration and grazing) will maintain tree and shrub cover below target thresholds.
Vegetation composition: soft rush and common reed cover	Percentage cover in local vicinity of a representative number of monitoring stops	Total cover of soft rush (*Juncus effusus*) and common reed (*Phragmites australis*) less than 10%	Yes	Yes. Improved hydrology and grazing management will control dominance of these species.

Attribute	Measure	Target	Addressed by FRP?	Will restoration actions contribution to achieving target?
Vegetation structure: litter	Percentage cover in local vicinity of a representative number of monitoring stops	Total cover of litter not more than 25%	Yes	Yes. Appropriate grazing and vegetation management will prevent excessive litter accumulation.
Physical structure: disturbed bare ground	Percentage cover at, and in local vicinity of, a representative number of 2m × 2m monitoring stops	Cover of disturbed bare ground not more than 10%	Yes	Yes. Restoration measures will stabilise site conditions and reduce disturbance levels.
Physical structure: tufa formations	Percentage cover in local vicinity of a representative number of monitoring stops	Disturbed proportion of vegetation cover where tufa is present is less than 1%	Indirectly	Restoration measures are not specifically targeted at tufa areas, but improved hydrology and habitat condition may indirectly benefit tufa-associated vegetation.
Indicators of local distinctiveness	Occurrence and population size	No decline in distribution or population sizes of rare, threatened or scarce species associated with the habitat; maintain features of local distinctiveness, subject to natural processes	Indirectly	Restoration of hydrology, nutrient status and vegetation structure will benefit associated species and contribute to maintaining local distinctiveness.

2.1.3 National Fen Survey (Brophy et al., In prep)

The NFS (Brophy et al., In prep) provides the primary baseline dataset for Lisduff Fen SAC. The site was surveyed on 16 August 2022, with a total of 31.37 ha assessed, including 6.46 ha of Annex I 7230 Alkaline fen and 1.03 ha of Annex I quality 7140 Transition mire. Six monitoring stops were established within the 7230 habitat. Lisduff Fen SAC occupies a local basin and is bounded to the east by a deep, canalised watercourse. The southern section supports the best example of alkaline fen, while the northern part comprises cutover peat with a mosaic of poor fen, scrub and wet woodland. Grazing was recorded at the time of survey (6–7 cattle), although this was considered insufficient to control scrub encroachment. While cattle may browse some young woody growth, their primary role in scrub management is through trampling and physical disturbance, which can suppress scrub regeneration, damage stems and branches, reduce vigorous growth around scrub margins, and help maintain open fen conditions. The grazing intensity recorded during the survey was considered insufficient to exert this effect at a scale capable of limiting scrub expansion across the site.

The NFS identified several key pressures affecting the structure and function of the fen system:

- Hydrological modification;
- Vegetation succession (scrub encroachment);
- Abandonment of grazing regimes and undergrazing;
- Nutrient enrichment and localised impacts; and
- Physical disturbance in the form of historical land use (bog tracks and cutover peat areas)

The results of a field evaluation completed in 2026 and undertaken to inform the restoration planning process, are presented in Section 5 of this report.

The NFS described the site as largely unmanaged, with grazing present at the time of survey (6-7 cattle). However, the level and/or distribution of grazing recorded at the time of survey was not considered sufficient to prevent scrub encroachment and the development of rank vegetation, although the specific factors contributing to this were not identified in the NFS. No site-specific restoration or conservation measures were proposed, and the baseline information available from the survey was limited in its ability to directly inform detailed restoration planning.

In the NFS condition assessment, 7230 Alkaline fen was assessed as Unfavourable–Bad. No condition assessment was recorded for the limited areas of Annex I quality 7140 Transition mire. These findings indicate that targeted restoration measures will be required to improve habitat structure and function, and to prevent further deterioration of the Annex I fen habitats present within the SAC.

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, Roscrea (New Road), was reviewed to assess seasonal variability in rainfall at the site and surrounding areas (Met Eireann, 2025).

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

The 30-year monthly rainfall data indicate that rainfall is typically highest in late autumn and winter (with the greatest monthly averages in October, November and December), and lowest in spring (notably April). The rainfall data also indicates some variability around these averages, with monthly totals ranging from very low values to very high monthly totals exceeding 200 mm in the long-term record (Figure 3-1).

Total annual precipitation also varies between years, 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 (Figure 3-2).

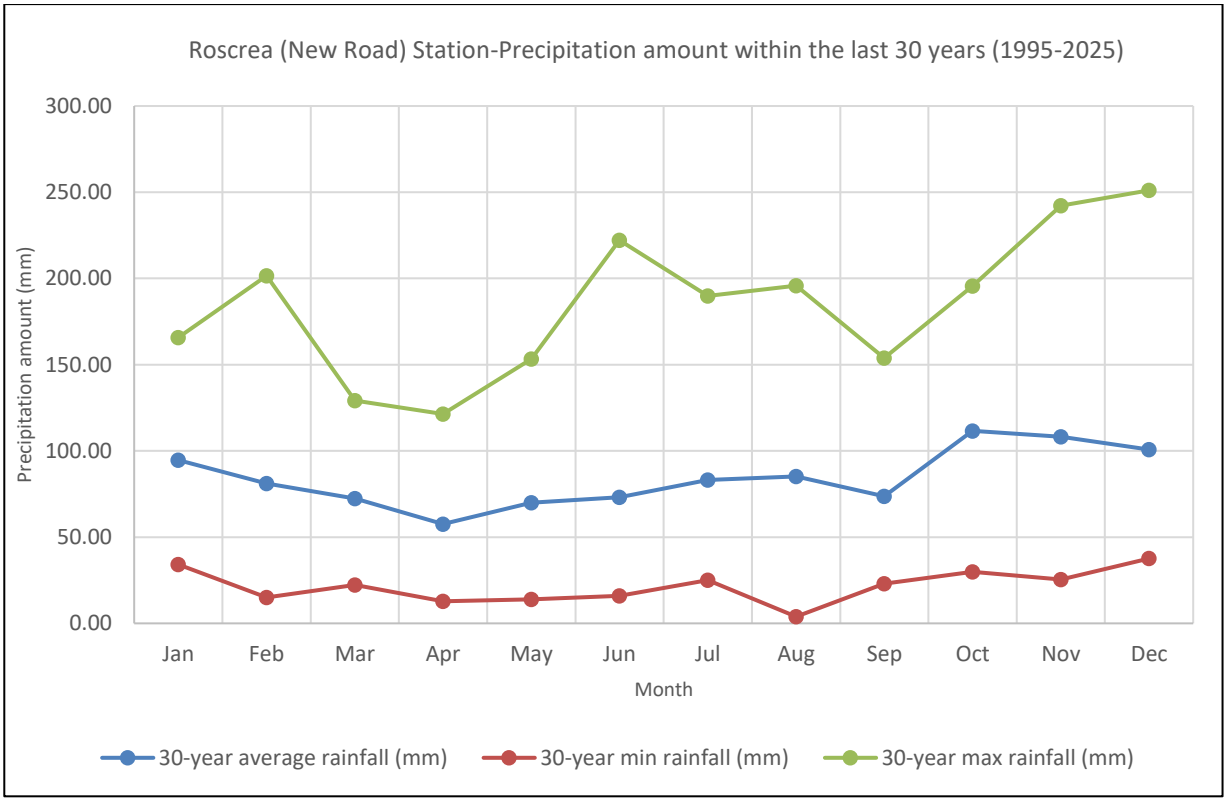


Figure 3-1: Roscrea (New Road) Station – Precipitation amount (mm) within the last 30 years (1995-2025)

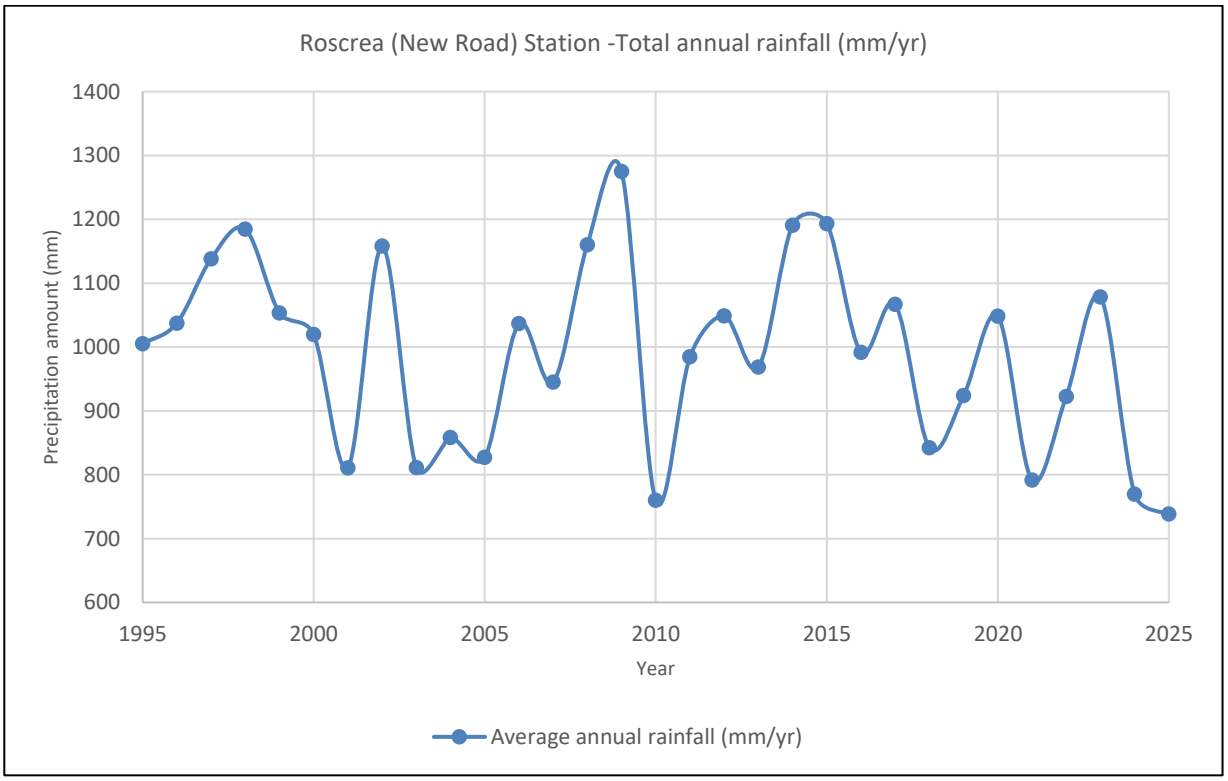


Figure 3-2: Roscrea (New Road) Station – Total annual rainfall (mm/yr)

3.1.2 Hydrogeological Setting

The site is mainly underlain by the Waulsortian Limestones with the Old Court Cherty Limestone located to the north of the site, with bedrock outcrops to the east of the site, as shown in Figure 3-3.

The limestones are classified by GSI as Locally Important Aquifers which is moderately productive only in Local zones (LI) with a fault line running from the northeast to the southwest. There is a Locally Important Gravel Aquifer (Lg) located 3 km to the north of the site. The aquifer classification is presented in Figure 3-4.

The subsoil (Quaternary sediments) overlying the bedrock primarily comprise Fen Peat with a small area of till derived from limestones to the northwest. Gravels derived from limestone are mapped in a small area within the site boundary. Alluvium is mapped in the southern part of the site. The subsoil type underlaying the site is presented in Figure 3-5.

Groundwater recharge rates are higher in the till area of (151 to 200 mm/year) and lower in the thick peat (1 to 50 mm/year), with).

Groundwater vulnerability within the site is moderate with a small area of high vulnerability in the northwestern section that underlays the till, as shown in Figure 3-6.

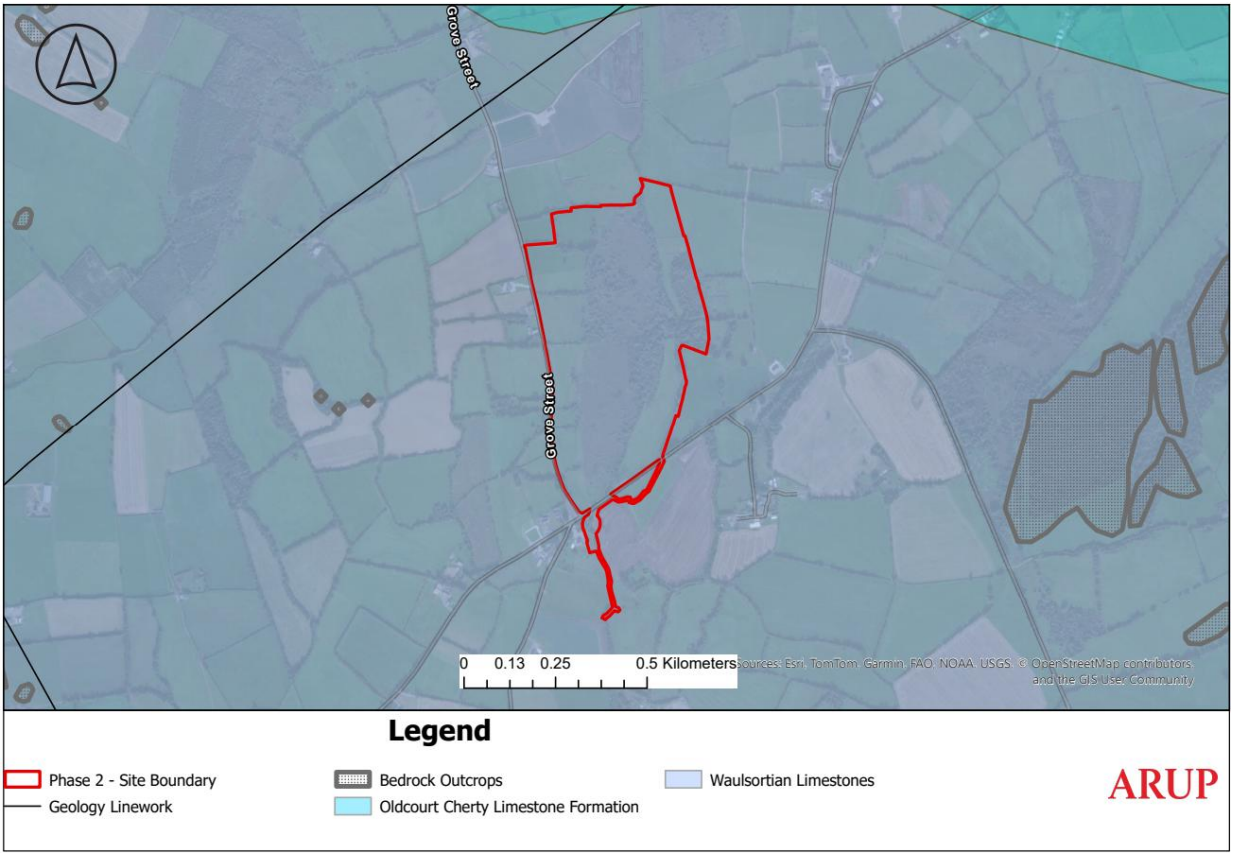


Figure 3-3: Bedrock geology of Lisduff Fen SAC

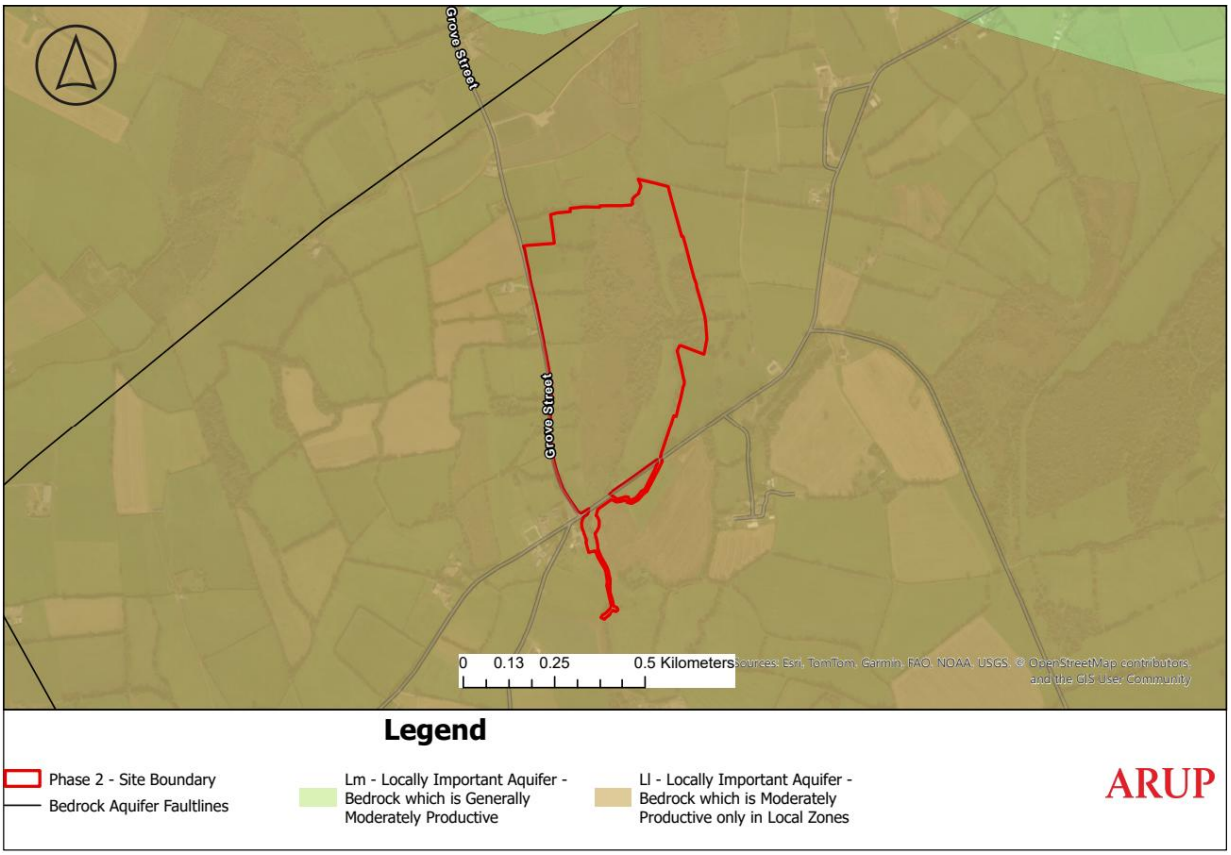


Figure 3-4: Aquifer classification and karst underlying Lisduff Fen SAC (GSI)

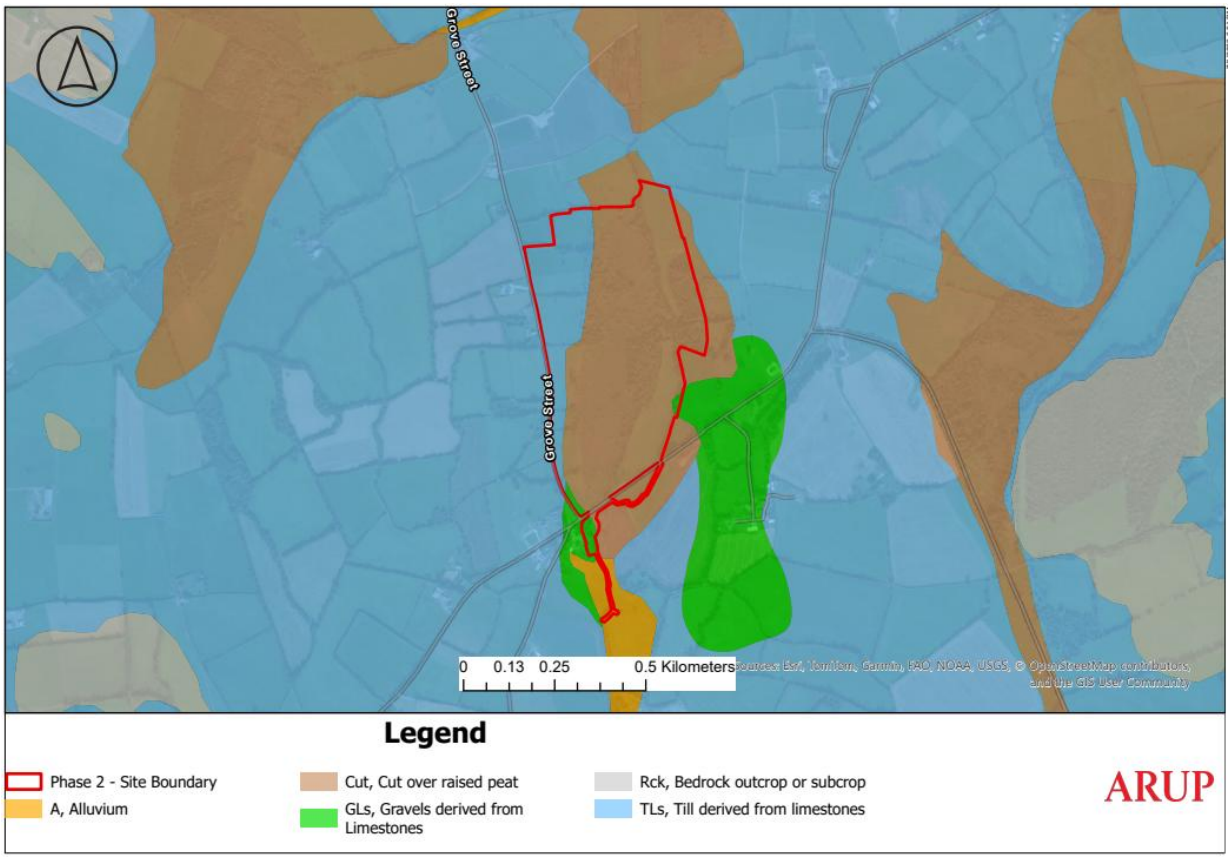


Figure 3-5: Quaternary Sediments within Lisduff Fen SAC (GSI)

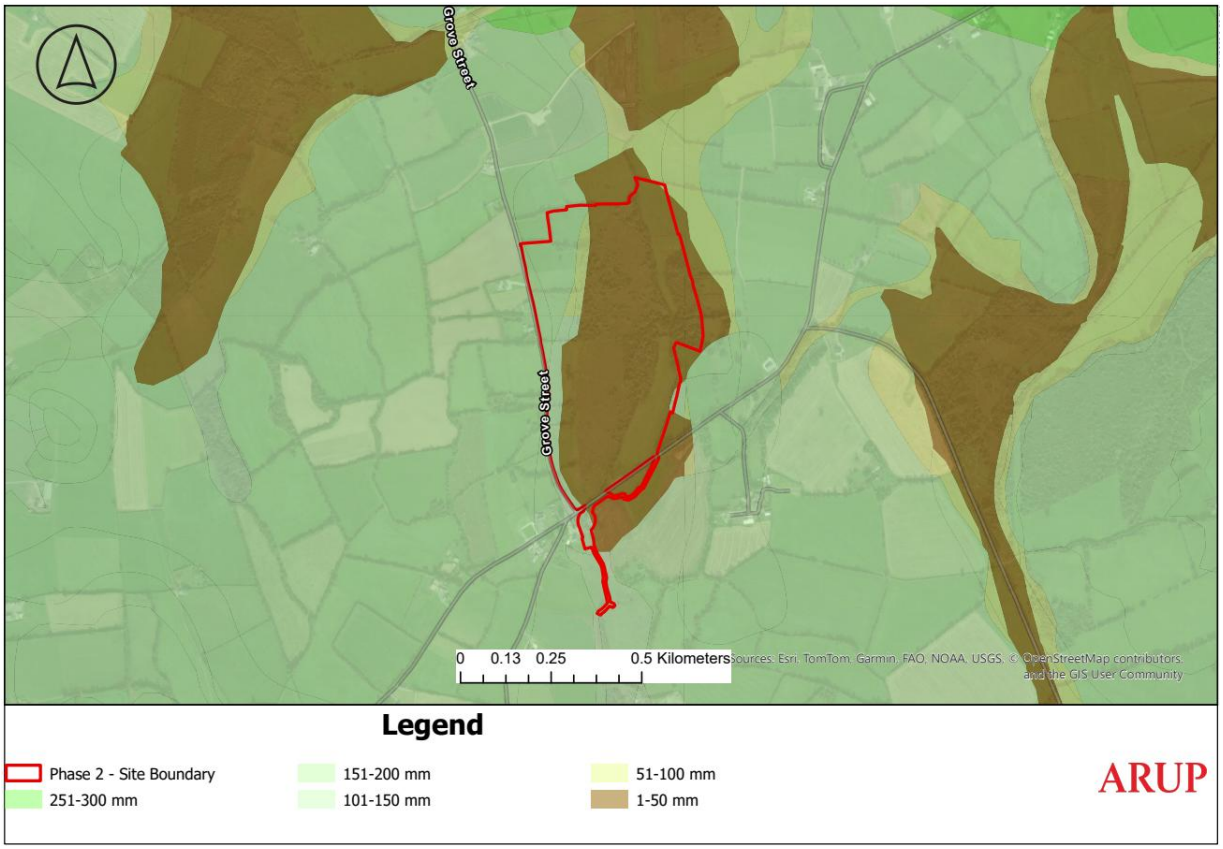


Figure 3-6: Groundwater recharge map for Lisduff Fen SAC

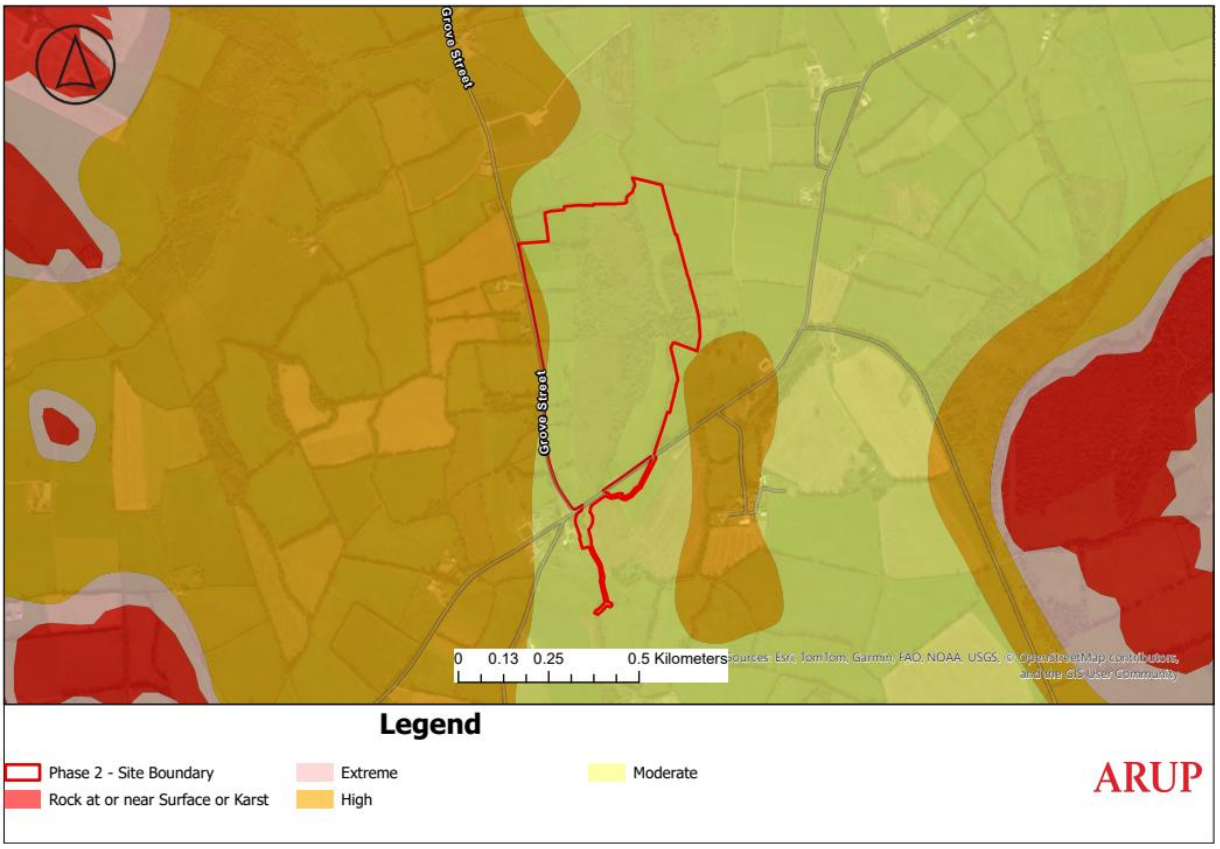


Figure 3-7 Groundwater vulnerability map for Lisduff Fen SAC (GSI)

3.1.3 Topographic and Surface Water Drainage

The site is located within the 25B Lower Shannon WFD Catchment and the Little Brosna_020 WFD sub-catchment. (Figure 3-10). The Rock_010 river enters the fen in the south and connects to the Rock_020 river within the fen. The Rock River is a tributary of the Little Brosna River, which eventually flows into the Shannon Estuary. The WFD river waterbodies, Rath_010 and Rath_020, are classified as 'Poor' and 'Moderate' WFD Status, respectively, and are considered 'at risk' of not achieving their WFD objectives.

The site is situated within a local topographic basin of relatively even elevation. Ground levels decrease gradually from north to south, ranging from approximately 69 to 70 mOD, while the site remains relatively flat along the west-east sections. Beyond the site boundary, the landscape becomes notably elevated in the northwest and south.

Historical mapping (late 1830s) indicates a drain along the eastern boundary of the site and a second drain that starts in the centre of the site and flows to the south (Figure 3-8). Three springs located approximately 75 m to north, 55 m to the east and within the western site boundary were identified on the historical maps, however there is no current information available to confirm their existence (Figure 3-9).

Maps from 1879, show an additional drain from the north to the centre of the site. The three historical drains are still present to this day. The site is current actively drained and differs from the site original hydromorphic conditions.

The National Fen Survey (NFS) carried out in 2022 (Brophy et al., In prep) mapped several drains and watercourses that have been dredged and canalised. A deep vegetated drain runs parallel to the eastern site boundary on the east in this area.

Lisduff Fen SAC has been designated as an area for restoration under the River Basin Management Plan for Ireland 2018-2021 (2nd cycle). The site boundary lies within the Rock (Birr) Area for Action, designated as an Area for Restoration and led by Offaly County Council.

The surface water drainage is presented in Figure 3-10.

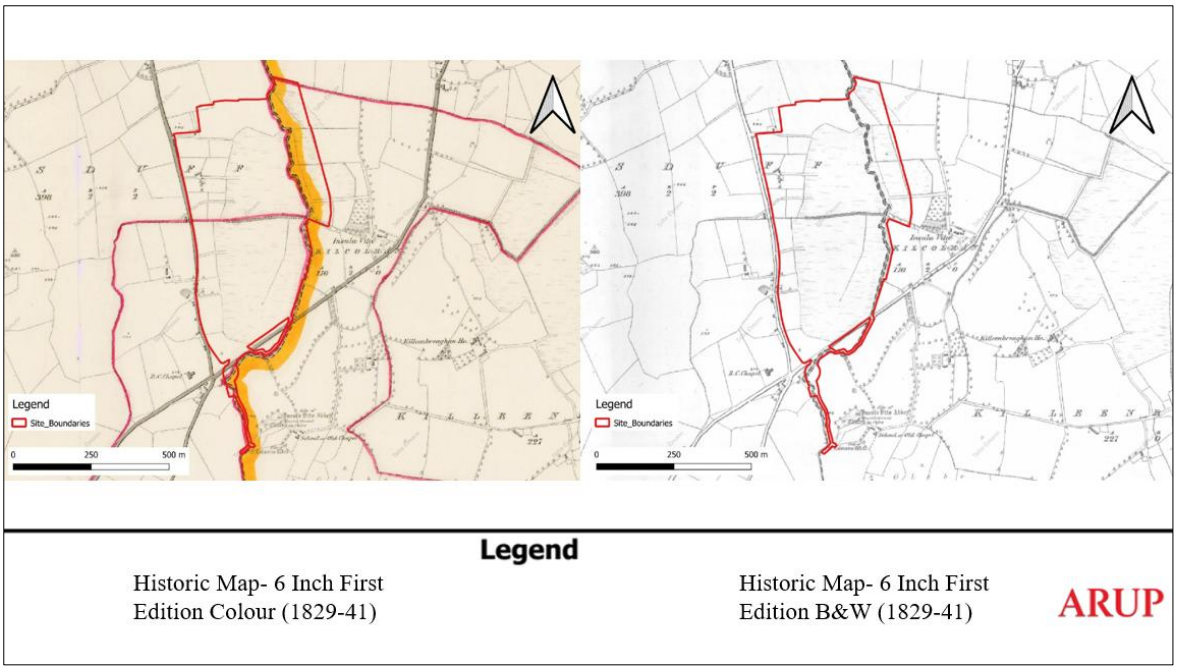


Figure 3-8: Historical water distribution and retention within wetland 1829-1841 (Tailte Éireann Historical mapping)

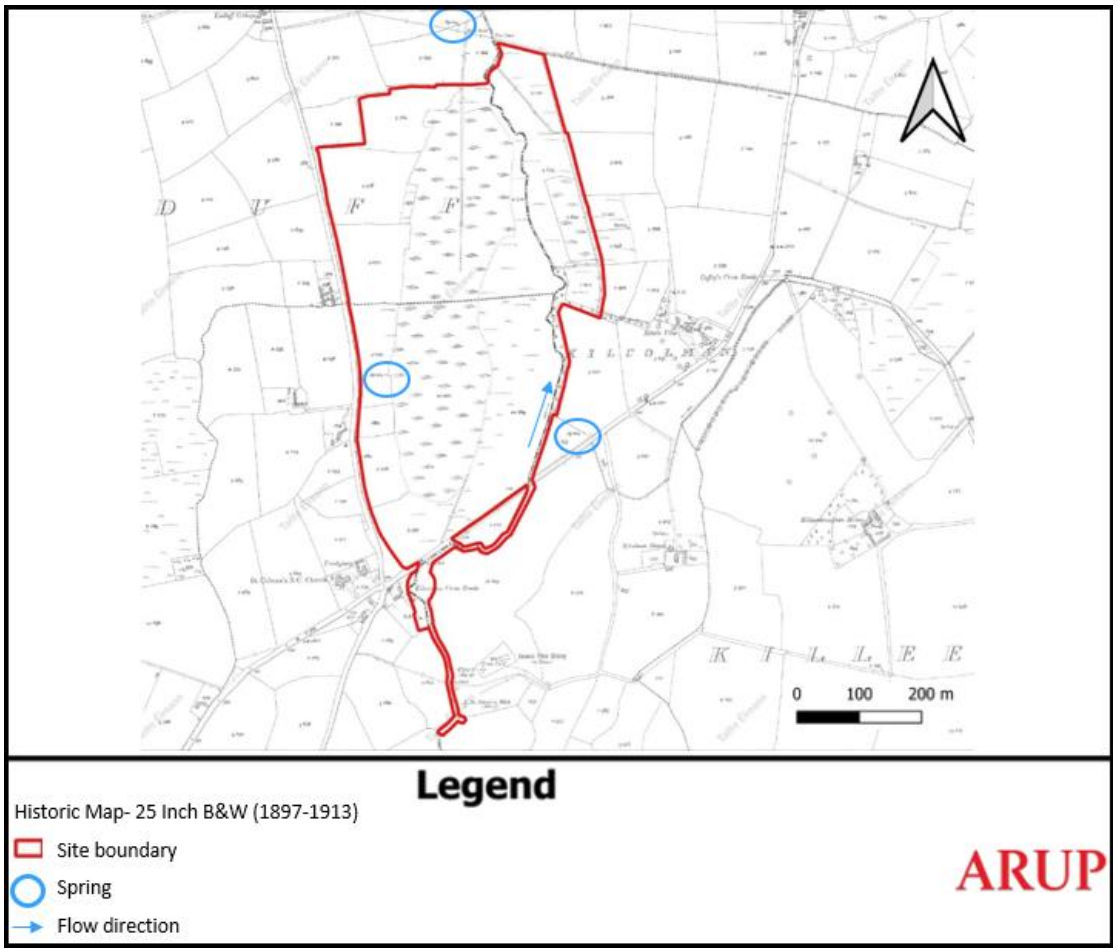


Figure 3-9: Historical water distribution and retention within wetland 1897-1913 (Tailte Éireann Historical mapping)

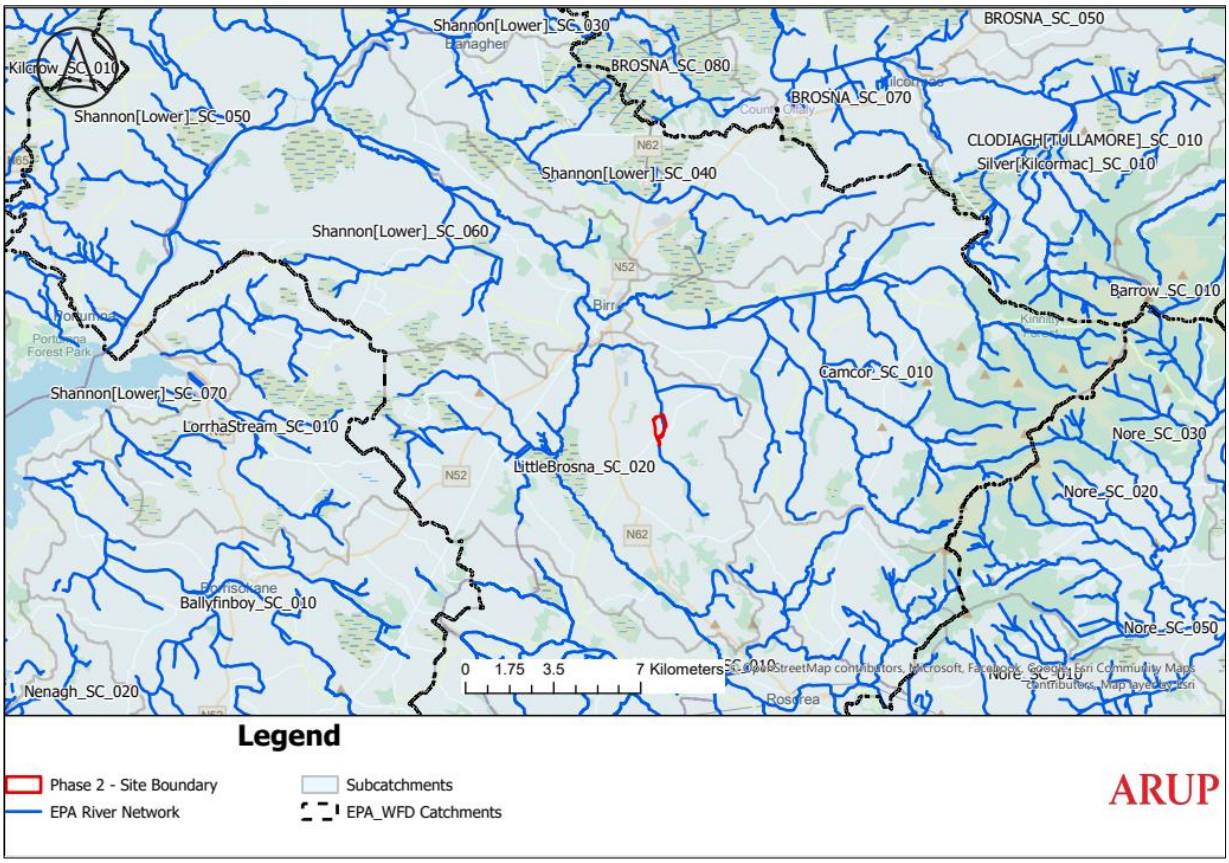


Figure 3-10: WFD Catchment and River sub-basin (EPA, 2025)

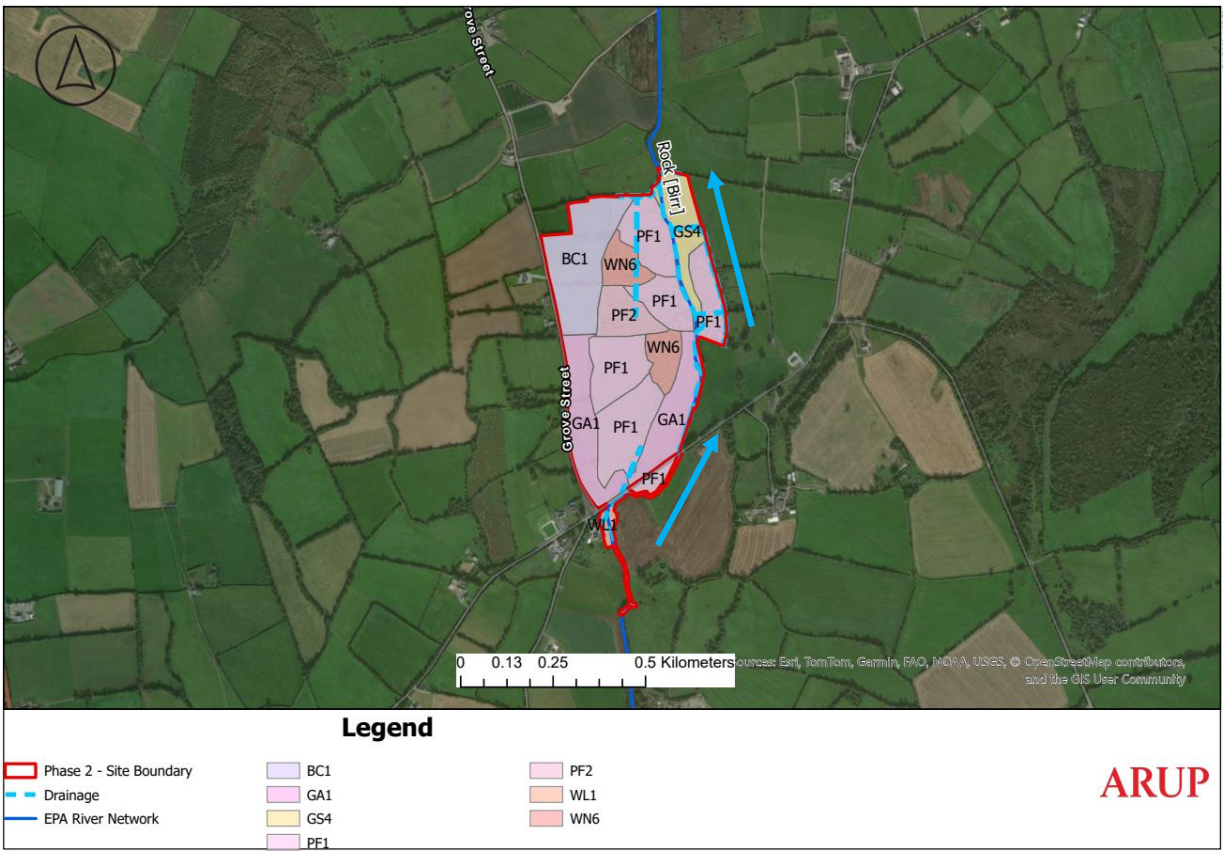


Figure 3-11: Mapped drainage network at Lisduff Fen SAC

The mapped Wetness Index[1] for the site indicates that the centre of the Lisduff Fen SAC site is classified as temporarily wet. This classification reflects alternating periods of saturation and dryness between 2012 and 2018. Variability in soil moisture conditions during this period has resulted in a heterogeneous landscape, supporting intermittent wetland characteristics across the site. The Wetness Index map is presented in Figure 3-12.

The total productivity map from 2017 onwards reveals that the centre of the site has low productivity, suggesting the bog remains intact. In contrast, areas nearer the site boundary display high productivity, indicating the area is drained or degraded. The total productivity map is presented in Figure 3-13. Aerial images from 1995-2018 show improved land near the site boundary and vegetated area near the centre of the site.

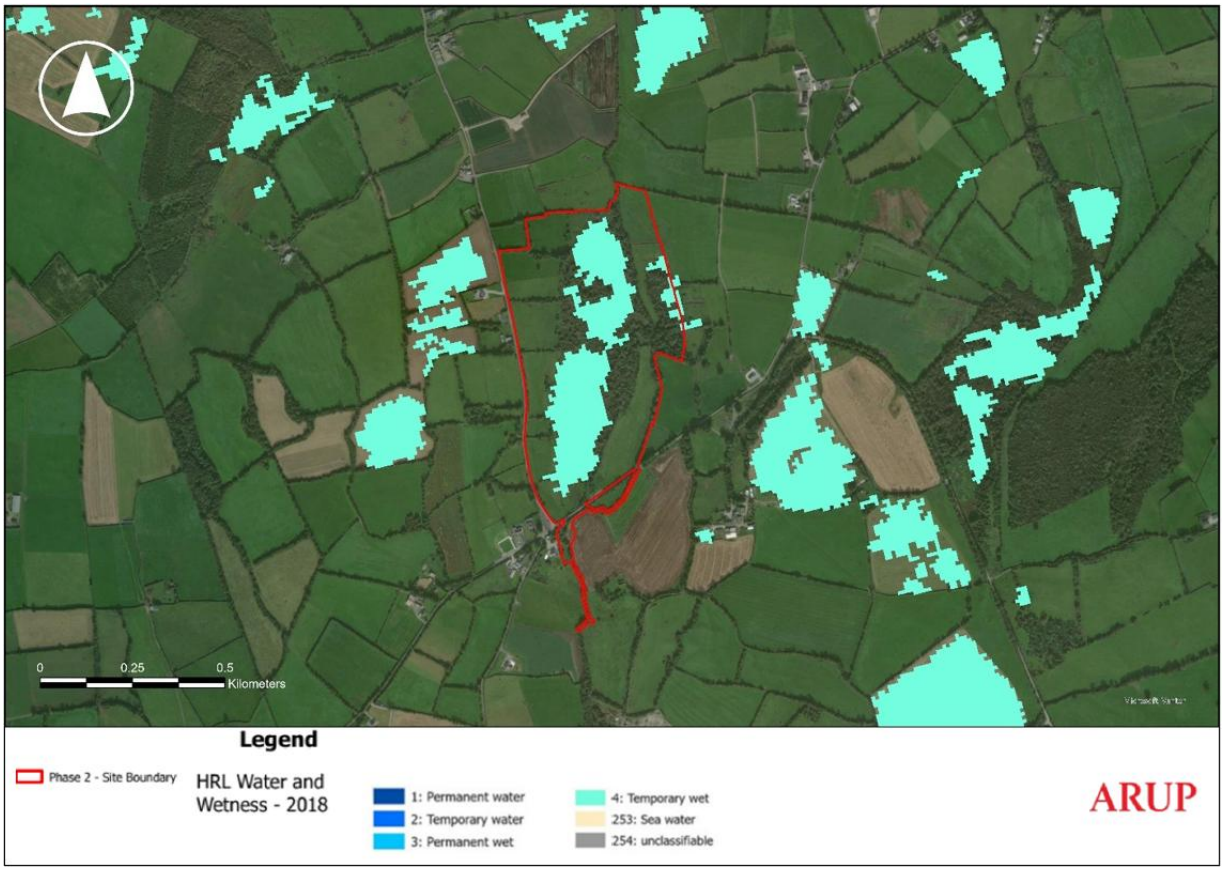


Figure 3-12: HRL Water and Wetness - 2018 of Lisduff Fen SAC (Copernicus, 2025)

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

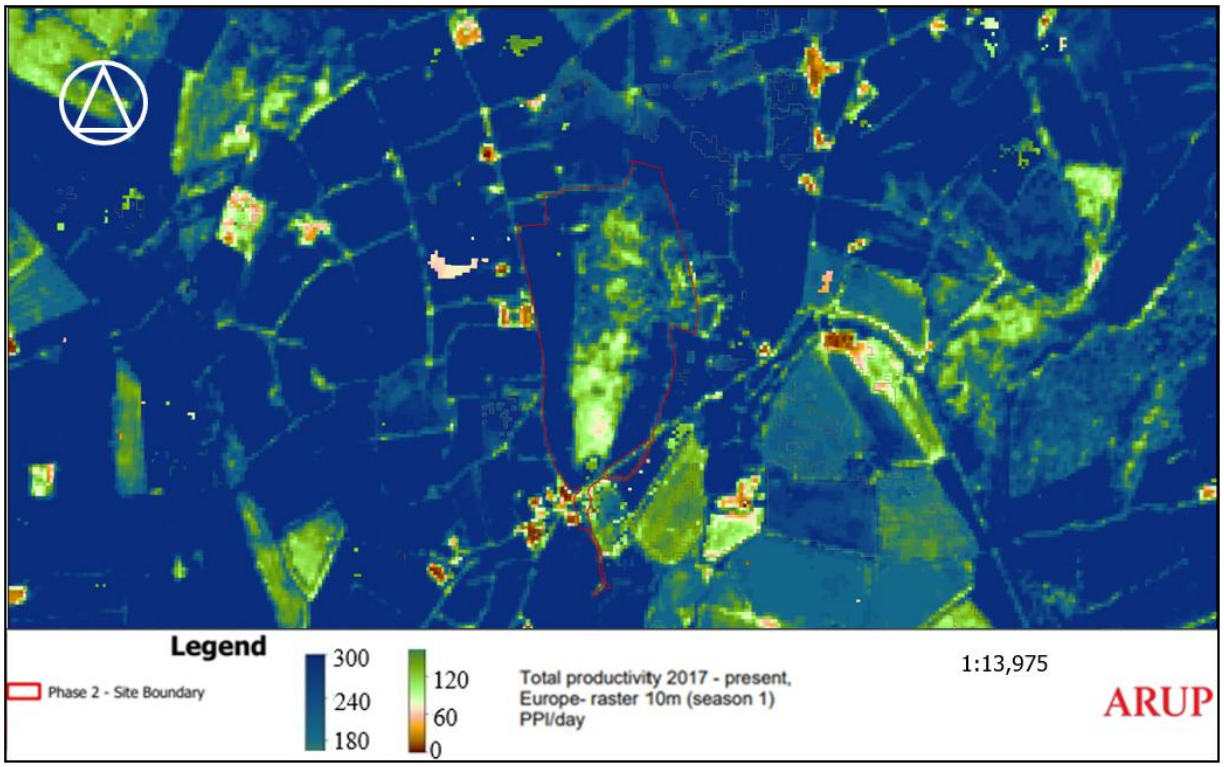


Figure 3-13: Total Productivity 2017 -present, Europe – raster 10m (season 1) of Lisduff Fen SAC (Copernicus, 2025)

Digital Terrain Model (DTM) map and the site photogrammetry were both generated from LiDAR images of Lisduff Fen SAC and are presented in Figure 3-14 and Figure 3-15. These images show that the most notable water feature is the eastern drain, identified as Rock Birr and a south-north drain located to the east of the site. Previous drainage network maps and site visits indicate there are other drains located to the north and centre of the site, which although were identified in the LiDAR images, are less clearly defined.

Figure 3-16 and Figure 3-17 show the two sections elaborated following DTM LiDAR images, providing information on the drains' dimensions. Drains are greater than 2m wide, and up to 1m deep.



Figure 3-14: Topographic (LiDAR) map of Lisduff Fen SAC



Figure 3-15: Site Photogrammetry map of Lisduff Fen SAC

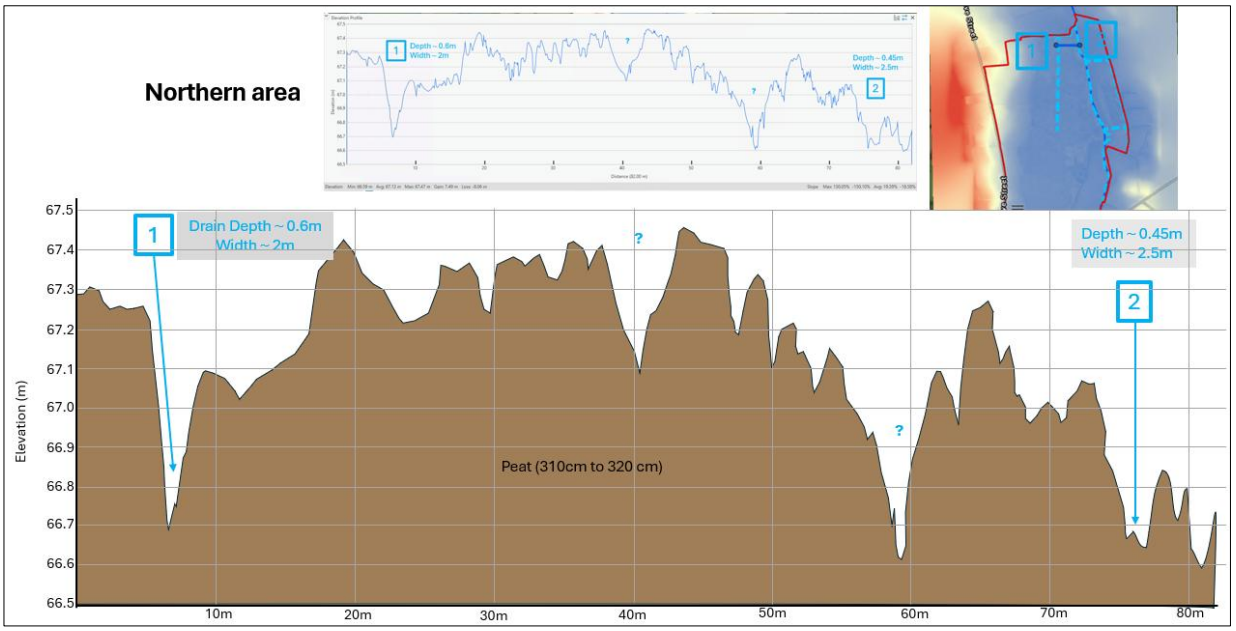


Figure 3-16: Northern cross section showing the northern drains– Lisduff Fen SAC

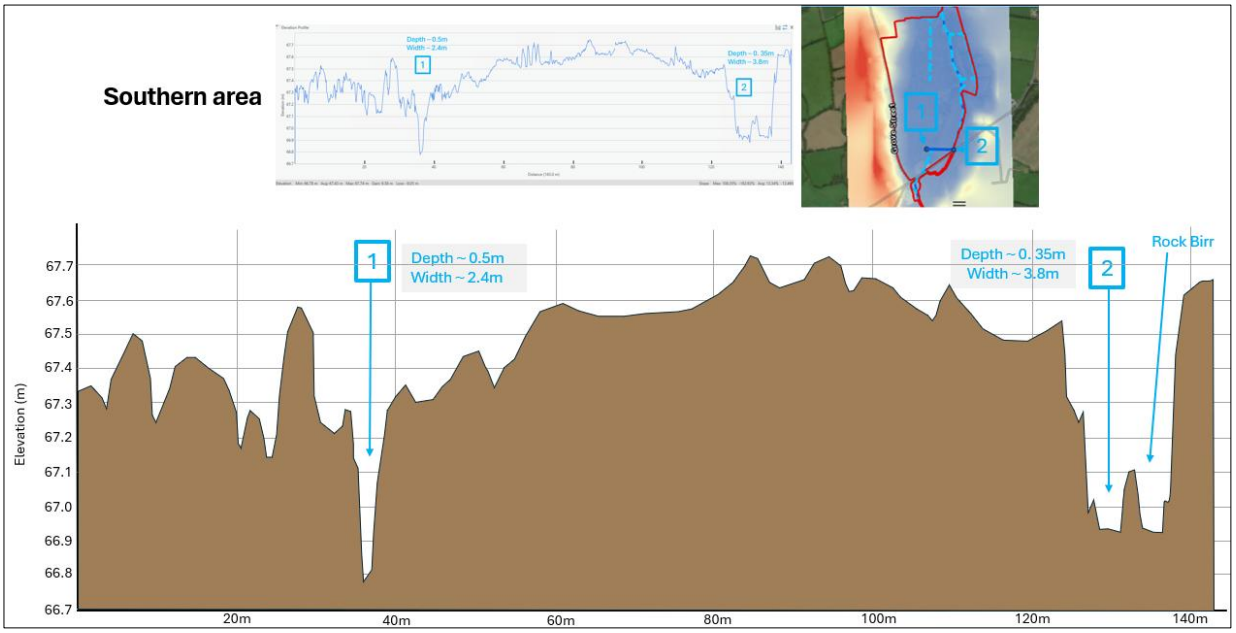


Figure 3-17: Southern cross section showing the southern drains– Lisduff Fen SAC

3.1.4 Land use Pressures and Water Quality

Pollution Impact Potential (PIP) maps (EPA,2025) show the risk areas on the landscape for losses of nitrate and phosphorus water bodies. The PIP maps estimate the annual nutrient losses from the agricultural land using spatial data on farm management, soils and hydrogeology. PIP maps for phosphorus and nitrate are presented in Figure 3-18 and Figure 3-19, respectively.

Areas identified as high risk for Phosphorus are typically characterised by poorly draining soils and moderate to high livestock intensity, which leads to overland flow pathways. Such

conditions facilitate the movement of phosphorus from the land surface into nearby waterbodies. The PIP map for phosphorus shows the land directly adjacent to the eastern and southwestern boundary of the site is classified as high risk from phosphorus run off. Additionally, mapping of phosphorus delivery flow pathways are present in the centre and eastern side of the fen and range from medium risk to very high risk. Flow delivery paths and points for phosphorus across the site is presented in Figure 3-20.

Areas identified as high risk for Nitrate are typically due to the presence of freely draining soils and groundwater pathways. The PIP map for nitrate shows an area in the northwestern part of the site is classified as high risk from nitrate, while land directly adjacent to the site along the western boundary also shows areas of high risk.

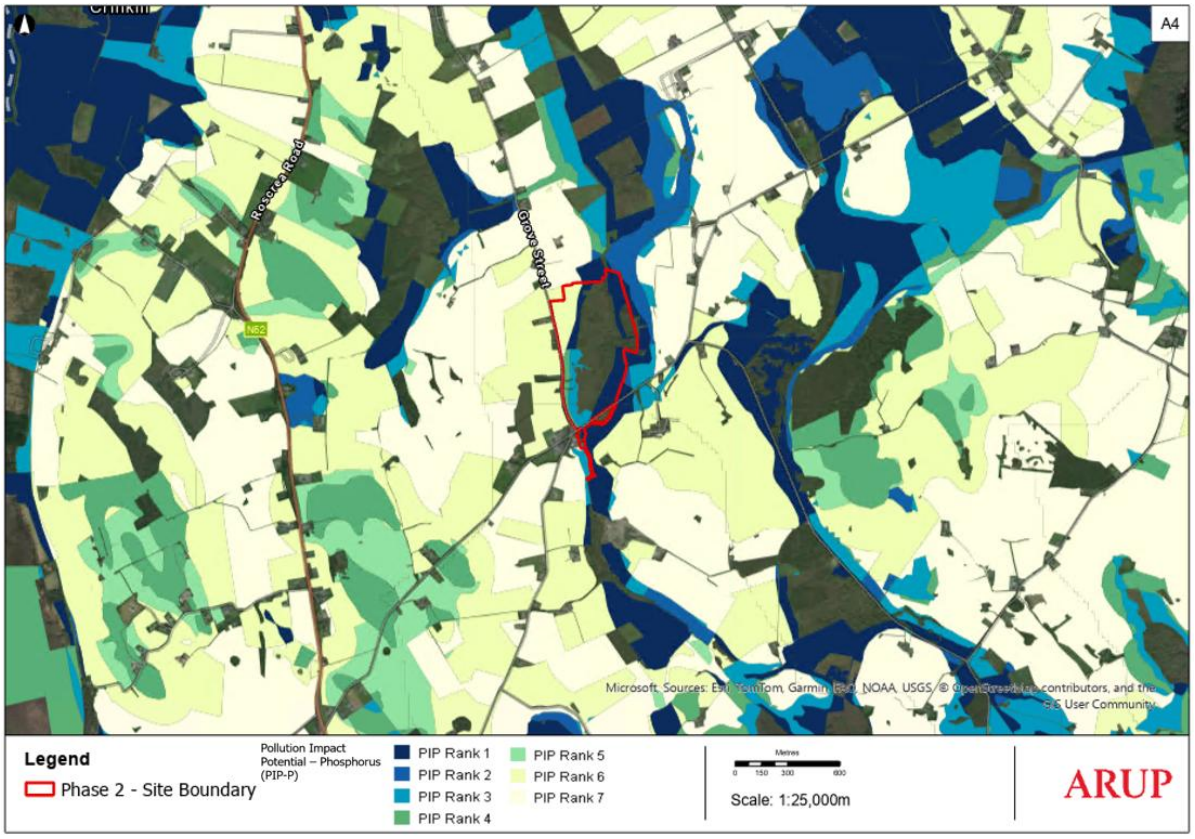


Figure 3-18 PIP maps (Phosphorus) of Lisduff Fen SAC

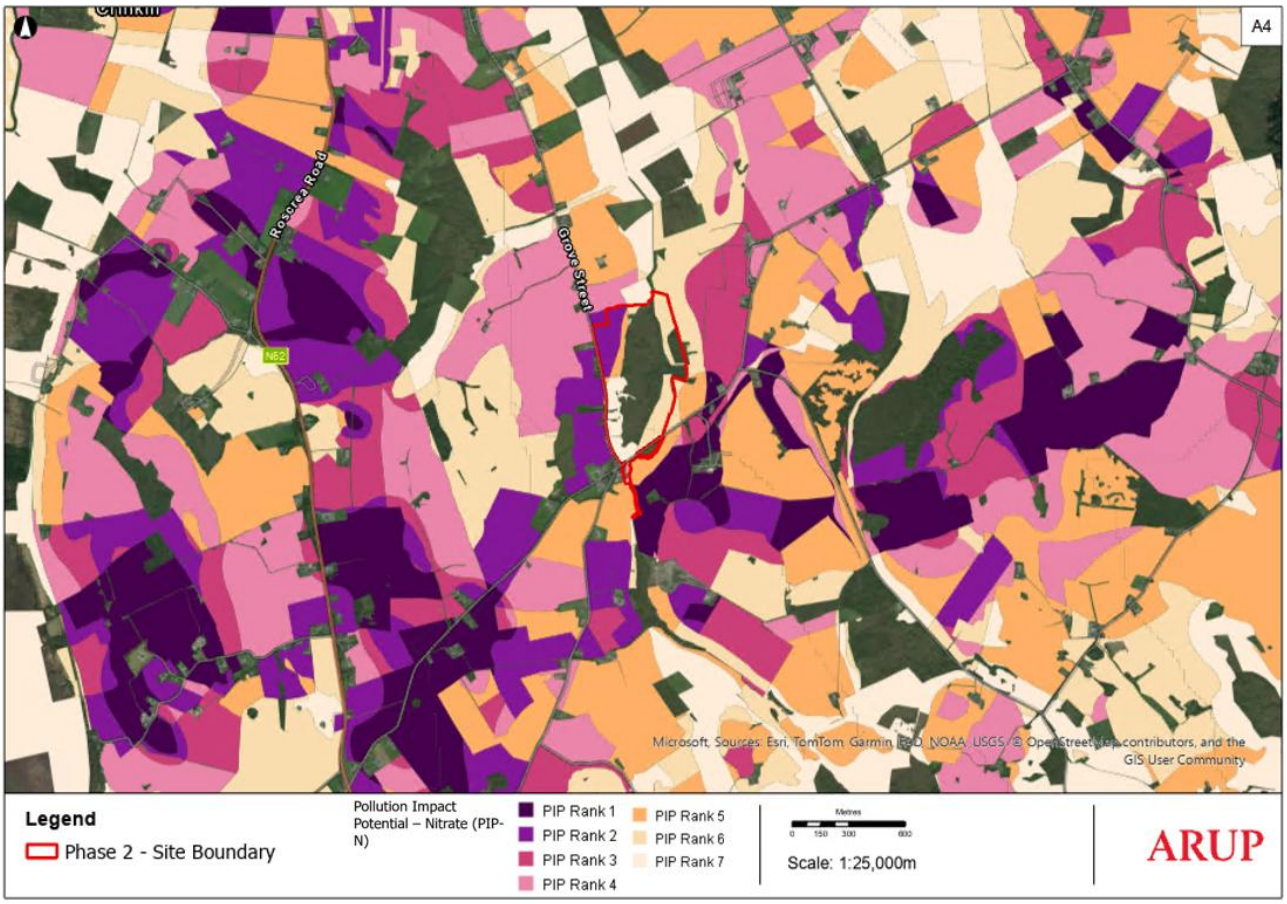


Figure 3-19 PIP maps (Nitrate) near surface pathway of Lisduff Fen SAC

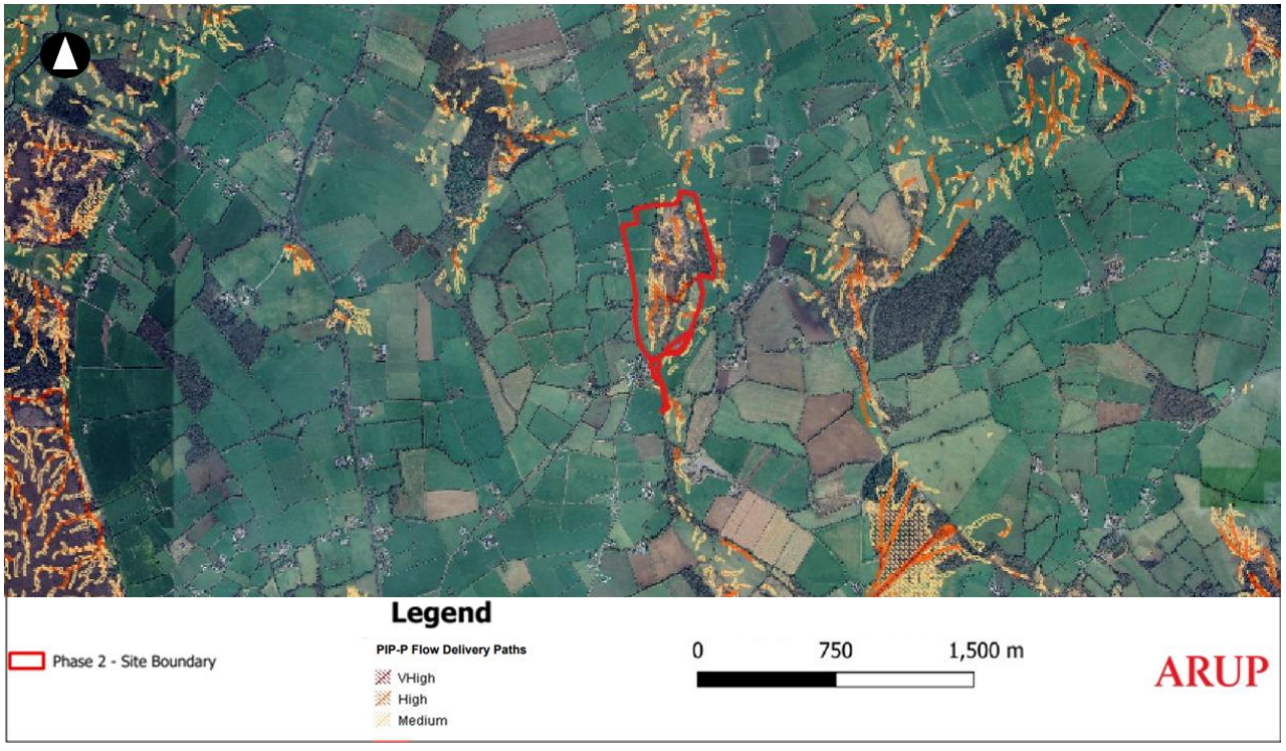


Figure 3-20 PIP-P Flow delivery paths and points for Phosphorus of Lisduff Fen SAC (EPA,2021)

3.2 Field Survey

Electrical conductivity (EC), pH, and peat depth data were recorded as part of the National Fen Survey (Brophy et al., In prep). EC ranged from 668 to 739 µS/cm and peat depth from 310 to 320 cm. However, the spatial location of these measurements was not provided.

Site monitoring was undertaken in February, April and June 2026, focusing on developing the understanding of the water regime, pressures and implementation of restoration measures within the site. The monitoring included peat depth probing, water quality monitoring (pH, EC, temperature, dissolved oxygen (DO), nitrate, and phosphate) and observations of water flow.

Samples for water quality were obtained from the drains located in the northern area, as well as from the drains located along the southern and western boundaries. 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.

3.2.1 Peat Depth Probing and Ground Investigations

Peat depth probing was conducted throughout the site to assess substrate characteristic (Figure 3-21), during February and June 2026 site visits. This showed spatial variability across the site, ranging from 0.15 m to 3.0 m. The deepest peat depths were recorded within the central and southeastern areas, reaching 2.5 m and 3.0 m, respectively, while shallower peat (0.15 m) was recorded in the southwest and along the northern section of the eastern drain.

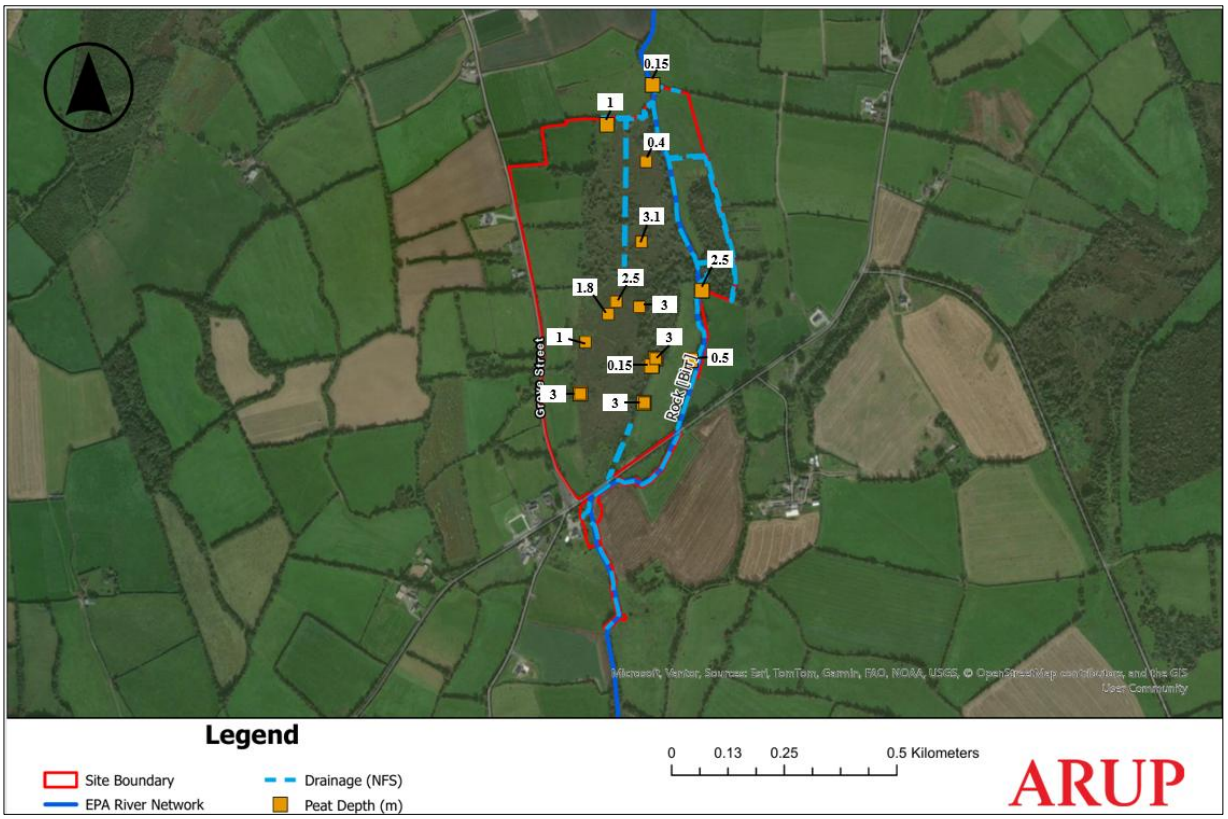


Figure 3-21 Baseline peat monitoring locations of Lisduff Fen SAC

3.2.2 Surface Water Drainage

3.2.2.1 Drainage Network Description

A spring is located approximately 100 m north of the site boundary. A second spring is identified in the western part of the site, where peat is relatively shallow (approximately 0.5 m) and groundwater upwelling was observed. This spring occurs close to a very wet area associated with a tufa (petrifying) spring. These features were previously identified in the NFS (2022).

The information collected in site visits in February, May and June 2026 are presented in Figure 3-22Figure 3-11.

The surface water main flow path occurs from south to north, flowing particularly along the eastern section of the site. The Rock Birr water course is located within the eastern site boundary. These water features are connected to other drains along the site.

Drain measurements in the southern section of the site varies from 1.5 to 1 m in depth and 2 to 3.5 m in width. The water level at most of the sampling points were measured at a depth of 0.5 m. A point within the Rock Birr water feature registered a water level of 0.75 m.

Drain measurements in the northern section of the site varies from 2.5 to 0.75 m in depth and 1 to 3 m in width. The water level ranges from 0.05 to 0.45 m.

The depth of this northern drain suggests that it may act as a hydraulic sink, intercepting groundwater flow and contributing to localised water table drawdown. This may reduce hydrological connectivity between the drain and adjacent fen habitats.

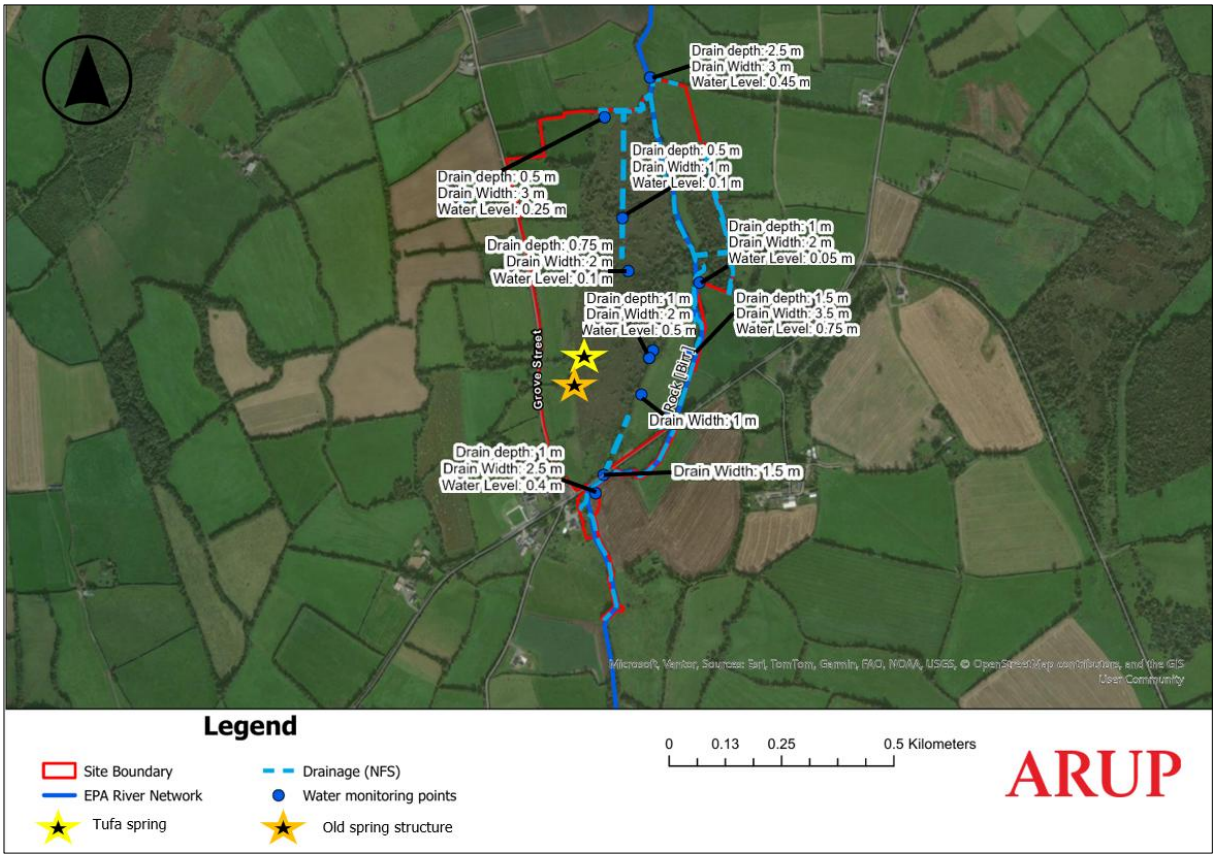


Figure 3-22: Baseline surface water monitoring locations (survey points) at Lisduff Fen SAC

3.2.3 Water Quality

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

Phosphate (PO4) concentrations consistently exceed the Water Framework Directive (WFD) good status environmental quality standard of 0.107 mg/L PO4 (0.035 mg/l PO4-P) (Figure 3-23). The results indicate phosphate concentrations ranging from 0.22 mg/L to 2.5 mg/L. This highest concentration of 2.5 mg/L was identified in the western area of the site, close to the tufa (Petrifying) spring. Other elevated concentrations were recorded within the central and northern areas of the site, including values of 0.72 mg/L and 2.33 mg/L.

Nitrate (NO_3-N) concentrations varied considerably across the site, ranging from 0.1 mg/L to 64.6 mg/L (Figure 3-24). Several recorded values exceed the ecological threshold of 1.8 mg/L NO_3-N (8 mg/L (NO_3^-) (EPA,2025b). The highest nitrate concentration of 64.6 mg/L was recorded in the April 2026 site monitoring within the central eastern area of the east drain. In the June 2026 site monitoring additional water samples were taken at the same location which registered concentrations of 5 mg/L and 0.1 mg/L. These results indicate that the high

concentration of 64.6 mg/L may be an isolated result due to other factors. The lowest nitrate concentration (0.1 mg/L) was recorded in the northern part of the site.

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

Measurements of pH (Figure 3-25), temperature (Figure 3-27); and EC (Figure 3-26) provided further information into site hydrology and groundwater influence. Temperature (°C) varied slightly from 9.6 °C to 11.3 °C. EC ranged from 558 µS/cm, which was recorded within the Rock Birr water feature in the extreme northeast of the site, to 749 µS/cm, in the south, close to the historical spring structure and tufa (Petrifying) spring.

Electrical conductivity values generally increased where lower water temperatures were recorded, suggesting a greater influence of mineral-rich groundwater at these locations. The neutral to slightly alkaline pH conditions ae consistent with a groundwater-fed calcareous fen system.

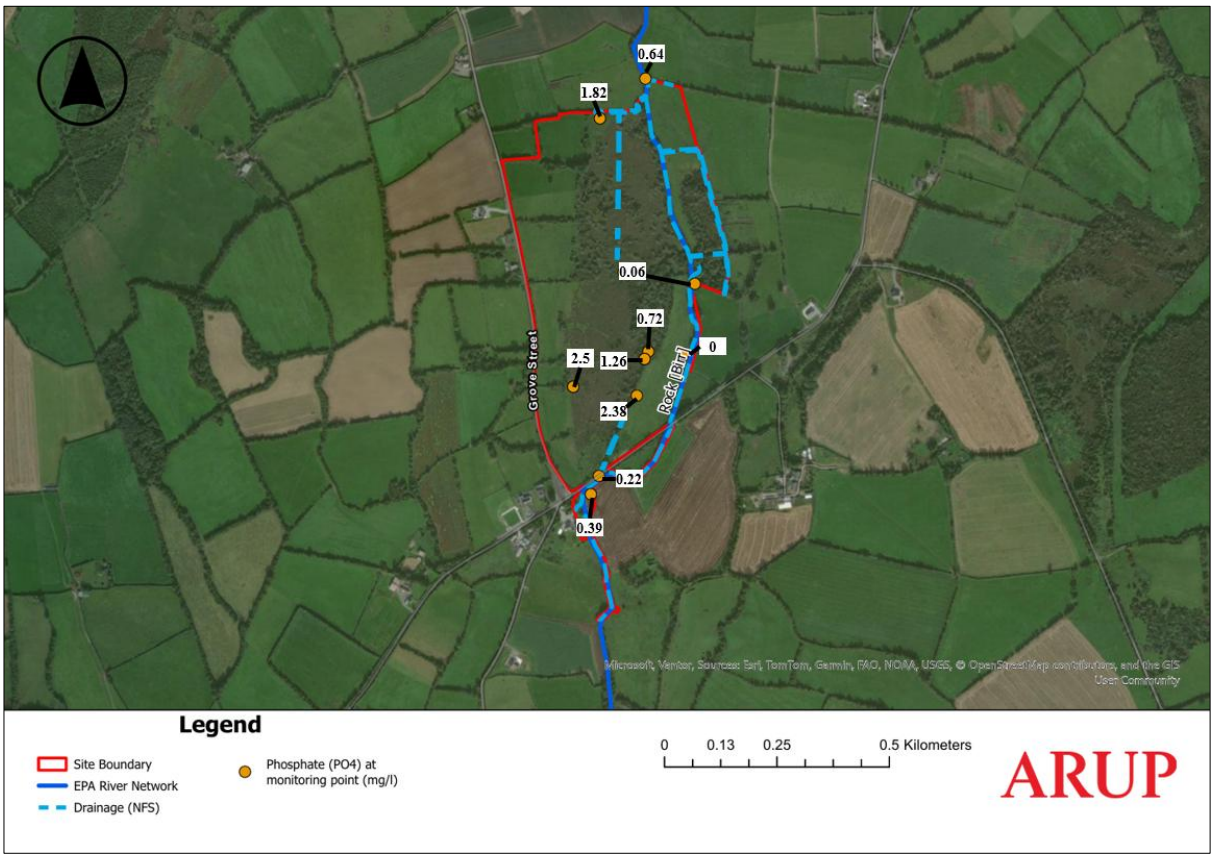


Figure 3-23: Phosphate (PO4) (survey points) at Lisduff Fen SAC

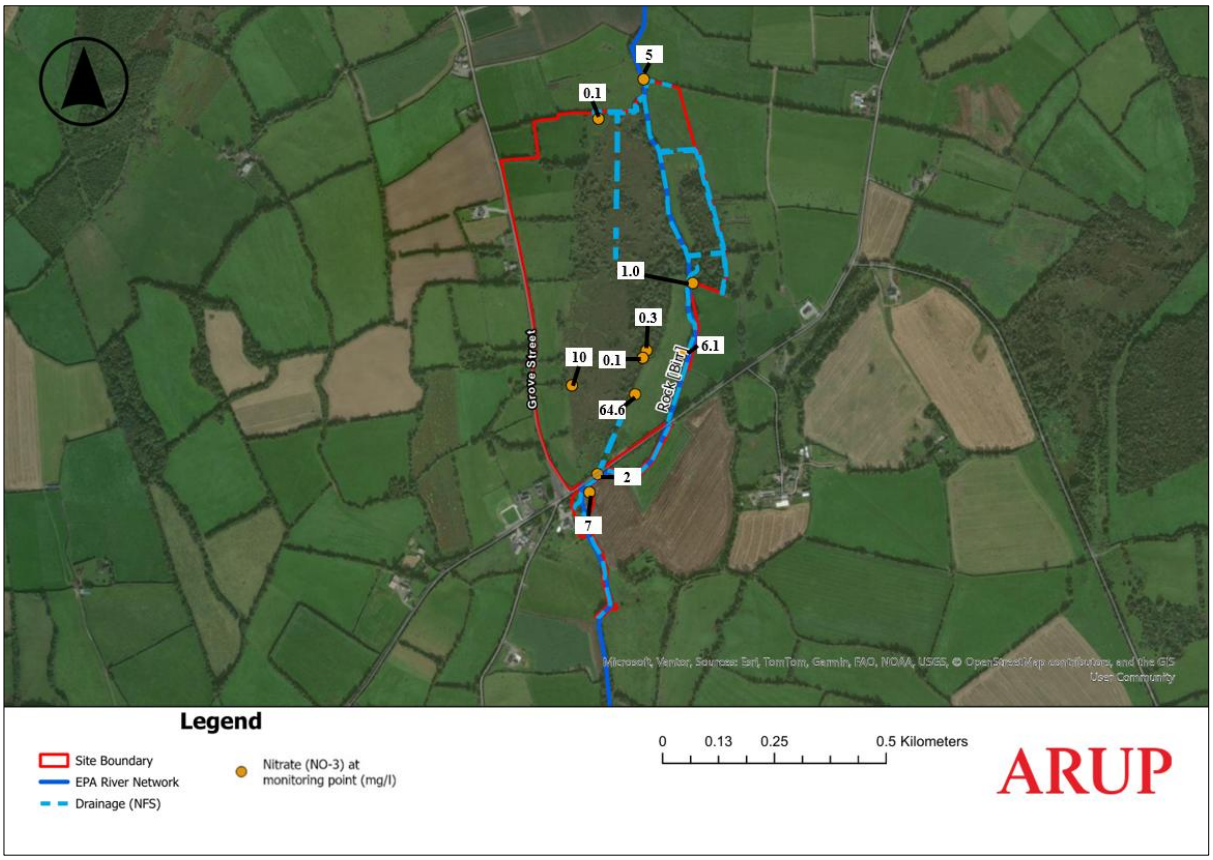


Figure 3-24: Nitrate (mg/l NO_3) (survey points) at Lisduff Fen SAC

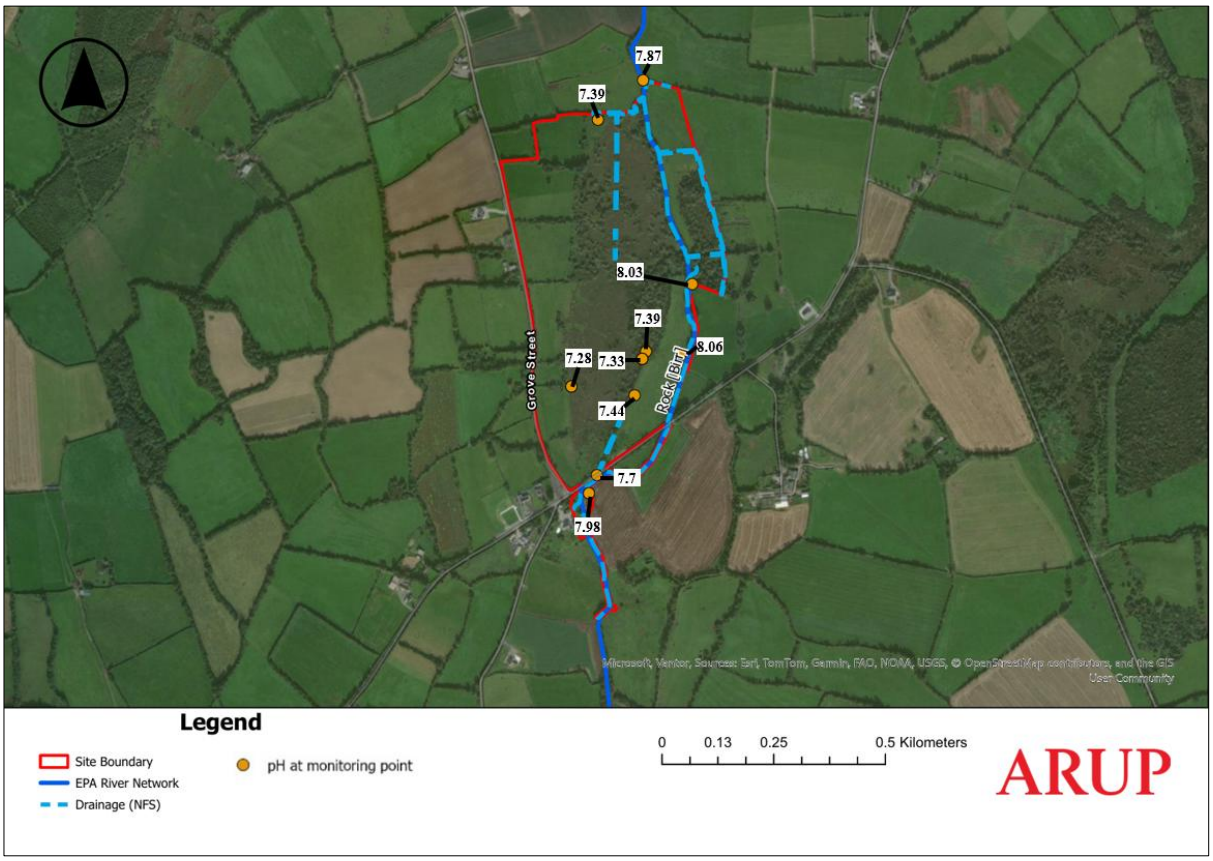


Figure 3-25: pH at (survey points) at Lisduff Fen SAC

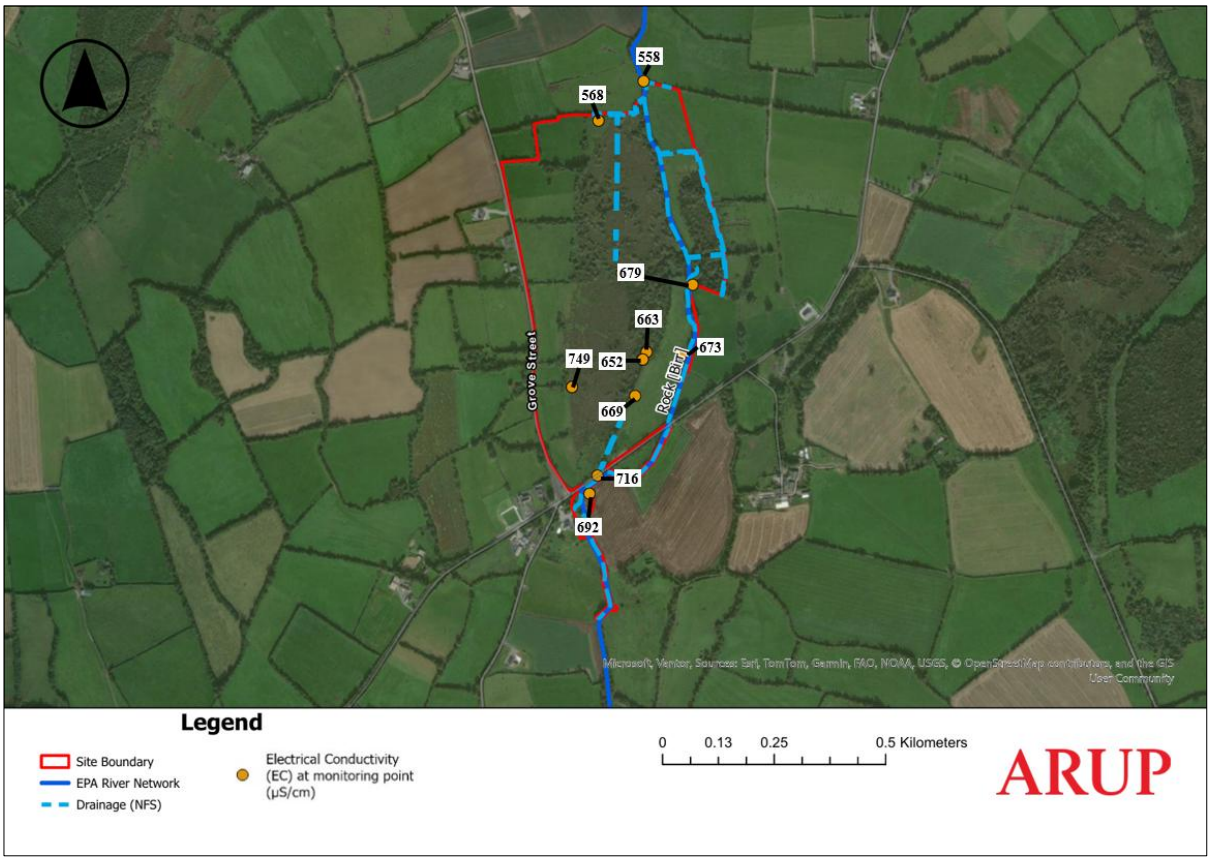


Figure 3-26: Electrical Conductivity (survey points) at Lisduff Fen SAC

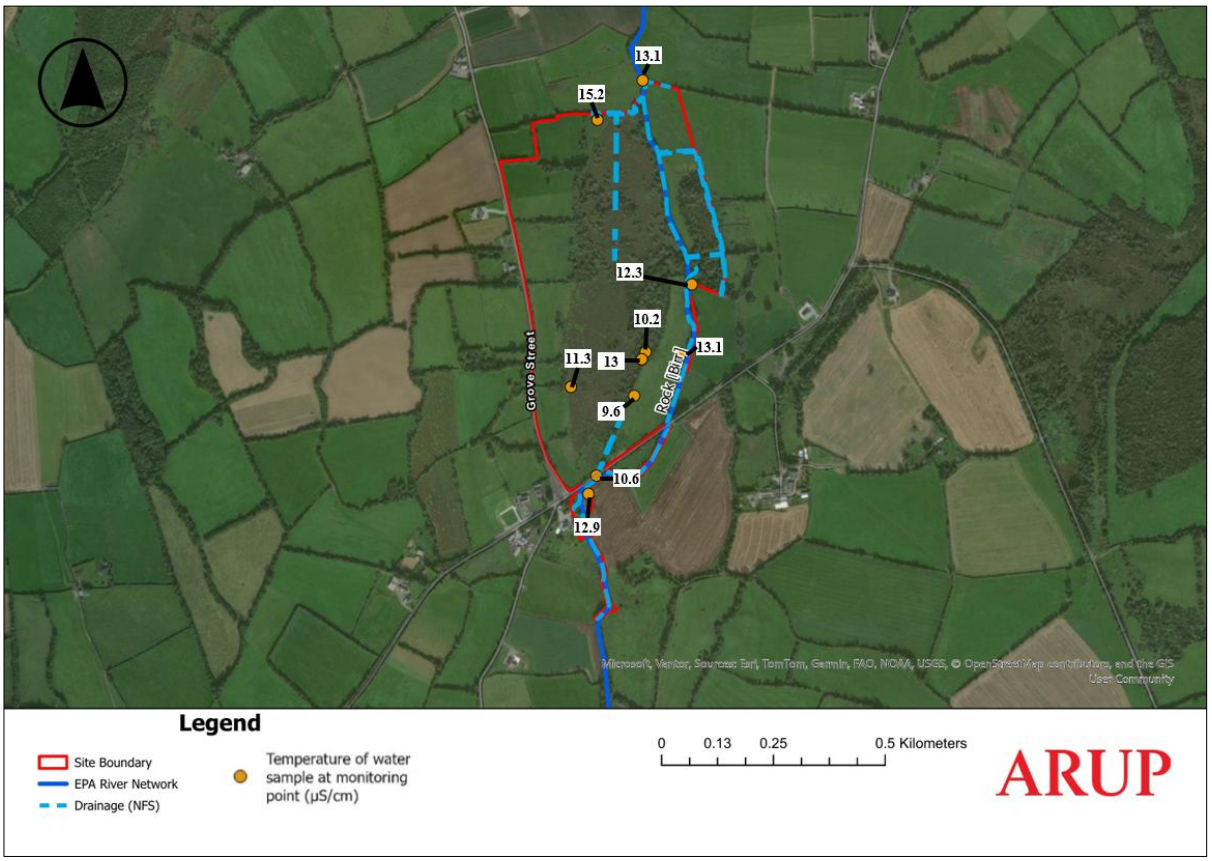


Figure 3-27: Temperature of water sample (survey points) at Lisduff Fen SAC

3.3 Conceptual Site Model

Under the WETMEC framework defined by Wheeler, Shaw & Tanner (2009), Lisduff Fen SAC is primarily consistent with a WETMEC 9 groundwater-fed valley-bottom fen, occurring within a low-lying valley setting where groundwater inputs maintain a shallow-water table and support minerotrophic fen conditions. The historical springs located to the north of the site are associated with WETMEC 16: groundwater-flushed bottom. The areas of the site associated with historical and current drainage are represented by the WETMEC 9b: part-drained groundwater bottom.

The characteristics of the site are:

- Lisduff Fen is a SAC, consisting of 7230 Alkaline fen and 7220 Petrifying springs habitat alongside the Annex II species Geyer's whorl snail (*Vertigo geyeri*) 1013.
- Annex I quality 7140 Transition mire and 91E0 Alluvial forests with *Alnus glutinosa* and Fraxinus excelsior (*Alno-Padion, Alnion incanae, Salicion albae*) (hereafter referred to as 91E0 Alluvial forests) habitats are also present within the site.
- The site occurs at elevations between approximately 69 and 70 mOD and is characterised by a generally flat to being in a local basin with elevation decreasing gradually in the centre of the site. Beyond the site boundary, elevated ground occurs to the west and south at approximately 114 mOD. The topography of the site is higher to the southwest with lower and flatter land to the northeast. These elevated areas likely function as groundwater recharge zones supplying groundwater to the fen system.
- The site is underlain by the Waulsortian Limestones. A small area in the southwest part of the Lisduff Fen SAC comprises gravels derived from limestone, which likely provide permeable pathways facilitating shallow groundwater movement towards the site. Other quaternary deposits within the site consist of fen peat (FenPt) and glacial till derived from limestone.
- Beneath the site lies a Locally Important Bedrock Aquifer which is moderately productive only in Local Zones (LI).
- Historical mapping and field observations suggest the presence of a three-groundwater discharge point (springs) associated with the site. Historical maps from the late nineteenth and early twentieth century identify springs to the north, west and southeast of the site.
- During the site visits an old spring structure in the western of the site was identified. Peat is shallow at this area (0.5 m) and upwelling groundwater was observed. This spring is close to a very wet area, where the tufa spring (petrifying spring) is located.

- Surface water flow across the site is interpreted to move predominantly to the north. Drains generally flow south to north linking into the wider drainage. Some drains exhibited little or no visible flow. The main drain is the Rock Birr water course identified along the eastern site boundary.
- The northern and southern section of the site supports the best-developed fen habitats, including Annex I alkaline fen The electrical conductivity values (558 to749 µS/cm) and neutral to slightly alkaline pH (7.39 to 8.06) indicate influence from calcium-rich groundwater, which supports the development of these fen habitats.
- High nitrates (64.6 mg/L) and phosphate concentration (2.38 mg/L) levels are associated primarily within the drains located in the southern area.
- The site's hydrological characteristics results from the combination of groundwater discharge, surface water inflow and drainage modification. Lisduff Fen SAC can be described as a soligenous fen with springs influence. Additionally, drains within parts of the fen may have modified local hydrological conditions, potentially promoting scrub encroachment and wet heath vegetation.

The CSM is presented in Figure 3-28.

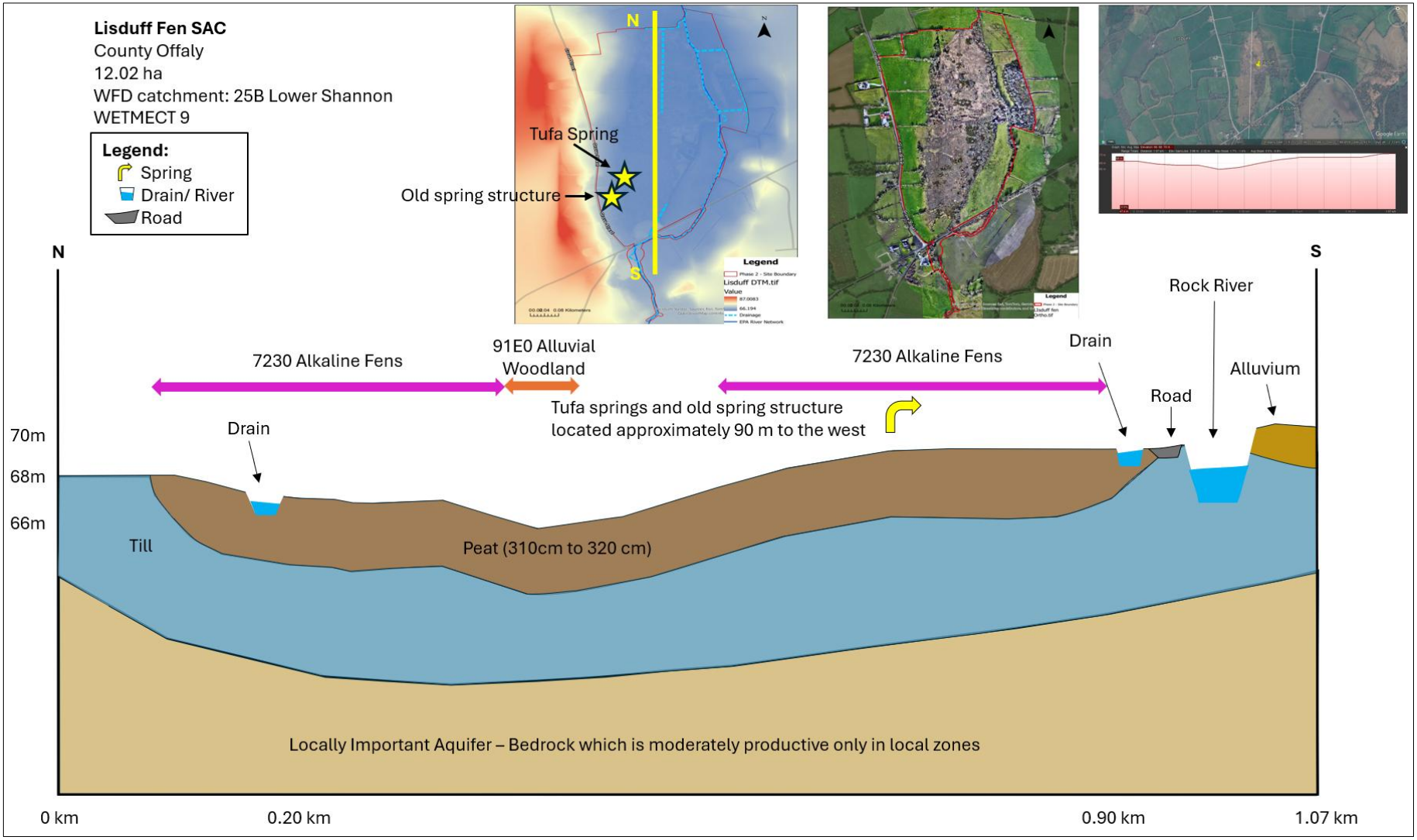


Figure 3-28 Conceptual Site Model of Lisduff Fen SAC

4 Ecology

4.1 Desk Study

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

- Biodiversity Maps - National Biodiversity Data Centre (NBDC);
- Monitoring and Assessment of EU Habitats Directive Annex I Priority Habitat Petrifying Springs, 2025 – Irish Wildlife Manuals 160.
- Monitoring of Sites and Habitat for Three Annex II Species of Whorl Snail (Vertigo) - (Maria P. Long and John T. Brophy);
- National Fen Survey (Brophy et al, In prep);
- NPWS Article 17 habitats distribution datasets;
- NPWS Protected Sites – Special Areas of Conservation – Lisduff Fen SAC;
- Plant Atlas 2020 website - Botanical Society of Britain & Ireland (BSBI);
- World Imagery Wayback - ArcGIS;

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, Lisduff Fen SAC was selected as one of the sites for field survey. Surveyed in August 2022, 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

The NFS findings and results from the ‘Monitoring and Assessment of EU Habitats Directive Annex I Priority Habitat Petrifying Springs 2025’ report at Lisduff Fen SAC revealed the presence of Annex I 7230 Alkaline fen and 7220 Petrifying springs as well as Annex I quality 7140 Transition mire and 91E0 Alluvial forests. The remainder of the habitats identified consists of

poor fen and flush, improved agricultural grassland, transition mires and quaking bog, dry calcareous and neutral grassland, wet grassland, wet willow-alder-ash woodland, arable crops, (mixed broadleaved woodland), depositing lowland rivers, scrub, hedgerows, and drains.

4.1.1.1 Annex Habitats

The following Annex I and Annex I quality habitat was identified and mapped:

- **7230 Alkaline fen** (6.46 ha) located in both the north and south of the site.
- **7220 Petrifying springs** (0.004ha) with three springs present located adjacent to centre of the site.
- **7140 Transition mire** (1.03ha) recorded in the north of the site within a mosaic of 7230 Alkaline fen.
- **91E0 Alluvial forests** are located in the northeast of the site.

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

4.1.1.2 Non-Annex/Fossitt habitats

Non-Annex I fen and other habitats were also recorded, with mapping based on Fossitt classification (Fossitt, 2000). Habitats recorded are detailed in Table 4-1.

Table 4-1: Habitat types and locations at Lisduff Fen SAC

Habitat Type	Location	Notes
BC1 – Arable crops	Covering the northwest of the site.	Consisting of several fields that are in tillage within the northeast area of the site.
FW4 – Drainage ditches	Spread across the site.	A network of drains run through the site, primarily along the eastern boundary of the site as well as in the north and south of the site.
GA1 - Improved agricultural grassland	Present within the southeast and southwest of the site.	This consists of several fields within these areas of the site.
GS4 – Wet grassland	Present in the northeast of the site.	Consisting of a single large area of wet grassland within a field, with the remaining part of the field outside of the site boundary.
PF1 – Rich fen and flush	Present across the site.	This habitat is present in several areas across the site, primarily in the north and south areas.

Habitat Type	Location	Notes
PF2 – Poor fen and flush	Present in the centre of the site.	Dominant habitat in this area.
PF3 – Transition mires and quaking bog	Present in the north of the site.	Overlapping with the Annex 7230 Alkaline fen, present in the north of the site within an area where PF1 is the dominant habitat type
WL1 - Treeline	Present in the southern-most area of the site.	This is the dominant habitat in the southern-most area of the site along the stream that flows through this area
WS1 - Scrub	Present in the north of the site.	This habitat is not dominant in any area of the site but exists at a notable level in areas of WN6 and PF2 in the north of the site.
WN6 – Wet willow-alder-ash woodland	Present in two areas in the north and centre of the site.	Dominant habitat in these areas.

4.1.2 Species

The following subsections outline the presence of species recorded at or within the zone of influence of Lisduff Fen 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 (Vertigo geyeri)

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

The qualifying species Geyer's whorl snail (*Vertigo geyeri*) 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 Lisduff Fen SAC, the overall conservation status of V. geyeri is assessed as Unfavourable – Bad, with declines recorded across recent monitoring periods. The species was not recorded during the most recent monitoring survey (2019–2024), nor in the preceding monitoring

period, representing a marked decline from earlier surveys where it was recorded at multiple locations within the site. This indicates a significant contraction in both distribution and abundance.

This decline is directly linked to changes in habitat condition. Evidence indicates drying and/or increased fluctuation in water levels, resulting in the loss of the consistently saturated microhabitats required by the species. The precise drivers of these hydrological changes are uncertain but are considered likely to include drainage within and outside the site, potential groundwater abstraction in the wider landscape, and changes in precipitation patterns (as evidenced by the rainfall data in Section 3.1.1).

Additional pressures include

- **Encroachment of scrub and coarse vegetation**, associated with reduced grazing pressure and changing hydrological conditions, which alter vegetation structure and reduce habitat suitability; and
- **Nutrient enrichment**, likely arising from adjacent agricultural activity, which can promote competitive vegetation and further degrade suitable habitat

These pressures are acting cumulatively to reduce habitat suitability and, if unaddressed, may lead to the continued absence or potential loss of the species from the site.

Management requirements for *V. geyeri* are consistent with those identified for the fen habitats at Lisduff Fen SAC. In particular:

- Restoration and maintenance of appropriate hydrological conditions are critical to re-establishing the saturated microhabitats required by the species;
- Implementation of light, appropriate grazing regimes is required to maintain open vegetation structure and prevent succession; and
- Targeted and sensitive scrub management, where necessary, should be undertaken to prevent encroachment while avoiding disturbance to potential refugia.

These measures, if successfully implemented, are expected to restore suitable habitat conditions for *V. geyeri* 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 4-2 were identified using the NBDC interactive maps service, reviewing the NFS documentation and from the ecological walkover conducted in 2026.

Table 4-2: Species records within Lisduff Fen SAC

Common Name	Latin name	Description	Most recent record
Marsh fritillary	*Euphydryas aurinia*	An Annex II species of Irish butterfly.	2016
Desmoulin's whorl snail	*Vertigo moulinsiana*	An Annex II species of Irish snail.	2005
Geyer's whorl snail	*Vertigo geyeri*	An Annex II species of Irish snail.	2005
Marsh whorl snail	*Vertigo antivertigo*	A species of Irish snail assessed as vulnerable.	2005
Smooth grass snail	*Vallonia pulchella*	A species of Irish snail assessed as vulnerable.	2005
Lustrous bog-moss	*Sphagnum subnitens*	A widespread wetland moss which is frequently found in base-rich flush edges, replacing the brown mosses that are found in the centre of the flush.	2005
Black bog-rush	*Schoenus nigricans*	A sedge species that grows in calcareous and base-rich fens, it is associated with 7230 Alkaline fen.	2026
Creeping bentgrass	*Agrostis stolonifera*	A native Irish grass species that can encroach onto degraded fen habitats.	2026
Heather	*Calluna vulgaris*	A native Irish plant species associated with wetland habitats, particularly bogs.	2026
Yellow starry feathermoss	*Campylium stellatum*	A native Irish species of brown moss which is an indicator of A7230 Alkaline fen habitat.	2026
Glaucous sedge	*Carex flacca*	A native Irish plant species often found in wetland habitats.	2026
Carnation sedge	*Carex panicea*	A native Irish plant species often found in wetland habitats.	2026
Flea sedge	*Carex pulicaris*	A native Irish plant species often found in wetland habitats.	2026
Small-fruited yellow-sedge	*Carex viridula*	A native Irish plant species often found in wetland habitats.	2026
Stonewort	*Chara spp.*	An aquatic plant species associated with alkaline wetland habitats.	2026
Meadow thistle	*Cirsium dissectum*	A native Irish plant species often found in wetland habitats.	2026
Comb-moss	*Ctenidium molluscum*	A native Irish moss species indicative of calcareous habitats.	2026

Common Name	Latin name	Description	Most recent record
Marsh helleborine	*Epipactis palustris*	A native Irish species of orchid found in wetland habitats.	2022
Marsh horsetail	*Equisetum palustre*	A native Irish plant species often found in wetland habitats.	2026
Common cottongrass	*Eriophorum angustifolium*	A native Irish plant species often found in wetland habitats.	2026
Meadowsweet	*Filipendula ulmaria*	A native Irish plant species often found in wetland habitats.	2026
Maidenhair pocketmoss	*Fissidens adianthoides*	A native Irish moss species often found in wetland habitats.	2026
Bogbean	*Menyanthes trifoliata*	A native Irish plant species often found in wetland habitats.	2026
Purple moor-grass	*Molinia caerulea*	A native Irish plant species often found in wetland habitats.	2026
Common reed	*Phragmites australis*	A native Irish plant species often found in wetland habitats.	2026
Aspen	*Populus tremula*	A native Irish tree species often found in wetland habitats	2022
Fen pondweed	*Potamogeton coloratus*	A native Irish plant species often found in wetland habitats.	2026
Tormentil	*Potentila etecta*	A native Irish plant species often found in wetland habitats.	2026
Bramble	*Rubus fruticosus*	A native Irish shrub species that can encroach onto degraded fen habitats.	2026
Hooked scorpion moss	*Scorpidium scorpioides*	A native Irish species of brown moss which is an indicator of 7230 Alkaline fen habitat.	2026
Devil's bit scabious	*Succisa pratensis*	A native Irish plant species often found in wetland habitats. Food plant for the marsh fritillary butterfly.	2026

4.1.2.3 Species within the Zone of Influence

Table 4-3 outlines notable records of functionally linked species recorded within the 2km distribution zone of influence around Lisduff Fen SAC within the last ten years from the NBDC, NFS, and from the ecological walkovers undertaken in 2026.

Table 4-3: Species records within the Zone of Influence of Lisduff Fen SAC

Legislative Protection	Common Name	Latin Name
EU Birds Directive	Black-headed Gull	*Chroicocephalus ridibundus*
EU Birds Directive	Lapwing	*Vanellus vanellus*
EU Habitats Directive	White-clawed Crayfish	*Austropotamobius pallipes*
EU Habitats Directive	Marsh Fritillary	*Euphydryas aurinia*
EU Habitats Directive	Desmoulin's whorl snail	*Vertigo moulinsiana*
EU Habitats Directive	Common Pipistrelle	*Pipistrellus pipistrellus*
EU Habitats Directive	Leisler's Bat	*Nyctalus leisleri*
EU Habitats Directive	Pine Marten	*Martes martes*
EU Habitats Directive	Soprano Pipistrelle	*Pipistrellus pygmaeus*
Wildlife Acts	Blackbird	*Turdus merula*
Wildlife Acts	Kestrel	*Falco tinnunculus*
Wildlife Acts	Redwing	*Turdus iliacus*
Wildlife Acts	Robin	*Erithacus rubecula*
Wildlife Acts	Swallow	*Hirundo rustica*
Wildlife Acts	Willow Warbler	*Phylloscopus trochilus*
Wildlife Acts	Yellowhammer	*Emberiza citrinella*
Wildlife Acts	Red Squirrel	*Sciurus vulgaris*
No legislative protection	Buzzard	*Buteo buteo*
No legislative protection	Chaffinch	*Fringilla coelebs*
No legislative protection	Chiffchaff	*Phylloscopus collybita*
No legislative protection	Dunnock	*Prunella modularis*
No legislative protection	Magpie	*Pica pica*
No legislative protection	Rook	*Corvus frugilegus*
No legislative protection	Freshwater Shrimp sp.	*Gammarus*
No legislative protection	Indet. Waterlouse sp.	*Asellus*
No legislative protection	22-spot Ladybird	*Psyllobora vigintiduopunctata*
No legislative protection	N/A - Beetle sp.	*Elmis aenea*
No legislative protection	N/A - Beetle sp.	*Limnius volckmari*
No legislative protection	Brimstone	*Gonepteryx rhamni*
No legislative protection	Orange-tip	*Anthocharis cardamines*
No legislative protection	Red Admiral	*Vanessa atalanta*
No legislative protection	Small Tortoiseshell	*Aglais urticae*
No legislative protection	Speckled Wood	*Pararge aegeria*
No legislative protection	N/A - Caddisfly sp.	*Rhyacophila dorsalis*

Legislative Protection	Common Name	Latin Name
No legislative protection	Blue-winged Olive	*Serratella ignita*
No legislative protection	Iron Blue Mayfly	*Baetis muticus*
No legislative protection	Brimstone Moth	*Opisthograptis luteolata*
No legislative protection	Goat Moth	*Cossus cossus*
No legislative protection	Meniscus Midge	*Dixidae sp.*
No legislative protection	Red Fox	*Vulpes vulpes*

4.2 Field Survey

Following a comprehensive review of available desktop data, a targeted follow-up ecological survey was undertaken on the site on 16 June 2026 and 8th September 2026. The field surveys concentrated on key areas highlighted during the desk-based assessment, specifically those with potential for restoration activities. These locations were investigated in detail to verify and further assess ecological conditions and parameters, ensuring that any recommended restoration measures would be both appropriate and effective in the identified zones.

Two survey forms were created to collect data relevant to:

- Monitoring data; and
- Pressures and threats.

4.2.1 Monitoring Points

The targeted walkover survey was a focused assessment designed to gather site-specific data at pre-identified locations. The walkover was designed to assess ecological condition at seven pre-identified monitoring points (Monitoring Points 1-7), selected based on hydrological features, habitat potential, and restoration feasibility. Monitoring Points 1–4 were surveyed on 16 June 2026 and Monitoring Points 5–7 were surveyed during a follow-up visit on 8 September 2026. The locations were determined through expert discussion and review of baseline data and will serve as fixed monitoring stations post-restoration. A map of survey points is provided in Appendix B.

These monitoring points now serve a dual purpose:

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

The surveys focused on two key components:

- Target Notes: Qualitative observations at each monitoring point, capturing site condition, vegetation structure, hydrological features, and legacy management.
- Pressures and Threats Identification: Systematic recording of anthropogenic and natural pressures affecting each location.

The surveys confirmed the presence of Annex I 7230 Alkaline fen at all seven monitoring points. Annex I 7220 Petrifying springs was recorded at Monitoring Points 3, 4, 5 and 6. Monitoring Points 5 and 6 supported black bog-rush and characteristic brown moss species, while Monitoring Point 7 supported 7230 Alkaline fen with a greater cover of scrub and negative indicator species.

4.2.2 Pressure & Threats

This section outlines the historical and current pressures and threats affecting fen habitats at Lisduff Fen SAC, with emphasis on the QI 7230 Alkaline fen and 7220 Petrifying springs and the Annex I quality 7140 Transition mire habitat.

4.2.2.1 7230 Alkaline fen

Historical Pressures

The NFS determined that the structure and functions of the Annex I quality 7230 Alkaline fen at Lisduff Fen SAC was 'unfavourable – bad', with negative pressures relating to drainage and problematic native species (scrub encroachment).

- **Scrub encroachment** was noted as occurring across the site, with particular pressure arising in the east of the site.
- **Drainage** was impacting the wider site and is likely contributing to the unfavourable structure and function of the 7230 Alkaline fen within the site.

Current Observations

Recent walkover surveys identified the following:

- **Abandonment of grazing regime/undergrazing** is evident across the monitoring points, with purple moor-grass Molinia caerulea and common reed Phragmites australis recorded within the 7230 Alkaline fen. The presence and cover of rank vegetation recorded during the surveys indicate that vegetation management is absent or unevenly distributed across the site**.**
- **Drainage** related pressures are recorded at Monitoring Points 1 and 2, where the historical drainage and local/arterial drainage schemes are identified as affecting the site.
- **Scrub encroachment** was recorded at Monitoring Point 7, where downy birch *Betula pubescens*, bramble *Rubus fruticosus* agg. and grey willow *Salix cinerea* were present. Shrub cover was recorded at 10–25%, indicating localised succession towards scrub within the 7230 Alkaline fen.
- **Eutrophication** was noted as a threat. Evidence of possible eutrophication is recorded most clearly at Monitoring Point 3, where frequent algae were noted, potentially originating from adjacent land use via nutrient enrichment. Monitoring Point 4 was

identified as having potential nutrient pressure due to proximity to improved agricultural grassland on the slope.

- **Invasive non-native species** were noted but are not considered to represent a significant pressure. A single sycamore sapling was recorded during the monitoring surveys, and invasive non-native species pressure was assigned low influence at that monitoring point only. This does not indicate a widespread invasive non-native species pressure across the monitoring network**.**

4.2.2.2 7220 Petrifying springs

Historical Pressures

The 'Monitoring and Assessment of EU Habitats Directive Annex I Priority Habitat Petrifying Springs 2025 report determined that the overall status of the Annex I 7220 Petrifying springs habitat at Lisduff Fen SAC was 'unfavourable – bad', with negative pressures relating to abandonment of management (e.g. lack of grazing or mowing), modification of hydrological flow (e.g. drainage), and mixed source pollution to surface and ground waters.

- **Rank vegetation** was noted as arising due to a lack of grazing or mowing (e.g. abandonment of management), leading to a negative shift in vegetation community composition.
- **Drainage** (e.g. modification of hydrological flow) was noted as an ongoing pressure across this habitat, also leading to a negative shift in vegetation community composition.
- **Eutrophication** in the form of elevated phosphate levels was noted within the area of 7220 Petrifying springs habitat surveyed.

Current Observations

Annex I 7220 Petrifying springs was recorded at Monitoring Points 3, 4, 5 and 6. The habitat occurred in association with 7230 Alkaline fen and supported positive indicator species including black bog-rush, small sedges and characteristic brown moss species.

- **Abandonment of grazing regime/undergrazing** was recorded within areas supporting 7220 Petrifying springs, indicating unmanaged conditions and grazing absence or abandonment of management. Coarse vegetation, including purple moor-grass Molinia caerulea and common reed Phragmites australis, was recorded within the habitat.
- **Eutrophication** is considered to exist as a threat to 7220 Petrifying springs. Possible nutrient-related pressure is more clearly indicated at Monitoring Point 3, where frequent algae and low-influence nutrient enrichment from adjacent land use were recorded. Monitoring Point 4 was not noted as obviously eutrophic but was identified

as having a potential nutrient threat due to proximity to improved agricultural grassland (off-site).

- **Scrub encroachment** was not identified as an existing pressure within the areas of 7220 Petrifying springs recorded at the monitoring points. However, scrub was recorded within adjacent 7230 Alkaline fen and may pose a future threat to the area and distribution of 7220 Petrifying springs.

4.2.2.3 7140 Transition mire

Historical Pressures

The status of 7140 Transition mire habitat at Lisduff Fen SAC was not assessed as part of the NFS, but historical pressures upon the 7230 Alkaline fen are considered to impact the 7140 Transition mire equally. Those pressures relate to drainage and scrub encroachment.

- **Drainage** was noted as an issue across the site and it is considered likely to be a historical pressure of 7140 Transition mire.
- **Scrub encroachment** was noted as an issue across the site and it is considered likely to be a historical pressure of 7140 Transition mire.

Current Observations

7140 Transition mire was not recorded at any of the seven current monitoring points; therefore, the 2026 ecological walkover does not provide direct monitoring-point evidence on current pressures affecting this habitat.

4.2.3 Additional Observations

Data collected during the 2026 ecological walkover and the associated pressures and threats assessment indicate that nutrient enrichment, hydrological instability, and suboptimal land management are acting in combination at Lisduff Fen SAC. Localised nutrient pressure was observed at several monitoring points, particularly where algae were present or where the site interfaces with adjacent improved agricultural grassland. These observations are consistent with the wider ecological assessment, which identified nutrient enrichment associated with adjacent land use (low influence) and water-related impacts as pressures affecting the site. The follow-up monitoring also identified localised variation in the condition of 7230 Alkaline fen, with strongly positive fen vegetation recorded at Monitoring Points 5 and 6 and greater scrub and negative indicator species cover recorded at Monitoring Point 7.

The *Vertigo* monitoring data provide additional insight into ecological processes operating at the site and highlight pressures not fully captured through the walkover alone. Despite apparently suitable habitat conditions for *Vertigo moulinsiana*, the population is continuing to decline, indicating that subtle or cumulative pressures are affecting habitat functionality rather than structure alone. Similarly, the absence of *Vertigo geyeri* in recent surveys is linked to drying

out and fluctuating water levels, confirming that hydrological instability is a key issue at a site-wide scale.

Hydrological instability is identified as the primary pressure acting on the site, with Vertigo monitoring indicating drying and fluctuating groundwater levels as a key driver of species decline. This is consistent with historical drainage impacts and current observations of modified hydrology, resulting in reduced soil saturation and degradation of moisture-dependent fen microhabitats. Suboptimal grazing management represents a secondary pressure, with both the walkover survey and supporting data indicating that grazing is insufficient and unevenly distributed. This has led to the development of rank vegetation (e.g. *Molinia caerulea* and *Phragmites australis*), altering vegetation structure and reducing habitat suitability, although localised appropriate grazing demonstrates its effectiveness in limiting scrub encroachment where applied.

Nutrient enrichment from adjacent agricultural land acts as a contributing pressure, with evidence of localised enrichment (e.g. algal growth) linked to fertiliser use, runoff, and surrounding land management. This promotes the dominance of competitive species and reduces overall ecological integrity. Scrub encroachment is also present as a linked pressure, associated with both drying conditions and inadequate grazing, leading to increased shading, evapotranspiration, and further habitat drying. More broadly, Vertigo monitoring highlights that multiple low-intensity agricultural pressures in the surrounding landscape (including runoff, water abstraction, and drainage modification) may be acting cumulatively to alter hydrological and nutrient pathways, thereby progressively reducing habitat suitability across the site

4.3 Site Conservation Priority Matrix for Lisduff Fen SAC

The restoration actions proposed (Table 4-4) for the Annex I 7230 Alkaline fen and 7220 Petrifying springs and Annex I quality 7140 Transition mire habitats are expected to deliver broader ecological benefits beyond their target habitat types. If these measures are successfully implemented and sustained, they may positively influence associated features such as European priority species, nationally important species, and locally significant habitats and species. In such cases, the additional restoration interventions outlined for these other features may become unnecessary or only partially required. However, to validate and understand the extent of these mutual benefits, ongoing post-restoration monitoring will be essential. This will ensure that improvements are not limited to Annex I and Annex I quality habitat alone but will also extend to the wider ecological network within and around the site.

Table 4-4: Site Conservation Priority Matrix for Lisduff Fen SAC

Level	Feature Type	Feature Name	Extent/ Population	Pressure/threat	Restoration Measure on-site	Restoration Measure off-site
1	Annex I SAC Habitat	7230 Alkaline fen	6.46 ha	Scrub encroachment Drainage Nutrient enrichment Invasive non-native species	Drain blocking measures and hydrological monitoring Maintenance or reintroduction of low intensity grazing where appropriate to manage rank vegetation Targeted scrub removal and monitoring of scrub encroachment Vegetation monitoring	Buffer zone management (Management of drainage and nutrient input)
		7220 Petrifying springs	0.004 ha	Rank vegetation Drainage Nutrient enrichment Scrub encroachment	Protection of spring heads and maintenance of stable hydrological conditions; Localised vegetation management where required; Hydrological monitoring Vegetation monitoring	Buffer zone management (Management of drainage and nutrient input)
	Annex I quality habitat	7140 Transition mire	1.03 ha	Scrub encroachment Drainage Nutrient enrichment	Maintenance or reintroduction of low intensity grazing where appropriate to manage rank vegetation Targeted scrub removal and monitoring of scrub encroachment Vegetation monitoring Drain blocking measures and hydrological monitoring	Buffer zone management (Management of drainage and nutrient input)

Level	Feature Type	Feature Name	Extent/ Population	Pressure/threat	Restoration Measure on-site	Restoration Measure off-site
		91E0 Alluvial forests	Not assessed as part of NFS	None identified – part of the wider hydrological monitoring to inform future measures	N/A	N/A
	Annex II SAC Species	Geyer's whorl snail (*Vertigo geyeri)*	See Table 4-2 and Table 4-3	Abandonment of grazing regime/undergrazing Agricultural activity	Maintenance or reintroduction of low intensity grazing where appropriate to manage rank vegetation Vegetation monitoring	Buffer zone management (Management of drainage and nutrient input)
	Annex II Non-QI Species	Desmoulin's whorl snail (*Vertigo moulinsiana*)				
		Marsh fritillary (*Euphydryas aurinia*)				
4	Nationally important species	See Table 4-2 and Table 4-3	See Table 4-2 and Table 4-3	Scrub encroachment Drainage Eutrophication	Drain blocking measures and hydrological monitoring Maintenance or reintroduction of low intensity grazing where appropriate to manage rank vegetation Targeted scrub removal and monitoring of scrub encroachment Vegetation monitoring	Buffer zone management (Management of drainage and nutrient input)
5	Habitats and species of local interest	GS4 – Wet grassland	See Table 4-1			
		PF1 – Rich fen and flush				
		PF2 – Poor fen and flush				
		PF3 – Transition mire and quaking bog				
		WN6 – Wet willow-alder-ash woodland				

4.4 Impact Assessment Notes

Restoration actions proposed for Lisduff Fen SAC aim to improve the ecological condition of sensitive fen habitats, particularly QIs of 7230 Alkaline fen and 7220 Petrifying springs, as well as the Annex I quality 7140 Transition mire and 91E0 Alluvial forests habitats present on site. These actions are designed to support favourable conservation status and enhance habitat resilience. However, potential impacts, both direct and indirect, must be carefully assessed to ensure compliance with Article 6(3) of the Habitats Directive.

The restoration measures proposed for Lisduff Fen SAC are directly connected to the management of the site and inherently connected with maintaining the favourable conservation status of the site's QIs: 7230 Alkaline fen, 7220 Petrifying springs and Geyer's whorl snail.

Potential Impacts

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

4.5 Good Practice Recommendations

Several good practice measures are recommended based on the requirement for compliance with legislation but also the occurrence of sensitive receptors and possible pathways for negative effects during preparation for or implementation of restoration actions. These are

summarised in Table 4-5 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	All vehicles should undergo stream cleaning before site entry. Identified buffers on IAS should be avoided during site preparation and restoration implementation. Consideration should be given to confirmatory survey to identify the latest *Rhododendron* infestation extent along with ecological oversight regarding works proximal to larger infestations.
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 Lisduff Fen 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 conservation status assessment (structure & functions) which are detailed in Section 2.1.1.

Table 5-1 Conservation Status Assessment (from NFS surveys)

OVERALL CONSERVATION STATUS ASSESSMENT				
Annex I habitat	**Area**	**Structure & functions**	**Future prospects**	**Overall Conservation Status**
7140	Not recorded	Not recorded	Not recorded	Not recorded
7220	Not recorded	Not recorded	Not recorded	Not recorded
7230		Unfavourable-Bad		

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 4.2.

5.2 Key Pressures

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

5.2.1 Flora and Fauna Pressures

The key pressures affecting the ecological receptors of Lisduff Fen SAC have been identified through a review of historical information and data captured during the 2026 ecological

walkover, including the assessment of condition and identification of pressures and threats. These pressures are ranked below based on their relative intensity, spatial extent, and ecological impact.

- **Absence of grazing and abandonment of management -** The absence of active grazing and the abandonment of traditional pastoral management represent the most significant pressures currently affecting the site. Data collected during the 2026 ecological walkover indicate that this pressure is consistent across all monitoring points and is associated with unmanaged, rank and tussocky vegetation structure. Mechanistically, the lack of grazing reduces disturbance and biomass removal, allowing dominant species such as *Molinia caerulea* and *Phragmites australis* to proliferate. This is supported by the follow-up monitoring, which recorded purple moor-grass and common reed within Monitoring Points 5–7. This results in reduced structural diversity, suppression of characteristic fen species, and a decline in habitat quality across Annex I 7230 Alkaline fen and 7220 Petrifying springs, as well as Annex I quality 7140 Transition mire and associated non-Annex habitats. This pressure interacts with other site pressures, particularly scrub encroachment and eutrophication, and is a key driver of declining ecological condition. This pressure also indirectly affects *Vertigo geyeri* by promoting rank vegetation and scrub development, reducing the availability of open, structurally suitable microhabitats required by the species. The implementation of a conservation grazing regime is expected to restore vegetation structure and support recovery of characteristic fen communities**.**

- **Drainage and hydrological modification –** Drainage is identified as both a historical and ongoing pressure at Lisduff Fen SAC. While its intensity varies spatially, it represents a significant but spatially variable pressure, particularly affecting parts of the site where historical drainage and local drainage schemes have altered hydrological conditions. Drainage lowers water tables, disrupts groundwater-fed systems, and reduces the extent of saturated conditions required for fen habitats. This results in shifts in species composition, reduced peat formation, and increased susceptibility to secondary pressures such as scrub development and nutrient enrichment. This pressure affects Annex I 7230 Alkaline fen and 7220 Petrifying springs, as well as Annex I quality 7140 Transition mire and associated non-Annex habitats. This is also identified as the principal pressure affecting *Vertigo geyeri*, as the species is dependent on stable, saturated microhabitats which are sensitive to even small changes in groundwater levels. Hydrological restoration measures, including drain blocking and rewetting, are expected to re-establish appropriate water regimes and support recovery of ecological function.

- **Nutrient enrichment (eutrophication) –** Nutrient enrichment is identified as a locally and spatially variable pressure, with clearer evidence at some monitoring points (MP 3 and 4). Data captured during the 2026 ecological walkover indicate that nutrient-related impacts are spatially variable, with clearer evidence at some monitoring points,

including the presence of algal growth and indications of nutrient inputs. In the context of surrounding land use, it is considered likely that adjacent agricultural land contributes to diffuse nutrient inputs via surface and/or groundwater pathways. Elevated nutrient availability leads to competitive dominance of fast-growing species, resulting in reduced species richness and the loss of characteristic fen vegetation. This pressure affects Annex I 7230 Alkaline fen and 7220 Petrifying springs, as well as Annex I quality 7140 Transition mire and is also considered to reduce habitat suitability for *Vertigo geyeri* through changes in vegetation composition and microhabitat structure. Engagement with landowners within the site and surrounding buffer areas is expected to help reduce nutrient inputs over time.

- **Scrub encroachment** – considered a threat to Annex I 7230 Alkaline fen and 7220 Petrifying springs alongside Annex I quality 7140 Transition mire, this pressure is leading to shifts in species composition and a decline in characteristic fen community vegetation. The follow-up monitoring recorded localised scrub encroachment at Monitoring Point 7, including downy birch, bramble and grey willow. While not extensively recorded within the monitoring points during the 2026 ecological walkover, its presence in adjacent areas and historical records indicate a continued risk to fen habitats. Encroachment by woody species leads to shading, litter accumulation, and altered microclimatic and hydrological conditions, resulting in a decline in open fen communities. This pressure affects Annex I 7230 Alkaline fen, 7220 Petrifying springs and Annex I quality 7140 Transition mire, as well as associated non-Annex habitats. Scrub development is closely linked to the absence of grazing and drainage, and its management will require a combination of grazing reintroduction and targeted manual removal. Encroachment of scrub and tall vegetation is also likely to contribute to reduced habitat suitability for *Vertigo geyeri* by altering microclimatic conditions and reducing the availability of open, moist fen microhabitats.

- **Invasive non-native species** – is currently considered a minor and localised pressure within the site to Annex I 7230 Alkaline fen. A limited occurrence of non-native species, including a sycamore sapling, was recorded during the 2026 ecological walkover. At present, this pressure is not considered to significantly influence habitat condition; however, there is potential for expansion if left unmanaged. Early intervention through manual removal is expected to be sufficient to prevent establishment and spread. No significant direct pressure on *Vertigo geyeri* is identified at present.

All identified pressures and threats have been 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 Lisduff Fen SAC, while delivering co-benefits to associated non-Annex habitats and protected species. The prioritisation of pressures (scrub encroachment, drainage, eutrophication, rank vegetation, and invasive non-native species) 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.

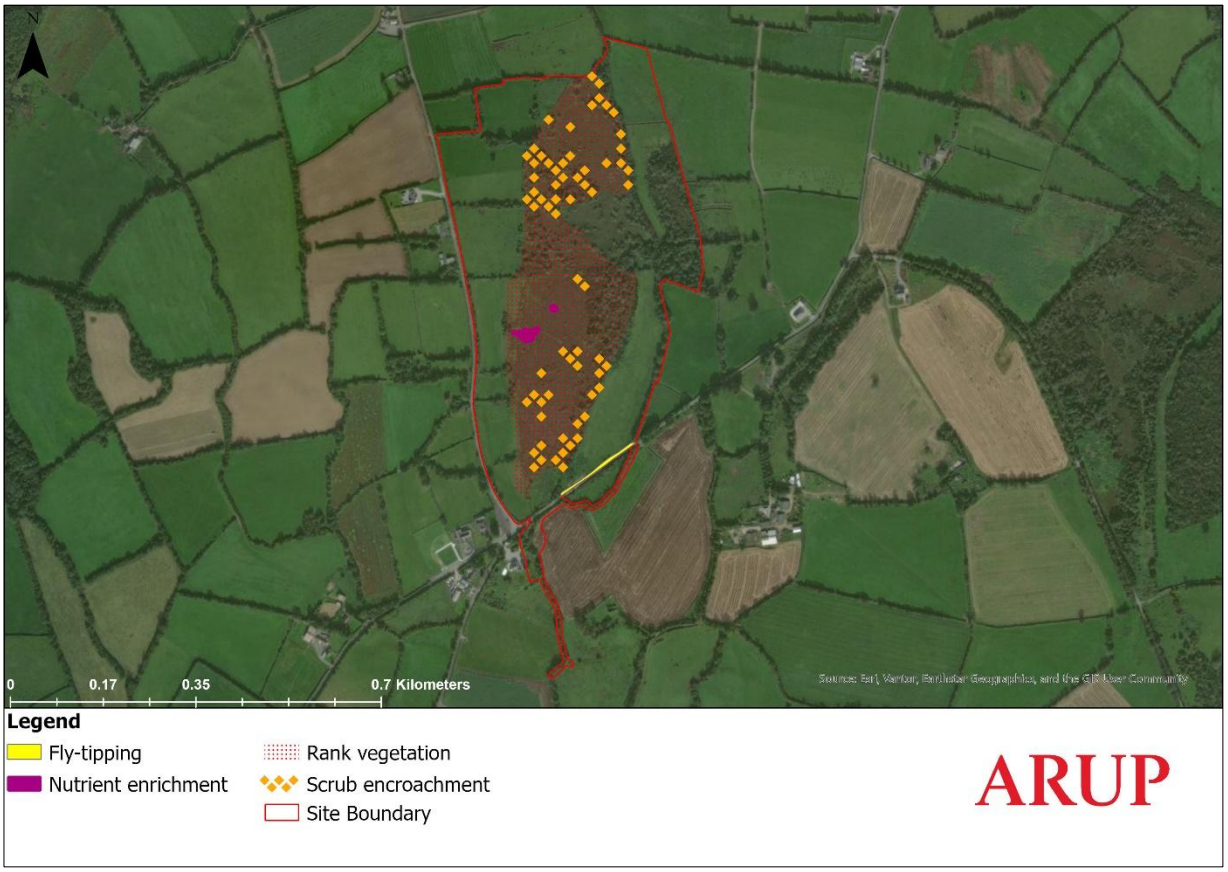


Figure 5-1 Pressures and threats recorded as present at Lisduff Fen SAC. Pressures and threats were compiled from desktop review and 2026 ecological walkover.

5.2.2 Fen Hydrology Pressures

The following hydrological pressures were identified within the Lisduff Fen SAC site:

- Drainage is identified as a historical pressure on the site, particularly influencing the central section, which is observed to be comparatively drier than the north and southern section. Previous site surveys informed that it was not possible to confirm the extent to which drainage is actively influencing the hydrological regime and affecting the development of fen habitats. Further monitoring and assessment would be required to determine whether drainage is a significant control on site.

The key hydrological features requiring further investigation include:

  - The drain located in the east, which appears to act as the main water input and water output, flowing northwards.

- The drain that starts in the centre that of the fen that flows over the northern boundary of the fen
- The drain within the fen that begins at the southern boundary and flowing in a northwards direction approximately halfway up the fen.
- The southeast and northwest areas, where potential springs have been identified and may contribute to localised groundwater inputs.
- Drains have been artificially cut, leading to deep and wide drains that are affecting the natural flow paths of the fen

Lowering and fluctuations of water levels:

- There is currently insufficient information to determine how water levels fluctuate over time or what is driving these changes. Further monitoring would be required to understand seasonal variation, the influence of drainage, and the role of groundwater inputs.
- The drains visited all had flow.

Adjacent land use that may influence site hydrology:

- In particular, farmland activities in the surrounding land may be affecting the water balance through changes in runoff, drainage and potentially altering hydrological connectivity with the fen.

5.2.3 Fen Nutrient Pressures

The following nutrient pressures were identified within the Lisduff Fen SAC site:

- Nutrient enrichment identified particularly within the southern section area likely due to internal nutrient enrichment linked to hydrological change and vegetation composition/structure and to adjacent agricultural activities. Higher nutrient concentrations were found throughout the site, nitrate concentrations reached highs of 64.6 mg/L in the southern internal drain. Phosphorus levels of 2.38 mg/L were encountered within the southern section.

These conditions have the potential to alter vegetation composition and impact the low-nutrient, calcium-rich conditions required to maintain favourable alkaline fen habitat and associated qualifying species.

6 Restoration Measures

6.1 Introduction

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

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

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

6.2 Hydrology Measures

The hydrological restoration objective for Lisduff Fen SAC is to improve parts of the site from WETMEC 9b (part-drained) to WETMEC 9a (wet) condition.

6.2.1 On-site Fen Hydrology Measures

Lidar images and site survey identified the main drains within the area: the water course identified as Rock Birr (IE_SH_25R020200) along the eastern perimeter of the site; the eastern drain located in southeastern of the site and the northern drain located in the northwest of the site. These three drains are flowing from south-north direct and influence the water balance and conditions of the fen habitat.

LiDAR data indicate that the eastern and northern drain are approximately 2 m wide and 1 m deep. Site surveys recorded water depths of approximately 0.5 m and 0.1 m in the eastern and northern drain, respectively. It also indicates that the eastern drain (Rock Birr water feature) within the site boundary varies from 3.8 to 2.5 m in width and 0.35 to 0.45 in depth. Recorded water depths during site surveys ranged from 0.05 to 0.75 m.

To improve water balance, raise the water table, and consequently reduce scrub encroachment while promoting favourable conditions for the development of the 7230 Alkaline fen habitats, drain blocking on these three drains is proposed.

The Rock Birr (IE_SH_25R020200) is an EPA water course and is part of a Drainage District managed by Offaly County Council. Consultation is required with Offaly County Council on the maintenance and function of the channel. Therefore, engagement with County Council will be required and possible drain monitoring prior any implementation of drainage measures.

A hydrological monitoring network will be established to assess site conditions. Monitoring will include the installation of piezometers and standpipes at six selected locations and two surface water monitoring points.

The locations for measures and monitoring are presented in Annex C and Figure 6-1.

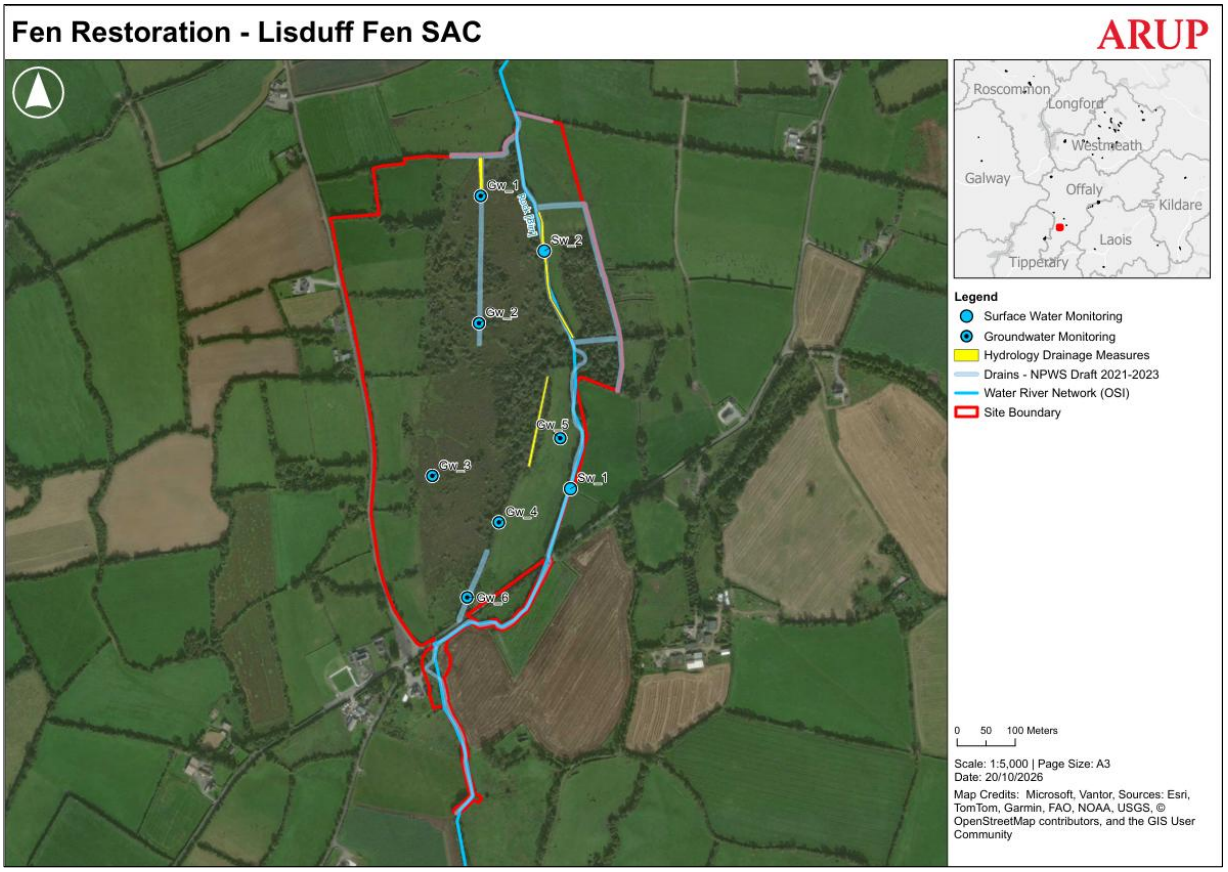


Figure 6-1: On-site proposed hydrological restoration measures and monitoring for Lisduff Fen SAC

6.2.2 Off-site Hydrology Measures

Engagement with adjacent landowners will be undertaken to avoid the introduction of new drainage works or the deepening of existing drains where hydrological connectivity to Lisduff Fen SAC. Engagement with landowners will be important to facilitate drainage management of the eastern drain located in southeastern of the site. Consultation with Offaly County Council will be required prior any drainage management implementation of the Rock Birr located along the eastern site boundary.

6.3 Nutrient Measures

The primary aim of the nutrient measures is to maintain appropriate water quality, particularly nutrient levels, to support the natural structure and functioning of the habitats. For water quality the target is to maintain, or where necessary restore, appropriate water quality, particularly pH and nutrient levels, to support the natural structure and functioning of fen habitats.

6.3.1 On-site Nutrient Measures

On-site nutrient measures will focus on the monitoring of water quality to improve understanding of nutrient dynamics within the site and to assess the effectiveness of any future off-site measures.

Water quality monitoring will include nitrate, phosphate, electrical conductivity (EC), pH and temperature.

Monitoring locations will include the piezometers to be installed in six areas across the site, and two surface water points along the Rock Birr eastern drain.

The objectives are to:

- Assess the efficiency of drainage measures (drain blocking);
- Identify spatial and temporal trends in nutrient concentrations;
- Improve understanding of nutrient sources and pathways (surface water vs groundwater).

The results of monitoring will be used to determine whether further intervention is required and to guide the selection of any additional nutrient management measures.

6.3.2 Off-site Nutrient Measures

Elevated nutrient concentrations are likely indicative to inputs from the surrounding agricultural activities, which are probably promoting nutrient enrichment via both surface and groundwater pathways.

Catchment-scale measures should target both phosphorus and nitrogen pathways based on observed spatial patterns. Measures should include source control through nutrient management planning, pathway interception to reduce nutrient transport.

6.4 Vegetation Measures

6.4.1 On-site Vegetation Measures

Proposed measures to address vegetation succession, invasive species and scrub encroachment include the following on-site measures which are described in order of priority in Table 6-1.

Table 6-1: On Site Vegetation Measures proposed for Lisduff Fen 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 in the areas highlighted in Figure 6-2. The purpose of this is to control/reduce the pressures of scrub encroachment and rank vegetation with regard to 7230 Alkaline fen, 7220 Petrifying springs and 7140 Transition mire habitats. The reintroduction of appropriate grazing is the principal restoration measure for the site, addressing the high influence of grazing absence recorded across all monitoring points. Grazing will aim to reduce sward dominance by *Molinia caerulea* and *Phragmites australis*, improve structural diversity, and maintain open fen conditions. Stocking levels and grazing timing should be carefully managed to avoid localised overgrazing or damage to sensitive areas, particularly in wetter zones.	NPWS (post-Tóchar)
2	Scrub encroachment management	Based on the results of vegetation monitoring and following on from liaison with landowners, scrub removal may be required. Scrub removal should be targeted and evidence-led, focusing on areas where scrub development is actively contributing to habitat degradation, particularly in locations where grazing absence has allowed woody species to establish. It is important to note that the purpose of scrub removal within the 7140 Transition mire area is to control scrub levels rather than eliminate as small stands of scrub form part of the transition mire community. Furthermore, areas of Annex I quality 91E0 Alluvial forests would not be targeted for scrub/tree removal. Approximate area for scrub removal based on current surveys and historical data is defined in Figure 6-3 but should be updated following the monitoring surveys to reflect the updated areas. Scrub removal should be undertaken in conjunction with the reintroduction of appropriate grazing, as removal alone will not prevent re-encroachment under current site conditions.	NPWS (post-Tóchar)
3	Vegetation monitoring	Monitoring points have been 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, 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.	Tóchar & NPWS (post-Tóchar)

Priority	Measure	Description	Responsibility
4	Removal of fly tipped materials	Litter removal should be undertaken manually where possible due to the sensitivity of the site. This will contribute to the long-term health of the vegetation community within the site. This measure will also aim to reduce localised nutrient enrichment and physical smothering of vegetation, both of which may contribute to declines in habitat quality where present.	NPWS (post-Tóchar)

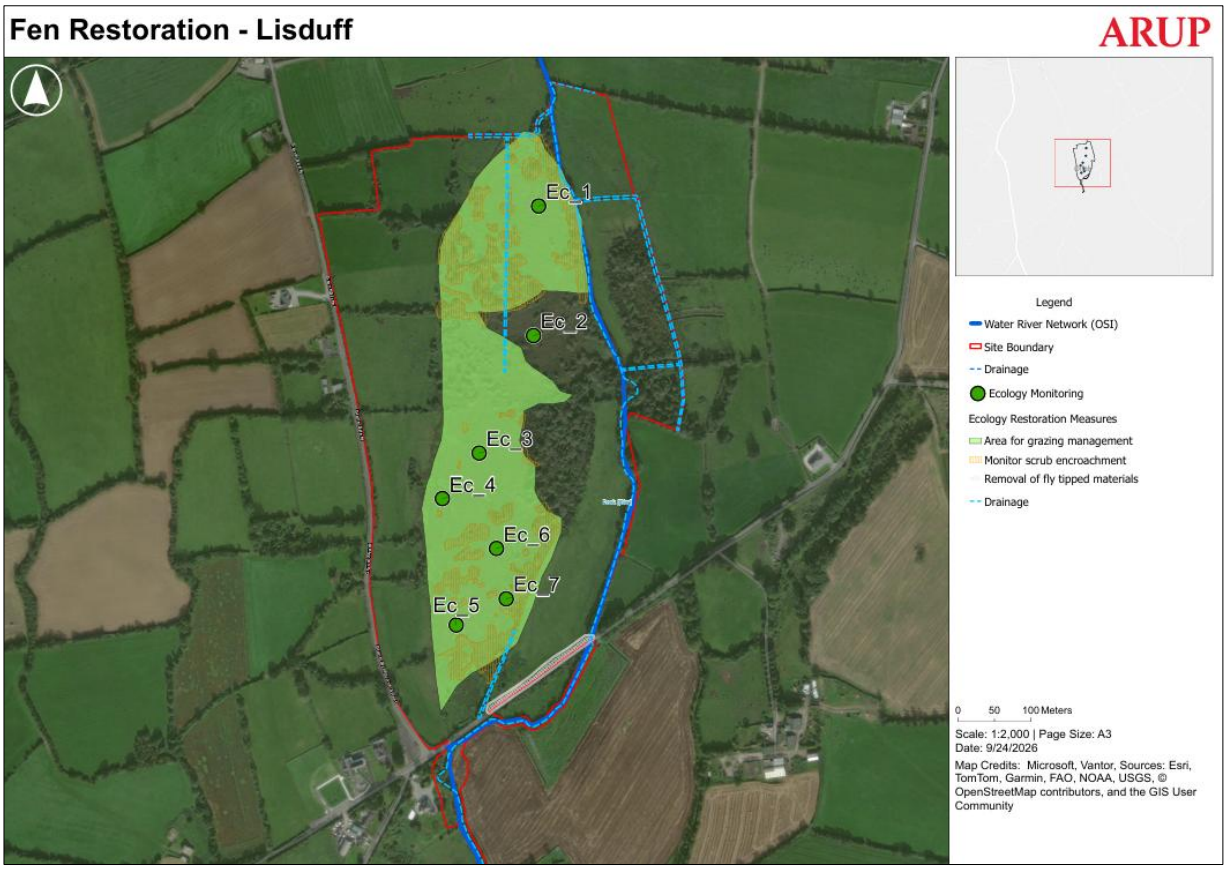


Figure 6-2 Proposed vegetation management measures and monitoring for Lisduff Fen SAC

6.4.2 Off-site Vegetation Measures

Proposed off-site vegetation measures include landowner engagement as shown in Table 6-2 below.

Table 6-2: Off-Site Vegetation Measures proposed for Lisduff Fen SAC

Priority	Measure	Description	Responsibility
1	Landowner engagement	Engaging with landowners surrounding the site regarding farming practices within and adjacent to an SAC with particular consideration for fens.	NPWS

7 Additional Considerations

7.1 Drainage Management Plan

Arterial Drainage Schemes were carried out under the Arterial Drainage Act, 1945 to improve land for agriculture and to mitigate flooding. Rivers, lakes weirs and bridges were modified to enhance conveyance, embankments were built to control the movement of flood water and various other work was carried out under Part II of the Arterial Drainage Act, 1945. The purpose of the schemes was to improve land for agriculture, to ensure that the three-year flood was retained in bank this was achieved by lowering water levels during the growing season to reduce waterlogging on the land beside watercourses known as callows. Flood protection in the benefiting lands was increased as a result of the Arterial Drainage Schemes.

The Brosna (Westmeath, Offaly and Laois) was the first scheme, which commenced in 1947. The last schemes were completed in the 1990s. Arterial Drainage schemes cover approximately 20% of the country, typically the flattest areas. The OPW is required to maintain Arterial Drainage schemes under sections 37 and 38 of the Arterial Drainage Act, 1945. The Act was amended on a number of occasions, e.g. to transpose EU Regulations and Directives such as the EIA, SEA, and Habitats Directives and the Aarhus Convention.

Drainage Districts were designated by the Commissioners of Public Works to improve land for agriculture and to mitigate flooding. Channels and lakes were deepened and widened, weirs removed, embankments constructed, bridges replaced or modified and various other work was carried out. Local authorities are charged with responsibility to maintain Drainage Districts. The Arterial Drainage Act, 1945 contains a number of provisions for the management of Drainage Districts in Part III and Part VIII of the act.

Lisduff fen SAC and its associated drainage network are not located within an OPW Arterial Drainage Scheme (ADS); however, Lisduff Fen SAC is part of a Drainage District managed by Offaly County Council. Consultation is required with Offaly County Council on the maintenance and function of the channel and the impact of the proposed restoration measures on the objectives of the drainage district.

The preliminary drainage management plan for Lisduff Fen SAC is presented in Appendix D.

7.2 Peat Stability Assessment

Restoration activities have the potential to introduce additional risk of peat stability issues. The combination of additional loading (e.g. when excavators are used) and a higher water table has the potential to increase risk. At present, no specific guidance is available in Ireland detailing how peat stability risks should be managed in restoration projects.

Undertaking detailed geotechnical assessments is beyond the scope of the FRP. However, preliminary peat stability analysis was undertaken to inform the level of assessment required prior to the implementation of restoration actions. This includes a review of the landslide susceptibility map and historic landslide events produced by the Geological Survey of Ireland

(GSI). The GSI landslide susceptibility map provides a preliminary indication of the susceptibility of a landslide based on several contributing factors, including where previous landslides have occurred and what caused them (slope, soil type and the impact of the flow of water in an area).

The proposed approach to peat stability is a tiered approach that aims to filter out low risk sites that can proceed with limited ground investigation, followed by more complex sites that require a more detailed quantitative assessment. Where risks cannot be excluded following these steps it may be necessary to progress to more detailed geotechnical studies.

The GSI landslide susceptibility map for Lisduff Fen SAC is presented in Figure 7-1 and indicates that the site is identified as low landslide susceptibility.

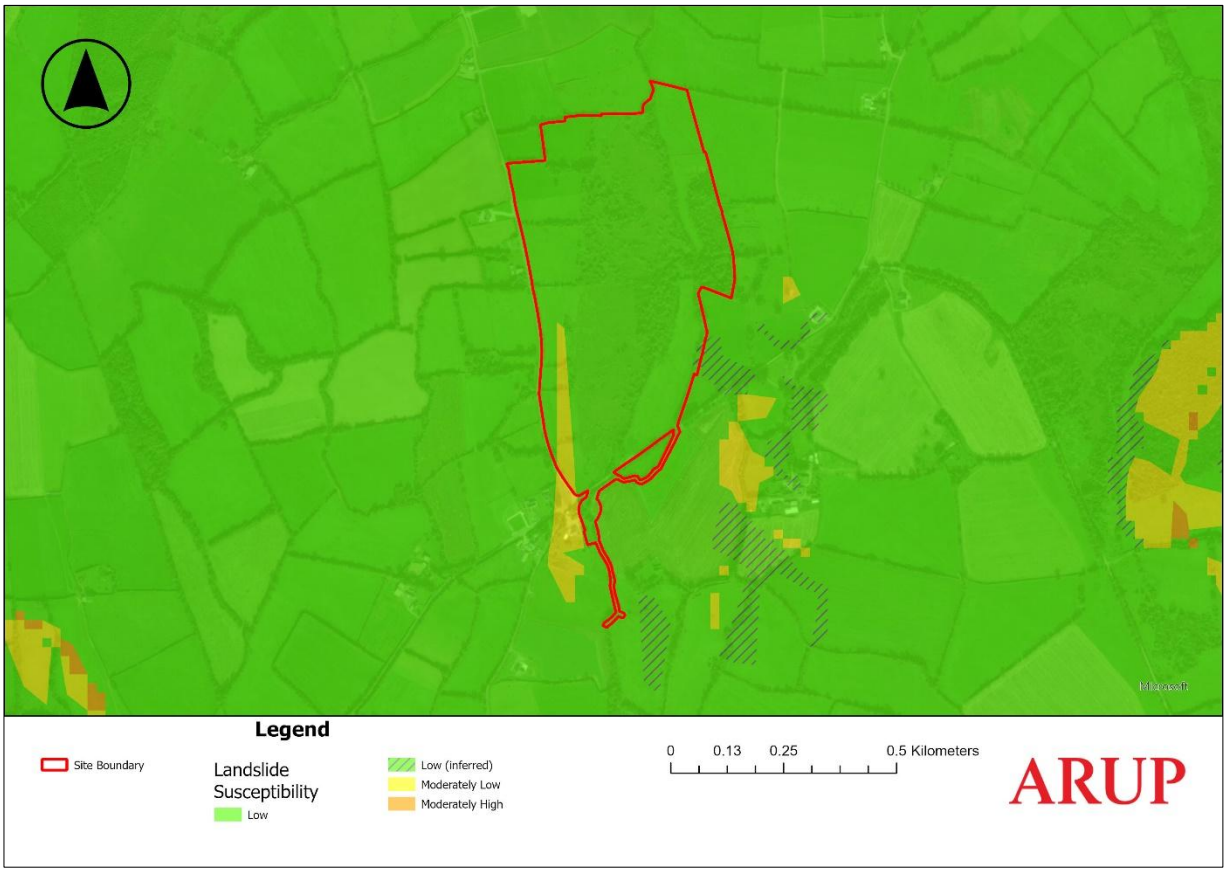


Figure 7-1: Geological Survey of Ireland Landslide Susceptibility mapping for Lisduff Fen SAC

7.3 Archaeology

The placename Lisduff was reviewed as part of the assessment and is recorded as An Lios Dubh, meaning "black fort"[2]. This placename suggests a possible historical association with a ringfort or enclosed settlement in the area and provides additional archaeological context for the site.

[2] logainm.ie | Placenames Database of Ireland

A desktop constraint assessment was conducted using the National Monuments Service (NMS) Historic Environment Viewer to evaluate the site boundary and immediate surrounding buffer zones against the statutory Record of Monuments and Places (RMP) and the Sites and Monuments Record (SMR). The assessment identified one architectural heritage site, Lisduff Cottage (14938005), located approximately 235 m north of the site (Figure 7-2: Archaeological Site for Lisduff Fen SAC (NMS, 2025)). However, this feature is not expected to be affected within the scope of the restoration measures.

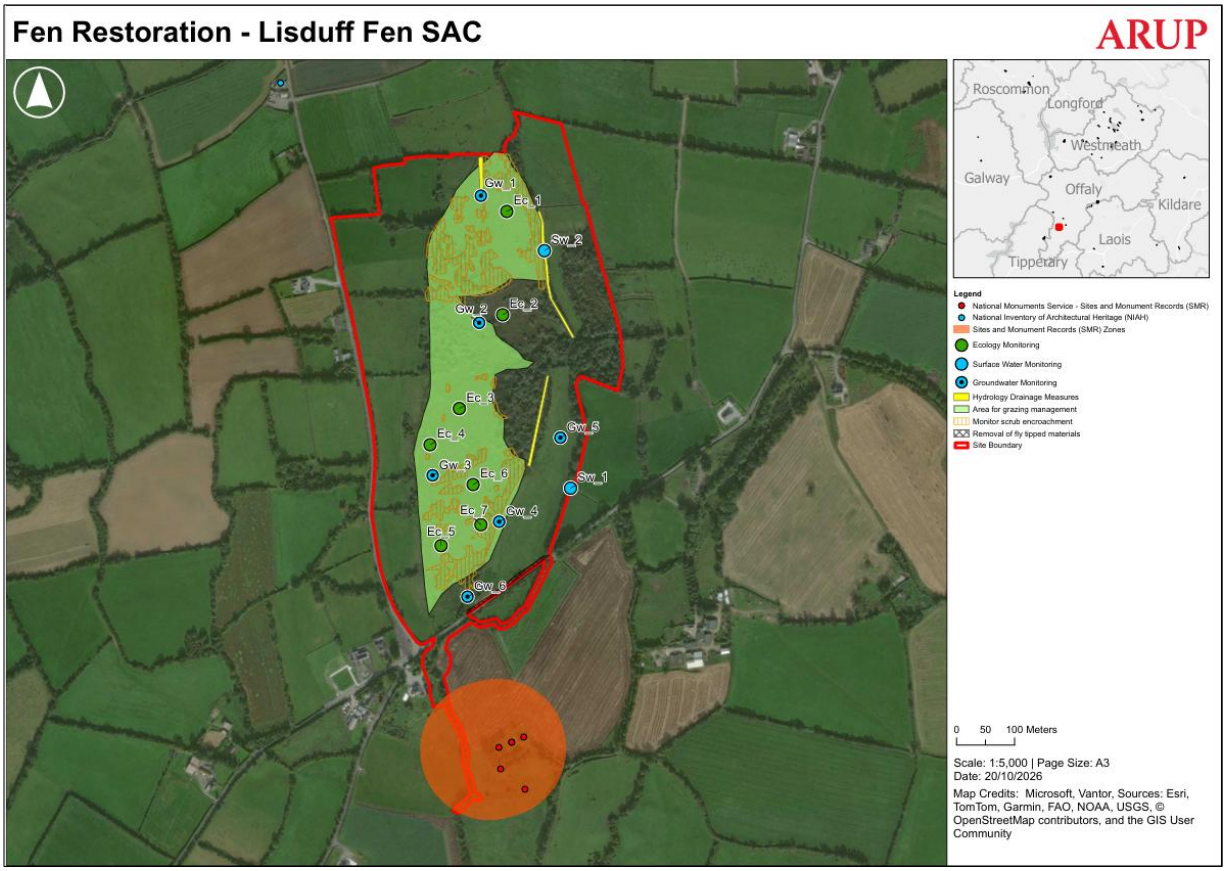


Figure 7-2: Archaeological Site for Lisduff Fen SAC (NMS, 2025)

8 Summary of Fen Restoration Plan Actions

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

Table 8-1: Role players in fen restoration plan

Measures	Stakeholder	Description
On-site	National Monument Services / County Council	An archaeological site was identified north of the site from the desk study. However, archaeologists will need to be engaged if potential sites are identified during the work within the boundary of the site.
	Landowners	Lisduff Fen SAC is under ownership by private individuals. Engagement with landowners regarding farming practices within an SAC.
	NPWS	Lisduff Fen is a designated SAC.
Off-site	LAWPRO	Lisduff Fen SAC within a Prioritised Area for Action (AFA0909) under LAWPRO Cycle 3 (2022-2027).
	Landowners & farmers	Engagement for uptake of catchment measures and regarding farming practices adjacent to SACs
Capacity building	NPWS	NPWS engaging in community education and events

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

Table 8-2: Implementation plan for Lisduff Fen SAC 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 Lisduff Fen SAC. 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			NPWS
1.2	**Drainage management plan**							
	Consultation with Offaly County Council on the drainage management plan is required to ensure compliance with legislation and local authority objectives.	Sitewide	Drainage management plan	Pre-restoration	NPWS	Offaly County Council	Arup	Within Tóchar project scope
1.3	**Archaeological assessment**							
	Consultation with National Monument Services on the archaeology is required to ensure compliance with legislation and local authority objectives.	Sitewide	Archaeological assessment report	Pre-restoration	NPWS	Offaly County Council	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. Surveys should also include identifying habitats for Geyer's whorl snail and Desmoulin's whorl snail which are within the areas for restoration measures. Where Geyer's or Desmoulin's whorl snail habitats overlap with areas for restoration, alternative measures will be discussed with the project team.	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 Construction Environmental Management Plan (CEMP).	Sitewide	ECoW report	Pre-restoration			Arup / Contractor	Within Tóchar project scope
3	**On-Site Restoration measures**							
3.1	**Hydrology measures**							
	Installation of Piezometers Piezometers will be used to monitor groundwater levels and support the interpretation of groundwater flow pathways. The data collected will help determine fen conditions across the site. **Surface water** Surface water points to be analysed along the eastern drain located within the site boundary (Rock Birr) will help to evaluate the water quality of Clareen stream and later the efficiency of drainage measures proposed.	Locations marked on restoration map	Water level	Restoration in 2027 and long-term	NPWS to facilitate access	Offaly Co. Co	Arup/ Contractor	Within Tóchar project scope

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Drainage measures along eastern site boundary identified as Rock Birr The drain is proposed to be blocked using plastic piling, designed to slow down water. The placement of dam locations should be determined to ensure that the variation in water levels upstream and downstream remains within 15–20 cm, consistent with established industry standards. This measure will require engagement with Offaly County Council since this drain identified as Rock Birr is part of a Drainage District and is also an EPA mapped water course.	Along the eastern boundary	Water management balance	Appropriate season following hydro monitoring	NPWS to facilitate	Offaly Co. Co	Arup/ Contractor	Within Tóchar project scope
	Drainage measures along within internal drains (southern and northern) The internal drain is proposed to be blocked using plastic piling, designed to slow down water. The spatial distribution of the dam locations to be designed to limit the difference in water level upstream and downstream of the dam to 15-20cm in line best practice.	Southern and Northern internal drain	Water management balance	Restoration in 2027 and long-term	NPWS to facilitate	Offaly Co. Co	Arup/ Contractor	Within Tóchar project scope
3.2	**Nutrient Measures**							

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Source control within site boundary Engage landowners to reduce nutrient application within site boundary through farmer training and nutrient management plan specific to fen.	Nutrients (Nitrate and phosphate), EC, pH		Restoration in 2027	NPWS to facilitate site access	Arup / Contractor	Within Tóchar project scope	Nutrients (Nitrate and phosphate), EC, pH
3.2	**Vegetation measures**							

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Proposed measures to address vegetation condition, ranking vegetation and grazing absence include: 1. Implementation of conservation grazing measures across fen habitats, with stocking levels and timing agreed with landowners; 2. Ongoing vegetation monitoring at defined monitoring points to assess species composition, sward structure and response to management; 3. Targeted scrub management, including removal where monitoring indicates scrub is contributing to habitat degradation; 4. Adaptive management of vegetation based on monitoring results, including refinement of grazing intensity and spatial targeting of scrub control.	Sitewide	Site records / habitat surveys	Restoration 2026-2027	NPWS to facilitate access		Arup / Contractor	
4 Off-Site Restoration measures								
4.1	**Hydrology measures**							

	Activity	Location	Monitoring/ implementation indicator	Timeframe	Key role player			Possible funding source
					National	Regional/ Local	Other	
	Engagement with landowners Agreements should be established to prevent drainage activities on neighbouring lands that could adversely affect the hydrological regime and water balance of Lisduff Fen SAC.	Surrounding landowners	Update of measures by landowners / farmers	Long-term	NPWS			NPWS
	Rainfall and evaporation monitoring using site-specific or nearby stations.	Surrounding areas	Rainfall and evaporation levels	Long-term	NPWS			NPWS
4.2	**Nutrient measures**							
	Targeted nutrient control measures should be implemented across the catchment to address both phosphate and nitrogen pathways. Measures may include engagement on best-practice nutrient management, avoidance of drainage works that enhance nutrient delivery pathways, and targeted interception of surface or shallow subsurface flows where monitoring identifies risks to fen.	Surrounding landowners	Uptake of measures by landowners	Long-term	NPWS, LAWPRO, Farming for Water EIP		Landowners	Catchment measures to be funded through Farming for Water EIP/ other similar
4.3	**Vegetation measures**							
	Landowner engagement regarding farming practices within and adjacent to an SAC, with particular care towards fens.	Agricultural lands surrounding the site.	Vegetation monitoring, hydrology monitoring	Long-term	NPWS	Offaly County Council	Landowners	TBC
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 tracks changes caused by drainage measures.	Allocated locations with the site	Nitrate, Phosphorus, EC, Temperature and pH	Long term	NPWS to facilitate site access			NPWS
5.2	**Nutrient monitoring**							
	Implement a water quality monitoring programme to monitor EC, Ph, Temperature, Nitrate and Phosphorus regularly.	Various locations within the site	Nutrients (Nitrate and phosphate), electrical conductivity and pH	Long term	NPWS to facilitate	Offaly County Council		Within Tóchar project scope
5.3	**Vegetation monitoring**							
	Habitat condition assessments will be included to track restoration progress.	Sitewide	Habitat condition	Long-term	NPWS	Offaly County Council		Within Tóchar project scope
6	**Capacity building and training**							
	Public meeting: To engage stakeholders on developments and results from the restoration measures.			Long-term	NPWS			NPWS
	Farmer training: Training such as that provided by the Farming for Water EIP will provide farmers with knowledge of alternative and habitat sensitive measures			Long-term	NPWS/ Farming for Water EIP / LAWPRO / Teagasc			Farming for Water EIP / other similar

8.1 Habitats Benefiting from Implementation of Restoration Actions

7230 Alkaline Fen

The proposed restoration measures will benefit 7230 Alkaline fens by addressing key pressures including grazing absence, hydrological modification and nutrient enrichment. The implementation of conservation grazing, in combination with hydrological restoration measures and targeted vegetation management, will improve sward structure, reduce the dominance of coarse species and maintain open, species-rich fen conditions. These measures will support the restoration of habitat structure and function and contribute to achieving the SSCOs for this qualifying habitat.

7220 Petrifying springs

The proposed restoration measures will benefit 7220 Petrifying springs through the restoration and maintenance of stable hydrological conditions, alongside the management of rank vegetation and nutrient inputs. Hydrological restoration measures are critical to supporting tufa-forming processes and maintaining saturated conditions required by this habitat. Conservation grazing and vegetation management will help to control rank growth and maintain suitable vegetation structure, while engagement on nutrient pressures will reduce risks from eutrophication. Together, these measures will support the long-term stability and ecological function of this habitat.

7140 Transition mire

The proposed restoration measures will benefit Annex I quality 7140 Transition mires by maintaining open, wet conditions and preventing succession. Conservation grazing and targeted scrub management will control vegetation structure and limit encroachment, while hydrological restoration measures will support appropriate water levels. These measures will help sustain the characteristic species composition of the habitat and maintain its ecological integrity over the long term.

91E0 Alluvial forests

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

Non-Annex Habitats/ Fossitt classified habitats

A range of non-Annex habitats within the site, including PF1 Rich fen and flush, PF3 Transition mire and quaking bog, PF2 Poor fen and flush, GS4 Wet grassland and associated treeline features, 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 qualifying species *Vertigo geyeri*, by improving the availability and quality of suitable fen habitat within the site.

The species has not been recorded in recent monitoring cycles, indicating a decline associated with changes in hydrological conditions, vegetation structure and management. Restoration measures targeting these pressures, particularly hydrological restoration, reintroduction of appropriate grazing, and management of vegetation succession, will contribute to the re-establishment of the stable, saturated microhabitats required by the species.

While recovery cannot be guaranteed, the proposed measures will create conditions more favourable for recolonisation and long-term persistence. These actions are also expected to deliver benefits for other species associated with fen habitats at the site, including Desmoulin's whorl snail (*Vertigo moulinsiana*) and marsh fritillary (*Euphydryas aurinia*), through improved habitat condition and ecosystem function.

9 References

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Appendix A – Non-Technical Summary

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan Non-Technical Summary			
Site Name	Lisduff Fen SAC	**NFS site no.**	107008
County	Offaly	**Designations**	*SAC 002147*
Fen habitats present (area)	7230 Alkaline fens (6.46 ha) 7140 Transition mire (1.03 ha)	**Species of note**	*Vertigo geyeri, Epipactis palustris, Populus tremula*

Site Description

Lisduff fen SAC is located 4 km southeast of Birr, Co. Offaly. The site occupies a local basin and has minor differences in elevations, with the western boundary at 70 mOD and the central area at 69 mOD. The site has been designated due to the presence of 7230 Alkaline fen, 7220 Petrifying springs and Geyer's whorl snail.

The site occupies a lowland setting within a predominantly agricultural landscape characterised by improved pasture, with adjacent land uses including conifer forestry and areas of wet grassland.

The site is dominated by fen habitat, principally rich fen, including extensive areas of 7230 Alkaline fen in the north and south of the site, as well as an area of Annex I quality 91E0 Alluvial forests and 7140 Transition mire. In addition, areas of non-Annex rich fen occur, some of which are rank in structure. Other habitats recorded within the site include scrub, wet grassland, wet woodland, wet heath, broadleaved forest, cut over bog, transition mire hollow raised bog and wet heath.

Management across much of the site is limited. Light cattle grazing occurs intermittently in the site contained by an electric fence in the west of the site, leaving some portions of the site overgrazed and others under grazed. There is scrub encroachment in the centre of the site that encroaches onto the 7230 Alkaline fen.

The site habitat map is presented in Figure 1.

Conceptual Site Model (CSM)

The topography of the site is relatively flat, ranging from 69 to 90 mOD, and being higher to the southwest with lower and flatter land to the northeast. Elevated ground occurs to the west and south of the site at approximately 114 mOD. These elevated areas likely function as groundwater recharge zones supplying groundwater to the fen system.

Under the WETMEC framework defined by Wheeler, Shaw & Tanner (2009), Lisduff Fen SAC is primarily consistent with a WETMEC 9 groundwater-fed valley-bottom fen, occurring within a low-lying valley setting where groundwater inputs maintain a shallow-water table and support minerotrophic fen conditions. The historical springs located to the north of the site are associated with WETMEC 16: groundwater-flushed bottom. The areas of the site associated with historical and current drainage are represented by the WETMEC 9b: part-drained groundwater bottom.

The site's hydrological characteristics results from the combination of groundwater discharge, surface water inflow and drainage modification. Lisduff Fen SAC can be described as a soligenous fen (groundwater-fed fen that receives mineral rich water) with springs influence. Additionally, drains that have been added in part of the fen which could have altered the hydrological regime in that area leading to more scrub and wet heath encroachment.

The CSM is presented in Figure 2.

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan Non-Technical Summary	
Key Pressures	
Hydrology Pressures	Drainage in both the southern and northern sections of the site may be disrupting hydrological connectivity, lowering water levels, and degrading alkaline fen habitats while promoting scrub encroachment. Additional pressures include fluctuating and reduced water levels, evidenced by low flow in input drains and extensive dry, degraded peat areas in the northern section.
Nutrient Pressures	Nutrient enrichment in Lisduff Fen SAC occurs especially in the southern section provably due to adjacent agricultural runoff and drying conditions that release stored nutrients, while in the southern area it is linked to internal changes in hydrology and vegetation.
Ecology Pressures	Drainage and hydrological modification, absence of grazing, nutrient enrichment and scrub encroachment are the principal pressures affecting the site. Together, these pressures alter hydrological conditions, reduce habitat quality, suppress characteristic fen species and drive vegetation change, resulting in a decline in the extent and quality of wetland habitats.
Objective of Restoration Plan	
The objective of the Lisduff Fen SAC Restoration Plan is 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 or preferable, and the objective is to improve the habitat condition.	
Restoration Measures	
Hydrology Measures	**On-Site Measures**: Water level management through blocking drains within the site. **Off-Site Measures**: Avoid the creation of new agricultural drains and deepening of existing drains where hydrological connectivity to Lisduff Fen SAC.
Nutrient Measures	**Off-Site Measures**: Source control through nutrient management planning, pathway interception to reduce nutrient transport.
Ecology Measures	**On-Site Measures**: Conservation grazing, targeted scrub management and removal, vegetation monitoring to inform adaptive management, and removal of fly-tipped materials.
Monitoring Progress	
Hydrology Monitoring	Groundwater and surface water monitoring within the fen as well as rainfall and evaporation monitoring.

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan Non-Technical Summary	
Nutrient Monitoring	Ongoing monitoring of habitats and drainage channels for water quality parameters within the fen
Ecology Monitoring	Habitat condition assessments to track restoration progress.
More information	
Fen Restoration Plan Report Tóchar website: https://www.tocharwetlands.ie/fen-restoration/	

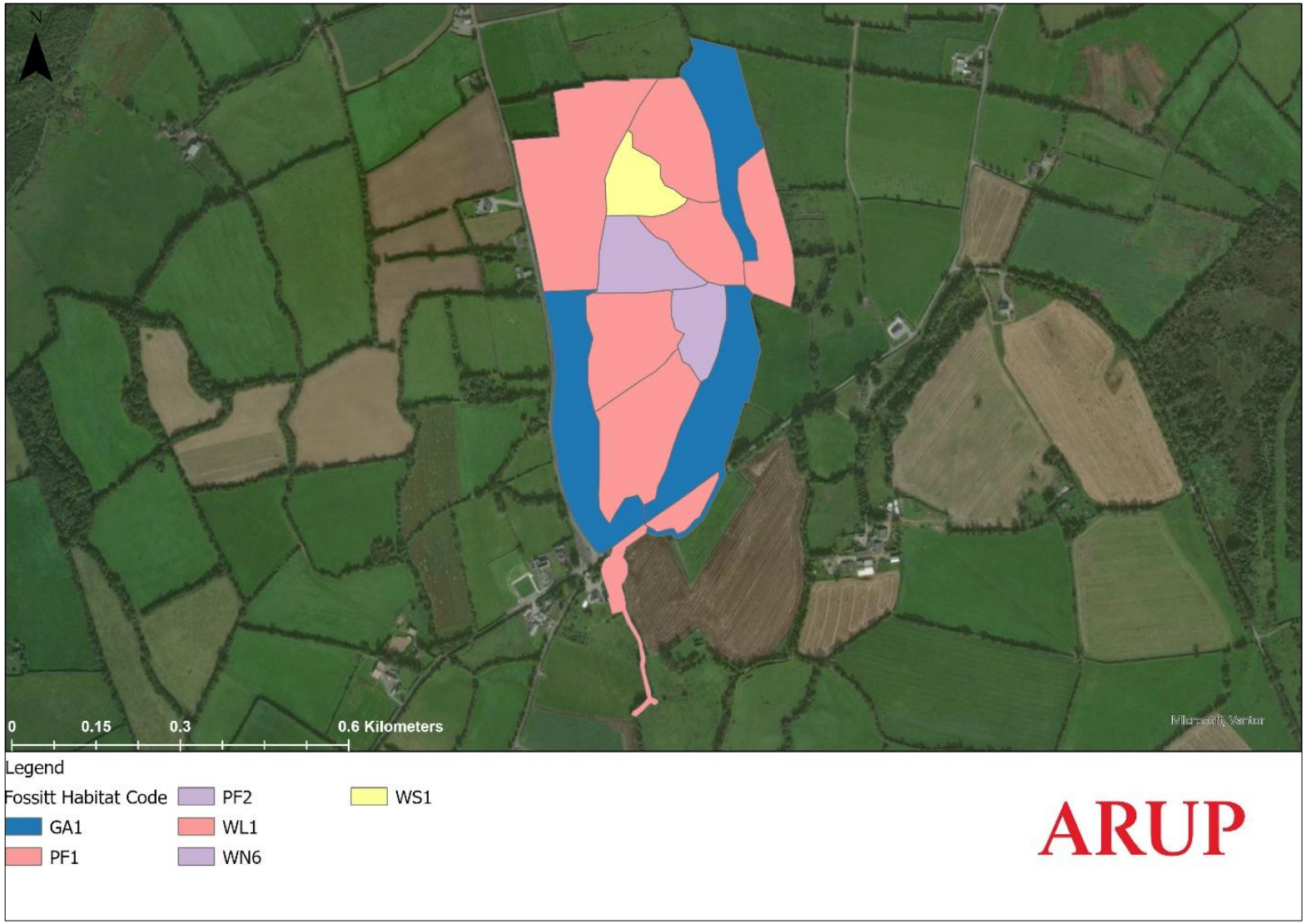


Figure 1: Site Habitat Map

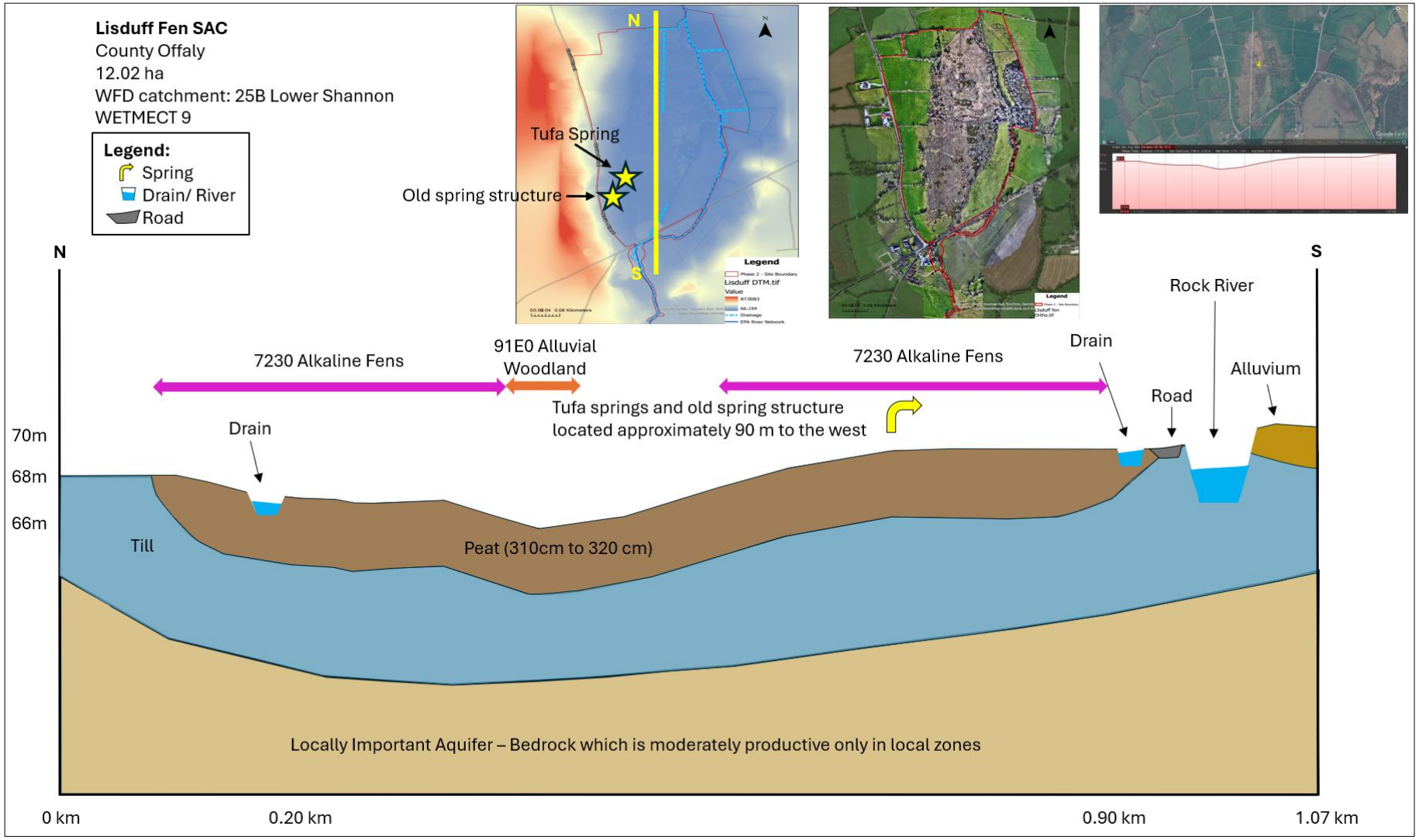


Figure 2: Conceptual Site Model

Appendix B – Ecological Survey Maps

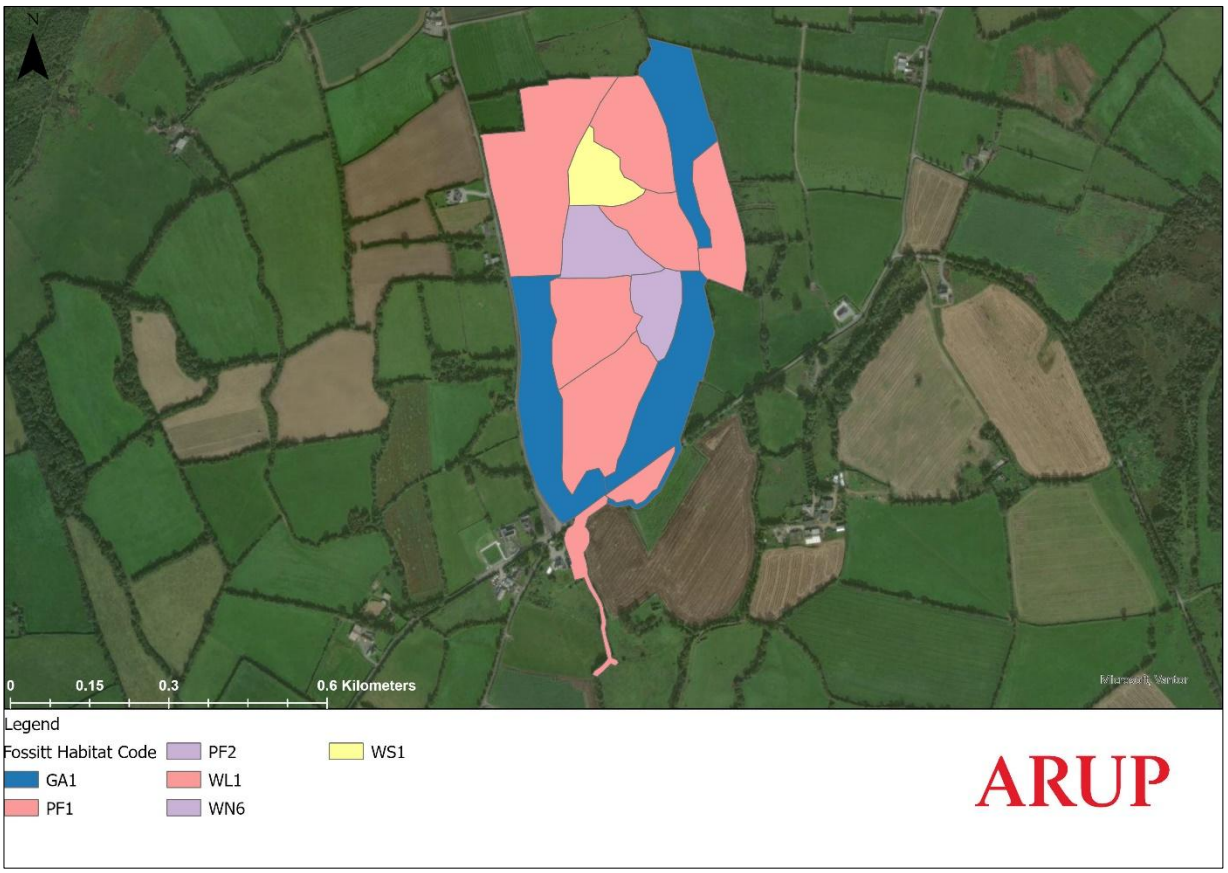


Figure 9-1: Habitats recorded during the 2022 NFS and classified according to the Fossitt Habitat Classification system. See Table 9-1 for the full directory of Fossitt Habitat codes.

Table 9-1: Annex I habitat and Fossitt habitat code directory

Annex I habitat code	Annex I habitat name	Fossitt Habitat Code	Fossitt Habitat Name
3110	Oligotrophic Isoetid lake habitat	FL1	Dystrophic lakes
3130	Slender Naiad-type lakes	FL2	Acid oligotrophic lakes
3140	Hard-water lakes	FL3	Limestone/marl lakes
3150	Rich pondweed lake habitat	FL4	Mesotrophic lakes
3160	Acid oligotrophic lakes	FL5	Eutrophic lakes
3180	Turloughs	FL6	Turloughs
3260	Vegetation of flowing waters	FL7	Reservoirs
3270	Chenopodion rubri	FL8	Other artificial lakes and ponds
4010	Wet heaths	FW1	Eroding/upland rivers
4030	Dry heaths	FW2	Depositing/lowland rivers
4060	Alpine and subalpine heath	FW3	Canals
5130	Juniper scrub	FW4	Drainage ditches
6130	Calaminarian grasslands	FP1	Calcareous springs
6210	Orchid-rich calcareous grassland	FP2	Non-calcareous springs
6230	Species-rich Nardus grassland	FS1	Reed and large sedge swamps
6410	Molinia meadows	FS2	Tall-herb swamps
6430	Hydrophilous tall-herb swamp	GA1	Improved agricultural grassland
6510	Hay meadows	GA2	Amenity grassland (improved)
7110	Raised bog (active)	GS1	Dry calcareous and neutral grassland
7120	Degraded raised bogs	GS2	Dry meadows and grassy verges
7130	Blanket bog (active)	GS3	Dry-humid acid grassland
7140	Transition mires	GS4	Wet grassland
7150	Rhynchosporion depressions	GM1	Marsh
7210	Cladium fens	HH1	Dry siliceous heath
7220	Petrifying springs	HH2	Dry calcareous heath
7230	Alkaline fens	HH3	Wet heath

Annex I habitat code	Annex I habitat name	Fossitt Habitat Code	Fossitt Habitat Name
8110	Siliceous scree	HH4	Montane heath
8120	Calcareous scree	HD1	Dense bracken
8210	Calcareous rocky slopes	PB1	Raised bog
8220	Siliceous rocky slopes	PB2	Upland blanket bog
8240	Limestone pavement	PB3	Lowland blanket bog
8310	Caves	PB4	Cutover bog
8330	Sea caves	PB5	Eroding blanket bog
91A0	Old oak woodland	PF1	Rich fen and flush
91D0	Bog woodland	PF2	Poor fen and flush
91E0	Alluvial woodland	PF3	Transition mire and quaking bog
91J0	Yew woodland	WN1	Oak-birch-holly woodland
		WN2	Oak-ash-hazel woodland
		WN3	Yew woodland
		WN4	Wet pedunculate oak-ash woodland
		WN5	Riparian woodland
		WN6	Wet willow-alder-ash woodland
		WN7	Bog woodland
		WD1	(Mixed) broadleaved woodland
		WD2	Mixed broadleaved/conifer woodland
		WD3	(Mixed) conifer woodland
		WD4	Conifer plantation
		WD5	Scattered trees and parkland
		WS1	Scrub
		WS2	Immature woodland
		WS3	Ornamental/non-native shrub
		WS4	Short rotation coppice
		WS5	Recently-felled woodland
		WL1	Hedgerows
		WL2	Treelines
		ER1	Exposed siliceous rock
		ER2	Exposed calcareous rock
		ER3	Siliceous scree and loose rock

Annex I habitat code	Annex I habitat name	Fossitt Habitat Code	Fossitt Habitat Name
		ER4	Calcareous scree and loose rock
		EU1	Non-marine caves
		EU2	Artificial underground habitats
		ED1	Exposed sand, gravel or till
		ED2	Spoil and bare ground
		ED3	Recolonising bare ground
		ED4	Active quarries and mines
		ED5	Refuse and other waste
		BC1	Arable crops
		BC2	Horticultural land
		BC3	Tilled land
		BC4	Flower beds and borders
		BL1	Stone walls and other stonework
		BL2	Earth banks
		BL3	Buildings and artificial surfaces

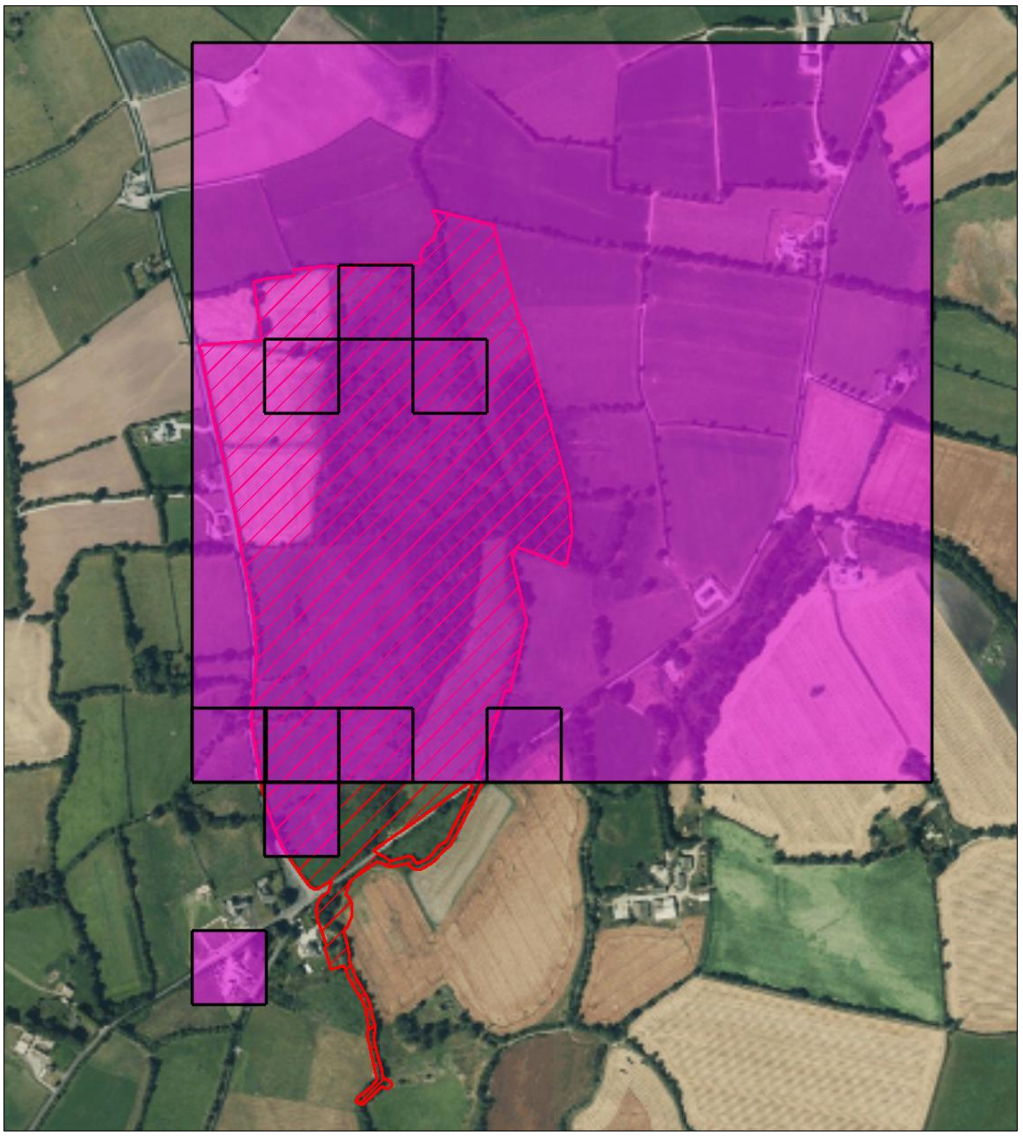


Figure 9-2: Distribution of Geyer's whorl snail within and adjacent to Lisduff Fen SAC using NBDC data viewer

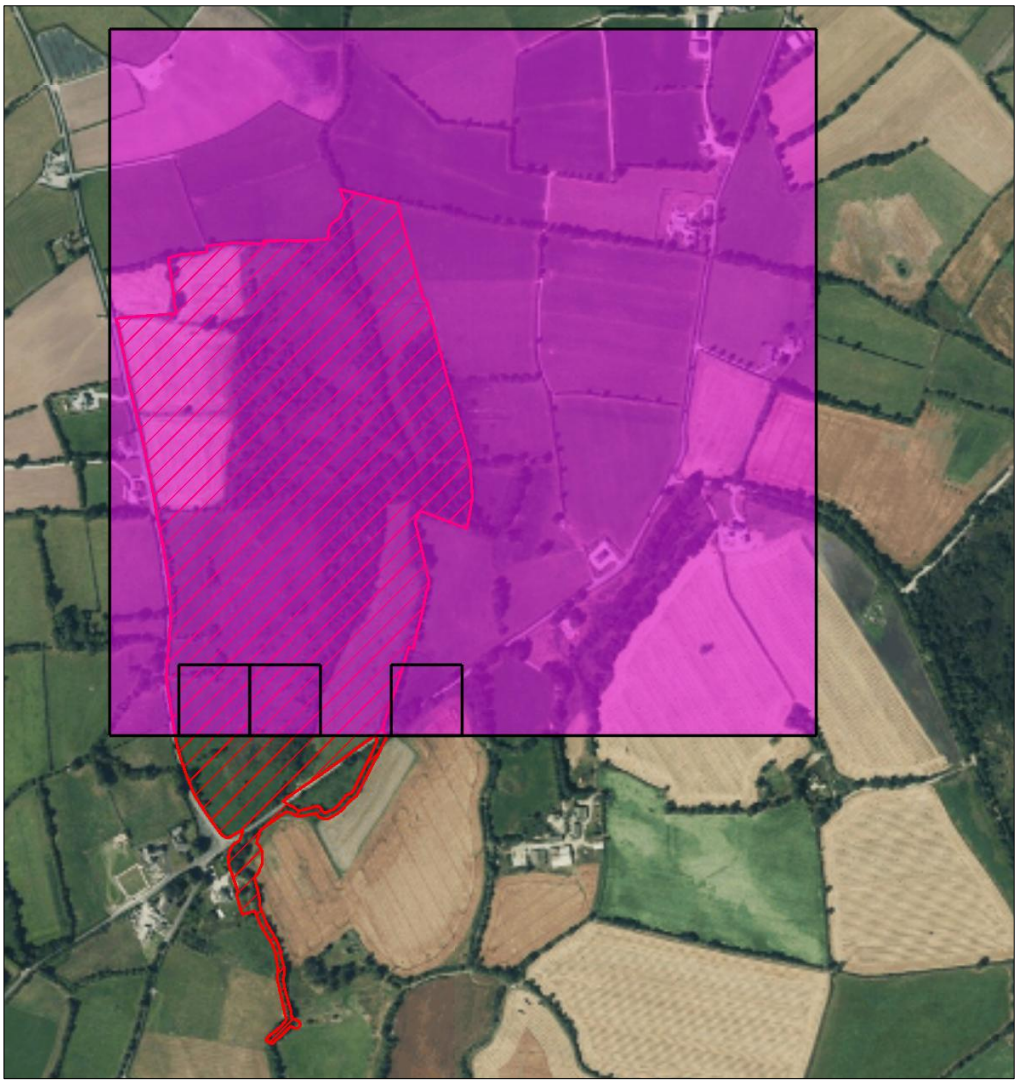


Figure 9-3: Distribution of Desmoulin's whorl snail within Lisduff Fen SAC using NBDC data viewer



Figure 9-4: Distribution of marsh fritillary within and adjacent to Lisduff Fen SAC using NBDC data viewer

Appendix C – Restoration measures and monitoring

Table 9-2: Long-term monitoring points for fen restoration at Lisduff Fen SAC

Point	Measure	Objective	Timeframe	Frequency of monitoring
Gw_1	Hydrological	Groundwater levels and quality monitoring	Long-term	Quarterly for year 1 Annual for year 2-5
Gw_2				
Gw_3				
Gw_4				
Gw_5				
Gw_6				
Sw_1		Monitoring of surface water levels and quality	Long-term	Quarterly for year 1 Annual for year 2-5
Sw_2				
Ec_1	Ecological	Monitoring within areas of 7230 Alkaline fens	Long-term	Seasonal for year 1 Every 3 years for year 2-5
Ec_2				
Ec_3				
Ec_4				
Ec_5				
Ec_6				
Ec_7				

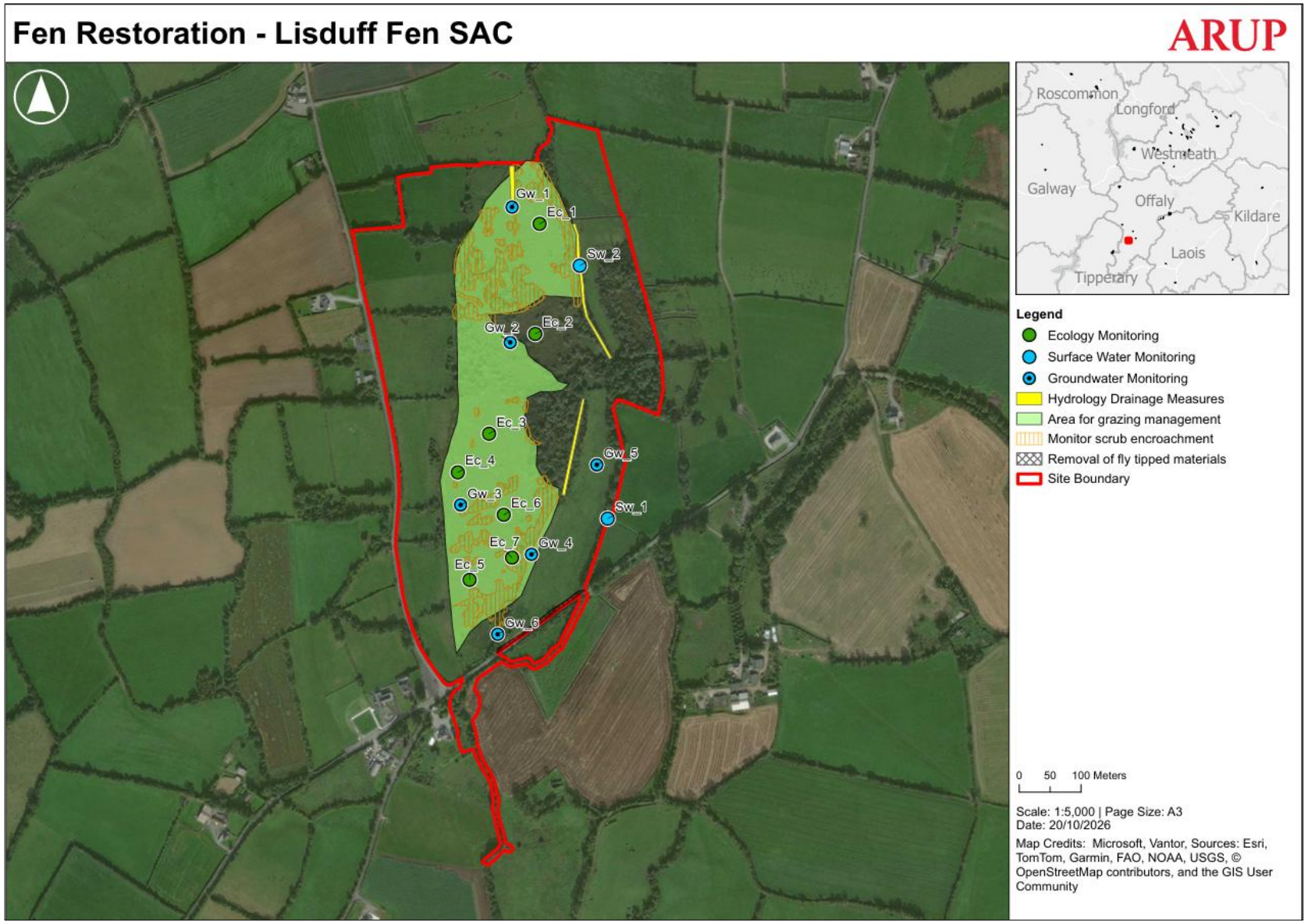


Figure 9-5: Proposed restoration measures and monitoring for Lisduff Fen SAC

Appendix D – Drainage Management Plan

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan: Drainage Management Plan			
Site name	Lisduff Fen SAC		
County	Offaly	NFS site No.	002147
Catchment overview:			
The site is located within the 25B Lower Shannon WFD Catchment and the Little Brosna_020 WFD sub-catchment. The Rock_010 river enters the fen in the south and connects to the Rock_020 river within the fen. The Rock River is a tributary of the Little Brosna River, which eventually flows into the Shannon Estuary. The WFD river waterbodies, Rath_010 and Rath_020, are classified as 'Poor' and 'Moderate' WFD Status, respectively, and are considered 'at risk' of not achieving their WFD objectives. The site is situated within a local topographic basin of relatively even elevation. Ground levels decrease gradually from north to south, ranging from approximately 69 to 70 mOD, while the site remains relatively flat along the west-east sections. Beyond the site boundary, the landscape becomes notably elevated in the northwest and south. The mapped drainage network is presented in Figure 1.			
WFD catchment	25B Lower Shannon	WFD Sub-catchment	Little Brosna_020 WFD
Drainage Area	None	Drainage District	None
Responsible authority	Offaly County Council	Maintenance date	TBD
Surrounding landowners	Private		
Wetland drainage Historical mapping indicates three drains within and around the site, all of which remain present today, demonstrating that the site is actively drained and modified from its original hydromorphic condition. Three springs were also mapped historically, although their current presence cannot be confirmed. The NFS (Brophy et al., in prep.) identified additional dredged and canalised drains and watercourses, including a deep vegetated drain along the eastern site boundary.			
Surface water inflow	South	Surface water outflow	North
Groundwater inflow	Three springs		
Internal drains	Several drains and watercourses that have been dredged and canalised	Perimeter drains	Rock Birr water course identified along the eastern site boundary.
On-site hydrology measures			
On-site measure 1	Drain blocking	Role player	NPWS/Surrounding landowners
On-site measure 2	Hydrological monitoring	Role player	NPWS/Surrounding landowners
Off-site hydrology measures			
Off-site measure	Engagement with landowners to avoid digging new drains	Role player	Surrounding landowners

NPWS Tóchar Midlands Wetland Restoration Scheme Fen Restoration Plan: Drainage Management Plan					
On - site nutrient measures					
On-site measure 1	Water quality monitoring		Role player		NPWS/Surrounding landowners
Off - site nutrient measures					
Off-site measure 1	Catchment measures should target phosphorus and nitrogen through nutrient management and flow interception		Role player		NPWS/Surrounding landowners
Proposed Water Monitoring:					
A hydrological monitoring network will be established to assess site conditions. Monitoring will include the installation of piezometers and standpipes at six selected locations and two surface water monitoring points (Figure 2).					
Indicator	Water level/ Water quality	Location	Various locations across site	Role players	NPWS/ Surrounding landowners

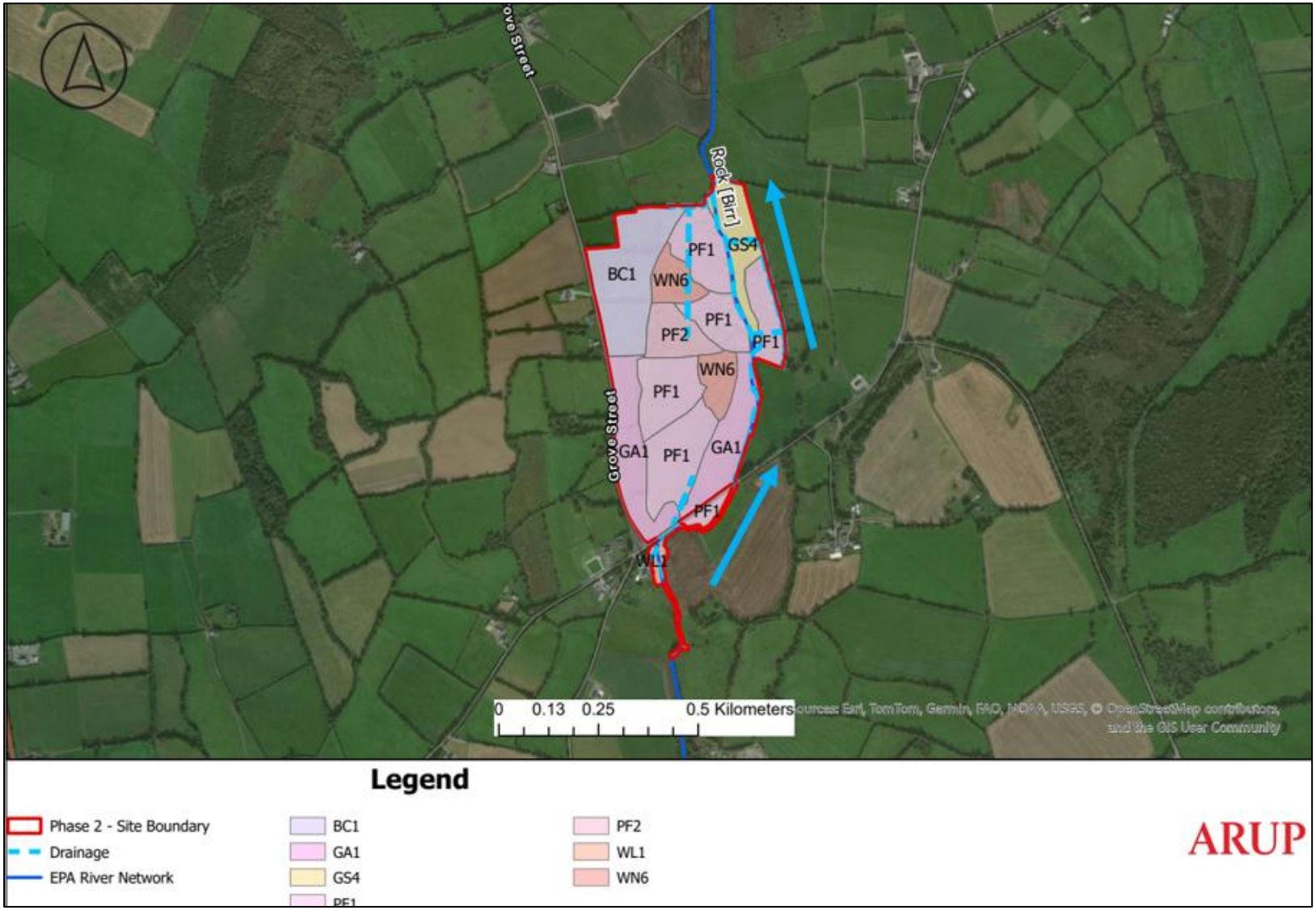


Figure 1: Mapped drainage network at Lisduff Fen SAC

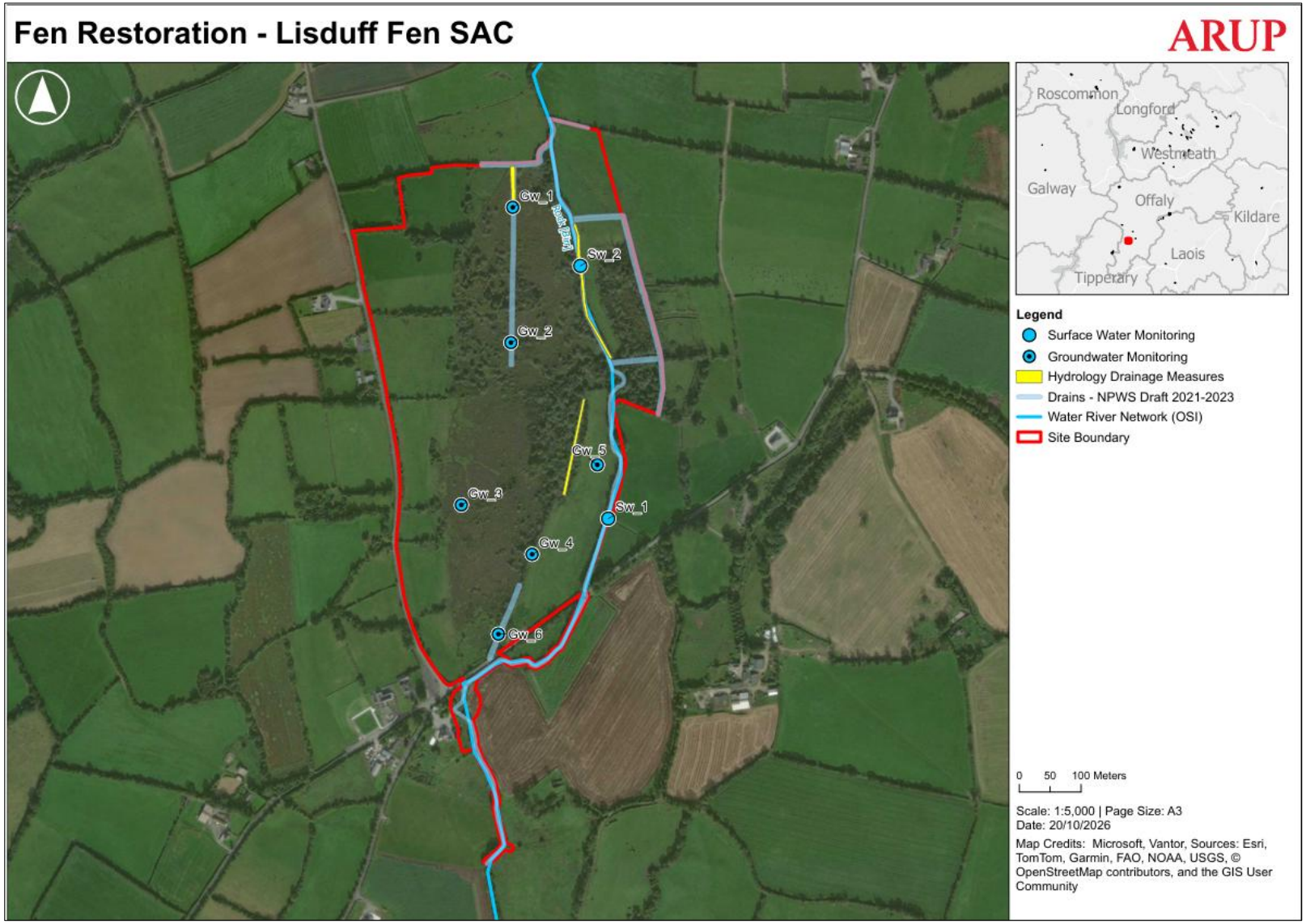


Figure 2: On-site proposed hydrological measures at Lisduff Fen SAC