

Natura Impact Statement for the Maintenance of Carrigahorig Arterial Drainage Scheme 2023

Final Report

December 2022

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Office of Public Works

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OPW

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Contract

This report describes work commissioned by the Office of Public Works under contract 188877 Work Package 2-2021 Environmental Consultancy services. Sophie Evans of JBA Consulting carried out this work.

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Purpose

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Executive summary

JBA Consulting has been commissioned by the Office of Public Works (OPW) to carry out a Natura Impact Statement for the Maintenance of the Carrigahorig Arterial Drainage Scheme (the "Scheme"). The Scheme implements the legal duty on the OPW under the Arterial Drainage Acts of 1945 and 1995 to maintain scheme channels and bridge/culvert structures that form part of the scheme and provide drainage of the benefiting lands.

The Scheme consists of 39.1km of watercourse, 0.3km of embankment and 68 bridges. The Scheme involves a range of standard maintenance activities, including in-channel vegetation management, silt removal, bridge/culvert maintenance and tree works. These are all carried out following detailed Environmental procedures (EPs) contained in OPW's Environmental Guidance: Drainage Maintenance and Construction (Brew & Gilligan 2019) which set out the minimum environmental and ecological standards that activities should follow.

A screening assessment had identified that the Scheme could have likely significant effects on six Natura 2000 sites. This report presents the examination of these, to determine if they would result in an adverse effect on site integrity and, if so, whether avoidance and mitigation could be applied to the Scheme to reduce these below the level at which adverse impacts would occur. Details of the screened-in sites are presented, including qualifying interest features, conservation objectives and threats and pressures.

A combination of desk-based assessments and field survey work were used to identify the baseline ecological conditions on and adjacent to the Scheme channels. Field assessment comprised of a walkover survey of all channels within Natura 2000 sites and a small buffer. The surveys identified a range of Annex I habitats adjacent to scheme channels, and the potential for several Annex II species to be present.

A detailed assessment of potential adverse impacts was carried out following the Source-Receptor-Pathway. Assessment of impacts of the Scheme on Natura 2000 sites highlighted potential adverse impacts on the Lough Derg, North-east Shore SAC, Lough Derg (Shannon) SPA, River Shannon Callows SAC and Kilcarren-Firvilee Bog SAC. Avoidance and mitigation measures are given for specific sections of each channel, and these will ensure no adverse impact on the integrity of any Natura 2000 sites and their conservation objectives.

An in-combination assessment was completed looking at relevant plans and projects. One planning permission was identified which could potentially, although very unlikely, give rise to adverse impacts on the integrity of the Lough Derg (Shannon) SPA, when assessed in combination with the proposed Scheme. This project is a development of cattle sheds and effluent storage with a discharge point to Scheme channel C2/1. Measures to mitigate the in-combination effect are given for the relevant section of channel C2/1 and this is sufficient to avoid any adverse effect on integrity of the Lough Derg (Shannon) SPA.

The NIS has concluded that, given the avoidance and mitigation measures proposed, the proposed drainage maintenance operations in the Carrigahorig Arterial Drainage Scheme will not have an adverse impact on the integrity of any Natura 2000 site, in light of its conservation objectives and best scientific knowledge, either alone or in combination with other plans or projects.

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Abbreviations

AA	Appropriate Assessment
CIEEM	Chartered Institute of Ecology and Environmental Management
CJEU	Court of Justice of the European Union
DoEHLG	Department of Environment, Heritage and Local Government
COs	Conservation Objectives
EC	European Commission
EDM	Environmental Drainage Maintenance
EIA	Environmental Impact Assessment
EP	Environmental Procedure
EPA	Environmental Protection Agency
EREP	Environmental River Enhancement Programme
GIS	Geographic Information System
GWB	Groundwater body
HDPE	High Density Polyethylene
IFI	Inland Fisheries Ireland
INNS	Invasive Non-Native Species
IROPI	Imperative Reasons of Overriding Public Interest
LSE	Likely Significant Effect
MAC	Maintenance Access Corridor
NBDC	National Biodiversity Data Centre
NIS	Natura Impact Statement
NPWS	National Parks and Wildlife Service
OPW	Office of Public Works
OSi	Ordnance Survey Ireland
QI	Qualifying Interest
RBMP	River Basin Management Plan
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SOP	Standard Operating Procedure
SPA	Special Protection Area
SWD	Surface water dependent
WFD	Water Framework Directive
ZOI	Zone of Influence

1 Introduction

1.1 Background

JBA Consulting has been appointed by the Office of Public Works (OPW), to undertake environmental consultancy services in relation to Arterial Drainage. This report presents a review, completed once every five years of the impacts of the maintenance of the Carrigahorig Arterial Drainage Scheme in relation to the European Communities (Birds and Natural Habitats) Regulations 2011-2021 which implements the Habitats Directive (Directive 92/43/EEC).

The proposed Scheme is the Maintenance of the Carrigahorig Arterial Drainage Scheme, furthermore, referred to as the "Scheme", and is required as part of maintenance activities under the Arterial Drainage Acts of 1945 and 1995, and includes the Scheme channels that drain into the north-east corner of Lough Derg.

An Appropriate Assessment (AA) screening (JBA 2022) identified that an Appropriate Assessment (Stage 2) is required at this location due to the presence of five Special Areas of Conservation (SAC) and one Special Protection Area (SPA) within the potential zone of influence (ZoI) of the proposed maintenance works for the Carrigahorig Arterial Drainage Maintenance Scheme.

Previous assessments were undertaken for the Scheme for the purposes of Appropriate Assessment by JBA in 2014 (JBA 2014) and 2017 (JBA 2017). Due to the identification of potentially significant effects in relation to the proposed works at this location, this Natura Impact Statement (NIS) has been prepared to re-assess the impacts on the Natura 2000 sites and the overall network, and review and update appropriate avoidance and mitigation measures where necessary.

1.2 Legislative Context

The Habitats Directive (Directive 92/43/EEC) aims to maintain or restore the favourable conservation status of habitats and species of community interest across Europe. The requirements of Articles 6(3) and 6(4) of the Habitats Directive have been transposed into Irish legislation by means of *inter alia* the European Communities (Birds and Natural Habitats) Regulations 2011-2021 as amended.

Under the Directive a network of sites of nature conservation importance have been identified by each Member State as containing specified habitats or species requiring to be maintained or returned to favourable conservation status. In Ireland, the network consists of Special Areas of Conservation (SACs) and Special Protection Areas (SPAs), and also candidate sites, which form the Natura 2000 network.

Article 6(3) of the Habitats Directive requires that, in relation to European designated sites (i.e. SACs and SPAs that form the Natura 2000 network), *"any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives"*.

A competent authority, in this case the OPW as a public body, can only agree to a plan or project after having determined that it will not adversely affect the integrity of any Natura 2000 site, in light of its conservation objectives and best scientific evidence, either alone or in combination with other plans or projects.

Under article 6(4) of the Directive, if adverse impacts are likely, and in the absence of alternative options, a plan or project must nevertheless proceed for imperative reasons of overriding public interest (IROPI), including social or economic reasons, a Member State is required to take all compensatory measures necessary to ensure the overall integrity of the Natura 2000 site.

The Planning and Development Act 2000, and amendments, consolidates all planning legislation from 1963 to 1999 and is the basis for the Irish planning code, setting out the detail of regional planning guidelines, development plans and local area plans as well as the basic framework of the development management and consent system. The Act sets out the requirement of a Natura Impact Statement for a plan, to meet the requirements of article 6(3) of the Habitats Directive, the consideration of in-combination effects and classify any impacts in view of the conservation objectives of Natura 2000 sites.

1.3 Appropriate Assessment Process

Guidance on the AA process was produced by the European Commission (EC) in 2002, which was subsequently developed into guidance specifically for Ireland by the Department of Environment, Heritage and Local Government (DoEHLG) (2010). These guidance documents identify a staged approach to conducting an AA, as shown in Figure 1-1.



Figure 1-1. The Appropriate Assessment Process (DoEHLG, 2010)

1.3.1 Stage 1 - Screening for AA

The initial, screening stage of the Appropriate Assessment is to determine:

- whether the proposed plan or project is directly connected with, or necessary for, the management of the European designated site for nature conservation
- if it is likely to have a significant adverse effect on the European designated site, either individually or in combination with other plans or projects

For those sites where likely significant effects (LSE) are identified, either alone or in combination with other plans or projects, further assessment is necessary to determine if the proposals will have an adverse impact on the integrity of a European designated site, taking into account the site's conservation objectives (i.e. the process proceeds to Stage 2).

1.3.2 Stage 2 - AA

This stage requires a more in-depth evaluation of the plan or project, and the potential direct and indirect adverse impacts arising from it on the integrity and the interest features of the European designated site(s), alone and in-combination with other plans and projects, considering the site's structure, function and conservation objectives and best scientific knowledge in the field. Where required, mitigation or avoidance measures will be suggested.

The competent authority can only agree to the plan or project after having ascertained that it will not adversely affect the integrity of the site(s) concerned. If this cannot be determined, and where mitigation cannot be achieved, then alternative solutions will need to be considered (i.e. the process proceeds to Stage 3).

1.3.3 Stage 3 and 4 – Alternative solutions and IROPI

Where adverse impacts on the integrity of Natura 2000 sites are identified, and mitigation cannot be satisfactorily implemented, alternative ways of achieving the objectives of the plan or project that avoid adverse impacts need to be considered. If none can be found,

the process proceeds to Stage 4. Where adverse impacts of a plan or project on the integrity of Natura 2000 sites are identified and no alternative solutions exist, the plan or project will only be allowed to progress if imperative reasons of overriding public interest can be demonstrated. In this case compensatory measures will be required.

1.4 Arterial Drainage Maintenance background

Between 1945 and 1995, under the Arterial Drainage Act (1945), the OPW completed 34 Arterial Drainage Schemes on river catchments, along with five estuarine embankment schemes (over 11,500km of channel and 730km of embankments). The OPW is statutorily obligated to maintain arterial drainage channels under the 1945 Arterial Drainage Act, and since their completion, maintenance of these Arterial Drainage Schemes has been ongoing, with the majority of channels maintained every five years. However, larger channels tend to be only maintained every ten years, on average.

2 Methodology

2.1 Guidance

This NIS has been prepared having regard to the Birds and Habitats Directives, the European Communities (Birds and Natural Habitats) Regulations 2011-2021 as amended and relevant jurisprudence of the EU and Irish courts. The following documents have also been used to provide guidance for the assessment:

- DoEHLG (2010) Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities. Department of the Environment, Heritage and Local Government.
- European Commission (EC) (2019) Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC, Office for Official Publications of the European Communities, Luxembourg. European Commission.
- EC (2021) Assessment of plans and projects in relation to Natura 2000 sites - Methodological guidance on Article 6(3) and (4) of the Habitats Directive 92/43/EEC. European Commission.
- EC (2013) Interpretation Manual of European Union Habitats. Version EUR 28. European Commission.
- Environmental Protection Agency (EPA) maps website (<https://gis.epa.ie/EPAMaps/>)
- Chartered Institute of Ecology and Environmental Management (CIEEM) (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland - Terrestrial, Freshwater and Coastal, Version 2.1.
- National Parks and Wildlife Service (NPWS) website (www.npws.ie), (<https://www.npws.ie/>), where site synopses, Natura 2000 data forms and conservation objectives were obtained along with Annex 1 habitat distribution data and status reports.
- NPWS (2019). The Status of EU Protected Habitats and Species in Ireland. Volume 1: Summary Overview. Unpublished NPWS report.
- NPWS (2019). The Status of EU Protected Habitats and Species in Ireland. Volume 2: Habitat Assessments. Unpublished NPWS report.
- NPWS (2019). The Status of EU Protected Habitats and Species in Ireland. Volume 3: Species Assessments. Unpublished NPWS report.
- OPR (2021) Appropriate Assessment Screening for Development Management. OPR Practice Note PN01.
- Ryan Hanley (2014) Stage 1: Appropriate Assessment Screening Methodology for the Maintenance of Arterial Drainage Schemes.
- Ryan Hanley (2014) Source » Pathway » Receptor Chains for Appropriate Assessment. Arterial Drainage Maintenance Categories.

2.1.1 Ecological surveys

To inform the Appropriate Assessment process, a number of assessments and ecological surveys have been conducted, including:

- An ecological desk-based assessment to collate information on designated sites and protected and notable species, reported in detail in the AA screening (JBA 2022).
- An ecological walkover survey conducted on 11th October and 18th October 2022, by JBA Ecologists Hannah Mulcahy and Damian McAndrew.

During the ecological walkover survey, the habitats previously mapped in 2017 were reviewed and where necessary updated or boundaries revised. Aerial photographs and site

maps assisted the habitat survey. Habitats have been named and described following Fossitt (2000). Nomenclature for higher plants follows Stace (2019).

Protected species, including mammals (e.g. Otter, Badger) and birds, were surveyed based upon sightings and signs of activity during the habitat survey and also by the identification of potentially suitable habitats. This included a preliminary assessment of features with suitability for roosting bats and recording of any Invasive Non-Native Species (INNS) found. All evidence of protected habitats and species was recorded in a digital database where relevant, and all information gathered was provided to the OPW on a separate GIS database.

2.2 The Adverse Effect on Site Integrity test

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of qualifying interest. The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level. Upon the conclusion of the AA, the competent authority should grant consent to the plan or project only after having ascertained that it will not adversely affect the integrity of the Natura 2000 site(s) concerned.

An assessment of whether there could be an adverse effect on site integrity is done using the source-pathway-receptor model which is a conventional model used for determining the risk of impact to a site or qualifying interest (OPR 2021; Ryan Hanley 2014b). Risk is the likelihood or expected frequency of a specified adverse consequence or impact. Applied to the Scheme, it expresses the likelihood of an adverse impact arising because of the Scheme activities. A hazard presents a risk when it is likely to affect something of value (i.e. the Natura 2000 sites and their Qualifying Interests (QIs)). It is the combination of the probability of the hazard occurring and its consequences that is the basis of a risk assessment which an NIS essentially is:

$$\text{Risk} = \text{probability of an event} \times \text{consequential damage}$$

The source-pathway-receptor model is a useful tool to determine if a risk is present, and to help quantify the risk to see if the threshold of an adverse effect on site integrity is reached. For a risk to be present, all three elements must be present.

Source: The source considered in this NIS is the proposed works or activity that will occur as a result of the Scheme. Key considerations in assessing the source are the nature and scale of the potential impacts that may arise, such as the type of contaminants that may arise, the contaminant loading and other physical attributes. The point of occurrence is a critical reference point for assessing the attributes of the source of any potential adverse impacts.

Pathway: Pathways are established by surface water, groundwater and land and air connections. The pathway includes everything between the source and the receptor; from point of release of potential adverse impacts, such as contaminants, to the receptor. The location, nature, connectivity and extent of wells, groundwater dependent ecosystems, aquifers and faults can all influence the nature of a pathway. Rivers, streams and drainage ditches could all act as potential pathways for potential waterborne impacts. Where the pathway includes surface or groundwater bodies, the WFD status of that body is reviewed as this informs the ability of it to transfer impacts and its resistance and resilience of adverse impacts. Land and air pathways to be considered include those that may transfer direct physical impacts, noise and visual disturbance (vibrations) and dust or other airborne particles.

Receptor: The receptor is the QI features of the relevant Natura 2000 sites, their Conservation Objectives (COs) and the overall integrity of the Natura 2000 sites. To determine the significance of potential adverse impacts on the integrity of the Natura 2000 site, the COs of each site are assessed relative to the potential impacts that may

occur because of the proposed works. The conservation objectives are the fundamental unit on which the assessment is based. If the project were to undermine or make these objective more difficult to achieve, the conservation status of the QI features becomes harder to achieve, and the quality and condition of the site will be reduced, reducing the 'integrity' of the Natura 2000 site. Each Natura 2000 site will either have specific or generic conservation objectives. Detailed site-specific conservation objectives have now been provided for most SACs and SPAs throughout Ireland.

The overall aim of COs is to maintain or restore the favourable conservation conditions of the Annex I habitats and/or the Annex II species for which a SAC has been selected, under which the site-specific objectives contain more detailed attributes, measures and targets.

Favourable conservation status of a **habitat** is achieved when:

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

The favourable conservation status of a **species** is achieved when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

The conservation objectives for SPAs are also to maintain or restore the favourable conservation condition of the bird species listed as QIs for SPAs, which are defined by the following list of attributes and targets:

- Population trend: Measure of percentage change and whether the long-term population trend stable or increasing.
- Distribution: Number, range, timing and intensity of use of areas. There is to be no significant decrease in the range, timing or intensity of use of areas by specific or generic bird species, other than that occurring from natural patterns of variation.

The conservation objectives for non-breeding birds QIs for SPAs are as follows:

- To maintain the favourable conservation condition of the non-breeding water bird Special Conservation Interest species listed for a SPA.
- To maintain the favourable conservation condition of the wetland habitat for a SPA as a resource for the regularly occurring migratory water birds that utilise it.

Some Natura 2000 sites do not have specific COs for each QI and instead have only the general objectives listed above. Where these sites are screened into the assessment, detailed COs have been derived from other nearby Natura 2000 sites with the same QIs. In these cases, the necessary assumption has been made that the sites have similar characteristics, and the conservation objectives are likely to be similar for the specific habitat or species type in terms of conservation requirements.

Site integrity is assessed based on each conservation objective of each qualifying interest feature. Should any conservation objective be undermined by the proposed work, the site integrity will therefore be adversely affected. Low-impact effects that are too small or

short-lived to undermine the achievements of the conservation objectives are therefore not likely to adversely affect the site integrity.

2.2.1 Avoidance and Mitigation Measures

To ensure that any recommended mitigation measures are sufficient and proven to be successful, they are designed in accordance with the most up to date best practise guidelines and tailored where necessary to the conditions on-site and nature of the relevant receptors. OPW have a detailed process to ensure ecological measures are included during project implementation, along with audits to check compliance. Any avoidance and mitigation measures are assessed for evidence of their effectiveness and the certainty with which they can be implemented, as well as certainty with which they will avoid or reduce impacts. This forms a critical part of the assessment of residual effects and whether these could still result in adverse impacts.

2.2.2 In-combination Assessment

The in-combination assessment followed the process for in-combination set out by the DTA Handbook (Tyldesley & Chapman 2013). The in-combination impacts are considered only after the assessment of the project alone. If the result of this is that the Scheme will have no effect at all on a Natura 2000 site, then no in-combination assessment is necessary. However, where there is no adverse effect on site integrity, but some adverse effect, an assessment of this adverse effect in-combination with other plans or projects is carried out. Other plans or projects were identified within the relevant pathway screening distance set out in Ryan Hanley (2014a). Plans and projects were searched for using the National Planning Application Database, EIA portal and Myplan.ie databases (all accessible online), and any plans or projects that will take place from 2023 onwards (the period of assessment for the Scheme) were included, as well as projects completed before 2023 where the full impacts of that project are yet to be realised. If no other plans or projects are identified, then the assessment is complete. Where other plans or projects are identified then initially a review is made of its AA screening, or AA, and if the Competent Authority for the plan or project has made a final determination of no effect on the integrity of any Natura 2000 site, either alone or in-combination, this determination is used in this assessment. Where there is not a full AA, or the findings are unclear or out of date, the plan or project documentation is checked for credible evidence of real (not hypothetical) risk to a Natura 2000 site. Where these are identified then a detailed assessment is carried out. The impact assessment follows the method set out in Section 2.2 and applies mitigation where necessary to determine if adverse effects on site integrity are expected from the combination of plans and projects with the Scheme. A summary of the approach is presented in Figure 2-1. The final iteration of the in-combination assessment, including a search of relevant plans or projects, was completed on the 10th of October 2022.

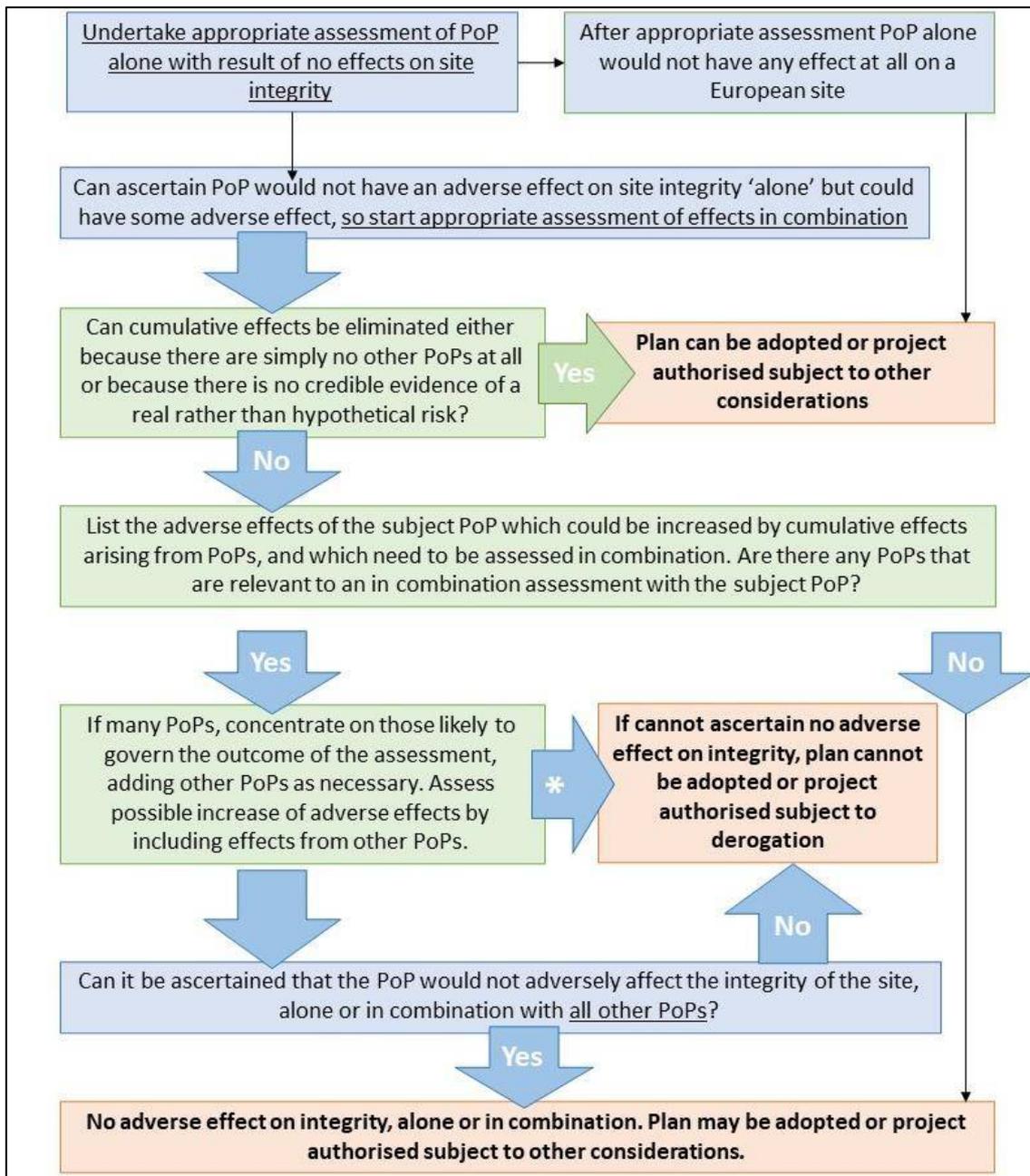


Figure 2-1. Flow diagram of process for in-combination assessment (modified from Tyldesley & Chapman 2013)

2.2.3 Consultation

No formal consultations for this NIS were completed in preparation of this draft, although there is ongoing dialogue between the OPW, IFI and NPWS in relation to arterial drainage schemes. This draft will form the basis of a consultation with NPWS, as the Statutory Nature Conservation Body, prior to final determination by OPW.

This report has been produced using currently available information, with the most up-to-date versions used. Where new, or updated, information becomes available the OPW will consider and review the findings of this assessment, if necessary.

3 Project Description

3.1 The Carrigahorig Scheme and Proposed Works

The Carrigahorig Arterial Drainage Scheme is located in County Tipperary. It includes 39.1km of watercourse and 0.3km of embankment (Figure 3-1) along with 68 bridges (Figure 3-2). The watercourses consist of 14 channels, with the main channel (C1) divided into five sections. They drain primarily agricultural land from south-east towards an outfall at the north-east corner of Lough Derg. All channels and structures are included in the assessment on a precautionary basis, as unplanned works are sometimes needed to maintain the function of the Scheme.

3.2 Drainage Maintenance Activities

Arterial Drainage maintenance includes a range of operations such as silt and vegetation management, mowing and structure maintenance, and listed as channel, embankment or structure maintenance with the categories set out in Table 3-1. This maintenance is required to retain the arterial drainage scheme design capacity. The maintenance types can happen for two reasons, the first is as part of regular planned works, and the extent of this is shown in Table 3-1, but maintenance may be needed on any of the channels or structures where a change in conditions necessitates the work. For the purpose of this assessment, it is assumed that any of the activities shown in Table 3-1 could occur on any of the channels.

Table 3-1. OPW Drainage Maintenance Types

Category	Maintenance Type	Code	Planned Maintenance Extent
Channel Maintenance	Silt and vegetation management	A	17 (34.0km)
	Aquatic vegetation cutting	B	0
	Bank protection	C	0
	Bush cutting/Branch trimming	D	15 (33.6km)
	Tree cutting	E	1 (6.4km)
	Other	K	0
Embankment Maintenance	Bush cutting/Branch trimming	D	1 (0.3km)
	Tree cutting	E	1 (0.3km)
	Mulching	F	1 (0.3km)
	Mowing	G	0
	Gate installation	H	0
Structural Maintenance	Sluice maintenance	I	0
	Bridge maintenance	J	0
	Bank protection	C	0
	Bush cutting/Branch trimming	D	0
	Tree cutting	E	0

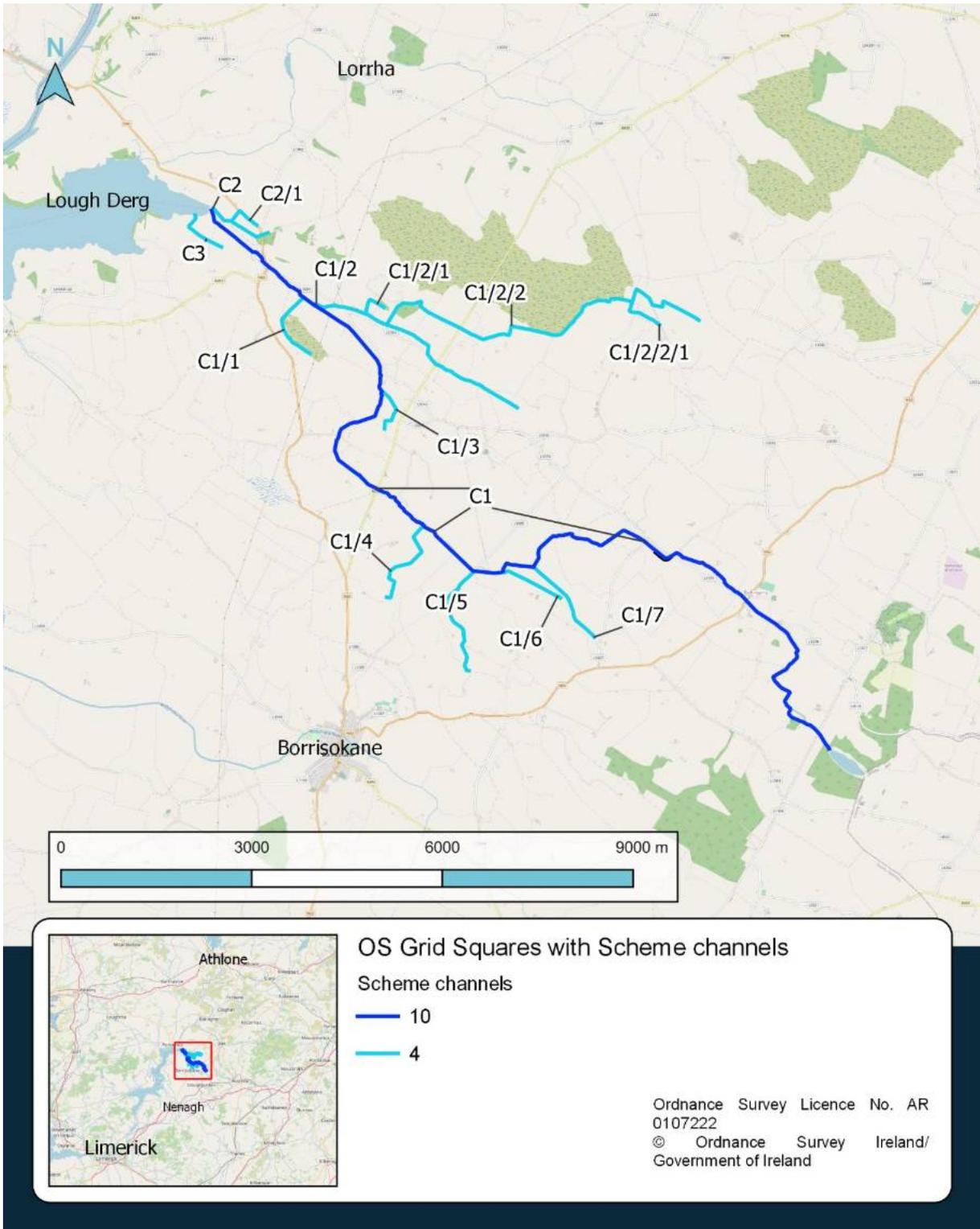


Figure 3-1. Carrigahorig Scheme channels showing frequency of maintenance.

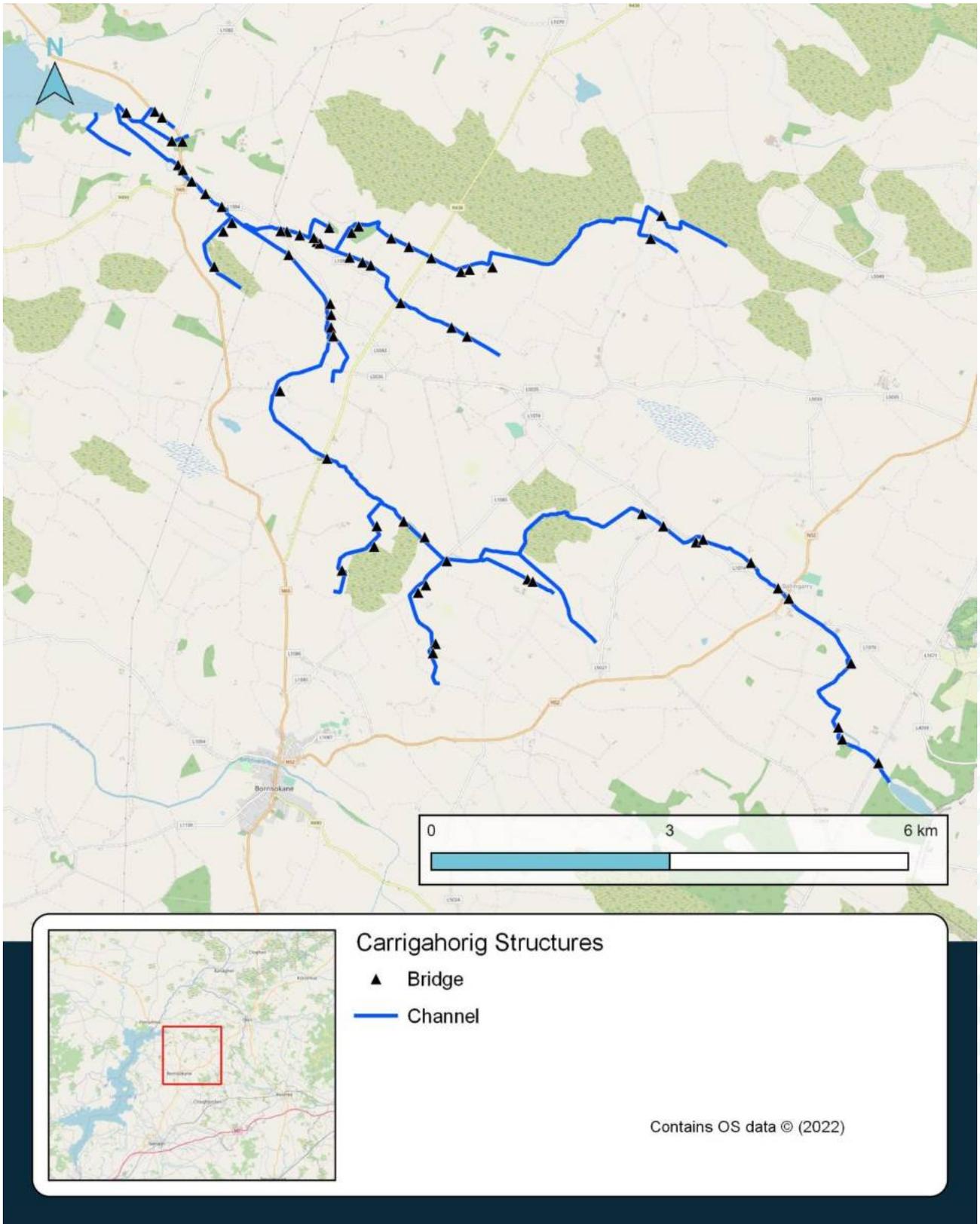


Figure 3-2. Scheme structure locations

3.2.1 Channel Maintenance Activities

The majority of drainage maintenance activities are focused on channel maintenance. While the frequency of maintenance on an individual channel may vary, with some channels requiring maintenance annually and others only requiring maintenance every twenty years, the average channel requires maintenance every four to six years. In this regard, approximately 2,000km of channels are maintained annually and nearly all of the 11,500km of channels across Irelands Arterial Drainage Schemes will have been maintained at least once over a period of five years. Channel maintenance is organised on a regional basis, with OPW Arterial Drainage Maintenance Regional Offices in Limerick, Headford, Co. Galway and Trim, Co. Meath.

Scheme Design Standards

Arterial Drainage Schemes constructed under the Arterial Drainage Act, 1945 were designed to provide an outfall for drainage of agricultural lands, and generally provided protection for a 3-year flood event. Where the creation of an outfall dictated the design bed levels, greater protection than the 3-year flood event was achieved as a consequence. In the case of modern flood relief schemes, flood protection for a 100-year flood event would be the design objective.

The original Scheme designs, including the outfall datum for each of the Arterial Drainage Schemes, are available in the relevant OPW Arterial Drainage Maintenance Regional Office. This includes the mapped Scheme design, and the associated long sections and cross sections. These designs are used to inform channel maintenance.

Types of Channel Requiring Maintenance

In the years following the construction of a drainage scheme there is a tendency for the channel capacity to be progressively reduced due mainly to the transportation and deposition of bed materials, the accumulation of silt and the growth of in-channel vegetation. The resultant channel maintenance consists of repetitive works of a cyclical nature, to restore the Schemes design levels i.e. outfall datum in order to maintain the channel's designed capacity to convey water.

Channels are prioritised for maintenance based on the rate of deterioration and the risk arising. The selection takes account of requests from the general public and potential flooding risk to roads, properties, urban areas and sewage works (OPW 2011a).

Plane Bed to Low Gradient Channels

Some 60 – 70% of maintained channels are of gentle longitudinal gradient and subject to relatively rapid deposition of silt, especially those that are subject to prolific growth of in-channel vegetation. The majority of maintenance works are therefore located on smaller lower-lying channels, with 90% of works in channels with a base width of <3m (OPW 2011a). In such channels silt and in-channel vegetation may cause the low flow level to rise by 50-300mm above the Scheme design level. In such circumstances maintenance is focused on restoring both low-flow and flood-flow water levels to original Scheme design.

Medium to High Gradient Channels

A smaller proportion of channels are steep and fast flowing and are subject to flash floods, bank erosion and rapid movement of bed gravel. The steeper sections of channel normally require relatively little and infrequent maintenance works (OPW 2011a) as opposed to channels of low gradient which are subject to rapid accumulation of silt and proliferation of vegetation. These channels will have a greater requirement for bank protection works.

Periods and Cycles of Maintenance

The average channel requires silt and vegetation management every four to six years. However, channels with prolific weed growth may require maintenance annually, particularly where downstream bridges are at risk of being blocked due to a flow of decaying vegetation in autumn. Conversely, some channels may only require in-stream

maintenance every twenty years due to the self-cleaning characteristics e.g. high gradient channels.

Where the period between previous channel maintenance works has been exceptionally long, dense scrub and woody vegetation can establish along the channel and within the maintenance access corridor. In such circumstances, drainage maintenance works will include the removal of scrub/transitional woodland (code WS1 in the Fossitt Classification, 2000) that has developed along the banksides via bush cutting/branch trimming, tree cutting or mulching. This is undertaken between the 1st September and 28th February to avoid the residential bird nesting season (from the 1st March to 31st August as per the Wildlife Act (1976)).

In contrast, in-stream works for silt and vegetation management are carried out outside of the salmonid spawning season (May to September) and the times that early life stages of salmonid fish will be present as per Section 173 of the Fisheries (Consolidation) Act (1959) on channels with salmonid spawning habitat. Any works required during this period are carried out in consultation with IFI. As a result, there may be a two stage approach to the works, with silt and in-stream vegetation management carried out during the open season (i.e. summer months), while woody vegetation removal is carried out in the winter months.

Other restrictions on works may also apply in relation to the presence/absence of other protected species such as White-clawed Crayfish *Austropotamobius pallipes* and Sea Petromyzon *marinus*, River Lampetra *fluviatilis* and Brook Lamprey *Lampetra planeri* which will influence the timing of works.

3.2.2 Embankment Maintenance Activities

A total of 5 No. Estuarine Embankment Schemes were constructed under the 1945 Act. In addition, a number of the Arterial Drainage Schemes have embanked sections.

Scheme Design Standards

As above for the Arterial Drainage Schemes, Estuarine Embankment Schemes constructed under the Arterial Drainage Act 1945 were designed to provide an outfall for drainage of agricultural lands, and generally provided protection for a 3-year flood event. Where the creation of an outfall dictated the design bed levels, greater protection than the 3-year flood event was achieved as a consequence. In the case of modern flood relief schemes, flood protection for a 100-year flood event would be the design objective.

The original Scheme designs are available in the relevant OPW Arterial Drainage Maintenance Regional Office. This includes the mapped Scheme design, and the associated long sections and cross sections.

Types of Embankments Requiring Maintenance

All embankments and associated sluice structures (see section 3.2.3) are inspected annually for signs of disrepair.

Regular inspections are carried out on sections of embankments, which are known from experience to be at risk, together with additional inspections after a storm surge at sea or a high tidal/flood event. Maintenance of embankments includes removal of vegetation to allow for inspection of the embankment, and in some cases the replacement of existing fencing with gates to allow for future access during maintenance.

3.2.3 Structural Maintenance Activities

Structural Design Standards

During the construction of the Arterial Drainage Schemes, some 18,500 No. accommodation bridges were identified and modified, or replaced as required. These bridges provide farmers owning land on both sides of a channels with farm vehicular and/or foot access from one side to the other. The type of bridge provided depended on

the width, depth and required flow capacity of the channel, and ranged from concrete piped culverts to relatively large structures formed on concrete or masonry abutments spanned by structural steel beams, or lattice girders together with concrete or timber decking.

During the Estuarine Embankment Schemes, existing sluice structures were identified and modified, or replaced as required. Additional sluice structures were constructed as required bringing the total number to approximately 750. The function of these sluice structures is to allow water from the floodplain behind the embankments to discharge to the main river or estuary.

Types of Structures Requiring Maintenance

In general, as channel maintenance proceeds, the bridges are examined by the supervisory industrial staff and if required, repairs/replacements are scheduled. The type of bridge structures, which are most likely to have fallen into a critical state of disrepair, are those with timber decking supported on steel beams, and those in which abutment foundations are being undercut. There is a standard type of design for the replacement of these structures, which consists essentially of mass concrete abutments with reinforced cast in-situ decking. This type of structure is simple to construct and under normal circumstances, it will last for many years with little or no maintenance.

On many occasions, it is not necessary to totally replace a bridge, and repairs such as underpinning the foundation or replacement of wing-walls, parapets or sections of the deck may be all that is required to extend the useful life of the structure. Where bridge maintenance may be required, a Bridge Inspection Form will be filled out by the Foreman, prior to the works. This will determine the need for further assessment and potentially, any mitigation measures that may be required.

All embankments and associated structures are inspected annually for disrepair. Due to the time elapsed since scheme completion, some of these sluice structures have reached their design life and have started to fail. In this instance, full replacement is required. Typically, this involves the installation of pre-cast headwalls and back walls, and the replacement of existing corrugated galvanised steel pipes with PVC plastic pipes.

Sluice doors are the most frequent part of the sluice structure that are required to be repaired or replaced. Repairs to a sluice door consist of replacing the arms/hinges on the existing cast iron door. On occasion, the existing cast iron door would be replaced with a high-density polyethylene (HDPE) door. Blockages often occur at the doors of the sluices due to silt build up. These blockages are removed using along reach excavator working from the bank of the channel.

Maintenance of bridges, structures and/or sluices will only occur within the scheme after following the relevant environmental procedures as detailed in the OPW Environmental Procedures document (Brew & Gilligan, 2019) and using specific mitigation measures where identified in environmental assessments. Structures are included in this assessment in as far as works do not take place in the channel. This means that general repairs to the structure, vegetation management and inspections are considered. This NIS does not include assessment for the removal, demolition, replacement or erection of bridges, sluices or structures.

3.2.4 Maintenance works considered outside of the Scheme Design Standards and outside of normal Arterial Drainage Maintenance Works

Occasionally, works are required that can be considered outside of the scope of the normal Arterial Drainage Maintenance Works to maintain a scheme. Works considered outside of the normal scope of statutory arterial drainage maintenance works are not assessed for impacts in this report.

Works that could be considered outside of the normal scope of works include those involving extensive bank protection measures, removal of mature woodland, unplanned

bridge maintenance works or any other unplanned works within the zone of influence of a Natura 2000 site.

3.2.5 Plant and Machinery

The types of machinery typically utilised during maintenance works would include 3600 hydraulic excavators (from 15-20 tonne excavators), mini-diggers, tractors and trailers, tipper lorries, hydraulic shears, hydraulic secateurs, chainsaws, mulchers and mowers; the machinery used is dependent on the maintenance activity being conducted.

The removal of dense in-stream silt and vegetation requires the use of a hydraulic excavator with a 1.5m wide (approximate) bucket (capacity approximate 500ltrs). For standard excavators, works progress at a rate of 700m to 900m per week. In relation to long-reach excavators, works progress at a slower rate of between 200m and 350m per week. Rates may change due to channel width or ground conditions.

3.2.6 Maintenance Access Corridors (MAC) and Working Zone

Maintenance sites are generally accessed via the public road and through farmland. A maintenance access corridor is utilised along one side of a channel for maintenance purposes. These established routes are used to track the hydraulic excavators for maintenance and for the disposal of spoil (see section 3.2.8). The same route is generally followed every maintenance cycle. This approach avoids disturbance of habitats on the opposite bank during works.

Where grasslands are present within the maintenance access corridor, the impact is predominantly temporary as the grasslands are trampled by machinery and can recolonise following completion of the maintenance activities. Within woodland and scrub habitats a linear path more typical of disturbed vegetation i.e. scrub/transitional woodland (WS1) will be evident along the maintenance access corridor due to regular machine access. In this regard, the disturbance regime associated with the tracking of plant machinery along the maintenance access corridors on the channel bank arrests succession to mature woodland such that scrub/transitional woodland (WS1) dominates. Where mature trees are present these are generally avoided by plant machinery.

Structures are generally accessed through farmland from the public road above. Plant machinery will utilise the same maintenance access corridor used for channel maintenance to gain access to the structure. Where individual trees, woodland and scrub habitats are present at the location of the structure, these may be removed to facilitate bridge inspection and works. Where mature trees are present these are generally avoided by plant machinery.

The location of drainage maintenance works is generally accessed via public roads and through farmland, with the siting of mobile short-term staff welfare facilities, plant storage and car parking agreed with local landowners. There is no requirement for temporary site lighting.

There is a requirement for water supply and disposal of wastewater from the welfare facilities (see section 3.2.8 in relation to waste disposal).

3.2.7 Site Compounds (Welfare Facilities), Access Routes and Haul Roads

Haul roads are generally not required to facilitate drainage maintenance activities. Where access is required in soft ground conditions, plant equipment will be brought in on tracks or temporary matting will be laid to provide a corridor for machinery access. Where matting is utilised, it will be completely removed post completion of works to allow vegetation to recolonise. All plant and machinery is confined to one defined access route to minimise disturbance.

All plant and machinery are regularly maintained and serviced to minimise release of hydrocarbons. All hydraulic excavators and other plant machinery use long life engine oil

and biodegradable hydraulic oil. Fuelling and lubrication are conducted a minimum of 50m away from all channels. Spill kits are present in all plant used in maintenance activities. Integrated submersible pumps are also deployed in the event of structural maintenance and the requirement for dewatering of excavations.

3.2.8 Waste Output/Disposal

The material removed from a channel during silt and vegetation management is normally spread thinly along the bank or on top of existing spoil heaps where present within the access corridor. All dead wood material is left on site to decompose or is removed off site under local landowner agreements. Where mulchers or mowers are deployed, the arisings are left on site to decompose, or the mulched material is buried.

Construction and demolition waste from structures includes broken concrete and stone. Steel railings are returned to the depot for recycling. Used engine oil and hydraulic oil is disposed of by a licensed waste handler. Toilet facilities are maintained by a licensed waste handler. Any waste generated on site is returned to the depot for segregation and disposal by a licensed waste handler.

3.2.9 Working Hours

All maintenance activities are undertaken during daylight hours. Standard working hours are 8.00am to 4.30pm, with lunch and tea breaks, Monday to Friday. There is no requirement for temporary site lighting to facilitate works. Machines are powered down when not in use.

3.2.10 Environmental Training

Environmental training of all staff involved in drainage maintenance is an ongoing process. Technical and Operational Staff completed formal training in Environmental Drainage Maintenance (EDM) in 2004. This training course was revised and expanded under the OPW's Environmental River Enhancement Programme (EREP) and was delivered to all staff in 2010. The training programme delivered included presentations in river corridor ecology, the Environmental Drainage Maintenance Guidance Notes (Ten Steps to Environmentally Friendly Maintenance), maintenance strategies involving both 'enhanced maintenance' and 'capital enhancement', and OPW's Environmental Management Protocols and Standard Operating Procedures (SOPs). Both sets of training were developed and delivered by IFI.

The formal approach to EDM Training was complimented with on-site training. Regular site visits from IFI and OPW's Environment Section provided further guidance and advice to operational staff. Auditing of operational staff on the implementation of the Environmental Drainage Maintenance Guidance Notes (Ten Steps to Environmentally Friendly Maintenance) was also carried out by both IFI and OPW's Environment Section.

In addition, other environmental training took place as deemed beneficial, e.g. in 2008, the majority of the technical and operational staff were trained in Otter Awareness. This course, provided by the Department of Zoology, Trinity College Dublin, included presentations on Otter ecology, and on-site identification of Otter signs and suitable habitat.

More recently, an environmental training course was designed and provided by JBA Consulting to all OPW staff in 2017 and 2018. It was given in three different stages. Management staff were given a more detailed 2-day course in Environmental and Ecological training. Ground staff were given 1.5 days of training in the environment and ecology. Modules were designed to assist staff in understanding the relevant legislation, recognising ecologically sensitive habitats and species, invasive non-native species identification and general environmental and ecological training relevant to their work. This included a half day practical session where ecologists demonstrated the identification of the elements taught in the classroom, in the field.

Training in the completion of an Environmental Risk Assessment and Bridge Inspections from an ecological perspective, was designed and provided by JBA Consulting to OPW Foremen and selected engineering staff in 2018. Further to this, all operational staff attended a 1-day environmental training course which included detailed guidance on the OPW's Environmental Management Procedures in 2019.

3.2.11 Environmental Audits

A portion of operational crews have been audited annually by the OPW Environment Section, IFI and since 2018 by independent consults for the implementation of the Environmental Drainage Maintenance Guidance Notes (Ten Steps to Environmentally Friendly Maintenance). The OPW's Environmental Management Protocol and EPs. Auditing is carried out by independent consults on a rotational basis to ensure all operational crews are audited at least once every three years. All audit results are forwarded to the relevant engineer for that Scheme within two working weeks. In the event of an audit showing elements of unreasonable non-compliance with procedures, the relevant Engineer will be notified within one working day. Audit results are also forwarded to OPW Environment Section for inclusion in monthly regional benchmarking reports. In the event of non-compliance audit, refresher training is provided to the staff (in Ten Steps to Environmentally Friendly Maintenance) and a re-audit is carried out within a short period of time.

3.2.12 Environmental Management Protocol and Environmental Procedures

The OPW's Environmental Management Procedures (Brew & Gilligan, 2019) set out how regional management staff manage a range of environmental aspects, including programming of works to accommodate certain environmental windows or restrictions on timing of works, and recording of data. A total of 31 No. EPs are applied during operational works. The 31 EPs replace the previous SOPs. These EPs set out actions designed to eliminate, or substantially reduce, likely impacts to identified species and their associated habitats. A brief summary of these is as follows.

Planning EPs relevant to Management Staff:

- Including Environmental Risk Assessment Procedure; and
- Appropriate Assessment Procedure

Implementation EPs - relevant to all staff:

- Environmental Drainage Maintenance Guidance Notes (10 Steps to Environmentally Friendly Maintenance)
- Tree Management Procedure
- Silt Management Procedure
- Machinery related procedure

Invasive Species EPs - relevant to all staff:

- Spread of Invasive Plant (Low Biosecurity) Procedure
- Spread of Water Based Invasives (High Biosecurity) Procedure

Species EPs - relevant to all staff:

- Salmonid Procedure
- Otter Procedure
- Bats Procedure
- Freshwater Pearl Mussel Procedure

Habitat EPs - relevant to all staff:

- Alluvial (Wet Woodland) Procedure
- Wetland Procedure

The description of activities, assessment and mitigation measures described in this report relate to the content of the published OPW Environmental Procedures (Brew & Gilligan 2019). An Environmental Risk Assessment process has been developed by the OPW which will be filled in by the program producer for >3m base width main channels where maintenance has not occurred for 15 years, and embankment works where maintenance has not occurred for 15 years.

4 Screening Assessment Results

4.1 Introduction

An Appropriate Assessment screening, addressing Stage 1 of the AA process, has already been completed for the Carrigahorig Arterial Drainage Scheme (JBA 2022). This identified that likely significant effects on Natura 2000 sites may occur because of the proposed maintenance activities, and therefore a Stage 2 Appropriate Assessment is necessary.

From the screening exercise it has been determined that likely significant effects may arise on seven Natura 2000 sites because of the Scheme. The seven sites and the pathways to impact are shown in Table 4-1, along with additional sites that were considered as they are within the Scheme ZOI but screened out.

Table 4-1. Screening Assessment summary

Site	Surface water	Land	Groundwater	Comment
Ballyduff/Clonfinane Bog SAC (000641)	NA	NA	No LSE	Within GWB containing scheme channels but no impacts due to distance in poorly productive aquifer.
Kilcarren-Firville Bog SAC (000647)	No LSE	LSE	LSE	Active and degraded raised bogs, and depressions on peat substrates of <i>Rhynchosporion</i> are all potentially present within the ZOI as Scheme channels are within the SAC. These habitats may be affected by land pathway. Two of these may be impacted upon via groundwater pathways.
Lough Derg, North-East Shore SAC (002241)	LSE	LSE	LSE	Overlapping the footprint of the planned works, this SAC supports three habitats which are affected by surface water and groundwater pathways: calcareous fens, alkaline fens and alluvial forests. As drainage maintenance works are proposed for within site boundaries adverse impacts via land pathway may also arise. The only qualifying interest of this site to be unaffected will be the Yew woodlands.
River Shannon Callows SAC (000216)	No LSE	LSE	NA	These sites, which share a common boundary within the project ZoI, are in the same surface water catchment but upstream of Lough Derg with no flow path for surface water impacts. Otters from the SAC may be found in scheme channels.
Middle Shannon Callows SPA (004096)	No LSE	NA	NA	

Site	Surface water	Land	Groundwater	Comment
Lough Derg (Shannon) SPA (004058)	LSE	LSE	LSE	Works are within the footprint of the SPA. This SPA has habitats which support four protected bird species, and wetland habitats, which could be impacted upon via all three pathways. The birds potentially affected are Cormorant, Tufted Duck, Goldeneye and Common Tern.
Slievefelim to Silvermines mountains SPA (004165)	NA	NA	No LSE	Within GWB containing scheme channels but no impacts due to distance in poorly productive aquifer.
Bolingbrook Hill SAC (002124)	NA	NA	No LSE	
Silvermine Mountains SAC (000939)	NA	NA	No LSE	
Silvermines Mountains West SAC (002258)	NA	NA	No LSE	
Liskeenan Fen SAC (001683)	LSE	NA	LSE	Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i> , are a surface water and groundwater dependent habitat falling within the zone of influence of the planned works within 1km.
Arragh More (Derrybreen) Bog SAC	No LSE	NA	LSE	These SACs have groundwater dependent features, but no surface water features, and share the same groundwater body as Scheme channels and so are within the ZOI.
Scohaboy (Sopwell) Bog SAC	No LSE	NA	LSE	

The screening assessment identified the following QIs of the Natura 2000 sites with LSE requiring further assessment:

Lough Derg, North-east Shore SAC

- Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*
- Alkaline fens
- Alluvial forest with *Alnus glutinosa* and *Fraxinus excelsior*

River Shannon Callows SAC

- Otter

Lough Derg (Shannon) SPA

- Cormorant (*Phalacrocorax carbo*)

- Tufted Duck (*Aythya fuligula*)
- Goldeneye (*Bucephala clangula*)
- Common Tern (*Sterna hirundo*)
- Wetland and Waterbirds

Liskeenan Fen SAC

- Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*

Kilcarren-Firville Bog SAC

- Active raised bogs
- Degraded raised bogs still capable of natural regeneration
- Depressions on peat substrates of the *Rhynchosporion*

Arragh More (Derrybreen) Bog SAC

- Degraded raised bogs still capable of natural regeneration

Scohabog (Sopwell) Bog SAC

- Degraded raised bogs still capable of natural regeneration

The screening assessment also identified which Scheme activities are likely to cause these Likely Significant Effects. The sources of impact to be considered in the NIS are set out in Table 4-2.

Table 4-2. Details of potential sources of impact

Activity	Impact
Disturbance of species and habitats	
Vehicle movement along maintenance access corridor and during operation; vehicle operations in bridge and sluice maintenance	Habitat disturbance/compaction
	Species disturbance from adjacent habitat: Noise Visual Vibration
Release of suspended solids	
Silt and vegetation management; sluice maintenance	Release of solids downstream – impacting aquatic and riparian species
Release of nutrients/changes in nutrient levels	
Silt and vegetation maintenance	Release from dredged material into bankside habitat
	Re-suspension of deposited nutrients
Vegetation cutting	Release from decaying cut material into embankment and channel
	Release from plant material cut and floating downstream in channel
Changes in water levels	
Silt and vegetation management	Removal of blockages lowers upstream surface water level
Silt and vegetation management	Removal of blockages changes upstream groundwater levels

5 Existing Environment

5.1 Overview

This section summarises the findings of the ecological walkover surveys of the embankments and channels along the Carrigahorig Stream, near Lough Derg and Kilcarren-Firville Bog.

5.2 General ecology of the site

The Carrigahorig Scheme area begins on the banks of Lough Derg, partially within the Lough Derg SPA and Lough Derg, North-East Shore SAC, and extends up the Carrigahorig Stream, along the boundary of Kilcarren-Firville Bog SAC. It includes depositing lowland rivers, drainage ditches and embankments. Much of the surrounding land is improved agricultural grassland and mixed coniferous woodland is also present. Wet riparian woodland that has the potential to be the Annex I habitat Alluvial Woodland is present along the banks of Lough Derg and along channel C2.

The description from 2017, which remains accurate and relevant (as verified by a 2022 walkover survey) also states the following:

"Kilcarren-Firville Bog SAC, located around channel C1/2/2 in some sections, has coniferous plantations adjacent to it, along with mixed broadleaved / conifer woodland and a small area of wet willow-alder-ash woodland.

Annex I habitats present, or potentially present, include 7110 Active raised bogs, 7120 Degraded raised bogs still capable of natural regeneration, potential 91E0 Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) and potentially the Annex I habitat of Watercourses of plain to montane levels with Ranunculion fluitanis and Calltricho-Batrachion vegetation (3260)."

5.3 Habitats

Habitat data has been compiled from walkover surveys completed by JBA Consulting in October 2022, along with NPWS data on habitat distribution. A range of Fossitt habitats were identified during the walkover surveys. They are listed in Table 5-1. Only Annex I habitats, or habitats within Natura 2000 sites are discussed in detail.

Table 5-1. Habitats recorded within surveyed areas

Habitat Type	Fossitt code	Potential Annex I
Mesotrophic standing waterbody	FL4	No
Depositing / lowland Rivers	FW2	Yes - Watercourses of plain to montane levels with <u>Ranunculion fluitanis</u> and <u>Calltricho-Batrachion</u> vegetation (3260)
Drainage ditches	FW4	No
Improved agricultural grassland	GA1	No
Dry meadows and grassy verges	GS2	No
Raised bog / cutover bog	PB1 / PB4	Yes - 7110 Active raised bogs, 7120 Degraded raised bogs
(Mixed) broadleaved woodland	WD1	No
(Mixed) broadleaved/ conifer woodland	WD2	No

Habitat Type	Fossitt code	Potential Annex I
(Mixed) conifer woodland	WD3	No
Conifer plantation	WD4	No
Hedgerows	WL1	No
Treelines	WL2	No
Wet willow-alder-ash woodland	WN6	Yes - 91E0 Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno-Padion</i> , <i>Alnion incanae</i> , <i>Salicion albae</i>)
Scrub	WS1	No

Of these habitats, there are three possible Annex I habitats recorded, listed in Table 5-2. The locations of these habitats are shown in Appendix A.

Table 5-2. Annex I habitats recorded within surveyed areas

Annex I Habitat Type	Equivalent Fossitt Habitats	Location and source
91E0 Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno-Padion</i> , <i>Alnion incanae</i> , <i>Salicion albae</i>)	WN6	Potentially present around Channels C2, C2/1, the very northern extent of C1, and within 100m of C3 (Field surveys 2022 & 2017).
7110 Active raised bogs and 7120 Degraded raised bogs still capable of natural regeneration	PB1, PB4	Present along most of the length of Channel C1/2/2 (Field surveys 2022 & 2017).
3260 Watercourses of plain to montane levels with <i>Ranunculion fluitanis</i> and <i>Callitriche-Batrachion</i> vegetation	FW2	Potentially present to the north-west corner of Channel C1/2/2/1, the northern extent of C1 and C2/1, and along C3 (Field surveys 2022 & 2017).

5.3.1 [91E0] Alluvial forests with Alder and Ash

This habitat is present at several locations around Scheme channels within the SAC and includes willows *Salix* spp., Alder *Alnus glutinosa* and Ash *Fraxinus excelsior*. It occasionally has an understory of Hawthorn *Crataegus monogyna*, Bramble *Rubus fruticosus* agg. and Elder *Sambucus nigra* and, in some locations, has developed from treelines that have been left to succeed naturally to woodland. The alluvial woodland near to the bog contained a wider variety of these species than the woodlands by Lough Derg.

Many of these woodlands, in particular those near to Lough Derg, have the potential to be the priority Annex I habitat 91E0 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*). This is based on the nature and location of the woodlands and the presence of the key canopy species Alder, Ash and Willows. Negative indicator species were not identified as being present and positive indicator species are potentially present also. These habitats are treated as the Annex 1 habitat Alluvial forests on a precautionary basis, although detailed surveying may reveal some to be of poor quality or too heavily modified to qualify.

Alluvial forest is located on channel C1 0-250 chains, C2 0-300 chains and 350-900 chains, and C2/1 0-200 chains.

5.3.2 [7110] Active raised bogs and [7120] Degraded raised bogs still capable of natural regeneration

Kilcarren-Firville Bog is a lowland raised bog complex containing a large area of uncut high bog. It is designated for the habitats (7110) Raised Bog, (7120) Degraded Raised Bog and (7150) *Rhynchosporion* Vegetation, all of which are present within this area. The bog is located approximately 50m away from channel C1/2/2 where works are planned, with a buffer zone of scrub and dry grassland between it and the Scheme channels.

5.3.3 Watercourses of plain to montane levels with *Ranunculion fluitans* and *Callitricho-Batrachion* vegetation (3260)

The Carrigahorig Stream varies in width between 1 to 10 m in width. The substrate is predominantly composed of large cobbles and boulders with fine sediment in between. In-stream vegetation includes Common Reed *Phragmites australis*, Bur-reed *Sparganium* spp., Fool's watercress *Apium nodiflorum*, Starworts *Callitriche* spp., Brooklime *Veronica beccabunga*, Floating Sweet-grass *Glyceria fluitans*, Water Mint *Mentha aquatica* and Duckweed *Lemna* spp. Marginal vegetation includes Cock's-foot *Dactylus glomerata*, Angelica *Angelica sylvestris*, Meadowsweet *Fillipendula ulmaria*, Bracken *Pteridium aquilinum* and Willowherb *Epilobium* spp.

The Annex I habitat - Watercourses of plain to montane levels with the *Ranunculion fluitans* and *Callitricho-Batrachion* vegetation (3260), has been identified as potentially being present on site. It was not possible to fully identify the in-stream floating vegetation in detail during the walkover survey, however, a variety of floating vegetation was visible, and given the quality of the habitat in some areas, it is likely that this is the Annex I habitat 3260. Therefore, using the expert judgement of the ecologist on-site and the precautionary principle, areas where floating river vegetation is present with at least one of the priority species for this habitat have been identified as areas potentially supporting this Annex I habitat.

5.4 Fauna

Evidence of ecologically sensitive fauna found along the surveyed channels during ecological surveys is described in the following sections. Past records of protected fauna collated from NBDC website and OPW database, recorded as being present within approximately 2 km of the survey area within the last 10 years are found in Appendix C.

5.4.1 Aquatic species

It is likely that a range of aquatic species, and particularly fish, use the Scheme channels. The presence of fish is important for maintaining the overall ecosystem of Lough Derg and supporting the SPA bird species.

5.4.2 Mammals

Otter is potentially present on Scheme channels, particularly the larger channels and closer to Lough Derg. No direct evidence was recorded during the surveys in 2017 or 2022.

5.4.3 Birds

Both the area around Lough Derg and the bogs provide suitable habitat for a range of bird species, including those listed in the citation for Lough Derg (Shannon) SPA.

5.5 Invasive Non-native Species

The invasive non-native species, Japanese Knotweed *Reynoutria japonica*, listed on the third schedule of the EC (Birds and Natural Habitats) Regulations 2011 S.I. No. 477/2011, was recorded as being present during the site visit. It was identified approximately 40 m from the scheme channel on the side of a road running through Kilcarren-Firville Bog SAC.

The non-native invasive water mould Crayfish Plague *Aphanomyces astaci* has been confirmed in the Lorrha River which feeds into Lough Derg < 2 km from the Carrigahorig Stream (Waterways Ireland 2017).

6 Natura 2000 sites within the Zone of Influence of the scheme

6.1 Introduction

This chapter provides baseline information on the Natura 2000 sites within the ZoI of the drainage maintenance activities. Brief descriptions of the sites are provided, along with details of the qualifying interests, conservation objectives and site vulnerabilities. A full description of each site is given in Appendix B. The screened in sites are:

- Kilcarren-Firville Bog SAC (000647)
- Lough Derg, North-East Shore SAC (002241)
- Lough Derg (Shannon) SPA (004058)
- Liskeenan Fen SAC (001683)
- Arragh More (Derrybreen) Bog SAC (002207)
- Scohaboy (Sopwell) Bog SAC (002206)
- River Shannon Callows SAC (000216)

The location of these sites in relation to the Scheme is shown in Figure 6-1.

6.2 Kilcarren-Firville Bog SAC (000647)

Kilcarren-Firville Bog is situated approximately 2 km east of the village of Carrigahorig in north Co. Tipperary. It is a lowland raised bog complex which extends about 4.5 km from east to west and is bisected by a road. It contains a large area of uncut high bog.

6.2.1 Qualifying Interests

The site is a Special Area of Conservation (SAC) selected for the habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (* = priority), as detailed in Table 6-1.

Table 6-1 Qualifying Interests of Kilcarren-Firville Bog SAC

Code	Qualifying Interest	Screened in?
7110	Raised Bog (Active)*	Yes
7120	Degraded Raised Bog	Yes
7150	<i>Rhynchosporion</i> Vegetation	Yes

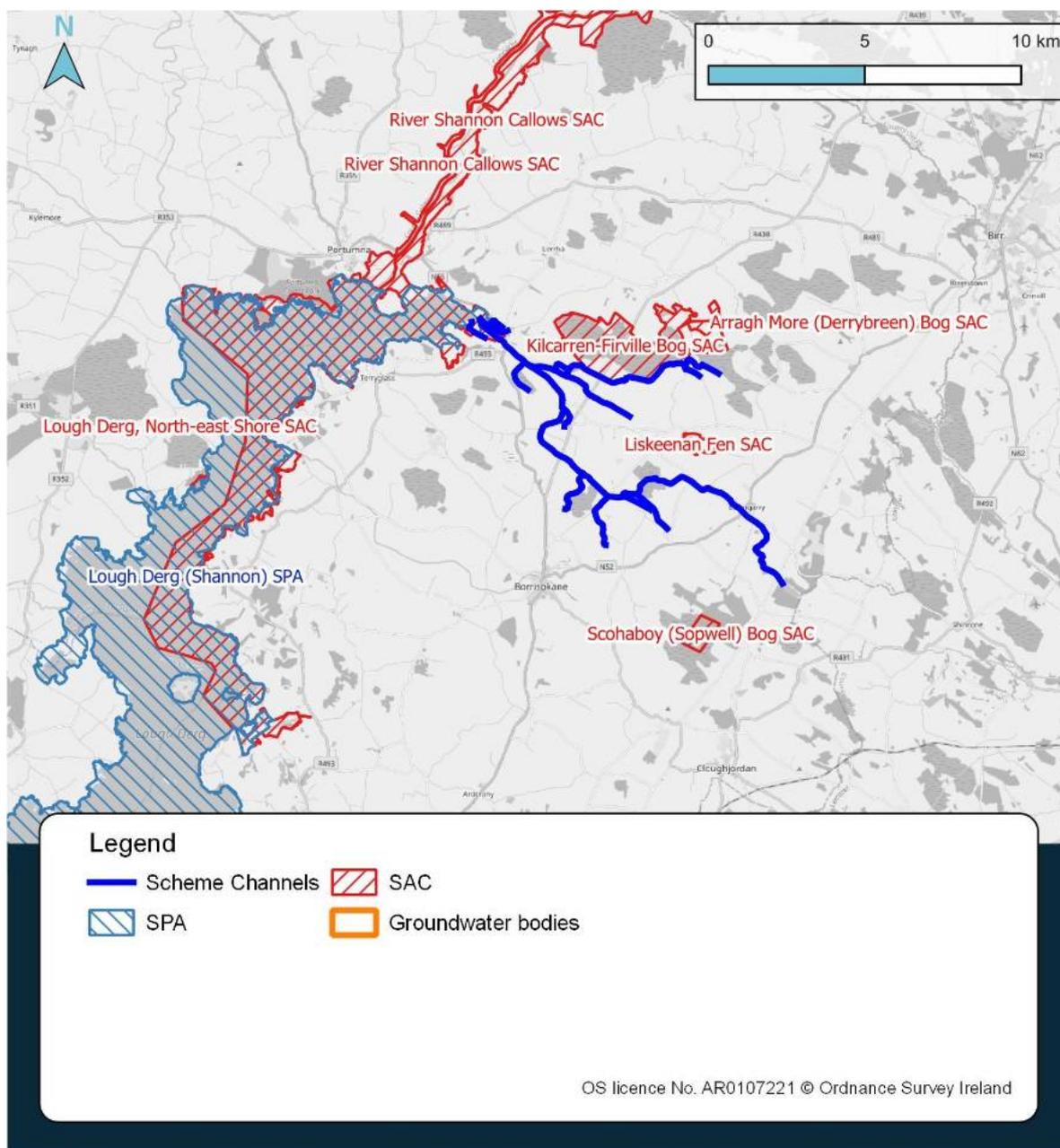


Figure 6-1. Carrigahorig Scheme locations and screened in Natura 2000 sites.

6.2.2 Conservation Objectives

The overall Conservation Objective for Kilcarren-Firville Bog SAC is to maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected. To achieve this, the following specific Conservation Objectives for the site are outlined (NPWS 2016c):

- Restore area of active raised bog to 92.4ha, subject to natural processes.
- Restore the distribution and variability of active raised bog across the SAC.
- No decline in extent of high bog necessary to support the development and maintenance of active raised bog.
- Restore appropriate water levels throughout the site.

- Restore, where possible, appropriate high bog topography, flow directions and slopes.
- Restore adequate transitional areas to support / protect the raised bog ecosystem and the services it provides.
- Restore 46.2ha of central ecotope/active flush/soaks/bog woodland as appropriate.
- Restore adequate cover of high quality microtopographical features.
- Restore adequate cover of bog moss (Sphagnum) species to ensure peat-forming capacity.
- Restore, where appropriate, typical active raised bog flora.
- Restore, where appropriate, typical active raised bog fauna.
- Maintain features of local distinctiveness, subject to natural processes.
- Negative physical features absent or insignificant.
- Native negative indicator species at insignificant levels.
- Non-native invasive species at insignificant levels and not more than 1% cover.
- Air quality surrounding bog close to natural reference conditions. The level of N deposition should not exceed 5kg N/ha/yr.
- Water quality on the high bog and in transitional areas close to natural reference conditions.

6.3 Lough Derg, North-East Shore SAC (002241)

Lough Derg, the lowest order lake on the River Shannon, is one of the largest bodies of freshwater in Ireland. This SAC, however, only includes the northern shore of the lake from the mouth of the Cappagh River in the north-west to just below Black Lough at the north-eastern shore.

6.3.1 Qualifying Interests

The site is an SAC selected for the habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (* = priority), as detailed in Table 6-2.

Table 6-2. Qualifying Interests of Lough Derg, North-East Shore SAC

Code	Qualifying Interest	Screened In?
5130	Juniper Scrub	No
7210	<i>Cladium</i> Fens*	Yes
7230	Alkaline Fens	Yes
8240	Limestone Pavement*	No
91E0	Alluvial Forests*	Yes
91J0	Yew Woodlands	No

6.3.2 Conservation Objectives

The overall Conservation Objective for Lough Derg, North-east Shore SAC is to maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected. In order to achieve this, the following specific Conservation Objectives for the site are outlined (NPWS 2019b). Only the objectives relating to those features screened in are included:

- Area of Annex I habitats stable or increasing, subject to natural processes.

- No decline in Annex I habitat distribution, subject to natural processes.
- Total cover of negative indicator species to be less than 10% in at least 50% of stops.
- At least 5% bare soil and/or at least 5% bare rock in at least 50% of stops.
- No decline in distribution or population sizes of rare, threatened or scarce species associated with the Cladium Fens and Alkaline Fens habitats; maintain features of local distinctiveness, subject to natural processes.
- Maintain active peat formation, where appropriate.
- Maintain, or where necessary restore, appropriate natural hydrological regimes necessary to support the natural structure and functioning of the habitat.
- Maintain, or where necessary restore, as close as possible to natural or semi-natural, drainage conditions.
- Maintain appropriate water quality, particularly pH and nutrient levels, to support the natural structure and functioning of the habitat.
- Maintain adequate cover of typical species, including brown mosses and vascular plants.
- Cover of native negative indicator species at insignificant levels.
- Cover of non-native species less than 1%.
- Cover of scattered native trees and shrubs less than 10%.
- Cover of disturbed bare ground not more than 10%. Where tufa is present, disturbed bare ground not more than 1%.
- Maintain soil pH and nutrient status within natural ranges.
- Maintain variety of vegetation communities, subject to natural processes.
- Total cover of soft rush (*Juncus effusus*) and common reed (*Phragmites australis*) less than 10%.
- Total cover of litter not more than 25%.
- Indicators of local distinctiveness are maintained.

6.4 Lough Derg (Shannon) SPA (004058)

Lough Derg lies within counties Tipperary, Galway and Clare and is the largest of the River Shannon Lakes, being some 40 km long. Its maximum breadth across the Scarriff Bay - Youghal Bay transect is 13 km but for most of its length it is less than 5 km wide. The lake is relatively shallow at the northern end being mostly 6 m in depth but in the middle region it has an axial trench and descends to over 25 m in places (NPWS, 2014a).

6.4.1 Qualifying Interests

The site is a Special Protection Area (SPA) selected for the QI features detailed in Table 6-3.

Table 6-3. Qualifying Interests of Lough Derg (Shannon) SPA

Code	Qualifying Interest	Screened in?
A017	Cormorant (<i>Phalacrocorax carbo</i>) - breeding	Yes
A061	Tufted Duck (<i>Aythya fuligula</i>) - wintering	Yes
A067	Goldeneye (<i>Bucephala clangula</i>) - wintering	Yes
A193	Common Tern (<i>Sterna hirundo</i>) - breeding	Yes
A999	Wetland and Waterbirds - wintering	Yes

6.4.2 Conservation Objectives

The overall Conservation Objective for Lough Derg (Shannon) SPA is to maintain or restore the favourable conservation condition of the Annex II species for which the SPA has been selected.

To acknowledge the importance of Ireland's wetlands to wintering waterbirds, "Wetland and Waterbirds" may be included as a Special Conservation Interest for some SPAs that have been designated for wintering waterbirds and that contain a wetland site of significant importance to one or more of the species of Special Conservation Interest. Thus, a second objective is included as follows: to maintain or restore the favourable conservation condition of the wetland habitat at Lough Derg (Shannon) SPA as a resource for the regularly occurring migratory waterbirds that utilise it (NPWS, 2022a).

6.5 Liskeenan Fen SAC (001683)

Liskeenan Fen is a small turlough-like fen situated about 10 km north-west of Borrisokane and just 1 km from the village of Aglish, in north Co. Tipperary. The site floods in winter via a swallow hole in the far north-west corner. The eastern part of the site consists of a small, dry, inactive raised bog on which mixed woodland is developing, as well as an extensive and unusual area of flooded cut-away.

6.5.1 Qualifying Interests

The site is an SAC selected for the habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (* = priority), as detailed in Table 6-4.

Table 6-4. Qualifying Interests of Liskeenan Fen SAC

Code	Qualifying Interest	Screened in?
7210	Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i>	Yes

6.5.2 Conservation Objectives

The overall Conservation Objective for Liskeenan Fen SAC is to maintain or restore the favourable conservation condition of the Annex I habitat for which the SAC has been selected. To achieve this, the following specific Conservation Objectives for the site are outlined (NPWS, 2018):

- Area of Calcareous Fens stable or increasing, subject to natural processes.
- No decline in Calcareous Fen distribution, subject to natural processes.
- Maintain active peat formation, where appropriate.
- Maintain, or where necessary restore, appropriate natural hydrological regimes necessary to support the natural structure and functioning of the Calcareous Fen habitat.
- Maintain, or where necessary restore, as close as possible to natural or semi-natural drainage conditions.
- Maintain appropriate water quality, particularly pH and nutrient levels, to support the natural structure and functioning of the habitat.
- Maintain adequate cover of typical species, including brown mosses and vascular plants.
- Cover of native negative indicator species at insignificant levels.
- Cover of non-native species less than 1%.
- Cover of scattered native trees and shrubs less than 10%.

- Cover of disturbed bare ground not more than 10%. Where tufa is present, disturbed bare ground not more than 1%.
- 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.

6.6 Arragh More (Derrybreen) Bog SAC (002207)

Arragh More (Derrybreen) Bog SAC occurs within the larger raised bog system that is designated as Arragh More Bog NHA (000640). It is situated 9.5 km north-east of Borrisokane in County Tipperary. It lies in the townlands of Arraghmore and Derrybreen.

6.6.1 Qualifying Interests

The site is an SAC selected for the habitats and/or species listed on Annex I / II of the E.U. Habitats Directive, as detailed in Table 6-5.

Table 6-5. Qualifying Interests of Arragh More (Derrybreen) Bog SAC

Code	Qualifying Interest	Screened in?
7210	Degraded Raised Bog	Yes

6.6.2 Conservation Objectives

The overall Conservation Objective for Arragh More (Derrybreen) Bog SAC is to maintain or restore the favourable conservation condition of the Annex I habitat for which the SAC has been selected (NPWS, 2022b). There are no site-specific objectives for Arragh More (Derrybreen) Bog SAC.

6.7 Scohaboy (Sopwell) Bog SAC (002206)

Scohaboy (Sopwell) Bog SAC occurs within the larger raised bog system that is designated as Scohaboy Bog NHA (002206). It is situated 4 km north-west of Cloughjordan in Co. Tipperary. It lies within the townland of Sopwell. The site comprises a relatively large, flat area of raised bog that includes both areas of high bog and cutover bog (NPWS, 2016b)

6.7.1 Qualifying Interests

The site is an SAC selected for the habitats and/or species listed on Annex I / II of the E.U. Habitats Directive, as detailed in Table 6-6.

Table 6-6. Qualifying Interests of Scohaboy (Sopwell) Bog SAC

Code	Qualifying Interest	Screened in?
7210	Degraded Raised Bog	Yes

6.7.2 Conservation Objectives

The overall Conservation Objective for Scohaboy (Sopwell) Bog SAC is to maintain or restore the favourable conservation condition of the Annex I habitat for which the SAC has been selected (NPWS, 2022c). There are no site-specific conservation objectives for Scohaboy (Sopwell) Bog SAC.

6.8 River Shannon Callows SAC (000216)

The River Shannon Callows is a long and diverse site which consists of seasonally flooded, semi-natural, lowland wet grassland, along and beside the river between the towns of Athlone and Portumna. It is approximately 50 km long and averages about 0.75 km wide

(reaching 1.5 km wide in places). Along much of its length the site is bordered by raised bogs (many, but not all, of which are subject to large-scale harvesting), esker ridges and limestone-bedrock hills. The soils grade from silty-alluvial to peat (NPWS 2020b).

6.8.1 Qualifying Interests

The site is an SAC selected for the habitats and/or species listed on Annex I / II of the E.U. Habitats Directive, as detailed in Table 6-7.

Table 6-7. Qualifying Interests of River Shannon Callows SAC

Code	Qualifying Interest	Screened in?
7210	<i>Molinia</i> meadows on calcareous, peaty or clayey-silt-laden soils (<i>Molinia caeruleae</i>)	No
6510	Lowland hay meadows (<i>Alopecurus pratensis</i> , <i>Sanguisorba officinalis</i>)	No
7230	Alkaline fens	No
8240	Limestone pavements	No
91E0	Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno-Padion</i> , <i>Alnion incanae</i> , <i>Salicion albae</i>)	No
1355	<i>Lutra lutra</i> (Otter)	Yes

6.8.2 Conservation Objectives

The overall Conservation Objective for River Shannon Callows SAC is to maintain or restore the favourable conservation condition of the Annex I habitat for which the SAC has been selected (NPWS, 2022d). There are detailed conservation objectives relating to each of the QI features. Those relevant to the only screened in feature, Otter, are:

- Distribution (no significant decline in percent of positive survey sites)
- Extent of terrestrial habitat (no significant decline in area)
- Extent of freshwater habitat (no significant decline in length)
- Couching and holting sites (no significant decline in number)
- Fish biomass available (No significant decline in weight)
- Barriers to connectivity (No significant increase in number)

7 Appropriate Assessment

7.1 Introduction

The following chapter assesses the potential for adverse impacts on the screened in Natura 2000 sites in more detail, using the detailed information assembled from the baseline ecology and designated site details, and examines where adverse impacts may arise from the sources of impact from the Scheme. Where potentially significant adverse impacts are identified, avoidance and mitigation measures are proposed to offset these impacts. These are discussed in the following sections.

The screened in Natura 2000 sites are:

- Kilcarren-Firville Bog SAC (000647)
- Lough Derg, North-East Shore SAC (002241)
- Lough Derg (Shannon) SPA (004058)
- River Shannon Callows SAC (000216)
- Liskeenan Fen SAC (001683)
- Arragh More (Derrybreen) Bog SAC (002207)
- Scohaboy (Sopwell) Bog SAC (002206)

7.2 Identification of Potential Sources of Impact

The potential sources of impact were set out in the screening assessment and summarised in Table 4-2.

7.3 Impact Assessment

All combinations of impact sources and ecological receptors are assessed to see if there are adverse effects on site integrity. The assessment and results are presented Table 7-1.

7.3.1 Do nothing scenario

There is a legal requirement from the Arterial Drainage Acts to maintain the Scheme, so in the absence of a change in the legislation, there is no option to not to maintain the scheme. In some cases sites have been developed behind the embankments or in the benefitting lands within the scheme. In the absence of maintenance, the conveyance of the channels would reduce and blockages would likely develop, raising upstream water levels, bank failure would be likely and there would be increased wetness of adjacent habitats including increased flood risk to land and properties.

Table 7-1. Assessment of Impacts

Qualifying Interest	Potential Source of Impact	Relevant COs to impact	Impact on Attribute and Target Prior to Mitigation / Avoidance	Avoidance / Mitigation Measures	Residual Impact Assessment
Lough Derg, North-east Shore SAC					
Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i> Alkaline fens Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i>	Release of suspended solids <i>Surface water</i>	Water quality Drainage Hydrological regime Habitat quality (negative indicators and typical species)	The Carrigahorig Scheme channels partly overlap with the SAC. Channel works on the entirety of channel C3 and C2/1, and from Lough Derg to Carrigahorig on channel C2 are within this SAC. calcareous and Alkaline fens were not identified during the site survey in this location, but wet woodland was present around C2, C2/1, the very northern extent of C1, and within 100m of C3. Due to the proximity and connectivity via surface water, there is the potential for effects on the SAC because of suspended solids and changes to nutrient levels or pollutants from Scheme activities. Any impacts that may occur through the release of suspended solids, changes to nutrient levels or pollutants to alluvial habitats could impact on the vegetation composition and structure of the habitats, the ecosystem functioning and the habitat area and distribution. However, in most locations the woodland is raised well above the normal water level, and typically only receives surface water during periods of high flow (when maintenance would not be taking place). This means that the short-term changes in surface water quality from the Scheme would not impact on the wet woodland.	Not required.	No adverse impact.
	Release or changes in nutrient levels/pollutants <i>Surface water</i>				
	Changes in water levels/channel morphology <i>Surface water</i>				

Qualifying Interest	Potential Source of Impact	Relevant COs to impact	Impact on Attribute and Target Prior to Mitigation / Avoidance	Avoidance / Mitigation Measures	Residual Impact Assessment
	Physical disturbance of habitats <i>Land</i>	Habitat area and distribution Physical structure (bare ground)	<p>The Carrigahorig Scheme channels partly overlap with the SAC. However, calcareous and alkaline fens were not identified during the site survey in this location, but wet woodland was present around C2, C2/1, the very northern extent of C1, and within 100m of C3.</p> <p>Physical alterations causing a reduction in area or quality of habitats, can be caused by trampling, extensive removal of vegetation, in particular within the SAC, and destruction of the composition and structure of the habitats present. Alterations to the structure of interconnected wetland habitats can cause a reduction in habitat quality.</p> <p>A reduction in habitat quality and physical alterations can also be caused by the introduction of non-native invasive species by machinery or equipment. Japanese Knotweed has been identified directly adjacent to the area of works.</p>	<p>Follow EP 30 Alluvial (Wet Woodland) (Brew & Gilligan, 2019) where habitat is known to be present on channels: C1 0-250 chains, C2 0-300, 350-900 chains, C2/1 0-200 chains.</p> <p>In these locations maintenance must be carried out from the opposite bank to the one supporting woodland or if not possible then the section skipped.</p> <p>No new MAC should be created through the alluvial forest.</p>	No adverse impact.
	Changes in GWB water level <i>Groundwater</i>	Water quality Hydrological regime Drainage conditions	<p>No maintenance activities are proposed inside areas of calcareous or alkaline fens, but activities are planned on channels with alluvial woodland adjacent.</p> <p>Alluvial forests are also a groundwater dependant habitat that require groundwater levels to be within a certain limit. Alterations to the hydrological regimes of these Annex I habitats, because of changes to water levels and channel morphology, may dry the habitats out or cause them to be permanently waterlogged.</p> <p>Scheme activities will restore the system to, or sufficiently close to, the design standard and is done on a repeating cycle meaning this only a small change in each maintenance period. Only a proportion (15-30%) of channels are maintained in any one year and between maintenance periods silt and vegetation accumulate so that only small temporary changes in surface water drainage patters occur and there is no likelihood of adverse impacts.</p>	Not required.	No adverse impact.

Qualifying Interest	Potential Source of Impact	Relevant COs to impact	Impact on Attribute and Target Prior to Mitigation / Avoidance	Avoidance / Mitigation Measures	Residual Impact Assessment
Lough Derg (Shannon) SPA					
Cormorant (<i>Phalacrocorax carbo</i>) Tufted Duck (<i>Aythya fuligula</i>) Goldeneye (<i>Bucephala clangula</i>) Common Tern (<i>Sterna hirundo</i>)	Physical disturbance of habitat <i>Land</i>	Maintain/restore wetland habitat Maintain/restore breeding sites	Cormorant and Common Tern nest on islands and remote shores within the lake. Great Crested Grebe nest on platforms on the lake. Tufted Duck make nests near to water in dense habitats such as scrub. These habitats are close to the scheme channels, and as such, impacts to these species are possible. Vehicle movements along MAC and during maintenance activities, removal of bankside vegetation to facilitate access and as part of maintenance activities and embankment maintenance may result in physical disturbance to habitats which support wintering and breeding birds. If works are undertaken during the breeding season, and without appropriate checks on vegetation to be removed, nests and/or chicks could be damaged or destroyed. The availability and quality of nesting habitat could also be reduced.	Within the SPA the existing MAC will be used. Creating a new MAC within this boundary would require a separate assessment. Follow EP25 Birds (Brew & Gilligan, 2019): on all Scheme channels within the SPA. The channels within the SPA are: C1 -200 chains, C2 0-300 chains, C2/1 0-100 chains and C3 0-650 chains. No maintenance activities will be carried out within the SPA boundary between September and February (inclusive). Areas of scrub (Tufted Duck nesting habitat) outside the SAC but within 200 m should be removed outside of the nesting bird season to avoid disturbing Tufted Duck nests. No such habitat should be removed from inside the SAC without a separate assessment as it may result in depletion of core nesting habitat for Tufted Duck.	No adverse impact.
Wetland and Waterbirds	Removal of habitat suitable for bird species <i>Land</i>		Cormorant and Common Tern nest on islands and remote shores within the lake. Great Crested Grebe nest on platforms on the lake. No such habitat is located within the scheme channels so there will be no impacts on breeding habitat for these species. Tufted Duck make nests near to water in dense habitats such as scrub. These habitats are close to the scheme channels, and as such, impacts to this species are possible. Vegetation (trees, scrub, tall ruderal and riparian vegetation) may need to be removed to maintain the MAC, and as part of the vegetation management and embankment maintenance activities. Many waterbirds use such habitats for sheltering and nesting, and as a result, will be displaced if habitat is removed.		
	Noise/ visual/ vibration disturbance of species <i>Land</i>	Maintain/restore distribution of species	The waterbirds listed as QIs of the SPA are species that are sensitive to disturbance. Disturbance may be visual from general presence of staff and machinery, or through noise from staff and machinery operating. Although temporary, disturbance can cause displacement of individuals, which may contribute to reduced fitness and increased stress.		No adverse impact.

Qualifying Interest	Potential Source of Impact	Relevant COs to impact	Impact on Attribute and Target Prior to Mitigation / Avoidance	Avoidance / Mitigation Measures	Residual Impact Assessment
			<p>Wintering birds will typically be sensitive to disturbance between November and March, however resident birds can be disturbed throughout the year, and breeding birds can be disturbed during the period March to September. Winter migratory or breeding season activities can lead to mortalities in themselves, so unnecessary stresses must be avoided. Any unnecessary stresses upon wintering and breeding birds can impact upon the population trends of a species and species distribution.</p> <p>Cormorant and Common Tern nest on islands and remote shores within the lake. Great Crested Grebe nest on platforms on the lake. Tufted Duck make nests near to water in dense habitats such as scrub. These habitats are close to the scheme channels, and as such, impacts to these species which breed within the SAC are possible.</p> <p>Disturbance to nesting birds could cause abandonment of nests or chicks. If the impact is significant, it could affect population trends.</p>		
	<p>Release of suspended solids <i>Surface water</i></p> <p>Release or changes in nutrient levels/ pollutants <i>Surface water</i></p>	<p>Maintain/ restore wetland habitat</p>	<p>The waterbird populations for which the SPA is designated are dependent on a number of habitats with connectivity to surface waters. Reducing quality of surface water would degrade these habitats, reducing habitat area and cause birds to find habitat elsewhere or reduce the number of birds the site could support.</p> <p>Nutrient level increases could cause an increase in vegetation growth, blocking light for understory or underwater species. Eutrophication, caused by discharges of detergents, phosphates or sewage, can cause an increase in algal growth in water, which de-oxygenates the water as it dies off, causing fish kills and smothers the typical vegetation present. A reduction in habitat quality and the availability of suitable prey species can also occur from poisoning as a result of the release of pollutants. Protected birds that rely on fish, such as Cormorant, will travel to other locations to find suitable fish, or they may eat poisoned fish, resulting in mortalities. Changes in water levels and channel morphology would also make a</p>	<p>EP10 silt management is implemented as standard, but will be done with particular care on channels within 1km of the SPA. For the closest channels, those within 200m, and with the smallest amount of time for dilution to reduce suspended solid concentrations, the following measures must be implemented:</p> <ul style="list-style-type: none"> - leaving 20m unmaintained on minor channel outfalls to major channels, stagger this unmaintained length 	<p>No adverse impact.</p>

Qualifying Interest	Potential Source of Impact	Relevant COs to impact	Impact on Attribute and Target Prior to Mitigation / Avoidance	Avoidance / Mitigation Measures	Residual Impact Assessment
			<p>habitat unsuitable for birds such as Tufted Duck or Goldeneye, that may feed on small invertebrates such as crustaceans, molluscs and small fish.</p> <p>Compliance with the EPs that apply to all drainage maintenance activities means that there should be no impact on these habitats, and thus waterbirds and their food sources.</p>	<p>on following maintenance cycles</p> <ul style="list-style-type: none"> - restrict maintenance to the middle 2/3rd section of the channel, and to one riverbank - leave a 1.5 m buffer of undisturbed ground on the top of the banks to act as a sediment trap <p>The channels inside and within 200m of the SPA are: C1 0-400 chains, C2 0-600 chains, C2/1 0-400 chains and C3 0-850 chains.</p>	
	<p>Changes in water levels/ channel morphology <i>Surface water</i></p>		<p>Drainage maintenance activities, such as silt and vegetation management and aquatic vegetation cutting, can result in the deepening and widening of channels, which could impact on surface water flows and water table levels. This could then have adverse impacts on the habitat area of the wetlands and the population trend and distribution of the waterbirds they support.</p> <p>Scheme activities will restore the system to, or sufficiently close to, the design standard and is done on a repeating cycle meaning this only a small change in each maintenance period. Only a proportion (15-30%) of channels are maintained in any one year and between maintenance periods silt and vegetation accumulate so that only small temporary changes in surface water drainage patterns occur and there is no likelihood of adverse impacts.</p>	<p>Not required.</p>	<p>No adverse impact.</p>

Qualifying Interest	Potential Source of Impact	Relevant COs to impact	Impact on Attribute and Target Prior to Mitigation / Avoidance	Avoidance / Mitigation Measures	Residual Impact Assessment
Liskeenan Fen SAC					
Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i>	Release of suspended solids Release or changes in nutrient levels/ pollutants <i>Surface water</i>	Water quality Drainage Hydrological regime Habitat quality (negative indicators and typical species)	Scheme channels drain away from the SAC. There will be no upstream impact from changes in water quality in the SAC.	Not required.	No adverse impact.
	Changes in water levels/ channel morphology <i>Surface water</i>		Maintenance of natural hydrological processes is an important attribute to support the natural structure and function of calcareous fens. Changes to water levels could cause changes to vegetation composition and structure as plants and species present adapt to the new water levels. Scheme activities will restore the system to, or sufficiently close to, the design standard and is done on a repeated cycle meaning this only a small change in each maintenance period. Only a proportion (15-30%) of channels are maintained in any one year and between maintenance periods silt and vegetation accumulate so that only small temporary changes in surface water drainage patters occur and there is no likelihood of adverse impacts.		
	Changes in GWB water level <i>Groundwater</i>	Water quality Hydrological regime Drainage conditions	The silt and vegetation management in Scheme channels may result in a small lowering of the water level within the channel, and in a karstic groundwater body this can low water levels within the groundwater body where there is direct discharge into the Scheme channel. Scheme activities will restore the system to, or sufficiently close to, the design standard and is done on a repeated cycle meaning this only a small change in each maintenance period. Only a proportion (15-30%) of channels are maintained in any one year and between maintenance periods silt and vegetation accumulate so that only small temporary changes in surface water drainage patters occur. These small changes mean that over 700m between the SAC and Scheme channels within the karstic groundwater body,	Not required.	No adverse impact.

Qualifying Interest	Potential Source of Impact	Relevant COs to impact	Impact on Attribute and Target Prior to Mitigation / Avoidance	Avoidance / Mitigation Measures	Residual Impact Assessment
			there will be no significant alteration to groundwater levels at the SAC, and therefore no adverse impacts will occur.		
Kilcarren-Firville Bog SAC					
<p>Raised Bog (Active)*</p> <p>Degraded Raised Bog still capable of natural regeneration</p> <p><i>Rhynchosporion</i> Vegetation</p>	<p>Physical disturbance of habitats</p> <p><i>Land</i></p>	<p>Habitat area</p> <p>Vegetation structure</p> <p>Vegetation quality</p> <p>Vegetation composition</p>	<p>Channel C1/2/2 runs adjacent to Kilcarren-Firville Bog SAC. The field survey confirmed that, although bogs do not occur directly adjacent to the channels, they are separated by small areas of wet woodland, mixed woodland and conifer plantation. Therefore, the Annex I bog habitats will not be directly impacted by the Scheme works. However, vehicles moving and working in the MAC could be directly operating in bog habitat. This could impact on attributes including habitat area and vegetation structure and composition.</p> <p>The MAC around Channel C1/2/2 is well-established and used typically once every ten years, by a machine passing only once in each direction. This means that the impacts will be short-term and not result in significant adverse impacts.</p> <p>Japanese Knotweed (JK) has been identified directly adjacent to the area of works. Disturbance to existing stands can cause the spread of the species by releasing tiny fragments into the surrounding habitats (typically up to 7m away).</p> <p>Physical alterations resulting from disturbance or introduction of non-native invasive species, can be temporary or permanent dependant on the nature and extent of the habitat alteration. Japanese Knotweed infestations can take years to eradicate. Alterations to habitats can reduce their area, structure and composition. The stand is currently outside the area needed for the Scheme, so no impacts will occur.</p>	<p>Access to Channel C1/2/2 must be done using the existing MAC on the left bank only.</p> <p>Creation of a new MAC within the SAC would require a separate assessment.</p> <p>The Japanese Knotweed at C1/2/2 500 chains should be checked before maintaining this section and if it encroaches within 10m of the MAC it should be eradicated.</p>	No adverse impact.
	<p>Changes in GWB water level</p> <p><i>Groundwater</i></p>		<p>Drainage maintenance activities, such as silt and vegetation management and aquatic vegetation cutting can result in the deepening and widening of channels which could impact on groundwater levels. This could have adverse impacts on these habitats and a number of attributes, including habitat area, habitat distribution, vegetation composition and structure and typical species.</p> <p>Scheme activities will restore the system to, or sufficiently close to, the design standard and is done on a repeating cycle</p>	Not required.	No adverse impact.

Qualifying Interest	Potential Source of Impact	Relevant COs to impact	Impact on Attribute and Target Prior to Mitigation / Avoidance	Avoidance / Mitigation Measures	Residual Impact Assessment
			<p>meaning this only a small change in each maintenance period. Only a proportion (15-30%) of channels are maintained in any one year and between maintenance periods silt and vegetation accumulate so that only small, temporary changes in water patters occur and there is no likelihood of adverse impacts.</p>		
Arragh More (Derrybreen) Bog SAC					
Degraded Raised Bogs still capable of natural regeneration	Changes in GWB water level <i>Groundwater</i>	Hydrological regime Vegetation quality Water quality	<p>Drainage maintenance activities, such as silt and vegetation management and aquatic vegetation cutting can result in the deepening and widening of channels which could impact on groundwater levels. This could have adverse impacts on these habitats and a number of attributes, including habitat area, habitat distribution, vegetation composition and structure and typical species.</p> <p>Scheme activities will restore the system to, or sufficiently close to, the design standard and is done on a repeating cycle meaning this only a small change in each maintenance period. Only a proportion (15-30%) of channels are maintained in any one year and between maintenance periods silt and vegetation accumulate so that only small, temporary changes in drainage patters occur and there is no likelihood of adverse impacts.</p>	Not required.	No adverse impact.
Scohaboy (Sopwell) Bog SAC					
Degraded Raised Bogs still capable of natural regeneration	Changes in GWB water level <i>Groundwater</i>	Hydrological regime Vegetation quality Water quality	<p>Drainage maintenance activities, such as silt and vegetation management and aquatic vegetation cutting can result in the deepening and widening of channels which could impact on groundwater levels. This could have adverse impacts on these habitats and a number of attributes, including habitat area, habitat distribution, vegetation composition and structure and typical species.</p> <p>Scheme activities will restore the system to, or sufficiently close to, the design standard and is done on a repeating cycle meaning this only a small change in each maintenance period. Only a proportion (15-30%) of channels are maintained in any one year and between maintenance periods silt and vegetation accumulate so that only small, temporary changes in drainage patters occur and there is no likelihood of adverse impacts.</p>	Not required.	No adverse impact.

Qualifying Interest	Potential Source of Impact	Relevant COs to impact	Impact on Attribute and Target Prior to Mitigation / Avoidance	Avoidance / Mitigation Measures	Residual Impact Assessment
River Shannon Callows SAC					
Otter	Disturbance <i>Land</i>	Extent of terrestrial habitat Extent of riparian habitat Couching and holting sites	<p>Vehicle movements along MAC and during maintenance activities, removal of bankside vegetation to facilitate access and as part of maintenance activities and embankment maintenance may result in physical disturbance to couching and holting sites as well as reducing suitable terrestrial habitat which support Otter that are functionally linked to the Otter population within the River Shannon Callows SAC, given that territories can be over 50km.</p> <p>No impacts are likely on the extent of riparian habitat as the Scheme maintains the channels in a functional state that would allow Otter to continue using them.</p>	Implement EP20 Otter on the channels directly connected to Lough Derg or which are wooded close to the branch with C1. These are C1, C2, C3, and C1/1 and C1/2 0-200 chains.	No adverse impact.

7.4 Site-specific mitigation measures

Table 7-2 summarises the specific measures identified in Table 7-1 that are necessary to avoid or mitigate any adverse impacts on the above Natura 2000 sites. These site-specific mitigation measures should be read in conjunction with the Scheme description detailed in Section 3, to understand the full scheme of works and all of the required mitigation measures.

Table 7-2. Specific mitigation measures

Potential Impact	Specific Avoidance and Mitigation Measures
<p>Lough Derg, North-east Shore SAC: Calcareous fens, Alkaline fens and Alluvial forests Physical disturbance of habitats</p>	<p>Follow EP 30 Alluvial (Wet Woodland) (Brew & Gilligan, 2019) where habitat is known to be present on channels: C1 0-250 chains, C2 0-300, 350-900 chains, C2/1 0-200 chains. In these locations maintenance must be carried out from the opposite bank to the one supporting woodland or if not possible then the section skipped. No new MAC should be created through the alluvial forest.</p>
<p>Lough Derg (Shannon) SPA: All QI Physical disturbance of habitat Removal of habitat suitable for bird species Noise and visual disturbance</p>	<p>Within the SPA the existing MAC will be used. Creating a new MAC within this boundary would require a separate assessment. Follow EP25 Birds (Brew & Gilligan, 2019): on all Scheme channels within the SPA. The channels within the SPA are: C1 - 200 chains, C2 0-300 chains, C2/1 0-100 chains and C3 0-650 chains. No maintenance activities will be carried out within the SPA boundary between September and February (inclusive). Areas of scrub (Tufted Duck nesting habitat) outside the SAC but within 200 m should be removed outside of the nesting bird season to avoid disturbing Tufted Duck nests. No such habitat should be removed from inside the SAC without a separate assessment as it may result in depletion of core nesting habitat for Tufted Duck.</p>
<p>Lough Derg (Shannon) SPA: All QI Release of suspended solids Release or changes in nutrient levels/pollutants</p>	<p>EP10 silt management is implemented as standard but will be done with particular care on channels within 1km of the SPA. For the closest channels, those within 200m, and with the smallest amount of time for dilution to reduce suspended solid concentrations, the following measures must be implemented: leaving 20m unmaintained on minor channel outfalls to major channels, stagger this unmaintained length on following maintenance cycles restrict maintenance to the middle 2/3rd section of the channel, and to one riverbank leave a 1.5 m buffer of undisturbed ground on the top of the banks to act as a sediment trap The channels inside and within 200m of the SPA are: C1 0-400 chains, C2 0-600 chains, C2/1 0-400 chains and C3 0-850 chains.</p>
<p>Kilcarren-Firvilee Bog SAC: All QI Physical disturbance of habitats</p>	<p>Access to Channel C1/2/2 must be done using the existing MAC on the left bank only. Creation of a new MAC within the SAC would require a separate assessment. The Japanese Knotweed at C1/2/2 500 chains should be checked before maintaining this section and if it encroaches within 10m of the MAC it should be avoided, treated or managed based on recommendations from a competent ecologist.</p>

Potential Impact	Specific Avoidance and Mitigation Measures
River Shannon Callows SAC Otter	Implement EP20 Otter on the channels directly connected to Lough Derg or which are wooded close to the branch with C1. These are C1, C2, C3, and C1/1 and C1/2 0-200 chains.

With this mitigation in place the Scheme activities will not adversely affect the integrity of the Natura 2000 sites, in light of their conservation objectives and best scientific evidence. To confirm this conclusion, the following checklist, taken from DoEHLG (2010) has been completed (Table 7-3 and Table 7-4).

Table 7-3. Integrity of Site Checklist- Conservation Objectives

Conservation objectives: does the project or plan have the potential to:	Y/N
Cause delays in progress towards achieving the conservation objectives of the sites?	N
Interrupt progress towards achieving the conservation objectives of the sites?	N
Disrupt those factors that help to maintain the favourable conditions of the site?	N
Interfere with the balance, distribution and density of key species that are the indicators of the favourable condition of the site?	N

Table 7-4. Integrity of Site Checklist- Other Objectives

Other objectives: does the project or plan have the potential to:	Y/N
Cause changes to the vital defining aspects (e.g. nutrient balance) that determine how the site functions as a habitat or ecosystem?	N
Change the dynamics of the relationships (between, for example, soil and water or plants and animals) that define the structure and/or function of the site?	N
Interfere with predicted or expected natural changes to the site (such as water dynamics or chemical composition)?	N
Reduce the area of key habitats?	N
Reduce the population of key species?	N
Change the balance between key species?	N
Reduce diversity of the site?	N
Result in disturbance that could affect population size or density or the balance between key species?	N
Result in fragmentation	N
Result in loss or reduction of key features (e.g. tree cover, tidal exposure, annual flooding etc.)?	N

8 In-combination impacts

Projects and Plans that have the potential to contribute in-combination impacts and cumulative impacts upon Natura 2000 designated sites are considered in this section, as described in the *Guidelines for the Assessment of Indirect and Cumulative Impacts, as well as Impact Interactions* (Walker and Johnston 1999). Key points considered when assessing cumulative and in-combination impacts include the nature and scale of the potential impacts, including their potential magnitude and significance, the availability and quality of data, and the impacts that may have occurred with similar projects in the area, where available or observed.

The impact assessment identified two possible impacts which do not meet the threshold of adverse effect on site integrity alone, and these are examined to see if they could result in an adverse effect in-combination with other plans or projects. The impacts are:

- Disturbance on all QI of Lough Derg SPA
- Release of suspended solids on all QI of Lough Derg SPA

The avoidance and mitigation measures in place for all other LSE are considered sufficient that there would be no impact at all alone, so that no in-combination impacts are possible. Information on all plans and projects within 5km of the Scheme were gathered, and these were assessed to see if they could potentially result in similar impacts to the Scheme and, if so, the possibility of the impacts acting in-combination were considered.

8.1 Plans

In general, Plans rarely have foreseeable and real (not theoretical) impacts with Scheme implementation. However, where there is spatial and temporal overlap in actions and land designations in Plans, these are examined for potential impacts with the Scheme. The following Plans are considered for in-combination impacts as they either have spatial overlap with the scheme or affect similar ecological receptors:

- River Basin Management Plan for Ireland
- Tipperary County Development Plan

8.1.1 River Basin Management Plan for Ireland 2018-2021 and 2022-2027

The core objectives of the Water Framework Directive are to prevent deterioration, restore good status, reduce chemical pollution and achieve the water related objectives of protected areas. The River Basin Management Plan (RBMP) for Ireland 2018-2021 shows the ecological status of all monitored waters in the 2010-2015 period are as follows: 10.4% are High status, 46.3% are Good status, 25.5% are Moderate status, 17.6% are Poor status and 0.2% are Bad status (DHLGH, 2018). The plan is now being updated and the 2022-2027 plan is out for public consultation. It maintains the same aims of bringing rivers into good ecological status in line with WFD requirements.

The plan aims to improve the management and water quality of the River Basin, and hence the waterbodies inside the Carrigahorig Scheme. **Therefore, the Plan would not have any adverse impact alone on any Natura 2000 site and could not have impacts in-combination with the Scheme.**

8.1.2 Tipperary County Development Plan

The Tipperary County Development Plan (2022-2028) has specific policies and objectives that contribute to the conservation and protection of Natura 2000 sites in accordance with the Habitats Directive. The NIS of the development plan (CAAS, 2022) has been carried out and found that there are not likely to be significant, potentially significant or uncertain impacts on the network of Natura 2000 sites as a result of the County Development Plan.

Therefore, there will be no in-combination impacts of the Tipperary County Development Plan (2022-2028) and the Scheme.

8.2 Projects

8.2.1 Agricultural activities

Farmers and landowners may also undertake general agricultural operations in areas adjacent to the Carrigahorig Scheme Channels, which could potentially give rise to impacts of a similar nature to those arising from the planned OPW works. This could potentially result in additional periods of disturbance and a risk to water quality. Many agricultural operations are periodic, not continuous in nature, and qualify as a Notifiable Action that requires consultation with NPWS in advance of the works e.g. reclamation, infilling or land drainage within 30m of the river, removal of trees or any aquatic vegetation within 30m of the river, and harvesting or burning of reed or willow (NPWS 2020).

Agricultural operations must also comply with the EC (Environmental Impact Assessment) (Agriculture) Regulations 2011 and amendment 2017 S.I. No. 456/2011 and 407/2017 in relation to activities covered by the regulations:

- restructuring of rural land holdings,
- commencing use of uncultivated land or semi-natural areas for intensive,
- land drainage works on lands used for agriculture.

A NIS is required under Regulation 9 if it is likely to have a significant effect on a Natura 2000 site. The drainage or reclamation of wetlands is controlled under the Planning and Development (Amendment) (No. 2) Regulations 2011 and the European Communities (Amendment to Planning and Development) Regulations 2011.

There are currently no agricultural activities registered on the Planning websites where an NIS has been produced, so no in-combination impacts are possible.

8.2.2 OPW arterial drainage maintenance operations

Maintenance operations have been ongoing since the construction of the schemes following the 1945 Arterial Drainage Act, potentially resulting in adverse cumulative effects. However, as the maintenance operations are undertaken to restore the design level only, the hydrological and hydrogeological impact should be no greater than originally occurred upon the scheme's construction; no further deepening or widening will occur.

On a regional scale, neighbouring Arterial Drainage Schemes could be considered to have an adverse impact on Natura 2000 sites, particularly where large sites fall across two, or more scheme areas. However, this is not considered to be an issue for the Carrigahorig Scheme works.

The closest Schemes are Nenagh and Clareen, which both drain into the east of Lough Derg c. 25km and 27km south of the Carrigahorig Scheme. The Nenagh and Clareen Schemes are within separate surface water catchments to Carrigahorig.

Sections of the Carrigahorig Scheme have a groundwater body in common (IE_SH_G_178) with both the Nenagh and Clareen Schemes. However, at the closest point, the Schemes are c. 10km apart (Nenagh from Carrigahorig). Therefore, in-combination impacts are not possible in the low productivity aquifer. Therefore, the potential for adverse in-combination impacts from either of these schemes are negligible.

Therefore, the in-combination effects of the proposed works and other OPW arterial drainage maintenance operations are not likely to be significant.

8.3 EIA and Local Planning Projects

There are two EIA projects within 5km of the Scheme but both are for re-development of existing facilities and are located towards the eastern end of the Scheme, sufficiently

isolated from the Lough Derg (Shannon) SPA. There will therefore be no in-combination impacts from these projects.

There are 439 local planning applications. Of these there are six within 200m of Lough Derg (Shannon) SPA and a similar distance to Scheme channels. All six of these are alterations to existing properties that will not significantly alter drainage or increase disturbance. Two developments will involve significant changes in water discharge to Scheme channels, an increase in capacity for cattle at a farm in Kilfadda is discussed in Table 8-1. A conversion of a farm to a brewery on Channel C1 at 4000 chains will not result in a significant increase in effluent discharged to the river. No other developments have a pathway for in-combination impacts on the SPA either due to distance from Scheme channels or the nature of the planning application.

8.4 Significance of in-combination impacts and additional mitigation

There are a small number of potential in-combination effects where further consideration of the impacts and possible avoidance and mitigation measures may be needed. These are assessed in Table 8-1.

Table 8-1. In-combination assessment details

Scheme non-significant residual impact	Other project and potential in-combination impact	Additional mitigation required?
<p>Upgrading and new buildings for cattle at Kilfadda, Lorrha, Nenagh, Co. Tipperary</p>	<p>19600183, 19600183, 19601466, 20679</p> <p>These applications relate to creation of new storage facilities for cattle including treatment of effluent, and the application boundary includes a channel or pipe that runs from the cattle storage areas to Scheme channel C2/1 at 700 chains. There is no NIS for the project, but increased discharge into the channel could be conveyed to Lough Derg, approximately 2.8km downstream.</p> <p>The agricultural development has been designed to a high standard, with due consideration of appropriate storage volumes. The capacity for storage comfortably exceeds the levels that will be produced, so only a small amount of surface water run-off would be transported to the Scheme channels. The impact alone is expected to be very small so the possibility for in-combination impacts is also very small.</p>	<p>Although unlikely, a precautionary approach should be taken to maintaining channel C2/1 between 0-700 chains. In this section, a buffer of marginal vegetation must be left during silt and vegetation management to help filter water quality. Sections should also be skipped where possible, although this is not essential to reduce impacts. With these measures in place the in-combination impact would not result in adverse effects on the integrity of the Lough Derg (Shannon) SPA.</p>

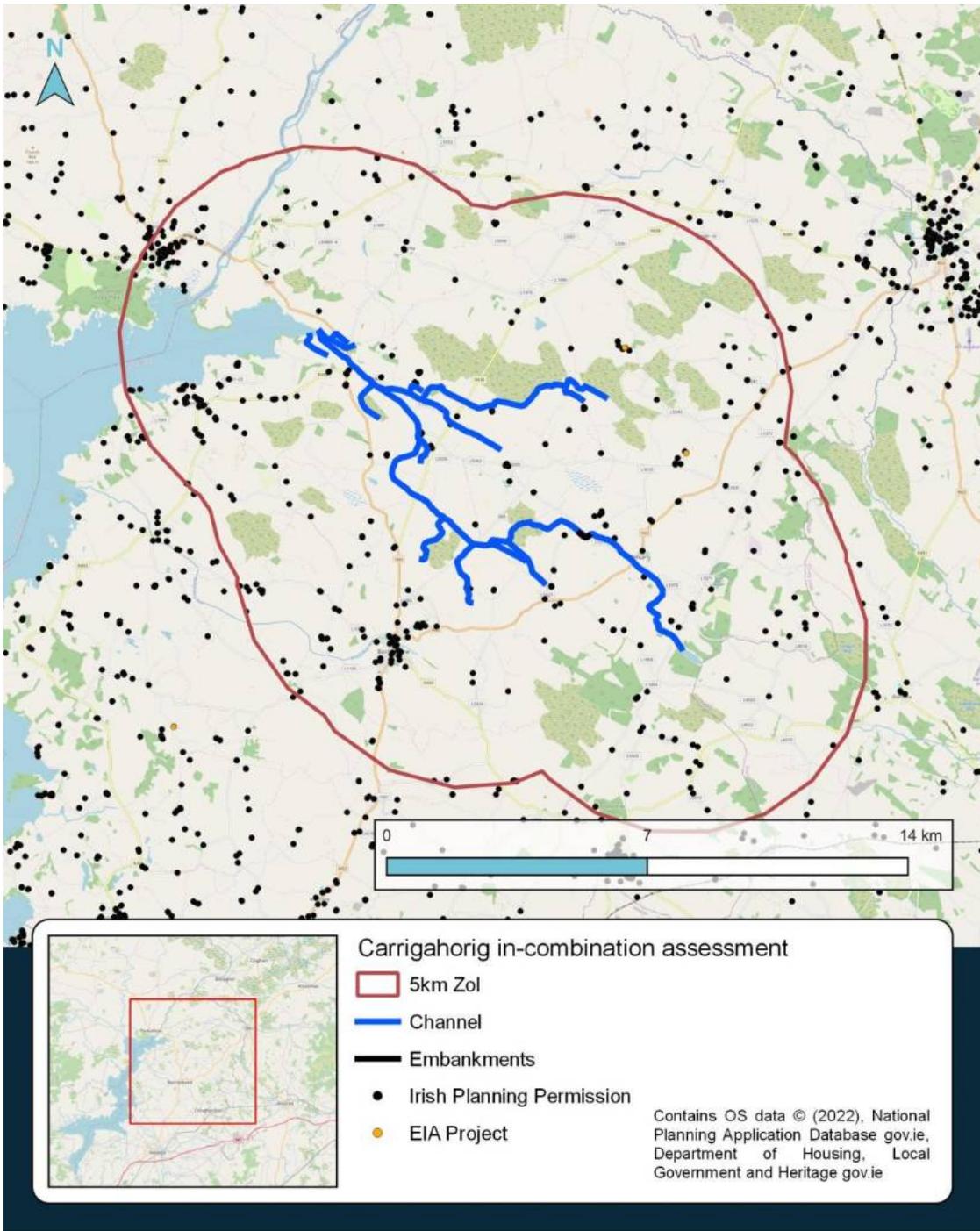


Figure 8-1. Location of EIA and planning projects

9 Conclusion

Following a comprehensive evaluation of the potential direct, indirect and in-combination impacts on the qualifying interests and conservation objectives for all Natura 2000 sites in the zone of influence of the Scheme, once relevant mitigation measures have been applied, it has been concluded that the Scheme will have no adverse impacts on the integrity of Natura 2000 sites or coherence of the Natura 2000 network in light of their conservation objectives and best scientific evidence.

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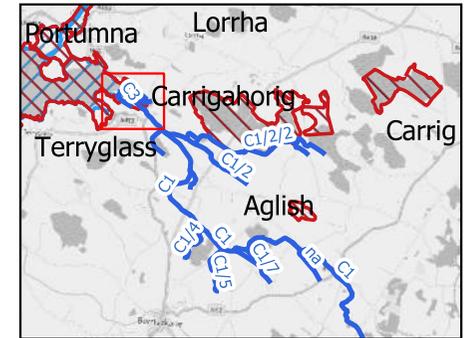
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Appendices

A Scheme Channel Maps

The following maps present a detailed view of the Scheme channels. They include the location of the Natura 2000 sites and the Annex 1 habitats present in and around these sites. The absence of Annex 1 habitats on the maps, particularly away from the Natura 2000 site boundaries, does not necessarily imply the absence of such habitats.



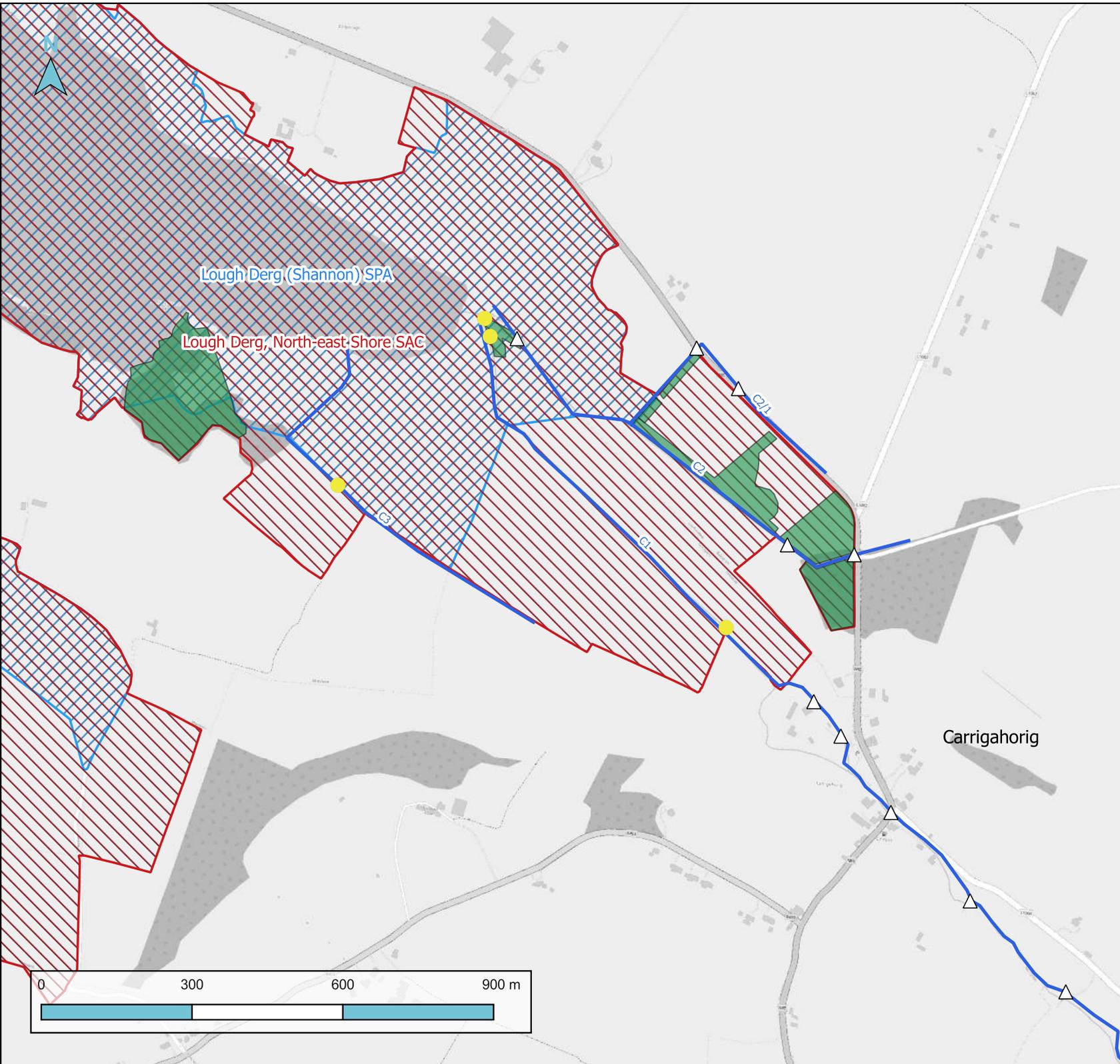
Carrigahorig Scheme Channels
Map 1 of 12

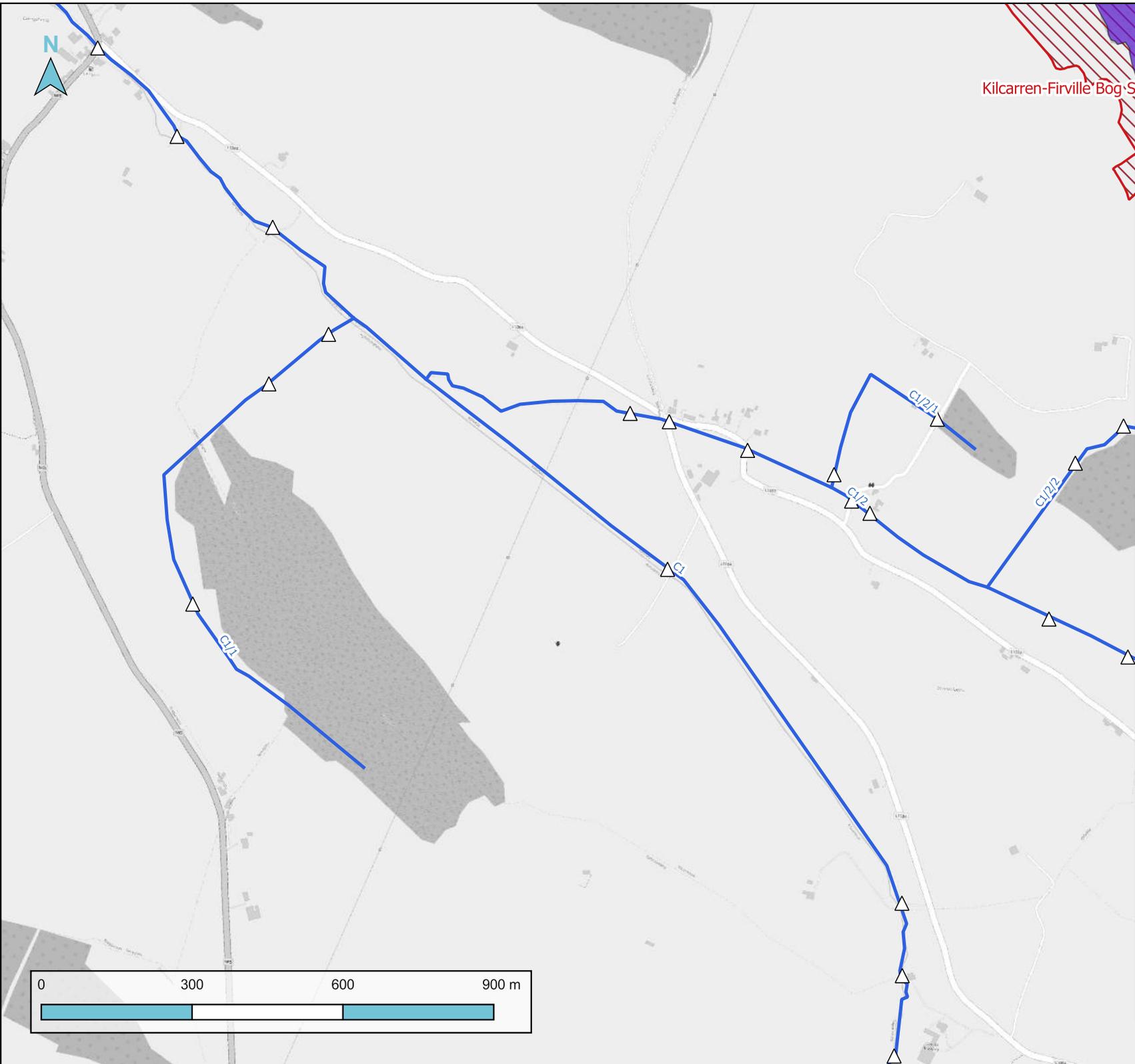
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- Carrigahorig Scheme Channels
- ▨ SAC
- ▨ SPA
- Annex 1 habitats
 - 91E0
 - 3260

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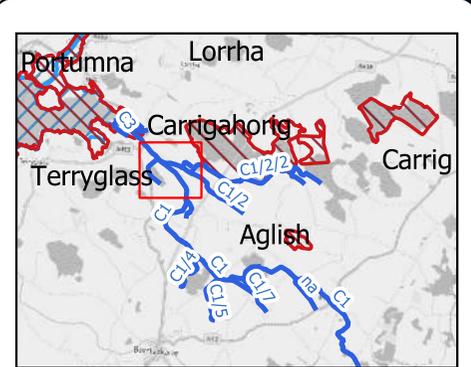
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Carrigahorig Scheme Channels Map 2 of 12

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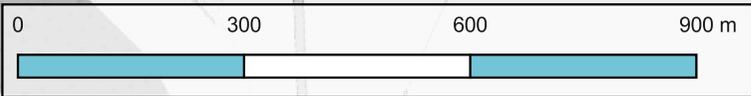
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Annex 1 habitats

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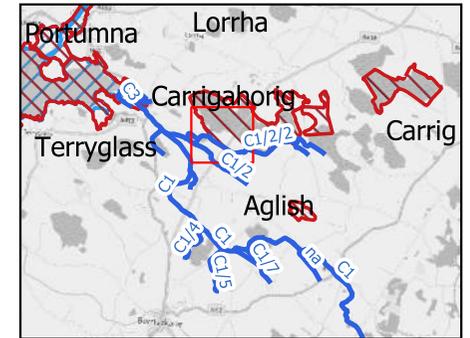
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Carrigahorig Scheme
Channels Map 3 of 12

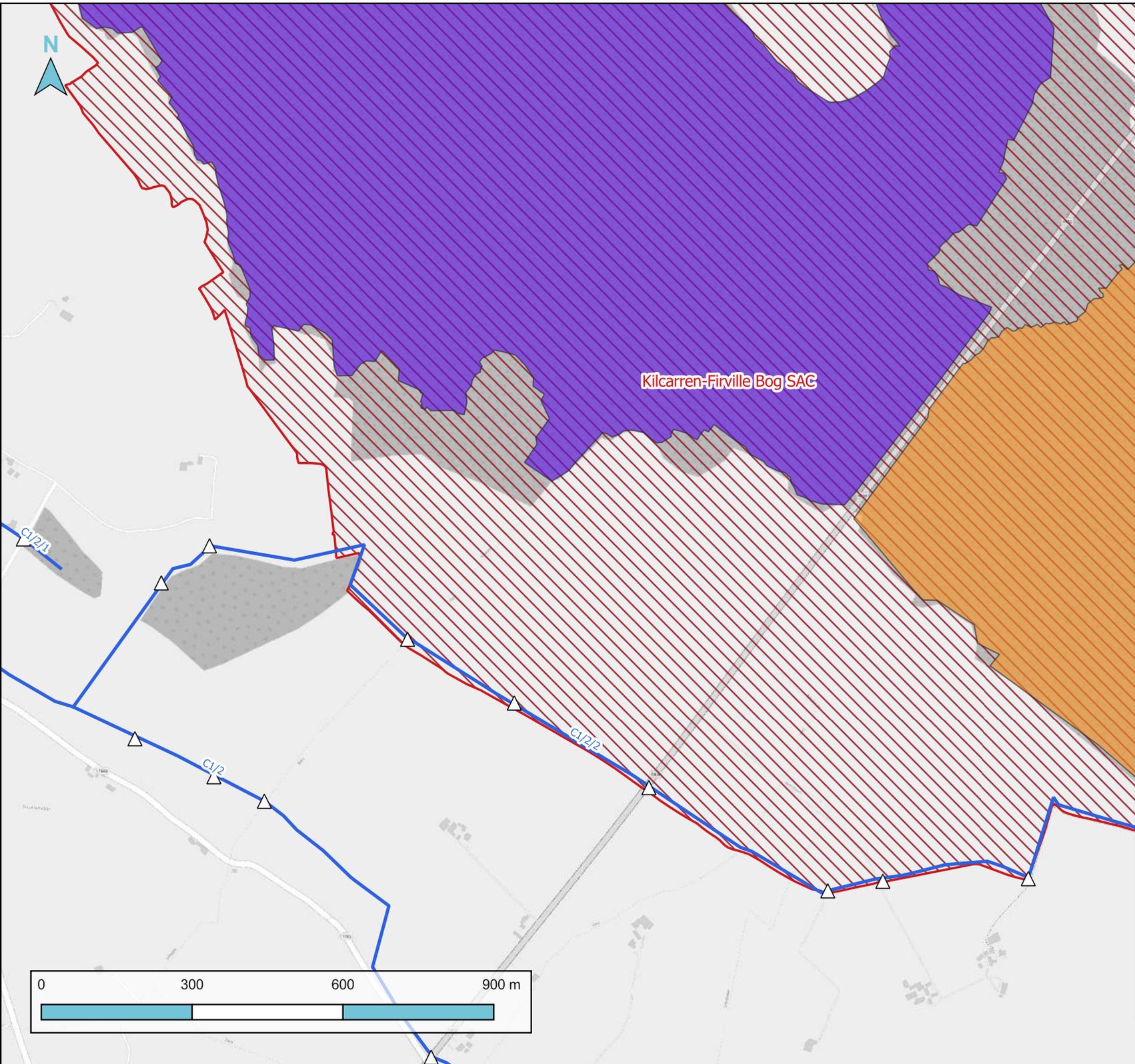
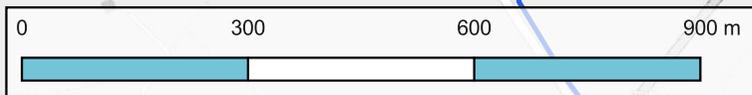
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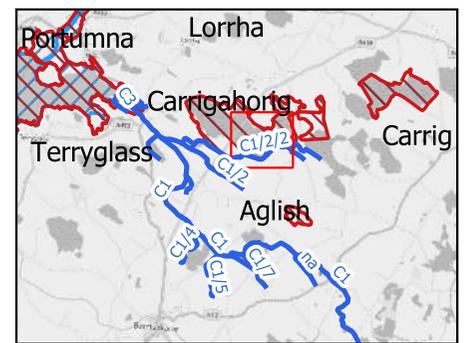
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- Annex 1 habitats**
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Kilcarren-Firville Bog SAC





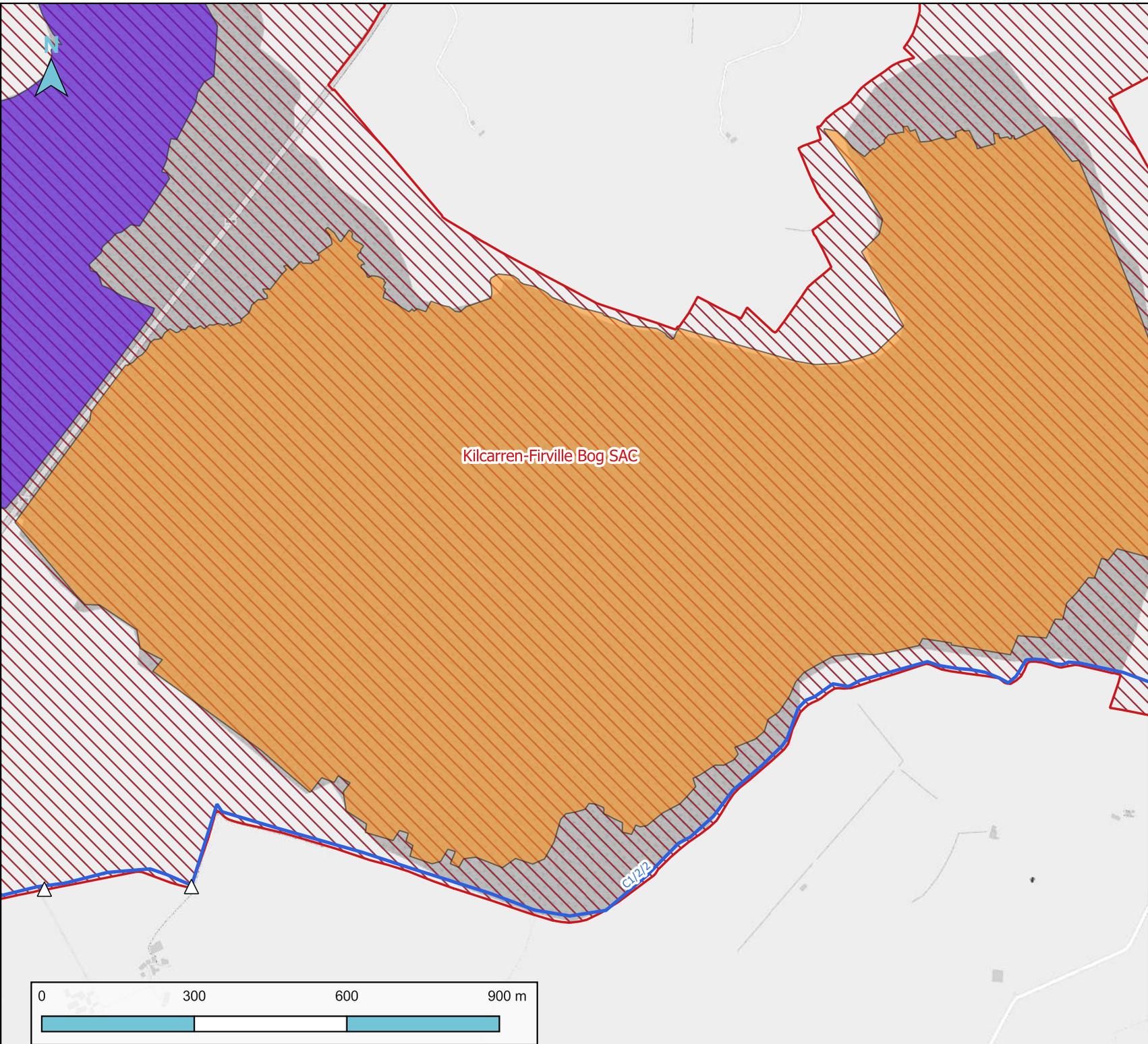
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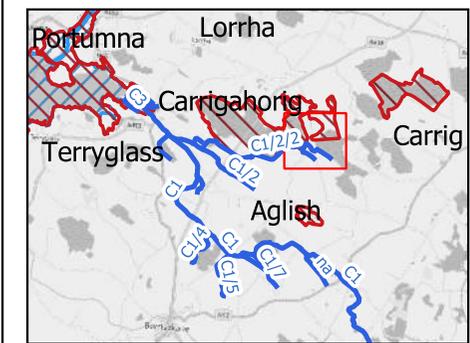
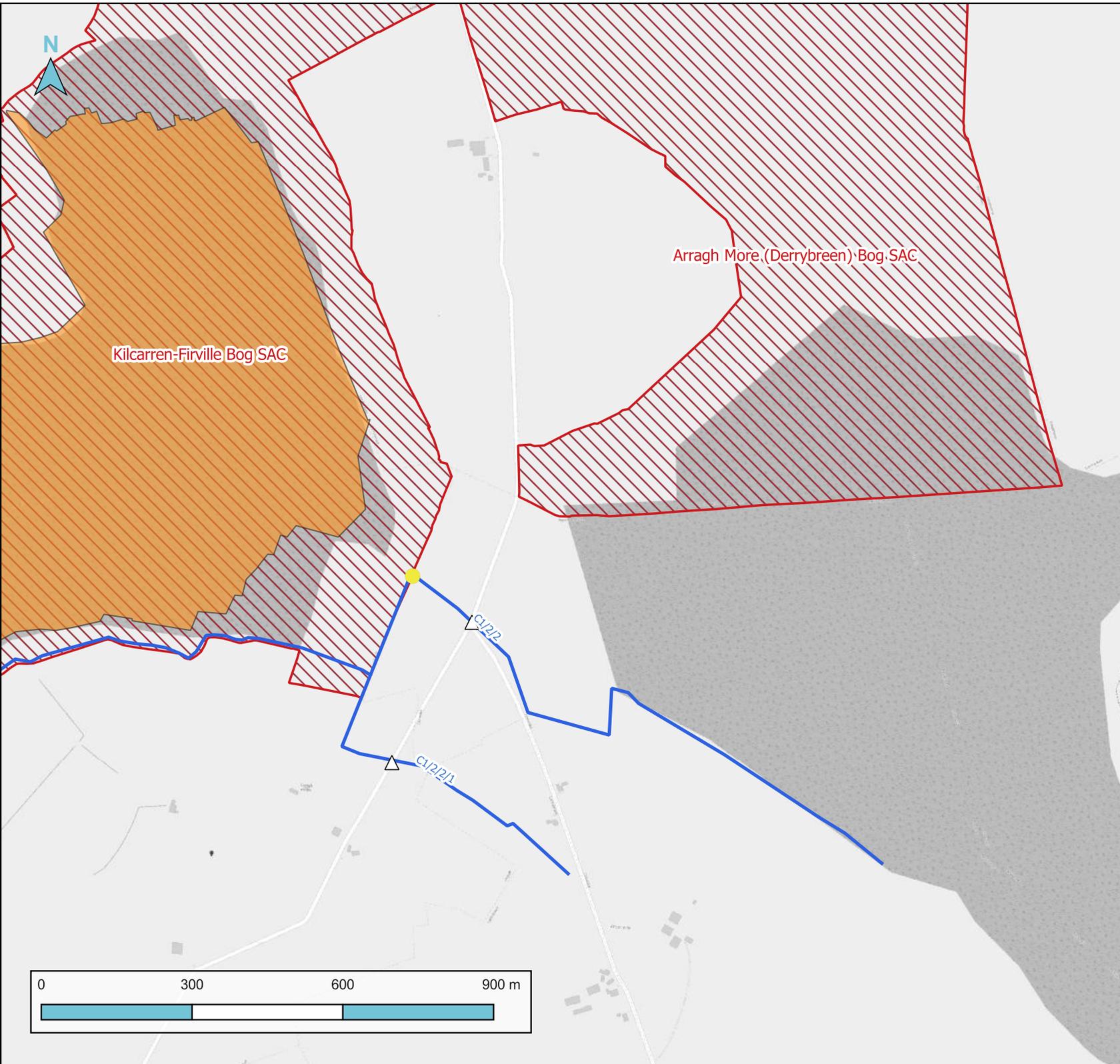
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- △ Carrigahorig Scheme Bridges
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- ▨ SAC
- Annex 1 habitats**
 - 7110
 - 7120
 - 3260

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Carrigahorig Scheme Channels Map 5 of 12

Legend

- △ Carrigahorig Scheme Bridges
- Carrigahorig Scheme Channels
- ▨ SAC

Annex 1 habitats

- 7110
- 3260

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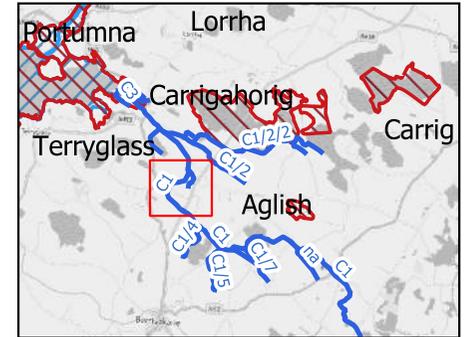


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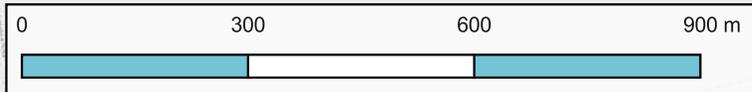
Carrigahorig Scheme
Channels Map 6 of 12

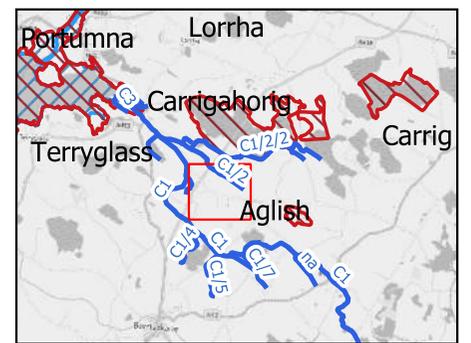
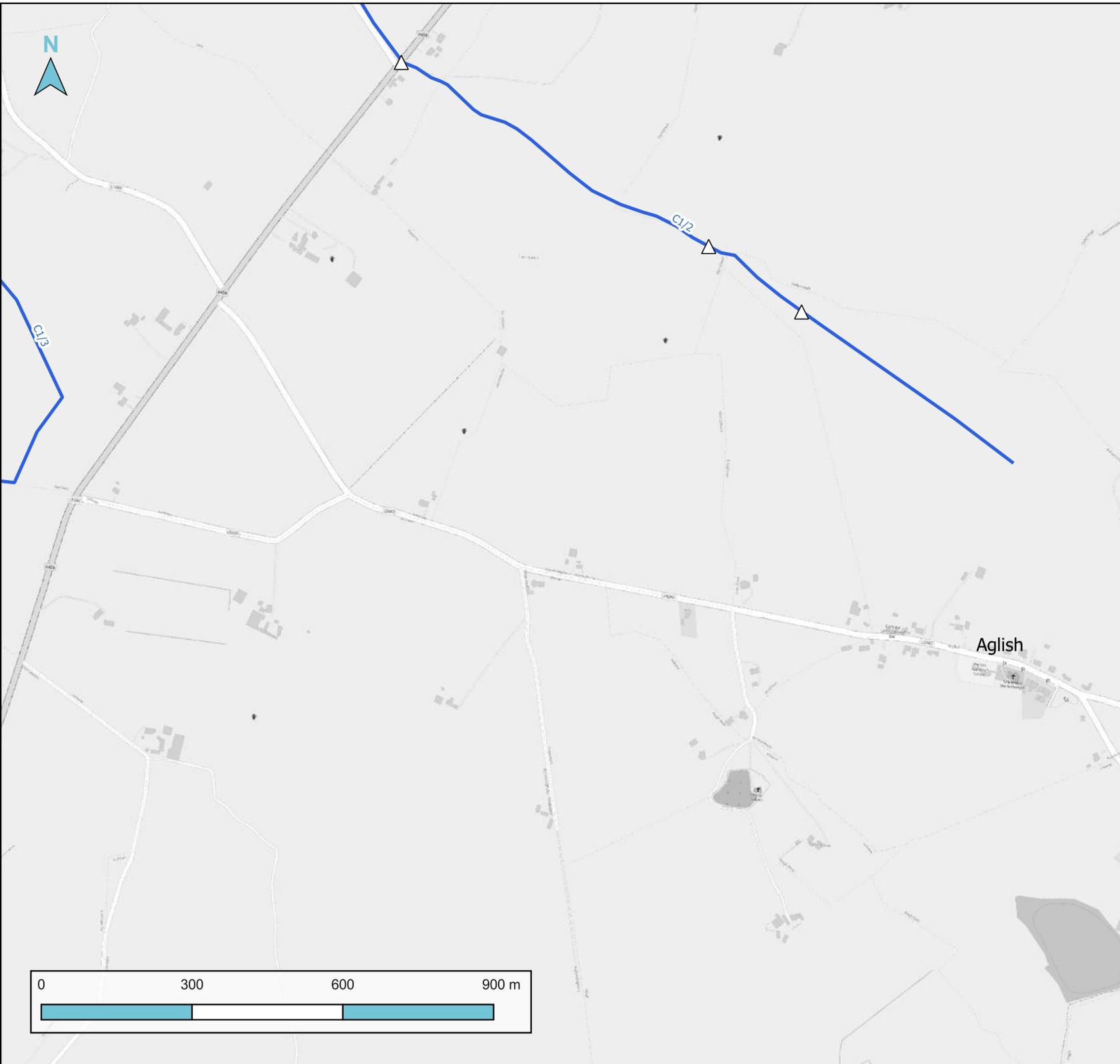
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Carrigahorig Scheme
Channels Map 7 of 12

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- △ Carrigahorig Scheme Bridges
- Carrigahorig Scheme Channels

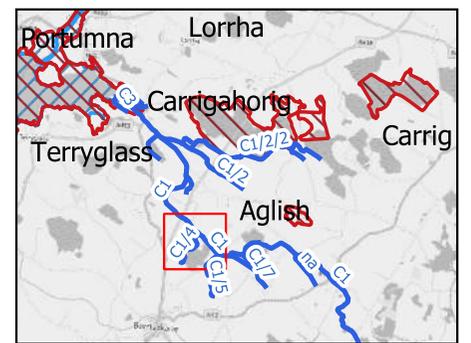
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Carrigahorig Scheme
 Channels Map 8 of 12

Legend

-  Carrigahorig Scheme Bridges
-  Carrigahorig Scheme Channels

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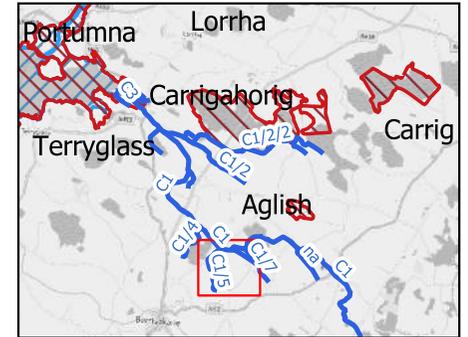
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Carrigahorig Scheme
 Channels Map 9 of 12

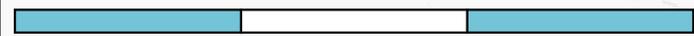
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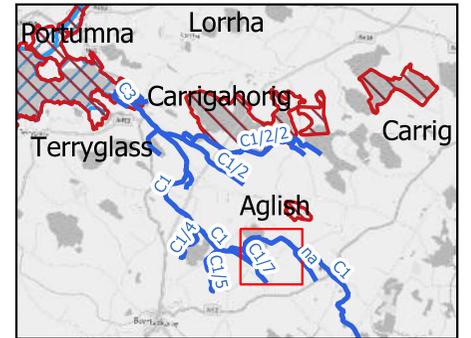
-  Carrigahorig Scheme Bridges
-  Carrigahorig Scheme Channels

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0 300 600 900 m





Carrigahorig Scheme
Channels Map 10 of 12

Legend

- △ Carrigahorig Scheme Bridges
- Carrigahorig Scheme Channels
- Carrigahorig Scheme Embankments

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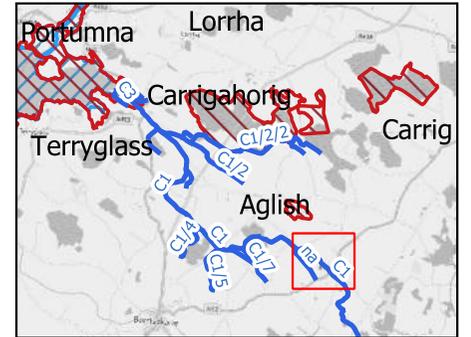
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 Channels Map 11 of 12

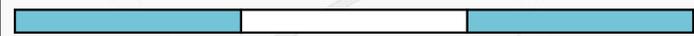
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-  Carrigahorig Scheme Embankments

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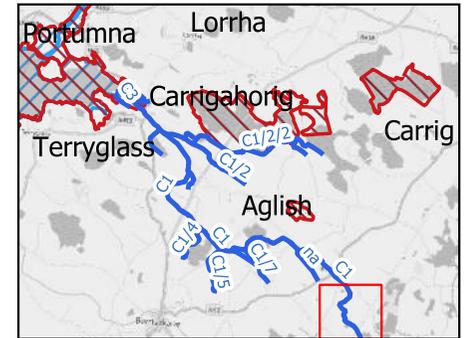
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Carrigahorig Scheme
Channels Map 12 of 12

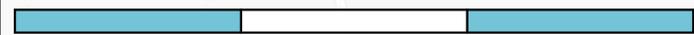
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B Details for Natura 2000 Sites in the Appropriate Assessment

B.1 Kilcarren-Firville Bog SAC

Kilcarren-Firville Bog is situated approximately 2 km east of the village of Carrigahorig in north Co. Tipperary. It is a lowland raised bog complex which extends about 4.5 km from east to west and is bisected by a road. It contains a large area of uncut high bog.

Active raised bog comprises areas of high bog that are wet and actively peat forming, where the percentage cover of bog mosses (*Sphagnum* spp.) is high, and where some or all of the following features occur: hummocks, pools, wet flats, Sphagnum lawns, flushes and soaks. Degraded raised bog corresponds to those areas of high bog whose hydrology has been adversely affected by peat cutting, drainage and other land use activities, but which are capable of regeneration. The *Rhynchosporion* habitat occurs in wet depressions, pool edges and erosion channels where the vegetation includes White Beak-sedge (*Rhynchospora alba*) and/or Brown Beak-sedge (*R. fusca*), and at least some of the following associated species, Bog Asphodel (*Narthecium ossifragum*), sundews (*Drosera* spp.), Deergrass (*Scirpus cespitosus*) and Carnation Sedge (*Carex panicea*).

The site contains substantial areas of active raised bog, which are largely confined to the wetter, more central areas of high bog. The vegetation here is typical of midland raised bogs, with Heather (*Calluna vulgaris*), Cross-leaved Heath (*Erica tetralix*), Common Cottongrass (*Eriophorum angustifolium*), Deergrass, Carnation Sedge, Bog Asphodel and bog mosses all being common. The active bog, and to a lesser extent the degraded areas, support occasional pool areas and quaking lawns dominated by *Rhynchosporion* vegetation. Typical species of the habitat are the bog moss *S. cuspidatum*, Bogbean (*Menyanthes trifoliata*), White Beak-sedge, Common Cottongrass, and Great Sundew (*Drosera anglica*). The cover of *Sphagnum cuspidatum* typically exceeds 50% in these areas.

The degraded raised bog tends to occur along the high bog margins where the peat has been subject to drying out. Degraded surfaces are usually dominated by a rather species-poor flora in which Heather, Bog Asphodel, Cottongrasses (*E. vaginatum* and *E. angustifolium*), Deergrass and Cross-leaved Heath are typically frequent. Sphagnum cover is low and permanent pool areas are rare. Localised flushes support Downy Birch (*Betula pubescens*) and Scots Pine (*Pinus sylvestris*).

The uncut high bog is surrounded by a large cutover area which is still subject to varying degrees of peat-cutting. The cutover bog is frequently dominated by Purple Moor-grass (*Molinia caerulea*), and Bog-myrtle (*Myrica gale*) is locally abundant. Birch woodland with some Holly (*Ilex aquifolium*) and willow (*Salix* spp.) is widespread in most cutover areas, and Scots Pine is common in a few locations. These scrub areas provide habitat for a population of the nationally rare shrub Alder Buckthorn (*Frangula alnus*). Some of the cutover has been reclaimed for grassland.

Peripheral areas at Kilcarren-Firville Bog have been extensively damaged by peat cutting, drainage and land reclamation. The structure of the high bog has been detrimentally affected by drainage effects over a long period of time through a lowering of the water table. This can lead to the decline in abundance of plant species of wet bog conditions. Without restoration works, further drying out of the bog surface is likely to occur and further peat cutting remains a threat.

Kilcarren-Firville Bog is of high conservation importance as it contains good examples of the priority Annex I habitat active raised bog and the non-priority habitats degraded raised bog and depressions on peat substrates (*Rhynchosporion*). The quality of these habitats is good, although the overall system has been detrimentally affected by drainage effects over a long period of time.

B.2 Lough Derg, North-east Shore SAC

Lough Derg, the lowest order lake on the River Shannon, is one of the largest bodies of freshwater in Ireland. This SAC, however, only includes the northern shore of the lake from GMY-JBAU-XX-CA-RP-BD-0002-A1-C04-Carrigahorig_NIS

the mouth of the Cappagh River in the north-west to just below Black Lough at the north-eastern shore. The greater part of this site lies on Carboniferous limestone, although there is Old Red Sandstone on the southern shores of the eastern section.

The geology of the lake shore is principally limestone and in places this protrudes at the surface in the form of boulders and rubble, and can be classified as limestone pavement. These are often bryophyte-rich surfaces or else support a calcareous grassland or heath flora, as well as some woody species, such as Yew (*Taxus baccata*) and Juniper (*Juniperus communis*). Examples occur at Cornalack, Kyleneilly and Portumna. The last two named areas were partly afforested but are proposed for restoration under a Coillte E.U. LIFE Programme. The geographical location of these examples of limestone pavement within the country is notable.

A second priority Annex I habitat, Cladium fen, occurs occasionally along the lake margins, mainly in association with alkaline fens, Common Reed (*Phragmites australis*) and other swamp vegetation. Typically, Great Fen-sedge (*Cladium mariscus*), which can be up to 2 m in height, forms dense stands. Associated species include Common Reed, Black Bog-rush (*Schoenus nigricans*), Water Horsetail (*Equisetum fluviatile*), Bottle Sedge (*Carex rostrata*) and occasional Slender Sedge (*Carex lasiocarpa*). This community generally merges with alkaline fen dominated by Black Bog-rush, with Purple Moor-grass (*Molinia caerulea*), Marsh Horsetail (*E. palustre*), Meadowsweet (*Filipendula ulmaria*) and scattered tussocks of Greater Tussock-sedge (*Carex paniculata*).

Yew woods in Ireland are mostly confined to the west of the country. However, a substantial area of Yew is located on limestone at Cornalack, where Yew forms a scrub woodland along the east shore of Lough Derg. Here, Yew is found in association with small amounts of Juniper, which forms protection against grazing for the young Yew. Other notable species present include Hawthorn (*Crataegus monogyna*), Hazel (*Corylus avellana*), Holly (*Ilex aquifolium*), Small-leaved Cotoneaster (*Cotoneaster microphyllus*), along with occasional Ivy (*Hedera helix*), Wild Strawberry (*Fragaria vesca*), Bramble (*Rubus fruticosus* agg.) and Wood-sorrel (*Oxalis acetosella*). Elsewhere, small stands of Yew up to 5 m high occur with Spindle (*Euonymus europaeus*), Blackthorn (*Prunus spinosa*), Gorse (*Ulex europaeus*) and Ash (*Fraxinus excelsior*). Due to shading, and in places cattle trampling, the ground flora supports few herbs. However, the bryophyte layer is well developed with many moss covered rocks present.

Juniper occurs throughout this site in a range of habitats, associated with calcareous grasslands, heath and limestone outcrops. Some of the finest examples of Juniper formations in Ireland occur along the lake edge where upright, bushy Juniper shrubs up to 3 m tall are found. Typically, Juniper forms dense hedges with Ash, Hawthorn, Gorse, Hazel and Bramble, and occasional Yew. These tall Juniper shrubs are a unique feature in Ireland, where it is more typically found growing in prostrate form. In places along the lake shore Juniper forms a mosaic with Black Bog-rush and Great Fen-sedge fen. The best examples are seen at the north and north-east of the site. On drier ground above the flood level, Juniper occurs in association with species-rich calcareous grassland with Mouse-ear Hawkweed (*Hieracium pilosella*), Daisy (*Bellis perennis*), Lady's Bedstraw (*Galium verum*), Wild Thyme (*Thymus praecox*) and Blue Moor-grass (*Sesleria albicans*). An extensive area of this vegetation is seen north of Kilgarvan Quay. Many of the islands also support significant Juniper cover. This is particularly evident on Bounla Island. Juniper generally occurs as fringing vegetation around the islands, which typically have wooded centres. At Cornalack, along the eastern shore of Lough Derg, tall Juniper is found in association with loose limestone rubble with a significant cover of Yew.

Deciduous woodlands are also a notable feature of the site, dominated by oak (*Quercus spp.*), as at Bellevue, and Hazel/Ash at many of the examples along the north-eastern shore. Typically, the ground layer includes Early-purple Orchid (*Orchis mascula*), violets (*Viola spp.*), Ivy, Lesser Celandine (*Ranunculus ficaria*), Bluebell (*Hyacinthoides non-scripta*), Wood Anemone (*Anemone nemorosa*), Wood-sorrel, Primrose (*Primula vulgaris*), Bramble, Ground Ivy (*Glechoma hederacea*), Pignut (*Conopodium majus*) and Honeysuckle (*Lonicera periclymenum*). Wet woodland is frequent along the lake shore, and in some areas this

conforms well with the E.U. Annex I habitat, alluvial woodland. At Kyleneelly wood, where some planting of commercial forestry has occurred, there are extensive areas of alluvial woodland which are subject to flooding. These woods are dominated by willows (*Salix* spp.) and Alder (*Alnus glutinosa*), with Downy Birch (*Betula pubescens*) and Ash also present. The ground flora of the undisturbed alluvial sites is often dominated by Yellow Iris (*Iris pseudacorus*), with a range of other species commonly present, including Bogbean (*Menyanthes trifoliata*), Marsh-marigold (*Caltha palustris*), Meadowsweet, Purple Loosestrife (*Lythrum salicaria*), horsetails (*Equisetum* spp.), Wild Angelica (*Angelica sylvestris*), Greater Tussock-sedge and Remote Sedge (*Carex remota*). Further examples of alluvial woodland occur at Portumna. Beech (*Fagus sylvatica*) and Scots Pine (*Pinus sylvestris*) are often present at the lake edge along areas which were once parts of estates. Some areas of coniferous forestry have been included within the site.

The only known site in the country for the Red Data Book plant Irish Fleabane (*Inula salicina*) occurs along the lake shore. This plant is legally protected under the Flora (Protection) Order, 1999. Other Red Data Book species present within this site are Marsh Pea (*Lathyrus palustris*) and Ivy Broomrape (*Orobanche hederæ*). The Red Data Book stonewort *Chara tomentosa* has its stronghold in Lough Derg.

The lake is rated as nationally important for waterfowl. The entire lake, including all of the islands, is a designated SPA (Special Protection Area). Counts from 1995/96 carried out at seven locations on the lake indicate that the lake holds nationally important numbers for Mute Swan, Cormorant, Mallard, Teal, Tufted Duck and Goldeneye. The lake also supports a number of Greenland White-fronted Goose, a bird species listed on Annex I of the E.U. Birds Directive. There is a Wildlife Sanctuary at the north western edge of the lake.

Lough Derg is of conservation interest also for its fish and freshwater invertebrates. Lampreys, listed under Annex II of the E.U. Habitats Directive, are known to occur and the lake contains an apparently self-sustaining landlocked population of Sea Lamprey (*Petromyzon marinus*). A landlocked population, where the fish are feeding and not completing a seaward migration, is unique in an Irish context, though there are several such populations in the U.S. and one is known from Loch Lomond in Scotland. Brook Lamprey (*Lampetra planeri*) is known to be common in the lower Shannon catchment where all three lamprey species breed.

The endangered fish species Pollan (*Coregonus autumnalis pollan*) is recorded from Lough Derg, one of only three sites in Ireland and in western Europe. The Pollan is a landlocked species of Coregonid or 'White Fish', thought to have colonised Irish waters after the last Ice Age. Its nearest relative, the Arctic Cisco, is found as far away as Alaska, Northern Canada and Siberia. Although it is anadromous throughout most of its northern range, the Irish population are all non-migratory and purely freshwater. Lough Derg is also a well known fishing lake with a good Trout (*Salmo trutta*) fishery. Atlantic Salmon (*Salmo salar*) also use the lake as a spawning ground. Although this species is still fished commercially in Ireland, it is considered to be endangered or locally threatened elsewhere in Europe and is listed on Annex II of the E.U. Habitats Directive.

Otter and Badger have been recorded within the site. Both of these species are listed in the Irish Red Data Book and are legally protected by the Wildlife Act, 1976.

Land use within the site is mainly of a recreational nature with many boat hire companies, holiday home schemes and angling clubs located at the lake edge.

Recreational disturbance may pose a threat to the wintering wildfowl populations, though tourism is scaled down during the winter. The water body is surrounded mainly by improved pastoral farmland to the south and east, with areas of bog to the south-west and west. Coniferous plantations are present along the west and northwest shore and small areas of these are included within the site. If these areas are felled no further planting should take place as afforestation damages the wetland habitats between the plantation and lake edge.

The main threats to the quality of the site are water polluting activities resulting from intensification of agricultural activities around the lake shore, uncontrolled discharge of sewage, which is causing eutrophication of the lake, and housing and boating development which has resulted in the destruction of lakeshore habitats. There is also significant fishing

and shooting pressure on and around the lake. Forestry can result in the loss of some areas of wetland habitat. The spread of Zebra Mussel (*Dreissena polymorpha*) in Lough Derg also poses a threat to the ecology of the lake.

This is a site of significant ecological interest, with six habitats listed on Annex I of the E.U. Habitats Directive. Four of these are priority habitats - *Cladium* fen, alluvial woodland, limestone pavement and Yew woodland. Other annexed habitats present include alkaline fen and Juniper scrub formations on heath and calcareous grasslands. In addition, the lake itself is an SPA that supports important numbers of wintering wildfowl, Greenland White-fronted Goose, Common Tern and Cormorant, a number of which are listed under Annex I of the E.U. Birds Directive.

B.3 Lough Derg (Shannon) SPA

Lough Derg lies within counties Tipperary, Galway and Clare and is the largest of the River Shannon Lakes, being some 40 km long. Its maximum breadth across the Scarriff Bay - Youghal Bay transect is 13 km but for most of its length it is less than 5 km wide. The lake is relatively shallow at the northern end being mostly 6 m in depth but in the middle region it has an axial trench and descends to over 25 m in places. The narrow southern end of the lake has the greatest average depth, with a maximum of 34 m. The greater part of the lake lies on Carboniferous limestone, but the narrow southern section is underlain by Silurian strata. Most of the lower part of the lake is enclosed by hills on both sides, the Slieve Aughty Mountains to the west and the Arra Mountains to the east. The northern end is bordered by relatively flat, agricultural country. The lake shows the high hardness levels and alkaline pH to be expected from its mainly limestone catchment basin, and it has most recently been classified as a mesotrophic system. The lake has many small islands, especially on its western and northern sides. The shoreline is often fringed with swamp vegetation. Aquatic vegetation includes a range of charophyte species, including the Red Data Book species, *Chara tomentosa*. The shoreline is often fringed by swamp vegetation, comprised of such species as Common Reed (*Phragmites australis*), Great Fen-sedge (*Cladium mariscus*) and Bottle Sedge (*Carex rostrata*).

The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Cormorant, Tufted Duck, Goldeneye and Common Tern. The E.U. Birds Directive pays particular attention to wetlands and, as these form part of this SPA, the site and its associated waterbirds are of special conservation interest for Wetland & Waterbirds.

Lough Derg is of importance for both breeding and wintering birds. The site supports a nationally important breeding colony of Common Tern (55 pairs recorded in 1995).

Management of one of the islands used for nesting has increased the area of suitable habitat available and prevented nests being destroyed by fluctuating water levels. Large numbers of Black-headed Gull have traditionally bred on the many islands (2,176 pairs in 1985) but the recent status of this species is not known. The islands in the lake also support a nationally important Cormorant colony - 167 pairs were recorded in 1995; a partial survey of the lake in 2010 recorded 113 pairs. Lough Derg is also a noted breeding site for Great Crested Grebe (47 pairs in 1995) and Tufted Duck (169 pairs in May 1995).

In winter, the lake is important for a range of waterfowl species, including nationally important populations of Tufted Duck (776) and Goldeneye (157) – all figures are mean peaks for 4 of the 5 seasons between 1995/96 and 1999/2000. Other species which occur in winter include Mute Swan (164), Whooper Swan (18), Wigeon (249), Teal (301), Mallard (376), Little Grebe (14), Cormorant (90), Coot (173), Lapwing (922), Curlew (66) and Black-headed Gull (732). Areas to north and south west of Lough Derg have been utilised in the past by small numbers of Greenland Whitefronted Goose – 19 geese were recorded on callowland near Portumna in 1996/97. A relatively small flock based in the Lough Derg-Lough Graney area and possibly further afield have been recorded in the Scarriff Bay area – 20 geese recorded in 2004. Few sightings, at either location have been made in recent years.

Hen Harrier are also known to roost in the reedbeds on the margins of the site during the winter.

Lough Derg (Shannon) SPA is of high ornithological importance as it supports nationally important breeding populations of Cormorant and Common Tern. In winter, it has nationally important populations of Tufted Duck and Goldeneye, as well as a range of other species including Whooper Swan. The presence of Whooper Swan, Greenland White-fronted Goose, Hen Harrier and Common Tern is of particular note as these are listed on Annex I of the E.U. Birds Directive. Parts of Lough Derg (Shannon) SPA are a Wildfowl Sanctuary.

B.4 Liskeenan Fen SAC

Liskeenan Fen is a small turlough-like fen situated about 10 km north-west of Borrisokane and just 1 km from the village of AGLISH, in north Co. Tipperary. The site floods in winter via a swallow hole in the far north-west corner. The eastern part of the site consists of a small, dry, inactive raised bog on which mixed woodland is developing, as well as an extensive and unusual area of flooded cut-away.

The main habitat at this site consists of calcareous fen. This is dominated by Black Bog-rush (*Schoenus nigricans*) and covers a wide area. Common Butterwort (*Pinguicula vulgaris*) also occurs here. Common Reed (*Phragmites australis*) and Great Fen-sedge (*Cladium mariscus*) are present in addition, and in places become dominant. The *Cladium* fen in the wettest parts of the centre also includes Bluntflowered Rush (*Juncus subnodulosus*), as well as Long-stalked Yellow-sedge (*Carex lepidocarpa*).

A secondary habitat which is also of interest is the regenerating flooded cut-away bog east of the fen. Wide flat expanses of bog mosses (particularly *Sphagnum cuspidatum*) and numerous large actively growing bog moss hummocks (with species such as *S. capillifolium*, *S. papillosum* and others) grow over an area of about 5 ha, surrounded by old turf banks. This acidic community contrasts sharply to the calcareous fen adjacent to it.

Also included in the site is a small field of species-rich dry grassland, which contains the rare species Green-winged Orchid (*Orchis morio*) and the decreasing species Cowslip (*Primula veris*). There is also a wet grassland area within the site, and a mixed woodland is developing on the bog in the east. All of these habitats add diversity to the site.

In summer the fen is grazed, but few cattle venture into the wettest centre. Any alteration of the swallow-hole could threaten the water levels at the site.

Liskeenan Fen is of conservation importance as it contains a good example of a *Cladium* fen, a habitat listed with priority status on the E.U. Habitats Directive. It is one of the only such fens remaining in the area, most of the rest having been drained in the past. The presence of a range of other habitat types in the site, along with some rare and scarce vascular plants, adds further to the value of the area.

B.5 Arragh More (Derrybreen) Bog SAC

Arragh More (Derrybreen) Bog SAC occurs within the larger raised bog system that is designated as Arragh More Bog NHA (000640). It is situated 9.5 km north-east of Borrisokane in County Tipperary. It lies within the townlands of Arraghmore and Derrybreen.

Degraded Raised Bog corresponds to those areas of high bog where the hydrology has been adversely affected by peat cutting, drainage and other land use activities, but which are capable of regeneration to Active Raised Bog (ARB) within 30 years.

Arragh More (Derrybreen) Bog SAC comprises 90.58 ha of raised bog (57.9 ha of high bog and 32.68 ha cutover) which occupies the north-western section of Arragh More Bog NHA (000640). Arragh More Bog NHA developed originally in at least 3 basins, aligned in a north-south direction, which were initially separated by low ridges of relatively impermeable glacial till overlying limestone bedrock. As these bogs grew they eventually coalesced over these low ridges to form one bog with a very complex shape. The SAC occupies the western parts of the 2 most northerly basins. The surface of the high bog in the central basin is lower than that to the east and south and receives significant amounts of runoff from them resulting in the development of an internal flush system. The SAC is bordered by forest plantations on cutaway to the north, raised bog and cutover to the east and south and agricultural grassland to the east.

The SAC was mostly afforested in the 1970s, with just over 12 ha (13%) of high bog in the north-east and south of the site being left unplanted. The remaining areas of intact high bog have been affected by drying out but still have vegetation typical of a Midland Raised Bog, consisting of Heather (*Calluna vulgaris*), Cottongrasses (*Eriophorum vaginatum* and *E. angustifolium*), Bog Asphodel (*Narthecium ossifragum*) and White Beak-sedge (*Rhynchospora alba*). Typical characteristic species for Midland Raised Bogs such as Bog Rosemary (*Andromeda polifolia*) and Cranberry (*Vaccinium oxycoccos*) are present. In addition to the more common hummock-forming bog mosses (*Sphagnum capillifolium*, *S. papillosum* and *S. subnitens*) which are widespread, some hummocks of the relatively scarce *S. austinii* and *S. fuscum* have been recorded. In the small remnants of the flush system at the extreme east of the site, Bog-myrtle (*Myrica gale*), Bilberry (*Vaccinium myrtillus*), Purple Moor-grass (*Molinia caerulea*), Soft Rush (*Juncus effusus*) and the bog moss *Sphagnum recurvum* become more common. The most strongly flushed areas, which partly lie within the site, are dominated by wet woodland with Birch (*Betula pubescens*), Alder (*Alnus glutinosa*), Willow (*Salix* spp.) and Rowan (*Sorbus aucuparia*) with a ground layer of grasses and the bog species listed above. This area grades eastwards into a Common Reed (*Phragmites australis*) swamp which is within the NHA but outside the SAC.

The remainder of the site was covered by conifer plantations, which were mostly felled by 2013. All the intensive drainage systems associated with the plantation were blocked by 2014 as part of an EU-funded Coillte LIFE Project Demonstrating Best Practice in Raised Bog Restoration in Ireland so as to raise the water table and restore Active Raised Bog (ARB) on the site. Prior to the felling, there were relatively few bog species present in the plantations except along fire breaks. With the clear-felling of conifers and blocking of drains, the high bog is re-wetting, water-levels in some areas now remain high throughout the year and limited areas of wet flats and hollows are developing. As a consequence, raised bog vegetation has returned, with Heather and Hare's tail Cotton-grass (*Eriophorum vaginatum*) dominating, while Common Cotton-grass (*Eriophorum angustifolium*), Bog Asphodel and White Beaksedge are locally common and small amounts of Bilberry and Cross-leaved Heath (*Erica tetralix*) are widespread. Bog mosses that are regenerating include *Sphagnum papillosum*, *S. capillifolium*, *S. palustre* and *S. subnitens*, with *S. recurvum* in drains. In the more flushed areas considerable amounts of Purple Moor-grass and Soft Rush are also present.

Two areas in the eastern section of the SAC are showing significant indications of recovery and represent Degraded Raised Bog (DRB) habitat. These areas are on two major water flow paths across the bog and now have standing surface water in the hollows and pools for most of the year and considerable areas of regenerating *Sphagnum* species. The larger and most easterly of these flow paths comes from areas of mineral soil and cutover bog to the east of the SAC. The areas fed by this flow path are likely to support vegetation characteristic of flushes and soaks and develop into areas of both Active Raised Bog (ARB) and possibly Bog Woodland. The other main flow path derives from the high bog and cutover to the south and will supply mainly bog water and therefore support a more standard ARB habitat. It is considered both areas will support some areas of ARB within 10–20 years and that these will continue to develop and spread over the following decades. It is expected that some of the area will develop further into Bog Woodland as the birch woodland develops on the more flushed areas of the site. There is a small area of Bog Woodland to the east but just outside the site. It contains the characteristic species for that habitat. In addition, it is estimated that restoration works carried out on this site may benefit the conservation of 3 ha of ARB in the adjacent area of Arragh More Bog NHA.

Arragh More (Derrybreen) Bog SAC is a site of considerable conservation significance, comprising as it does, a raised bog, a rare habitat in the E.U. and one that is becoming increasingly scarce and under threat in Ireland. Ireland has a high proportion of the total E.U. resource of Atlantic Raised Bog (over 50%) and so has a special responsibility for its conservation at an international level. The large area of Degraded Raised Bog habitat present is of significant conservation value as it is considered to be progressing to Active Raised Bog, which is a priority habitat in the E.U. and one that is scarce and under threat in Ireland and severely endangered in the EU. Some of the DRB in the more flushed parts of the bog may eventually develop into the very rare priority EU-Annexed habitat Bog Woodland (91D0),

which would add further to the scientific interest of the site. The site is, and will continue to be, actively managed for conservation as part of the Coillte EU LIFE Project.

B.6 Scohaboy (Sopwell) Bog SAC

Scohaboy (Sopwell) Bog SAC occurs within the larger raised bog system that is designated as Scohaboy Bog NHA (000937). It is situated 4 km north-west of Cloughjordan in Co. Tipperary. It lies within the townland of Sopwell. The underlying geology is carboniferous limestone.

The site comprises a relatively large, flat area of raised bog that includes both areas of high bog and cutover bog. The high bog has some steep marginal slopes associated with peat-cutting, drainage and forestry. The site is bounded by peatland on all margins, apart from the north where a stream flows along the northern margin. Cutover bog occurs in the south-east of the site and an area of clear-felled coniferous plantation is present on the high bog to the north of the site. Over 43 ha of the high bog was never afforested but a considerable proportion of that area was subjected to intensive, but shallow drainage. That drainage was not maintained and in some areas has naturally partly infilled by bog moss *Sphagnum* species regrowth over the years. The afforested area was planted in the 1980s and was all clear-felled by 2013 and the drains blocked as part of a restoration project. Overall, the high bog now appears to be re-wetting with large areas of wet flats and hummock/hollows developing.

Degraded Raised Bog corresponds to those areas of high bog where the hydrology has been adversely affected by peat cutting, drainage and other land use activities, but which are capable of regeneration to Active Raised Bog within 30 years.

Much of the unafforested high bog has vegetation typical of Midland Raised Bog type, consisting of Heather (*Calluna vulgaris*), Cottongrass (*Eriophorum* spp.), abundant Bog Asphodel (*Narthecium ossifragum*) and White Beak-sedge (*Rhynchospora alba*). Typical characteristic species for Midland Raised Bogs such as Bog Rosemary (*Andromeda polifolia*) and Cranberry (*Vaccinium oxycoccos*) are present. Bog moss (*Sphagnum* species) cover is regenerating with drains and former pool systems beginning to infill with *Sphagnum papillosum*, *S. capillifolium* and *S. cuspidatum*. The two scarce hummock forming bog mosses, *Sphagnum fuscum* and *S. austinii* occur, with the latter being locally frequent in places. Some of the recovering pool systems are quite large with Bog Bean (*Menyanthes trifoliata*) and Great Sundew (*Drosera anglica*) present.

When the conifer plantation within the SAC was removed, the intensive drainage system associated with it was blocked by 2014 as part of an E.U. funded Coillte LIFE Project Demonstrating Best Practice in Raised Bog Restoration in Ireland. This project aimed to raise the water table and restore Active Raised Bog (ARB) on the site. Prior to the felling there were relatively few bog species present within most of the plantation. With the clear-felling of conifers and blocking of drains the high bog appears to be re-wetting, with limited areas of wet flats and hollows already developing and water-levels now remain high throughout the year. While some recovery of bog vegetation has occurred, the majority of the former plantation will not develop raised bog vegetation characteristic of the wettest conditions as the surface slopes in this area are too steep and there is a considerable amount of conifer and birch regeneration occurring in these areas. The main benefit of the tree removal and the drain blocking will be to improve the hydrology of the adjacent areas of high bog. On the unafforested bog to the south of the plantation, three areas covering over 11.6 ha have been identified as Degraded Raised Bog (DRB) habitat. These now have standing surface water in the drains, hollows and pools for most of the year and considerable areas of regenerating *Sphagnum* species. It is considered that this area will rapidly develop into Active Raised Bog habitat within 10 years. It is not expected that the restoration works carried out on this site to date will provide significant benefits for the conservation of Degraded or Active raised bog habitats in the adjacent areas of Scohaboy Bog NHA due to the presence of significant drains on the site boundaries.

Much of the cutaway in the south-east of the site is dominated by Purple Moor-grass (*Molinia caerulea*), with scattered scrub of Gorse (*Ulex europaeus*) and Downy Birch (*Betula pubescens*). Peat cutting ceased in the area in 2015 and the cutover drains were all blocked in

late 2015. The area has now rewetted and should eventually support raised bog communities and species

Current landuse on the site consists of conservation management by the site owners, Coillte. Until recently, there was also turf cutting in the south-eastern corner of the site but this has now ceased. Damaging activities associated with this landuse, including drainage and burning, are continuing within Scohaboy Bog NHA. Drainage activities for turf cutting occurred widely in the past on adjacent areas of the high bog, but many of these drains have been blocked by the National Parks and Wildlife Service (NPWS) following acquisition of the land. Fire damage has been recorded in the 1980s and more recently in the west of the site and there is evidence of regular burning throughout the area. These activities have resulted in loss of habitat and damage to the hydrological status of the site, and pose a continuing threat to its viability.

Scohaboy (Sopwell) Bog SAC is a site of considerable conservation significance comprising raised bog, a rare habitat in the E.U. and one that is becoming increasingly scarce and under threat in Ireland. The site contains good examples of the E.U. Habitats Directive Annex I habitat Degraded Raised Bog (capable of regeneration) and supports a good diversity of raised bog microhabitats including some hummock/hollow complexes, tear pools and cutover bog. The site is being actively managed for conservation as part of a Coillte EU LIFE Project. This site is one of the more southerly raised bogs in the country, adding significantly to its ecological importance. Ireland has a high proportion of the total E.U. resource of raised bog (over 50%) and so has a special responsibility for its conservation at an international level. The presence of White-clawed Crayfish, a species listed in Annex II of the E.U. Habitats Directive, adds to the diversity and scientific value of the site.

B.7 River Shannon Callows SAC

The River Shannon Callows is a long and diverse site which consists of seasonally flooded, semi-natural, lowland wet grassland, along and beside the river between the towns of Athlone and Portumna. It is approximately 50 km long and averages about 0.75 km wide (reaching 1.5 km wide in places). Along much of its length the site is bordered by raised bogs (many, but not all, of which are subject to large-scale harvesting), esker ridges and limestone-bedrock hills. The soils grade from silty- alluvial to peat. This site has a common boundary, and is closely associated, with two other sites with similar habitats, River Suck Callows and Little Brosna Callows.

The River Shannon Callows is mainly composed of lowland wet grassland. Different plant communities occur, depending on elevation, and therefore flooding patterns. Two habitats listed on Annex I of the E.U. Habitats Directive are well-represented within the site – Molinia meadows and lowland hay meadows. The former is characterised by the presence of the Meadow Thistle (*Cirsium dissectum*) and Purple Moor-grass (*Molinia caerulea*), while typical species in the latter include Meadow Fescue (*Festuca pratensis*), Rough Meadow-grass (*Poa trivialis*), Downy Oat-grass (*Avenula pubescens*), Common Knapweed (*Centaurea nigra*), Ribwort Plantain (*Plantago lanceolata*) and Common Sorrel (*Rumex acetosa*). In places these two habitats grade into one another.

Low-lying areas of the callows with more prolonged flooding are characterised by Floating Sweet-grass (*Glyceria fluitans*), Marsh Foxtail (*Alopecurus geniculatus*) and wetland herbs such as Yellow-creed (*Rorippa* spp.), Water Forget-me-not (*Myosotis scorpioides*) and Common Spike-rush (*Eleocharis palustris*). Most of the callows consist of a plant community characterised by Creeping Bent (*Agrostis stolonifera*), Brown Sedge (*Carex disticha*), Common Sedge (*Carex nigra*), and herbs such as Marsh-marigold (*Caltha palustris*) and Marsh Bedstraw (*Galium palustre*), while the more elevated and peaty areas are characterised by low-growing sedges, particularly Yellow Sedge (*Carex flava* agg.) and Star Sedge (*Carex echinata*). All these communities are very diverse in their total number of plant species, and include the scarce species Meadow-rue (*Thalictrum flavum*), Summer Snowflake (*Leucojum aestivum*) and Marsh Stitchwort (*Stellaria palustris*).

A further two Annex I habitats, both listed with priority status, have a minor though important presence within the site. Alluvial forest occurs on a series of alluvial islands just below the

ESB weir near Meelick. Several of the islands are dominated by well-grown woodland consisting mainly of Ash (*Fraxinus excelsior*) and Willows (*Salix* spp.). The islands are prone to regular flooding from the river. At Clorhane, an area of limestone pavement represents the only known example in Co. Offaly. It is predominantly colonised by mature Hazel (*Corylus avellana*) woodland, with areas of open limestone and calcareous grassland interspersed. The open limestone pavement comprises bare or moss-covered rock, or rock with a very thin calcareous soil cover supporting a short grassy turf. The most notable plant in the grassy area is a substantial population of Green-winged Orchid (*Orchis morio*), which occurs with such species as Sweet Vernal-grass (*Anthoxanthum odoratum*), Quaking-grass (*Briza media*), sedges (*Carex caryophyllea*, *C. flacca*), Common Bird's-foot-trefoil (*Lotus corniculatus*), Common Knapweed (*Centaurea nigra*), and Ribwort Plantain (*Plantago lanceolata*). Ferns associated with the cracks in the pavement include *Asplenium trichomanes*, *A. ruta-muraria*, *A. adiantum-nigrum* and *Polypodium australe*. Bryophytes include *Grimmia apocarpa* and *Orthotrichum* cf. *anomalum*. Anthills are common within the open grassland. The Hazel wood is well-developed and has herbaceous species such as Primrose (*Primula vulgaris*), Common Dog-violet (*Viola riviniana*), Wood-sorrel (*Oxalis acetosella*) and Herb-Robert (*Geranium robertianum*). The wood is noted for its luxuriant growth of epiphytic mosses and liverworts, with such species as *Neckera crispa* and *Hylocomium brevirostre*. Yew (*Taxus baccata*) occurs in one area.

Other habitats of smaller area but also of importance within the site are lowland dry grassland, drainage ditches, freshwater marshes and reedbeds. The dry grassland areas, especially where they exist within hay meadows, are species-rich, and of two main types: calcareous grassland on glacial material, and dry grassland on levees of river alluvium. The former can contain many orchid species, Cowslip (*Primula veris*), abundant Adder's-tongue (*Ophioglossum vulgatum*) and Spring-sedge (*Carex caryophyllea*), and both contain an unusually wide variety of grasses, including False Oat-grass (*Arrhenatherum elatius*), Yellow Oat-grass (*Trisetum flavescens*), Meadow Foxtail (*Alopecurus pratense*), and Meadow Brome (*Bromus commutatus*). In places Summer Snowflake also occurs.

Good quality habitats on the edge of the callows included in the site are wet broadleaved semi-natural woodland dominated by both Downy Birch (*Betula pubescens*) and Alder (*Alnus glutinosa*), and dry broadleaved woodland dominated by Hazel. There are also areas of raised bog, fen on old cut-away bog with Black Bog-rush (*Schoenus nigricans*), and a 'petrifying stream' with associated species-rich calcareous flush which supports Yellow Sedge (*Carex lepidocarpa*), Blunt-flowered Rush (*Juncus subnodulosus*) and Stoneworts (*Chara* spp.). Immediately south of Portumna Bridge and south east of the town of Portumna the area of low-lying terrestrial land west of the river comprises a large area of the Annex I habitat alkaline fen. The fen comprises a complex of rich-fen plant communities. Sedges (*Carex lasiocarpa*, *Carex acutiformis*) and Bogbean (*Menyanthes trifoliata*) dominate parts of the fens while other small sedges are common throughout. The orchids Early Marsh Orchid (*Dactylorhiza incarnata*), Western Marsh Orchid (*D. majalis*) and Marsh Helleborine (*Epipactis palustris*) and the red-listed plant species Marsh Pea (*Lathyrus palustris*) have been recorded within the fen. Two species which are legally protected under the Flora (Protection) Order, 2015, occur in the site - Opposite-leaved Pondweed (*Groenlandia densa*) in drainage ditches, and Meadow Barley (*Hordeum secalinum*) on dry alluvial grassland. This is one of only two known inland sites for Meadow Barley in Ireland. The Red Data Book plant Green-winged Orchid is known from dry calcareous grasslands within the site. The site is of international importance for wintering waterfowl as numbers regularly exceed the 20,000 threshold (mean of 34,985 for five winters 1994/94-1998/99). Of particular note is an internationally important population of Whooper Swans (287). A further five species have populations of national importance (all figures are means for five winters 1995/96-1999/00): Mute Swan (349), Wigeon (2972), Golden Plover (4254), Lapwing (11578) and Black-tailed Godwit (388). Species which occur in numbers of regional or local importance include Bewick's Swan, Tufted Duck, Dunlin, Curlew and Redshank. The population of Dunlin is notable as it is one of the few regular inland flocks in Ireland. Small flocks of Greenland White-fronted Goose use the Shannon Callows; these are generally associated with larger flocks which occur on the adjacent Little Brosna Callows and River Suck Callows. Shoveler (an estimated 12 pairs in

1987) and Black-tailed Godwit (Icelandic race) (one or two pairs in 1987) breed within this site. These species are listed in the Red Data Book as being threatened in Ireland. The scarce bird Quail is also known to breed within the area. The callows has at times held over 40% of the Irish population of the globally endangered Corncrake, although numbers have declined in recent years. A total of 66 calling birds were recorded in 1999, but numbers have dropped significantly since then. The total population of breeding waders (Lapwing, Redshank, Snipe and Curlew) in 1987 was one of three major concentrations in Ireland and Britain. The population of breeding Redshank in the site was estimated to be 10% of the Irish population, making it nationally significant. Also, the Annex I species Merlin and Hen Harrier are regularly reported hunting over the callows during the breeding season and in autumn and winter.

This site holds a population of Otter, a species listed on Annex II of the E.U. Habitats Directive, while the Irish Hare, which is listed in the Irish Red Data Book, is a common sight on the callows.

The Shannon Callows are used for summer dry-stock grazing (mostly cattle, with some sheep and a few horses), and permanent hay meadow. About 30 ha is a nature reserve owned by voluntary conservation bodies. The River Shannon is used increasingly for recreational purposes with coarse angling and boating accounting for much of the visitor numbers. Intermittent and scattered damage to the habitats has occurred due to over-deepening of drains and peat silt deposition, water-skiing, ploughing and neglect of hay meadow (or reversion to pasture). However, none of these damaging activities can yet be said to be having a serious impact. Threats to the quality of the site may come from the siting of boating marinas in areas away from centres of population, fertilising of botanically-rich fields, the use of herbicides, reversion of hay meadow to pasture, neglect of pasture and hay meadow, disturbance of birds by boaters, anglers, birdwatchers and the general tourist. The maintenance of generally high water levels in winter and spring benefits all aspects of the flora and fauna, but in this regard, summer flooding is a threat to breeding birds, and may cause neglect of farming.

The Shannon Callows has by far the largest area of lowland semi-natural grassland and associated aquatic habitats in Ireland, and one in which there is least disturbance of natural wetland processes. Botanically, it is extremely diverse with two legally protected species of plants and many scarce species. Excellent examples of two habitats listed on Annex I of the E.U. Habitats Directive occur within the site – Molinia meadows and lowland hay meadows with good examples of a further three Annex habitats (two with priority status). In winter the site is internationally important for numbers and species of waterfowl. In spring it feeds large numbers of birds on migration, and in summer it holds very large numbers of breeding waders, rare breeding birds and the endangered Corncrake, as well as a very wide variety of more common grassland and wetland birds. The presence of Otter, an Annex II species, adds further importance to the site. (From NPWS 2020b)

C Protected Flora and Fauna and Invasive Species

Protected flora and fauna present or adjacent to the Scheme post-2000, compiled from the National Biodiversity Data Centre map database.

Common name	Latin Name	Date of last record	Designation
Birds			
Barn Owl	<i>Tyto alba</i>	31/12/2011	Birds of Conservation Concern - Red List
Barn Swallow	<i>Hirundo rustica</i>	31/12/2011	Birds of Conservation Concern - Amber List
Black-headed Gull	<i>Larus ridibundus</i>	31/12/2011	Birds of Conservation Concern - Red List
Common Coot	<i>Fulica atra</i>	31/12/2011	Birds of Conservation Concern - Amber List
Common Kestrel	<i>Falco tinnunculus</i>	26/10/2017	Birds of Conservation Concern - Amber List
Common Linnet	<i>Carduelis cannabina</i>	31/12/2011	Birds of Conservation Concern - Amber List
Common Snipe	<i>Gallinago gallinago</i>	26/10/2017	EU Birds Directive >> Annex II, Section II Bird Species Birds of Conservation Concern - Amber List
Common Starling	<i>Sturnus vulgaris</i>	31/12/2011	Birds of Conservation Concern - Amber List
Common Swift	<i>Apus apus</i>	31/12/2011	Birds of Conservation Concern - Amber List
Dunlin	<i>Calidris alpina</i>	31/12/2011	EU Birds Directive >> Annex I Species Birds of Conservation Concern - Amber List
Eurasian Curlew	<i>Numenius arquata</i>	31/12/2011	EU Birds Directive >> Annex II, Section II Bird Species Birds of Conservation Concern - Red List
Eurasian Woodcock	<i>Scolopax rusticola</i>	23/01/2017	EU Birds Directive >> Annex II, Section I Bird Species Birds of Conservation Concern - Amber List
Great Crested Grebe	<i>Podiceps cristatus</i>	29/06/2015	Birds of Conservation Concern - Amber List
House Sparrow	<i>Passer domesticus</i>	31/12/2011	Birds of Conservation Concern - Amber List
Little Grebe	<i>Tachybaptus ruficollis</i>	31/12/2011	Birds of Conservation Concern - Amber List
Mallard	<i>Anas platyrhynchos</i>	31/12/2011	EU Birds Directive >> Annex II, Section I Bird Species
Mute Swan	<i>Cygnus olor</i>	31/12/2011	Birds of Conservation Concern - Amber List
Northern Lapwing	<i>Vanellus vanellus</i>	31/12/2011	EU Birds Directive >> Annex II, Section II Bird Species Birds of Conservation Concern - Red List
Red Grouse	<i>Lagopus lagopus</i>	31/12/2011	EU Birds Directive >> Annex II, Section I Bird Species Birds of Conservation Concern - Red List
Sand Martin	<i>Riparia riparia</i>	31/12/2011	Birds of Conservation Concern - Amber List

Common name	Latin Name	Date of last record	Designation
Short-eared owl	<i>Asio flammeus</i>	26/10/2017	EU Birds Directive >> Annex I Bird Species Birds of Conservation Concern - Amber List
Sky Lark	<i>Audia arvensis</i>	31/12/2011	Birds of Conservation Concern - Amber List
Spotted Flycatcher	<i>Muscicapa striata</i>	31/12/2011	Birds of Conservation Concern - Amber List
Whooper Swan	<i>Cygnus cygnus</i>	31/12/2011	EU Birds Directive >> Annex I Bird Species Birds of Conservation Concern - Amber List
Yellowhammer	<i>Emberiza citrinella</i>	31/12/2011	Birds of Conservation Concern - Red List
Mammals			
Eurasian Badger	<i>Meles meles</i>	31/12/2008	Protected Species: Wildlife Acts
Eurasian Pygmy Shrew	<i>Sorex minutus</i>	10/08/2012	Protected Species: Wildlife Acts
European Otter	<i>Lutra lutra</i>	29/06/2015	EU Habitats Directive >> Annex II, Annex IV Protected Species: Wildlife Acts
Pine Marten	<i>Martes martes</i>	18/02/2015	EU Habitats Directive >> Annex V Protected Species: Wildlife Acts
Soprano Pipistrelle	<i>Pipistrellus pygmaeus</i>	06/08/2014	EU Habitats Directive >> Annex IV Protected Species: Wildlife Acts
West European Hedgehog	<i>Erinaceus europaeus</i>	19/04/2016	Protected Species: Wildlife Acts
Invertebrates			
White-clawed Crayfish	<i>Austropotamobius pallipes</i>	09/09/2014	EU Habitats Directive >> Annex II, Annex V Protected Species: Wildlife Acts
Bryophytes			
Large White-moss	<i>Leucobryum glaucum</i>	04/02/2011	EU Habitats Directive >> Annex IV
Invasive species			
Canadian Waterweed	<i>Elodea canadensis</i>	02/09/2008	High Impact Invasive Species Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland)
Giant-rhubarb	<i>Gunnera tinctoria</i>	02/09/2008	High Impact Invasive Species Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland)
Himalayan Knotweed	<i>Persicaria wallichii</i>	12/06/2014	High Impact Invasive Species Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland)
Japanese Knotweed	<i>Fallopia japonica</i>	22/11/2017	High Impact Invasive Species Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland)
Jenkins' Spire Snail	<i>Potamopyrgus antipodarum</i>	03/08/2018	Medium Impact Invasive Species

D Details of Planned Maintenance Activities

The details of maintenance for each channel are shown in Table D10-1 and embankments in Table D1-2.

These details form the basis of the Scheme description. However, they are not a comprehensive list of works, and as explained in the project description, there is likely to be the need for unplanned and sometimes emergency maintenance works. These are considered in the assessment in so far as they fall within the described activities of the Scheme.

Table D10-1. Maintenance details for channels in Carrigahorig Arterial Drainage Maintenance scheme

Channel Ref	Freq. of Maint.	Year of Last Maint.	Timing	Machine Type	Works					Length (m)	Notes
					A	B	C	D	E		
C1	10	11/05/16	Any	Shortreach	x					1.367	
C1	10	12/05/16	Any	Shortreach	x					0.364	
C1	10	13/05/16	Any	Shortreach	x					5.094	
C1	10	14/05/16	Any	Shortreach				x	x	6.423	
C1	10	15/05/16	Any	Shortreach	x			x		5.447	
C1/1	4	30/01/02	Any	Shortreach	x			x		1.228	
C1/2	4	18/07/12	Any	Shortreach	x			x		3.795	
C1/2/1	4	26/09/07	Any	Shortreach	x			x		0.491	
C1/2/2	4	09/12/15	Any	Shortreach	x			x		6.226	
C1/2/2/1	4	21/10/15	Any	Shortreach	x			x		0.683	
C1/3	4	30/10/13	Any	Shortreach	x			x		0.81	
C1/4	4	06/12/06	Any	Shortreach	x			x		1.667	
C1/5	4	21/11/12	Any	Shortreach	x			x		1.926	
C1/6	4	15/11/06	Any	Shortreach	x			x		1.012	
C1/7	4	22/11/06	Any	Shortreach	x			x		1.493	
C2	4	14/08/92	Any	Shortreach	x			x		1.038	
C2/1	4	16/04/03	Any	Shortreach	x			x		0.564	
C3	4	08/10/03	Any	Shortreach	x			x		0.839	

Table D1-2. Maintenance details for embankments in Carrigahorig Arterial Drainage Maintenance scheme

Embankment Ref	Freq.	Year of Last Maint.	Timing of Works	Machine Type	Type of Maintenance					Length (km)	Notes
					D	E	F	G	H		
E1					x	x	x			0.38	Inspection, selective vegetation management and mulching of embankment cross section

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