Natura Impact Statement

Derrinlough Wind Farm

DOCUMENT DETAILS

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Planning and Environmental Consultants

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1. INTRODUCTION

1.1 Background

McCarthy Keville O'Sullivan Ltd. (MKO) has been appointed to prepare a Natura Impact Statement to allow the competent authority to conduct an Appropriate Assessment under Part XAB of the Planning and Development Acts 2000-2019 of a proposed wind energy development and all associated infrastructure located on Clongawny and Drinagh Bogs which are part of the Boora bog group in Co. Offaly.

An Appropriate Assessment Screening Report has been prepared and is provided in Appendix 1. This Appropriate Assessment Screening Report identified the European Sites upon which the proposed development has the potential to result in significant effects and the pathways by which those effects may occur. It has also identified those qualifying interests/special conservation interests that have the potential to be affected by the proposed development. The Screening Report identifies the European Sites upon which significant effects could not be excluded. Those sites will be assessed in this Natura Impact Statement.

This report has been prepared in compliance with Part XAB of the Planning and Development Acts 2000-2019, the Planning and Development Regulations 2001-2019 and relevant jurisprudence of the European and Irish courts. It has also been prepared in accordance with the European Commission guidance document Assessment of Plans and Projects Significantly affecting Natura 2000 Sites: Methodological Guidance on the provisions of Article 6(3) and 6(4) of the Habitats Directive 92/43/EEC (EC, 2001), European Communities (2018) 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 and the Department of the Environment's Guidance on the Appropriate Assessment of Plans and Projects in Ireland (December 2009, amended 11 February 2010).

In addition to the guidelines referenced above, the following relevant guidance was considered in preparation of this report:

1. *Council of the European Commission (1992) Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Official Journal of the European Communities. Series L 20, pp. 7-49.*
2. *European Communities (2000) 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,*
3. *EC (2007) Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC – Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the commission. European Commission.*
4. *EC (2013) Interpretation Manual of European Union Habitats. Version EUR 28. European Commission.*
5. *CIEEM (2018) Institute of Ecology and Environmental Management Guidelines for Ecological Impact Assessment.*

1.2 Statement of Authority

This report has been prepared by David McNicholas and Pat Roberts (B.Sc. Environmental Science, MCIEEM). Pat has over 14 years' experience in ecological management and assessment. David McNicholas has over 9 years' professional ecological consultancy experience and is a full member of the Chartered Institute of Ecology and Environmental Management. The baseline ecological surveys were undertaken by David McNicholas (BSc., MSc., MCIEEM), Sarah Mullen (BSc., PhD), James Owens (BSc., MSc.), Dr. Úna Nealon, Laoise Kelly (B.Sc), Julie O'Sullivan (BSc, MSc), John Hehir and Paddy Manley (B.Sc). (CIEEM). Úna Nealon's primary expertise lies in bat ecology. She completed her PhD with the Centre for Irish Bat Research, examining the impacts of wind farms on Irish bat species. James has over 4 years' consultancy experience and is a competent expert in undertaking ecological surveys. Sarah has over 4 years' professional ecological consultancy experience and a PhD on plant pollinator interactions in semi-natural grasslands. Laoise Kelly, Julie O'Sullivan, Paddy Manley and John Hehir all assisted in the gathering of baseline data at the proposed development site. They have relevant academic qualifications and are competent experts in undertaking the ecological surveys in which they were involved.

Field surveys were undertaken by John Hehir (BSc.), Tom Ryan (BSc.), Joe Kelly (BSc.), Patrick Manley (BSc.), Paul Troake, Dr Brian Madden (PhD) (BES), Shane O'Neill (BES) and Joe Adamson (BES). All of the surveyors listed above are competent experts for the purposes of the preparation of this EIAR and suitably qualified.

The bird survey methodologies have been peer reviewed by Dr Tom Gittings. Dr Gittings has been trading as an independent ecological consultant since 2001. He has over 18 years' experience as a professional ecologist and is a full member of the Chartered Institute of Ecology and Environmental Management.

All of the surveyors listed above are competent experts for the purposes of the preparation of this NIS and suitably qualified in ornithology and ecology.

2. CONCLUSIONS OF ARTICLE 6(3) APPROPRIATE ASSESSMENT SCREENING REPORT

The Article 6(3) Appropriate Assessment Screening report, that is provided as Appendix 1 to this NIS, concluded that there was potential for the proposed development to result in significant effects on the following European Sites:

- River Shannon Callows SAC
- Lough Derg, North-east Shore SAC
- Middle Shannon Callows SPA
- River Little Brosna Callows SPA
- Lough Derg (Shannon) SPA

The Qualifying Interests/Special Conservation Interests with the potential to be affected and the pathways by which any such effects may occur are set out below for each site. The location of the proposed development and connectivity with these EU designated sites is provided as Figure 2.1.

2.1 River Shannon Callows SAC

This SAC is located 2.3km north-west of the proposed development site (3.3km via surface water connectivity). There is hydrological connectivity between the proposed development and this SAC via watercourses within and adjacent to the site boundary that flow to the River Shannon. The proposed works have the potential to cause deterioration in surface water quality through the run-off of silt, hydrocarbons, cementitious material and other pollutants during the construction, operational and decommissioning phase of the development potentially affecting the following habitats and species:

- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0]
- *Lutra lutra* (Otter) [1355]

2.2 Lough Derg, North-east Shore SAC

This site lies 29.2km downstream of the proposed development site (via hydrological connectivity). Following the precautionary principle, the proposed works have the potential to cause deterioration in surface water quality through the run off of silt, hydrocarbons, cementitious material and other pollutants during the construction, operational and decommissioning phase of the development potentially affecting the following habitats and species:

- Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* [7210]
- Alkaline fens [7230]
- Alluvial forests with Alnus glutinosa and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0]

2.3 Middle Shannon Callows SPA

This European Site is located 2.3km north-west of the proposed development site (3.3km via surface water connectivity). There is hydrological connectivity between the proposed development and this SPA via watercourses within and adjacent to the site boundary that flow to the River Shannon. The proposed works have the potential to cause deterioration in surface water quality through the run-off of silt, hydrocarbons, cementitious material and other pollutants during the construction, operational and decommissioning phase of the development potentially affecting the downstream SCI:

- 'Wetland and Waterbirds'

This proposed development is within the core foraging distance or provides suitable habitat for a number of the SCI species of this SPA. On a precautionary basis, a potential pathway for significant effect was identified in the form of bird disturbance and displacement as a result of construction activity. In addition, the potential for collision risk associated with the operation of the turbines was identified. The SCI species that are potentially affected by the proposed development are listed below:

- golden plover
- whooper swan
- black-headed gull
- lapwing
- wigeon
- black tailed godwit

2.4 River Little Brosna Callows SPA

This SPA is located 4.48 km to the southwest of the proposed development site. There is no hydrological connectivity between the proposed development and this SPA and no potential for effects on habitats as a result of deterioration in water quality within the SPA. The proposed development is within the core foraging distance or provides suitable habitat for a number of the SCI species of this SPA. On a precautionary basis, a potential pathway for significant effect was identified in the form of bird disturbance and displacement as a result of construction activity. In addition, the potential for collision risk associated with the operation of the turbines was identified. The SCI species that are potentially affected by the proposed development are listed below:

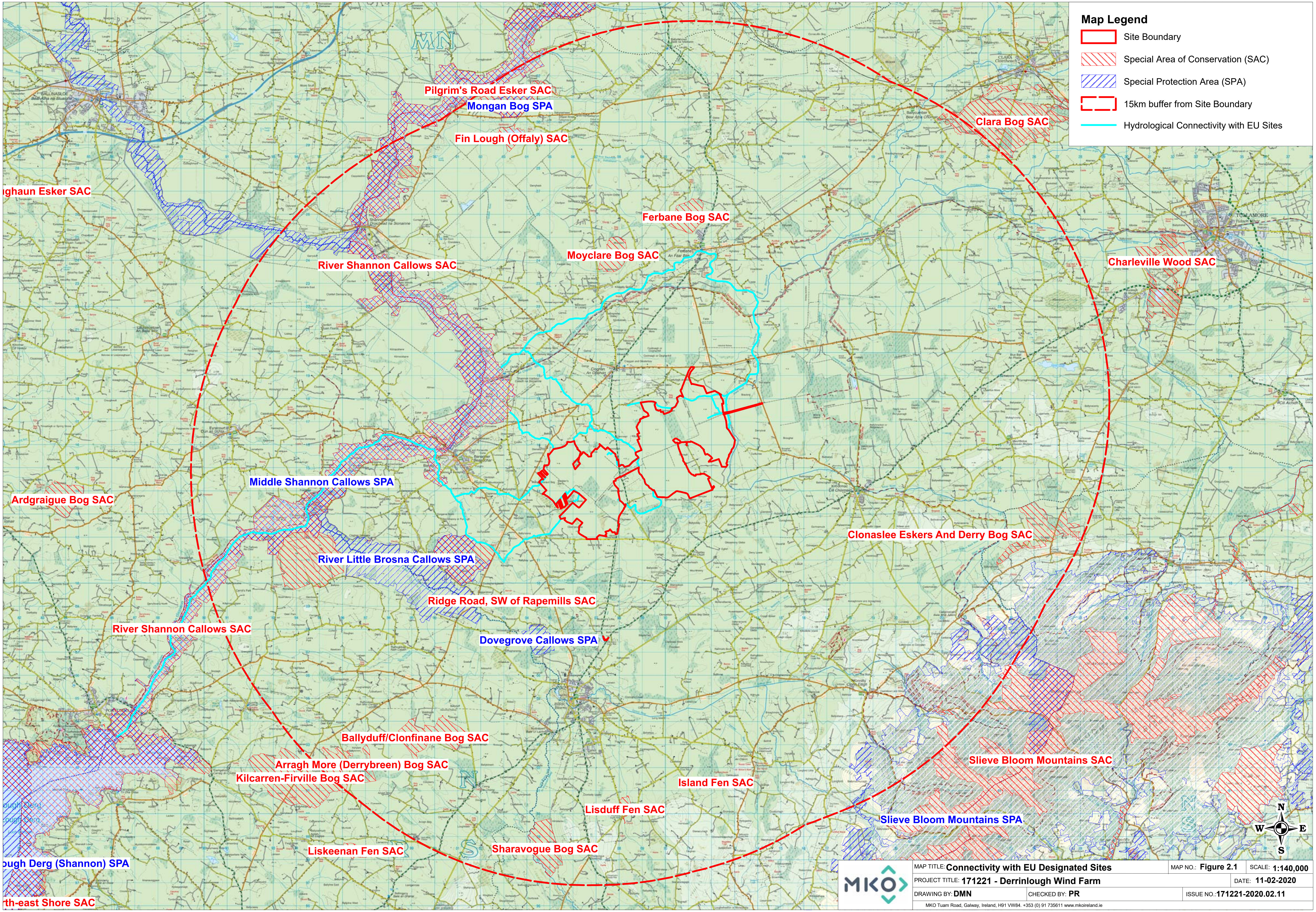
- black-headed gull
- whooper swan
- lapwing
- golden plover
- wigeon
- black-tailed godwit
- teal
- shoveler

2.5 Lough Derg (Shannon) SPA

There is no potential for disturbance, displacement or collision risk effects on SCI species as a result of any stage of the proposed development as it is 19km (29.2km via surface water connectivity) from the proposed development site, via surface water connectivity.

Following the precautionary principle, the proposed works have the potential to cause deterioration in surface water quality through the run off of silt, hydrocarbons, cementitious material and other pollutants during the construction, operational and decommissioning phase of the development potentially affecting the following SCI:

'Wetland and Waterbirds [A999]'.



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3. DESCRIPTION OF PROPOSED DEVELOPMENT

3.1 Site Location

The proposed development, known as Derrinlough Wind Farm is located on Clongawny and Drinagh Bogs which are part of the Boora bog group in Co. Offaly. The Boora bog group is regulated by the Environmental Protection Agency (EPA) under IPC Licence Register No. P0500-01.

The two bogs have a total area of approximately 2,360 hectares. Combined they are approximately 6km long in a north/south direction and 9km wide in an east/west direction at their widest point. The closest settlements to the site are Cloghan which is located approximately 2km to the north and Fivealley which is located approximately 2.5km to the south. Other settlements and towns in the area include Banagher (circa. 3km west), Ferbane (circa. 6km north), Birr (circa 7km south-west) and Shannonbridge (circa. 15km north-west). The townlands within which the site lies are listed in Table 1.1 of Chapter 1 of the EIAR accompanying this application.

3.2 Characteristics of the Proposed Development

3.2.1 Description of the project

The Proposed Development comprises:

1. 21 No. wind turbines with an overall blade tip height of up to 185 metres and all associated hard-standing areas.
2. 2 No. permanent Anemometry Masts up to a height of 120 metres.
3. Provision of new and upgraded internal site access roads, passing bays, amenity pathways, amenity carpark and associated drainage.
4. 2 No. permanent underpasses in the townland of Derrinlough. One underpass will be located beneath the N62 and one will be located beneath an existing Bord na Móna rail line.
5. 1 No. 110 kV electrical substation, which will be constructed in the townland of Cortullagh or Grove. The electrical substation will have 2 No. control buildings, associated electrical plant and equipment and a wastewater holding tank.
6. 5 No. temporary construction compounds, in the townlands of Clongawny More, Derrinlough, Derrinlough/Crancreagh, Drinagh and Cortullagh or Grove.
7. All associated underground electrical and communications cabling connecting the turbines to the proposed electrical substation.
8. 2 No. temporary security cabins at the main construction site entrances in the townland of Derrinlough.
9. All works associated with the connection of the proposed wind farm to the national electricity grid, which will be to the existing Dallow/Portlaoise/Shannonbridge 110 kV line.
10. Removal of existing meteorological mast.
11. Upgrade of existing access and temporary improvements and modifications to existing public road infrastructure to facilitate delivery of abnormal loads including locations on the N52 and N62; construction access for delivery of construction materials at locations on the N62 and R357; operational access onto L7009 in the townland of Cortullagh or Grove and amenity access off R357 and L7005.
12. All associated site works and ancillary development including signage.
13. A 10-year planning permission and 30-year operational life from the date of commissioning of the entire wind farm.

The planning application for the proposed wind farm includes connection to the national electricity grid. All elements of the proposed project, including grid connection and any works required on public roads to accommodate turbine delivery, have been considered.

This application seeks a ten-year planning permission and 30-year operational life from the date of commissioning of the entire wind farm.

3.2.2 Development layout

The overall layout of the Proposed Development is shown on Figure 3-1. This drawing shows the proposed locations of the wind turbines, electricity substation, construction compounds, internal roads layout and the site entrances. A detailed description of all elements of the development, including construction methodology and site layout drawings of the proposed development are included in Chapter 4 and Appendix 4-1 of the EIAR accompanying this application. A summary description is provided below.

3.2.3 Construction details

3.2.3.1 Turbine Foundations

Each wind turbine is secured to a reinforced concrete foundation that is installed below the finished ground level on a granular sub-base after the excavation of soil and peat. The size of the foundation will be determined by the turbine manufacturer, and the final turbine selection will be the subject of a competitive tender process. Different turbine manufacturers use different shaped turbines foundations, ranging from circular to hexagonal and square, depending on the requirements of the final turbine supplier. The turbine foundation transmits any load on the wind turbine into the ground.

After the foundation level of each turbine has been formed using piling methods or on competent strata, the bottom section of the turbine tower "Anchor Cage" is levelled and reinforcing steel is then built up around and through the anchor cage (Plate 3-1 below). The outside of the foundation is shuttered with demountable formwork to allow the pouring of concrete and is backfilled accordingly with appropriate granular fill to finished surface level (Plate 3-2 below). Detailed construction methodology for the turbine foundations is provided in Section 4.9, Chapter 4 of the EIAR accompanying this application.

Plate 3.1 Turbine Base 'Anchor Cage'

Plate 3.2 Finished Turbine Base

3.2.3.2 Hard Standing Areas

Hard standing areas consisting of levelled and compacted hardcore are required around each turbine base to facilitate access, turbine assembly and turbine erection. The hard-standing areas are typically used to accommodate cranes used in the assembly and erection of the turbine, offloading and storage of turbine components, and generally provide a safe, level working area around each turbine position. The hard-standing areas are extended to cover the turbine foundations once the turbine foundation is in place.

The proposed hard standing areas shown on the detailed layout drawings included in Appendix 4-1 of the EIAR accompanying this application.

3.2.3.3 Site Roads

To provide access within the site of the Proposed Development and to connect the wind turbines and associated infrastructure, new access roads will need to be constructed. Fehily Timoney & Company Ltd. (FTC) were appointed to assess the extent and condition of the existing site ground conditions and specify the type of road required to access all locations on site. The road construction preliminary design has taken into account the following key factors as stated in the FTC Peat and Spoil Management Plan including in Appendix 4-2 of the EIAR accompanying this application:

1. *Buildability considerations*
2. *Serviceability requirements for construction and wind turbine delivery and maintenance vehicles*
3. *Minimise excavation arisings*
4. *Requirement to minimise disruption to peat hydrology*

Whilst the above key factors are used to determine the road design, the actual construction technique employed for a particular length of road will be determined on the prevailing ground conditions encountered along that length of road.

The general road construction techniques to be considered are as follows:

- Construction of New Floating Roads over peat
- Construction of New Excavated Roads through peat
- Upgrade of Existing Tracks:
    - Existing Excavated Roads
    - Existing Floating Roads

The construction methodology proposed to be used for certain lengths of new and existing roads across the site are included in Section 4.9.2, Chapter 4 of the EIAR accompanying this application.

3.2.3.3.1 *Construction of New Excavated Roads*

The general construction methodology for the construction of excavated roads, as presented in the Peat and Spoil Management Plan (Appendix 4.2, of the accompanying EIAR), is summarised below. This methodology includes procedures that are to be included in construction to minimise any adverse impact on peat stability.

1. *Prior to commencing the construction of the excavated roads movement monitoring posts should be installed in areas where the peat depth is greater than 2.0m.*
2. *Interceptor drains should be installed upslope of the access road alignment to divert any surface water away from the construction area.*

3. *Excavation of roads shall be to the line and level given in the design requirements. Excavation should take place to a competent stratum beneath the peat (as agreed with the site designer).*
4. *Road construction should be carried out in sections of approximately 50m lengths i.e. no more than 50m of access road should be excavated without re-placement with stone fill unless otherwise agreed with the site designer or resident engineer on site.*
5. *All excavated peat shall be placed/spread alongside the excavations.*
6. *Side slopes in peat shall be not greater than 1 (v): 2 or 3 (h). This slope inclination will be reviewed during construction, as appropriate. Where areas of weaker peat are encountered then slacker slopes will be required. Battering of the side slopes of the excavations should be carried out as the excavation progresses.*
7. *The surface of the finished excavated access road will be 1.2m above existing ground level.*
8. *A layer of geogrid/geotextile may be required at the surface of the competent stratum (to be confirmed by the designer).*
9. *At transitions between floating and excavated roads a length of road of about 10m shall have all peat excavated and replaced with suitable fill. The surface of this fill shall be graded so that the road surface transitions smoothly from floating to excavated roa.*
10. *Where slopes of greater than 5 degrees are encountered along with relatively deep peat (i.e. greater than 1.5m) and where it is proposed to construct the access road perpendicular to the slope contours it is best practice to start construction at the bottom of the slope and work towards the top, where possible. This method avoids any unnecessary loading to the adjacent peat and greatly reduces any risk of peat instability. It should be noted that slopes greater than 5 degrees are not envisaged on site.*
11. *A final surface layer shall be placed over the excavated road, as per design requirements, to provide a road profile and graded to accommodate wind turbine construction and delivery traffic.*

3.2.3.3.2 Construction of New Floating Roads

Floating access roads are the predominant road construction type proposed for the site and will be used in areas where the peat depth is in excess of 1m. The use of new floated access tracks will be limited on site to areas of flatter terrain i.e. typically less than 5 degree slope.

The general construction methodology for the construction of floating roads, is outlined in section 4.9, Chapter 4 of the EIAR accompanying this application and in Peat and Spoil Management Plan (Appendix 4-2, of the accompanying EIAR) and is summarised below. This methodology includes procedures that are to be included in the construction to minimise any adverse impact on peat stability.

1. *Prior to commencing floating road construction movement monitoring posts should be installed in areas where the peat depth is greater than 2.0m.*
2. *Floating road construction shall be to the line and level requirements as per design/planning conditions.*
3. *Base geogrid to be laid directly onto the existing peat surface along the line of the road in accordance with geogrid provider's requirements.*
4. *Construction of road to be in accordance with appropriate design from the designer.*
5. *The typical make-up of the new floated access road is up to 1,200mm of selected granular fill with 2 no. layers of geogrid with possibly the inclusion of a geotextile separator. This may vary depending on designer requirements.*
6. *Following the detailed design of the floated access roads it may be deemed necessary to include pressure berms either side of the access road in some of the deeper peat areas. The inclusion of a 5m wide pressure berm (typically 1m in height) either side of the access road will reduce the likelihood of potential bearing failures beneath the access road.*
7. *The finished road surface width will be approximately 6m (to be confirmed by the designer).*

8. *Stone delivered to the floating road construction shall be end-tipped onto the constructed floating road. Direct tipping of stone onto the peat shall not be carried out.*
9. *To avoid excessive impact loading on the peat due to concentrated end-tipping all stone delivered to the floating road shall be tipped over at least a 10m length of constructed floating road.*
10. *Where it is not possible to end-tip over a 10m length of constructed floating road then dumpers delivering stone to the floating road shall carry a reduced stone load (not greater than half full) until such time as end-tipping can be carried out over a 10m length of constructed floating road.*
11. *Following end-tipping a suitable bull-dozer shall be employed to spread and place the tipped stone over the base geogrid along the line of the road.*
12. *A final surface layer shall be placed over the floating road, as per design requirements, to provide a road profile and graded to accommodate wind turbine construction and delivery traffic.*

3.2.3.4 Amenity Pathways and Carpark

Amenity pathways (walkways and cycleways) will be provided as part of the construction of the proposed development. The amenity pathways will be mainly located on the proposed internal road network. The roads will be re-purposed following construction to form the amenity pathways, in addition to being used for maintenance access during operation. The amenity pathways will have a high quality, final surfacing granular fill.

Amenity pathways are proposed to provide access points/links into and out of the site as follows:

- Internal link to R437 allowing further access to Drinagh and Derrybrat to facilitate potential future connection to Lough Boora Parklands.
- Link from the R357 and L7009 providing connectivity to the local Stonestown and wider Cloghan area.
- Link to the L7005 providing connectivity to the local Drinagh area.
- Link to the Bord na Móna boundary in Clongawny West to facilitate potential future connection to the R438.
- Link to the Bord na Móna boundary in southwest Drinagh to facilitate potential future connection to the proposed Whigsborough Walkway.

These amenity pathways and additional connections are discussed and shown in the Derrinlough Amenity Plan and are illustrated in Figure 4.1, both of which are included in Chapter 4 of the EIAR accompanying this application. The additional connections will be 3 metres in width and will be constructed using a similar methodology to the construction f the new floating roads, as outlined in Section 3.2.3.3.2 above.

A new public car park will also be provided for recreational use during the operational stage. The car park will be located adjacent to the proposed access off the R357, immediately north of the proposed substation. The location and configuration of the proposed car park, which will have capacity for 15 vehicles and will include suitable signage, is shown in Appendix 4.1, Chapter 4 of the EIAR accompanying this application. Amenity connectivity between Clongawny and Drinagh Bogs will be via an underpass beneath the N62 only.

3.2.3.5 Underpasses

Two permanent underpasses are proposed as part of the proposed development, the locations of which are as follows:

- Beneath the N62, immediately north of Derrinlough Briquette Factory.

- Beneath an existing Bord na Móna railway line in Clongawny Bog, immediately west of the N62 underpass.

Both underpasses will provide amenity connectivity between Clongawny and Drinagh Bogs and will also be used occasionally by vehicles for wind farm maintenance during the operational phase.

The underpasses will be approximately 35m in length, 4.5m wide and 4.5m high and will take the form of precast concrete box culverts which will be founded on an in-situ concrete base slab. The construction methodology for the construction of the underpasses, is outlined in section 4.9, Chapter 4 of the EIAR accompanying this application.

3.2.3.6 Onsite Electricity Substation and Control Building

Once ground preparation as per the methodology for site roads as described in Section 3.2.3.3 is completed, the onsite substation will be constructed by the following methodology:

- The area of the onsite substation will be marked out using ranging rods or wooden posts and the soil and overburden stripped and removed to nearby temporary storage area for later use in landscaping.
- The dimensions of the onsite substation area will be set to meet the requirements of Eirgrid and the necessary equipment to safely and efficiently operate the permitted wind farms;
- Two control buildings will also be built within the onsite substation compound;
- The foundations will be excavated down to the level indicated by the designer and appropriately shuttered reinforced concrete will be laid over it. An anti-bleeding admixture will be included in the concrete mix;
- The block work walls will be built up from the footings to DPC level and the floor slab constructed, having first located any ducts or trenches required by the follow on mechanical and electrical contractors;
- The block work will then be raised to wall plate level and the gables and internal partition walls formed. Scaffold will be erected around the outside of the building for this operation;
- The concrete roof slabs will be lifted into position using an adequately sized mobile crane;
- The timber roof trusses will then be lifted into position using a telescopic load all or mobile crane depending on site conditions. The roof trusses will then be felted, battened, tiled and sealed against the weather.
- The electrical equipment will be installed and commissioned.
- Perimeter fencing will be erected.
- The construction and components of the substation will be to ESB or Eirgrid specifications.

3.2.3.7 Temporary Construction Compounds

The temporary construction compounds will be constructed as follows:

- The area to be used as the compound will be marked out at the corners using ranging rods or timber posts. Drainage runs and associated settlement ponds will be installed around the perimeter;
- The compound platform will be established using a similar technique as the construction of the substation platform discussed above;
- A layer of geo-grid will be installed and compacted layers of well graded granular material will be spread and lightly compacted to provide a hard area for site offices and storage containers;

- Areas within the compound will be constructed as site roads and used as vehicle hardstandings during deliveries and for parking;
- The compound will be fenced and secured with locked gates if necessary; and,
- Upon completion of the proposed development the temporary construction compound will be decommissioned by backfilling the area with the material arising during excavation, landscaping with topsoil as required.

3.2.3.8 Site cabling

Each turbine will be connected to the on-site electricity substation via an underground 33 kV (kilovolt) electricity cable. Fibre-optic cables will also connect each wind turbine to the wind farm control building in the onsite substation compound. The electricity and fibre-optic cables running from the turbines to the onsite substation compound will be run in cable ducts approximately 1.3 metres below the ground surface, along the sides of or underneath the internal roadways. The route of the cable ducts will follow the access track to each turbine location. The indicative position of the cable trench relative to the roadways is shown in section in Chapter 4 of the EIAR accompanying this application.

Clay plugs will be installed at regular intervals of not greater than 50 metres along the length of the trenches to prevent the trenches becoming conduits for runoff water. While the majority of the cable trenches will be backfilled with native material, clay subsoils of low permeability will be used to prevent conduit flow in the backfilled trenches. This material will be imported onto the site should sufficient volumes not be encountered during the excavation phase of roadway and turbine foundation construction.

3.2.3.9 Grid Connection

A connection between the proposed development and the national electricity grid will be necessary to export electricity from the proposed wind farm. This connection will originate at the proposed onsite substation and will be connected to the national grid via either an underground grid connection cable or overhead line which will connect into the existing 110 kV transmission line located approximately 300m north of the substation. This connection route is illustrated in Chapter 4 of the EIAR accompanying this application. Planning permission is being sought for the overhead line and underground cabling options, however, only one option will be used to connect the proposed development to the national electricity grid.

Should the connection option of overhead line be chosen then approximately 530m of new 110kV transmission line and the installation of 6 No. new lattice towers will be required. The proposed lattice towers will all be located within the proposed development site. Each tower can have a footprint of up to approximately 70m^2 and an overall height of up to 20m. They will be lattice steel structures with cross-arms which can extend over the base footprint and internal bracing.

The cables will be laid in trenches as per Eirgrid and ESB Networks Specifications. Further information is also included in Section 4.9.4 of the EIAR. Two Line Cable Interface Masts (LCIM) will be used to connect the high voltage underground cable into the existing 110 kV line.

The LCIMs will be within the proposed development site. The LCIMs will be lattice steel structures with cross-arms which can extend over the base footprint and internal bracing and are very similar in size and character to the masts proposed for the overhead line option.

The exact final detail and specifications of the grid connection route and method for the proposed development will ultimately be decided by ESB/EirGrid. Detailed construction methodology for the construction of underground cabling and overhead grid lines is provided in Section 4.9, Chapter 4 of the EIAR accompanying this application.

3.2.3.10 Site Drainage

The drainage design for the proposed wind farm development has been prepared by Hydro Environmental Services Ltd. (HES), and by the firm's principal, Mr. Michael Gill. The drainage design has been prepared based on experience of the project team of other wind farm sites in peat-dominated environments, and the number of best practice guidance documents referred to in the References section of the EIAR accompanying this application.

The protection of the watercourses within and surrounding the site, and downstream catchments that they feed is of utmost importance in considering the most appropriate drainage proposals for the site of the proposed development. There is an existing drainage system and surface water discharges from the site which are regulated by the Environmental Protection Agency (Licence Ref. P0500-01). The proposed development drainage design for the proposed development has therefore been proposed specifically with the intention of having no negative impact on the water quality of the site and its associated rivers and lakes, and consequently no impact on downstream catchments and ecological ecosystems. The assessment of potential impacts on hydrology and hydrogeology due to the construction, operation and decommissioning of the proposed development is included in Chapter 9: Hydrology and Hydrogeology, included as Appendix 2 of this report.

No routes of any natural drainage features will be altered as part of the proposed development and turbine locations and associated new roadways were originally selected to avoid natural watercourses, and existing roads are to be used wherever possible. There will be no direct discharges to any natural watercourses, with all drainage waters being dispersed as overland flows. All discharges from the proposed works areas will be made over vegetation filters at an appropriate distance from natural watercourses. Buffer zones around the existing natural drainage features have been used to inform the layout of the proposed development.

3.2.3.11 Waste disposal

The Construction and Environmental Management Plan (CEMP) (Appendix 3) provides a Waste Management Plan (WMP) which outlines the best practice procedures during the excavation and construction phases of the project. The WMP will outline the methods of waste prevention and minimisation by recycling, recovery and reuse at each stage.

3.2.3.12 Peat Management

The site which is generally flat consists predominantly of bare, locally re-vegetated cutaway peat and shallow peat with an extensive drainage network. The site has been extensively harvested by Bord na Móna using mechanical harvesting equipment resulting in a well-drained and extensively trafficked peat. Bord na Móna has considerable experience in the handling of peat in these circumstances, both during peat production operations and during wind farm construction projects, particularly Mountlucas, Bruckana and Oweninny wind farms which are located on very similar terrain. This experience has shown that the most environmentally sensitive and stable way of handling and moving of peat is its placement across the site and at locations as close as possible to the excavation areas. The proposed methodology is outlined in the FTC Peat and Spoil Management Plan and is provided in Appendix 4-2 of the accompanying EIAR.

3.3 Operation

The proposed development is expected to have a lifespan of approximately 30 years. Planning permission is being sought for a 30-year operation period commencing from the date of full operational commissioning of the wind farm. During the operational period, on a day-to-day basis the wind turbines will operate automatically, responding by means of anemometry equipment and control systems to changes in wind speed and direction.

The wind turbines will be connected together and data relayed from the wind turbines to an off-site control centre. Each turbine will also be monitored off-site by the wind turbine supplier. The monitoring of turbine output, performance, wind speeds, and responses to any key alarms will be monitored at an off-site control centre 24-hours per day.

Each turbine will be subject to a routine maintenance programme involving a number of checks and changing of consumables, including oil changes. In addition, there will be a requirement for unscheduled maintenance, which could vary between resetting alarms to major component changes requiring a crane. Typically, maintenance traffic will consist of four-wheel drive vehicles or vans. The electricity substation and site tracks will also require periodic maintenance.

3.4 Decommissioning

The wind turbines proposed as part of the Proposed Development are expected to have a lifespan of approximately 30 years. Following the end of their useful life, the wind turbines may be replaced with a new set of turbines, subject to planning permission being obtained, or the Proposed Development may be decommissioned fully. The onsite substation will remain in place as it will be under the ownership of the ESB/EirGrid.

Upon decommissioning of the Proposed Development, the wind turbines would be disassembled in reverse order to how they were erected. All above ground turbine components would be separated and removed off-site for recycling. Turbine foundations would remain in place underground and would be covered with earth and reseeded as appropriate. Leaving the turbine foundations in-situ is considered a more environmentally prudent option, as to remove that volume of reinforced concrete from the ground could result in significant environment nuisances such as noise, dust and/or vibration. Site roadways could be in use for purposes other than the operation of the wind farm (such as amenity) by the time the decommissioning of the Proposed Development is to be considered, and therefore it may be more appropriate to leave the site roads in situ for future use. Underground cables, including grid connection, will be removed and the ducting left in place. A decommissioning plan will be agreed with Offaly County Council three months prior to decommissioning the Proposed Development. A decommissioning plan is contained in the CEMP included as Appendix 3.

3.5 Mitigation Measures and Best practice

This section describes the measures that are in place to avoid, reduce or offset any potentially harmful or negative effects on EU designated sites as a result of the proposed development.

The design of the Proposed Development, as described in Chapter 4 of the EIAR accompanying this application, sets out very clearly how the wind farm including the grid connection has been designed and will be operated in accordance with best industry practice to avoid any significant effects outside the site including the prevention of impacts on watercourses.

A Construction and Environmental Management Plan (CEMP) has been prepared and is included as Appendix 3 of this report. The CEMP will be in place prior to the start of the construction phase. Best practice measures which form part of the design of the project are included in Chapter 4 (Description of the Proposed Development) and in the relevant chapters of the EIAR.

The CEMP also outlines that a Site Supervisor/Construction Manager and/or Environmental Manager will be appointed to maintain responsibility for monitoring the works and Contractors/Sub-contractors from an environmental perspective. In addition, an Environmental Clerk of Works or Project Ecologist, Project Hydrologist, Project Geotechnical engineer will visit the site regularly and report to the Site Environmental Office. This structure will provide a “triple lock” review/interaction by external specialists during the construction phase.

Some of the key features of the environmental management strategy are provided below.

3.5.1 Water quality

The proposed development has been designed so that all large-scale infrastructure such as turbine and site compounds are located as far from watercourses as possible. These best practice construction measures are designed to avoid impacts on areas that are outside the site including downstream watercourses. The development has been designed to maintain a drainage neutral situation to avoid drainage related impacts (See Chapter 9: Hydrology and Hydrogeology).

The proposed development includes a detailed drainage plan that is included in full in Chapter 9 (Hydrology and Hydrogeology) of the EIAR, included as Appendix 2 of this report. This plan and all the associated measures have been taken into account in this assessment but are not included in full (to avoid repetition). The drainage philosophy overall is to minimise waters arising on site, to adequately treat any water that may arise and to ensure that the hydrological function of the watercourses on the site and in the wider catchment are not affected by the proposed works. This philosophy including all associated mitigation measures to protect local surface water quality are fully described in the Construction and Environmental Management Plan (CEMP) and Chapter 9 (Hydrology and Hydrogeology Chapter) of the EIAR, included as Appendix 3 and Appendix 2 respectively.

The Inland Fisheries Ireland (2016): *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters*; and the Scottish Natural Heritage (SNH) *Good Practice During Wind Farm Construction* (SNH, 2019, 4th Edition) will also be adhered to.

Section 9.4 of the Hydrology and Hydrogeology Chapter (Chapter 9) of the EIAR accompanying this application (Appendix 2) sets out in full the mitigation measures that will be implemented to protect water quality.

The key mitigation measure during the construction phase is the avoidance of sensitive aquatic areas where possible, by application of suitable buffer zones (i.e. 50m to main watercourses, and 10m to main drains). All of the key proposed development areas are located significantly away from the delineated 50m watercourse buffer zones with the exception of the upgrade of the existing watercourse crossing, new drain crossing and upgrades to existing site access tracks.

Increased surface water runoff during the operational phase of the development was considered, due to the replacement of vegetated surfaces with impermeable surfaces including hardstand areas, amenity links and substation.

The operational phase drainage system will be installed and constructed in conjunction with the existing bog drainage network and will include the following:

- Interceptor drains will be installed up-gradient of all proposed infrastructure to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where suspended sediment could become entrained. It will then be directed to areas where it can be re-distributed into downstream field drains;
- Collectors drains will be used to gather runoff from access roads and turbine hardstanding areas of the site, likely to have entrained suspended sediment, and channel it to new local settlement ponds for sediment settling;
- On sections of access road transverse drains ('grips') will be constructed where appropriate in the surface layer of the road to divert any runoff off the road into swales/roadside drains;
- Check dams will be used along sections of access road drains to intercept silts at source.
- Settlement ponds, emplaced downstream of access road sections and at turbine locations, will buffer volumes of runoff discharging from the drainage system during periods of high rainfall, by retaining water until the storm hydrograph has receded, thus reducing the hydraulic loading to existing drains;

- Settlement ponds will be designed in consideration of the greenfield runoff rate, existing bog settlement ponds will also buffer discharges from the two bogs (Clongawny and Drinagh); and,
- Finally, all surface water runoff from the development will have to pass through the settlement ponds at the bog outfall locations.

Decommissioning phase impacts will be similar to construction phase but the potential for impacts will be significantly less given that much of the infrastructure will remain in-situ (i.e. internal roads will be in use for amenity purposes and the substation will remain as part of Eirgrid network etc.). Temporary drainage measures as outlined in the Hydrology and Hydrogeology Chapter of the EIAR (Appendix 2) and best practice fuel/hydrocarbon cement management will be employed as required.

3.5.2 Hydrocarbons and Waste Material

The use of hydrocarbons during the construction process leads to the potential for pollution to enter the wider environment, including drainage ditches and watercourses. Leaks in poorly maintained plant and machinery could lead to hydrocarbon dispersal over works areas. Leaks in fuel storage tanks and spillages during refueling operations could lead to larger releases of hydrocarbons into the environment.

The Construction and Environmental Management Plan (CEMP) (Appendix 3) provides measures to avoid impacts on the wider environment as a result of pollution and are summarised below.

3.5.2.1 Refuelling, Fuel and Hazardous Materials Storage

The following mitigation measures are proposed to avoid release of hydrocarbons at the site:

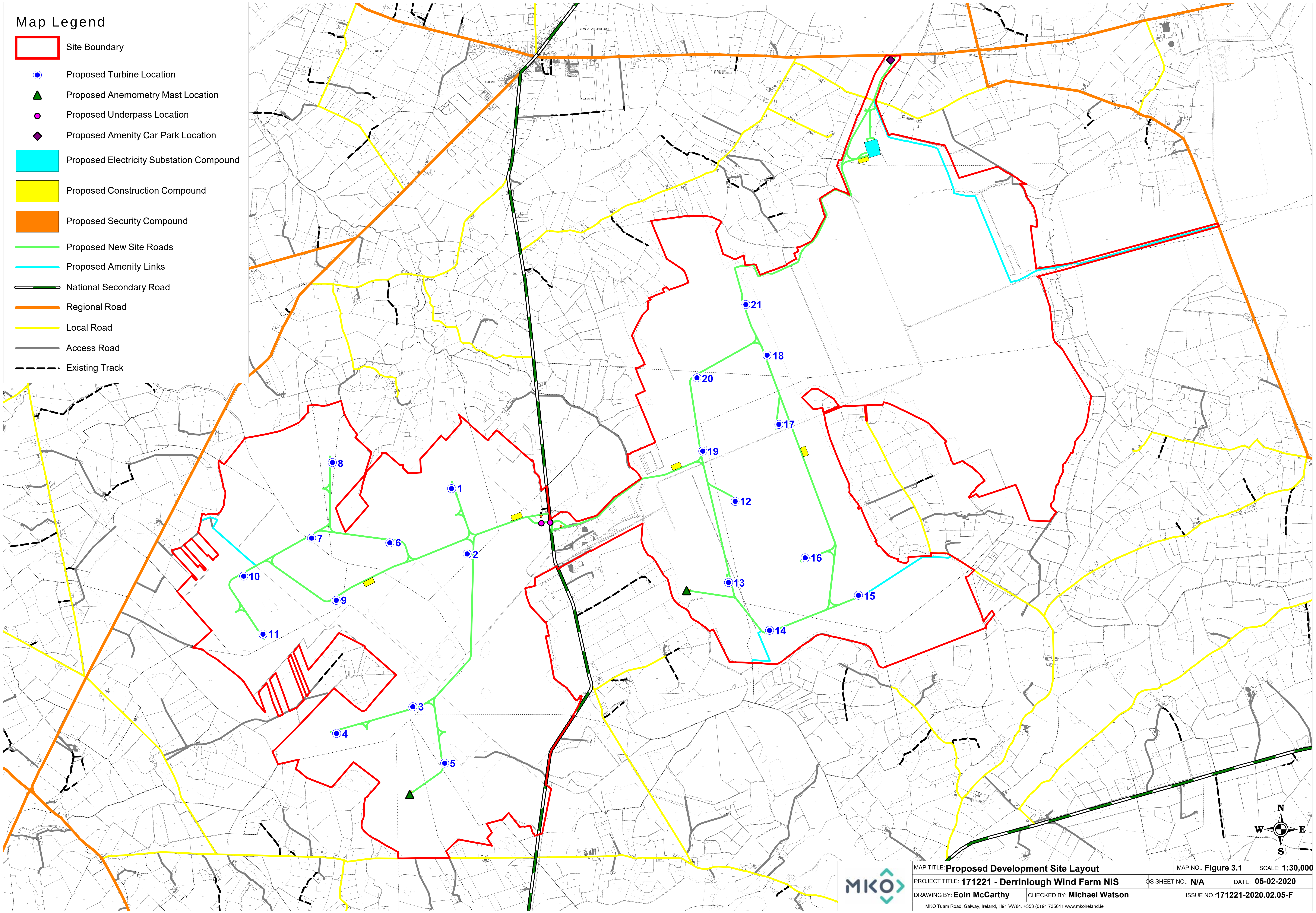
- Minimal refuelling or maintenance of construction vehicles or plant will take place on site. Off-site refuelling should occur at a controlled fuelling station;
- On-site refuelling will take place using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled off site and will be towed around the site by a 4x4 jeep to where machinery is located. It is not practical for all vehicles to travel back to a single refuelling point, given the size of the cranes, excavators, etc. that will be used during the construction of the wind farm. The 4x4 jeep will also carry fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use. Only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations.
- Fuels volumes stored on site should be minimised. Any fuel storage areas will be bunded appropriately for the fuel storage volume for the time period of the construction and fitted with a storm drainage system and an appropriate oil interceptor;
- The electrical substation compound will be bunded appropriately to the volume of oils likely to be stored, and to prevent leakage to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used will be regularly inspected for leaks and fitness for purpose; and,
- Spill kits will be available to deal with and accidental spillage in and outside the refuelling area.

3.5.2.2 Cement Based Products Control Measures

The following mitigation measures are proposed to avoid release of cement leachate from the site:

- No batching of wet-cement products will occur on site;

- Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will take place. Where possible pre-cast elements for culverts and concrete works will be used;
- No washing out of any plant used in concrete transport or concreting operations will be allowed on-site;
- Where concrete is delivered on site, only chute cleaning will be permitted, using the smallest volume of water possible. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed.
- Use weather forecasting to plan dry days for pouring concrete;
- Ensure pour site is free of standing water and plastic covers will be ready in case of sudden rainfall event;
- The small volume of water that will be generated from washing of the concrete lorry's chute will be directed into a concrete washout area, typically built using straw bales and lined with an impermeable membrane. below. The areas are generally covered when not in use to prevent rainwater collecting. In periods of dry weather, the areas can be uncovered to allow much of the water to be lost to evaporation. At the end of the concrete pours, any of the remaining liquid contents is tankered off-site. Any solid contents that will have been cleaned down from the chute will have solidified and can be broken up and disposed of along with other construction waste.



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4. CHARACTERISTICS OF THE RECEIVING ENVIRONMENT

The ecological surveys that were undertaken to inform this NIS are fully described in this section. The specific surveys that were undertaken to assess the potential effects on the identified European Sites are described below.

4.1 Ecological Survey Methodologies

4.1.1 Desk Study methodology

The desk study undertaken for this assessment included a thorough review of the available ecological data associated with the study area of the proposed development. Sources of data included the following:

- Review of existing information provided by Bord na Móna on the ecology of the proposed development site
- Review of NPWS Conservation Objectives supporting documents, site synopsis, standard data forms and supporting documents for EU Designated Sites,
- Review of online web-mappers: National Parks and Wildlife Service (NPWS), Environmental Protection Agency (EPA), EPA (Envision), Water Framework Directive (WFD), Geological Survey of Ireland (GSI) and Inland Fisheries Ireland (IFI)
- Review of the publicly available National Biodiversity Data Centre (NBDC) web-mapper,
- Inland Fisheries Ireland (IFI) reports, where relevant/available,
- Review of NPWS Article 17 metadata and GIS database.
- Records from the NPWS web-mapper and review of specially requested records from the NPWS Rare and Protected Species Database for the hectads in which the Proposed Project is located.

4.1.2 Scoping and Consultation

MKO undertook a scoping exercise during preparation of the EIAR accompanying this application in June 2018. Table 4.1 provides a list of the organisations consulted with regard to biodiversity during the scoping process, and notes where scoping responses were received.

The recommendations of the consultees have been taken into consideration in the preparation of this NIS.

Table 4-1 Scoping Response Summary

Consultee	Response
An Taisce	No response as of 31st January 2020
Bat Conservation Ireland	No response as of 31st January 2020
BirdWatch Ireland	Response received 08.11.2019. Scoping letter received by BWI and forwarded on to Policy Officer.
Irish Wildlife Trust	No response as of 31st January 2020
Department of Culture, Heritage, and the Gaeltacht	Response received 19.07.2018.

Consultee	Response
	Archaeology Assessment to be carried out by a suitably qualified archaeologist and by licence provided by DCHG. All previous surveys of the bog should be examined. A new survey of the bog should be undertaken including cleaning the drains and walking the bog. Buffer zones to be implemented where necessary.
Geological Survey of Ireland	Response received 27.11.2019. Derrinlough Mushroom Rock County Geological Site located within the development boundary- typically afforded county protection. Consult GSI Map Viewer for locating Natural Mineral Resources on site and Aquifer and Recharge points. Geohazards to be taken into consideration.
Inland Fisheries Ireland	No response as of 31st January 2020
Irish Peatland Conservation Council	Response received 14.11.2019. Requested a Bord na Móna Rehabilitation Plan.

4.2 Ecological Survey Methodologies

A comprehensive survey of the biodiversity of the entire site was undertaken on various dates, set out below, throughout 2018 and 2019. The following sections fully describe the ecological surveys that have been undertaken and provide details of the methodologies, dates of survey and guidance followed.

4.2.1 Ecological Multidisciplinary Walkover Surveys

Multidisciplinary walkover surveys were conducted on the throughout 2018 and 2019 in line with NRA (2009) guidelines (*Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes*) The survey timings fell within the recognised optimum period for vegetation surveys/habitat mapping, i.e. April to September (Smith *et al*., 2011).

All habitats within and adjacent to the proposed development site were readily identifiable during the site visit. A comprehensive walkover of the entire site was completed. Habitats were identified in accordance with the Heritage Council's '*Guide to Habitats in Ireland*' (Fossitt, 2000). Habitat mapping was undertaken with regard to guidance set out in '*Best Practice Guidance for Habitat Survey and Mapping*' (Smith et al., 2011).

4.2.2 Habitat and Vegetation Composition Surveys

The walkover surveys were undertaken in order to ground truth the information provided in previous ecological surveys of the bog that were undertaken by the Bord na Móna ecology team in 2014. The Bord na Móna ecology team originally classified the habitats on site according to the Bord na Móna habitat classification system, provided in Appendix 6.1 of the accompanying EIAR. Correspondence with the Heritage Council's *'Guide to Habitats in Ireland'* (Fossitt, 2000) is also described in Appendix 6.1, of the EIAR. Detailed habitat classification and assessment was undertaken by MKO at targeted locations within the development footprint, with relevés undertaken within representative habitats at each turbine base, substation, borrow pits etc. Relevés were 2x2 metres for all habitats except for woodland which were 20x20 metres. Where linear sections of woodland were assessed, two 10x10 metre relevés were taken as sufficient woodland width would not allow for a 20x20 metre relevé. The extent of each habitat on site was mapped on site using aerial photography, hand held GPS and smartphone technology. A representative photograph was also taken for each of the habitats recorded on site, including all relevés.

All habitats recorded on site and described in this EIAR chapter have been classified in accordance Fossitt (2000). In addition, peatland and woodland habitats outside of the proposed infrastructure footprint but within the study area are described in detail in this chapter. Full details of all the botanical surveys and results are provided in Appendix 6-4 of the accompanying EIAR and an assessment of the potential for the site to support Annex I habitats is also provided in this Appendix.

Botanical surveys for all turbine, road infrastructure, sub stations, grid connections and all other infrastructure were undertaken on 21st and 22nd of August and 18th - 19th of September 2019. Additional surveys of some areas of cutover bog were also undertaken on the 05 December 2019. Botanical surveys of the site were also undertaken on the 21st June 2018 and 28th September 2018. These surveys provided an understanding of the baseline and informed further survey work following finalisation of the proposed infrastructure layout. The habitat assessment surveys described in this report have been undertaken with reference to the following guidelines and interpretation documents:

- Perrin, P.M, Martin, J.R., Barron, J.R., Roche & O'Hanrahan, B. (2014) *Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland.* Version 2.0. Irish Wildlife Manuals, No. 79. National Parks and Wildlife Service.
- Cross, J. & Lynn, D. (2013) *Results of a monitoring survey of bog woodland.* Irish Wildlife Manuals, No. 69. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.
- Fernandez, F., Connolly K., Crowley W., Denyer J., Duff K. & Smith G. (2014) Raised Bog Monitoring and Assessment Survey 2013. Irish Wildlife Manuals, No. 81. National Parks and Wildlife Service, Department of Arts, Heritage and Gaeltacht, Dublin, Ireland.
- Commission of the European Communities (2007) Interpretation manual of European Union habitats. Eur 27. European Commission DG Environment.
- Foss, P.J. & Crushell, P. 2008, *Guidelines for a National Fen Survey of Ireland, Survey Manual.* Report for the National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Ireland.
- NPWS (2013) The Status of EU Protected Habitats and Species in Ireland. Habitat Assessments Volume 2. Version 1.1. Unpublished Report, National Parks and Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.
- NPWS (2019). The Status of EU Protected Habitats and Species in Ireland. Volume 2: *Habitat Assessments*. Unpublished NPWS report. Edited by: Deirdre Lynn and Fionnuala O'Neill

Habitats considered to be of ecological significance and in particular having the potential to correspond to those listed in Annex I of the EU Habitats Directive 92/43/EEC were identified and classified as Key Ecological Receptors (KERs).

Plant nomenclature for vascular plants follows '*New Flora of the British Isles*' (Stace, 2010), while mosses and liverworts nomenclature follows '*Mosses and Liverworts of Britain and Ireland - a field guide'* (British Bryological Society, 2010).

4.2.3 Otter Survey

Following a review of the previously completed ecological surveys and the results of the multi-disciplinary walkover survey; areas identified as providing potential habitat for otter were subject to specialist targeted survey. The otter survey of watercourses was conducted in 21st and 22nd August

2019, 18th and 19th September 2019 and 5th December 2019. Additional otter surveys were undertaken during a fisheries assessment of the watercourses both within and downstream of the study area on the 22nd and 23rd October 2019.

The otter survey was conducted as per NRA (2009) guidelines (Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes). This involved a search for all otter signs e.g. spraints, scat, prints, slides, trails, couches and holts. In addition to the width of the rivers/watercourses, a 10m riparian buffer (both banks) was considered to comprise part of the otter habitat (NPWS 2009). The dedicated otter survey also followed the guidance as set out in NRA (2008) *'Guidelines for the Treatment of Otters Prior to the Construction of National Roads Schemes'* and following CIEEM best practice competencies for species surveys (CIEEM, 2013).

4.2.4 Aquatic surveys

Aquatic habitat surveys of the Derrinlough Wind Farm site were conducted on Tuesday 22nd and Wednesday 23rd October 2019 by Ross Macklin. The aquatic and fisheries report (Triturus, December 2019) is included as Appendix 4.

Watercourses within and adjoining the site boundary were assessed in light of the proposed development, with survey effort focused on both instream and riparian habitats at each site. Surveys were focused at sites on the Feeghroe River (EPA code: 25F41), Mullaghkaraun Stream (25M48), Whigsborough Stream (25W43), Derrinlough Stream (25I29), Little Cloghan River (25L01), Silver River (25S02), Madden's Derry Stream (25M776), Stonestown Stream (25S55) and Grants Island Stream (25Y47), as well as three unnamed wetland/bog pool habitats.

Aquatic habitat assessment was conducted according to the methodology given in the Environment Agency's *'River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003'* (EA, 2003) and the Irish Heritage Council's *'A Guide to Habitats in Ireland'* (Fossitt, 2000). All sites were assessed in terms of:

- Stream width and depth and other physical characteristics,
- Substrate type, listing substrate fractions in order of dominance, i.e. large rocks, cobble, gravel, sand, mud etc.,
- Flow type, listing percentage of riffle, glide and pool in the sampling area,
- In-stream vegetation, listing plant species occurring and their percentage coverage of the stream bottom at the sampling site (as applicable) and on the bankside,
- Bankside vegetation composition.

4.2.5 Bird Surveys

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and March 2018 in the form of Vantage Point surveys and walked transects. Field surveys at Derrinlough were undertaken by MKO between April 2018 and September 2019 which included a range of various distribution and abundance surveys for targeted species as well as continuation of the Vantage Point Surveys.

Survey data gathered during the survey period October 2017 - September 2019 forms the core dataset for the assessment of effects on ornithology. It is supplemented by additional data derived from surveys undertaken on the site by BES between October 2014 and September 2017. The data provided in this report is robust and allows clear, precise and definitive conclusions to be made on the avian receptors identified within the subject site. Field survey methodologies have been devised to survey for the bird species composition and assemblages that occur within the study area and its hinterland and which are potentially susceptible to impacts from this type of development.

4.2.5.1 Initial Site Assessment

Based on the results of the desk study, consultation and reconnaissance site visits, the likely importance of the study area for bird species was ascertained. Based on the collated information available from the above preliminary assessment and adopting a precautionary approach, a site-specific scope for the ornithological survey was developed.

4.2.5.2 Survey Methodologies

The survey work undertaken between October 2017 and September 2019 forms the core dataset for the assessment of effects on ornithology. Surveys from the period October 2017 to March 2018 were undertaken by Biosphere Environmental Services (BES). Surveys from the period April 2018 to September 2019 were undertaken by McCarthy Keville O'Sullivan (MKO).

In the absence of specific national bird survey guidelines, the ornithological surveys were designed and undertaken in full accordance with '*Recommended bird survey methods to inform impact assessment of onshore wind farms*' (SNH, 2017).

The various survey types undertaken are described below.

4.2.5.2.1 *Vantage Point Surveys*

Vantage point surveys were undertaken in accordance with SNH guidance from October 2017 to September 2019. Surveys were conducted monthly throughout this survey period from ten fixed point vantage points (VP1 – VP10) to allow comprehensive coverage to a 500m radius of the outermost proposed turbines in accordance with SNH 2017. Vantage point surveys are designed to quantify the level of flight activity and its distribution over the survey area. The primary purpose of the survey is to provide data to inform the collision risk model, which makes predictions of mortality, from collisions with turbines. The validity of vantage point surveys were confirmed by MKO by conducting viewshed analysis, as described below, and further checked by a recce visit and field surveys. Figure 7.1 of the Ornithology chapter of the EIAR accompanying this application, shows the locations of all vantage points relative to the development site.

Viewshed Analysis

Viewshed analysis was carried out to confirm coverage of the study area from fixed vantage point locations (i.e. VP1 – VP10). Viewsheds were calculated using Resoft Wind Farm ZTV (Zone of Theoretical Visibility) software in combination with Mapinfo Professional (Version 10.0) using a notional layer suspended at 25m, which is representative of the minimum height considered for the Potential Collision Risk Area based on a worst-case scenario turbine model. While the relevance of being able to view as much of the site to ground level is acknowledged, the SNH guidance emphasises the importance of visibility of the 'collision risk volume' when the data is to be used to estimate the risk of collision with turbines by birds.

The area visible from each vantage point was ground-truthed (i.e. confirmed during field surveys) to incorporate landscape features (e.g. woodland, spoil heaps etc.) into the analysis that would not otherwise be accounted for in the computer modelling programme. The vantage points were selected to effectively cover the 500 m Survey Area to ground level, when truncated at 2km and all airspace out to 2km and beyond was visible.

The viewshed analysis involved testing each VP location for its visibility coverage by creating a viewshed point 1.5 meters in height (to represent the height of observer) on a map using 10 metre contours terrain data. The relative height of forestry and its effects on visibility is also accounted for.

Using the ZTV software, a viewshed of 360 degrees was produced calculating an area 25 metres from ground level up to a 2km radius. The resulting viewshed image was then cropped to 180 degrees to give the viewshed from each VP location in line with SNH (2014, 2017). At the time of selection for VPs the turbine locations, turbine model or swept heights were not known. The final turbine layout was received in November 2018, which was subsequently reviewed against the Viewshed Analysis to ensure that survey coverage was efficient.

In order to review the viewshed coverage from the VP locations and ensure that the viewsheds provided sufficient coverage of the proposed turbines and 500m of same, a 500m buffer was applied to the outer most turbines of the proposed wind farm development in line with SNH (2014, 2017). The viewshed analysis offers the best possible views of the study area with adequate coverage of the proposed turbine layout, using as few VPs as possible. The visible view shed at 25m is presented on Figures 7.2, 7.2.1, 7.2.2, 7.2.3, 7.2.4, 7.2.5, 7.2.6, 7.2.7, 7.2.8, 7.2.9, 7.2.10, of the Ornithology chapter of the EIAR accompanying this application.

Data Recording and Digitisation

Data on bird observations and flight activity was collected from a scanning arc of 180° and a 2km radius by an observer at each fixed location for six hours per month (SNH 2017). Due to weather constraints, some surveys ended early but were continued at a later date in the month to ensure that six hours of surveys were conducted per month in accordance with SNH guidance (2017). Surveys were scheduled to provide a spread over the full daylight period including dawn and dusk watches to coincide with the peaks in bird activity. Target species were as per listed in Table 1 of Appendix 7-1, of the Ornithology chapter of the EIAR accompanying this application.

Survey effort for vantage point watches is presented in Appendix 7-2, Table 1 of the Ornithology chapter of the EIAR accompanying this application. This includes full details of dates, times, survey locations, survey duration and weather conditions for each survey. Table 4-2 below shows a summary of the VP survey work undertaken.

Table 4-2 Vantage Point Survey Effort

Survey Season	Months	Minimum Effort per VP
2017/2018 Non-Breeding Season (10VPs)	Oct-Mar	36 hours/VP*
2018 Breeding Season (10VPs)	Apr-Sep	36 hours/VP
2018/2019 Non-Breeding Season (10VPs)	Oct-Mar	36 hours/VP
2019 Breeding Season (10VPs)	Apr-Sep	36 hours/VP

*** With the exception of VP8 during the 2017/18 Winter Season; this VP was surveyed for a total of 35 hours.**

Birds which use the airspace around turbines are susceptible to collision with operating turbines. The swept area of the rotor blade is the area in which a collision is theoretically possible. Possible collision height (PCH) is therefore defined as the area of space occupied by the turbine rotors. Observed flight activity was recorded as per defined flight bands which were chosen in relation to the dimensions of potential turbine models for the site. Bands were split into 0-10m, 10-25m, 25m-175m and 175m+. All flight activity within the height bands 25-175m and 175m+ is considered to be within the Potential Collision Height (PCH) with regard to the turbine swept area, based on a worst-case scenario for turbine modelling.

Each flight observation was assigned a unique identifier when mapped in the field and subsequently digitised using GIS software.

4.2.5.2.2 *Breeding Bird Surveys (O'Brien and Smith Methodology)*

Breeding walkover transect surveys were undertaken to determine the presence of bird species of high conservation concern and identify areas of possible, probable or confirmed breeding territories for bird species observed within the study area. Survey methodology followed the O'Brien and Smith method for lowland sites as outlined in Gilbert et al. (1998) and SNH (2017) ('The O'Brien and Smith (1992) method for censusing lowland breeding wader populations'). The survey area extended 500m beyond the site boundary as recommended by SNH (2017).

Transect routes were devised to ensure coverage of different habitat complexes between vantage point locations within the study area. Transects were selected in order to survey every area of suitable breeding/foraging habitat to within 100m, in areas where access allowed. Where access was not possible for example on 3rd party lands, the areas were surveyed from Bord na Móna property or public roads where possible. Target species included waders, raptors, waterbirds and gulls. Along with target species, all additional species observed were recorded to inform the evaluation of supporting habitat.

Walkover surveys were carried out from dawn onward during the core breeding season months of April, May and June (2018) and April, May, June and July (2019), with the site being visited on eight days per month. The core breeding season for lowland waders is April-June, which was surveyed during both the 2018 and 2019 breeding season. In addition, breeding season surveys in 2019 included the month of July to determine success of breeding birds or any potential late breeding pairs. Following all survey visits, the field maps were analysed to determine the number and location of breeding territories. All non-breeding individuals and species encountered were also recorded.

Survey effort is presented in Appendix 7-2, Table 2, of the Ornithology chapter of the EIAR accompanying this application. This includes full details of dates, times, survey locations, survey duration and weather conditions for each survey. Figure 7.3 of the Ornithology chapter of the EIAR accompanying this application shows the area surveyed.

4.2.5.2.3 *Winter Transect/Waterfowl Surveys*

Biosphere Environmental Services (BES) Surveys

During the winter of 2017/2018 BES undertook dedicated wetland and waterfowl surveys, with a particular emphasis on whooper swan and Greenland white-fronted goose. These species were targeted based on historical use of the wider area. The survey area extended to 5km from the development boundary. The areas surveyed included Noggusboy, Derries, Derrybrat, Boora complex and Turraun bog sites as well as grasslands with foraging potential for swans and geese. These surveys were undertaken on one day per month.

Walked transects were also conducted during the months of November, January and March during the winter season (October 2017 – March 2018). Transects were selected following identifiable tracks including railways through the bog. Methodology for these surveys was broadly based on Bibby et al. (2000). The number of transects used was determined by the size of the site and diversity of habitats present. Figure 7.7a of the Ornithology chapter of the EIAR accompanying this application, shows the transects used by BES in the 2017/2018 winter season, as well as the areas surveyed during waterfowl surveys within 5km.

McCarthy Keville O'Sullivan (MKO) Surveys

Significant wetland sites within 1km of the study area were surveyed for waterbird populations (i.e. waders, waterfowl, gulls, grebes and rails) by MKO in the winter 2018/2019 season (as per SNH 2017). The survey methodology employed followed the 'I-WeBS Counter Manual – Guidelines for Irish Wetland Bird Survey Counters' co-ordinated by BirdWatch Ireland. In accordance with SNH (2017), counts were undertaken bimonthly, August 2018 to May 2019, at each target wetland site during the wintering/migratory period. Counts were undertaken during daylight hours (including dawn and dusk) from suitable vantage points at the wetland sites. Surveys comprised of three survey days per visit, with two visits undertaken each month between August 2018 and May 2019.

In addition, transect routes were also undertaken to ensure coverage of different habitat complexes within the development site and 500m of same during winter months. While the primary concern during these surveys was wintering waterfowl, other target species (e.g. raptors, gulls, etc.) as well as passerines were also recorded. Survey effort, including details of survey duration and weather condition, is presented in Appendix 7-2, Table 6 of the Ornithology chapter of the EIAR accompanying this application and Figure 7.7b shows the surveyed area.

4.2.5.2.4 Migratory Bird Surveys

Based on the results of the desk study, consultation and reconnaissance site visits, the River Shannon and Little Brosna River were identified as potential commuting/migratory corridors for bird species, particularly swans and geese. Migratory VP watches began in September 2018 to monitor the movements of sensitive wildfowl, with an emphasis on whooper swan and Greenland white-fronted geese, in the wider surroundings of the proposed development. VPs were positioned along adjacent sections of the River Shannon and Little Brosna River within an 8km radius of the development site. Surveyors recorded the movements of swans, geese and other wildfowl within the SPAs to the west of the site and the surrounding areas. The aim was to determine if there was any connectivity between these SPAs and the proposed development site to the east, i.e. if regular commuting/migratory flights were recorded these would be considered to constitute evidence of connectivity between the SPA and the proposed development area.

Watches at the six vantage points (VPs) were undertaken from September 2018 to May 2019. Three-hour watches were undertaken at these six fixed VP locations. These surveys followed vantage point survey methods as outlined in SNH (2017). Each VP was surveyed twice per month with a minimum of a two-week gap between repeat visits. Surveys regularly alternated between dusk and dawn surveys to capture the peak activity times for migrating swans and geese or flock movements between roosting/feeding sites along the River Shannon corridor. Survey effort, including details of survey duration and weather condition, is presented in Appendix 7-2, Table 7 of the Ornithology chapter of the EIAR accompanying this application and Figure 7.8 shows the VP locations.

4.3 Desk Study Results

4.3.1 River Shannon Callows SAC

The proposed works have the potential to cause deterioration in surface water quality during the construction, and decommissioning phase of the development due to the release of pollutants including suspended solids and hydrocarbons, potentially affecting the following downstream aquatic habitats and supporting habitats for aquatic fauna:

- *Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno- Padion, Alnionincanae, Salicionalbae*)
- *Lutra lutra* (Otter) [1355]

The relevant QIs and the associated conservation objectives are presented in Table 4-3.

Table 4-3 Qualifying Interest and Conservation Objectives

Qualifying Interest	Conservation Objective
*Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno- Padion, Alnionincanae, Salicionalbae*)	To maintain or restore the favourable conservation condition of the Annex I

Qualifying Interest	Conservation Objective
Lutra lutra (Otter) [1355]	habitat(s) and/or the Annex II species for which the SAC has been selected.

4.3.1.1 Review of site-specific pressures and threats

As per the Natura 2000 Data Form, the site-specific threats, pressures and activities with potential to impact on the SAC were reviewed and considered in relation to the proposed development. These are provided in Table 4-4.

Table 4-4 Site-specific threats, pressures and activities

Negative Impacts			
Rank	Threats and Pressures		Inside/Outside
Medium	B02.02	Forestry clearance	Inside
Medium	A08	Fertilisation	Inside
High	J02.04.01	Flooding	Inside
Low	J02.05	Modification of hydrographic functioning, general	Inside
Medium	J02.11	Siltation rate changes, dumping, depositing of dredged deposits	Inside
High	A04.03	Abandonment of pastoral systems, lack of grazing	Inside
High	A03.03	Abandonment / lack of mowing	Inside
Low	G01	Outdoor sports and leisure activities, recreational activities	Inside
High	A07	Use of biocides, hormones and chemicals	Inside
Low	A04.02.05	Non-intensive mixed animal grazing	Inside
Low	D01.01	Paths, tracks, cycling tracks	Inside
Medium	J02.05.02	Modifying structures of inland water courses	Inside
Low	B06	Grazing in forests/ woodland	Inside
Low	J02.01	Landfill, land reclamation and drying out, general	Inside
Medium	A10.01	Removal of hedges and copses or scrub	Inside
Low	C01.03.02	Mechanical removal of peat	Inside
Medium	K03.04	Predation	Inside
Low	F03.01	Hunting	Both
Low	G05.01	Trampling, overuse	Both

Negative Impacts			
Rank	Threats and Pressures		Inside/Outside
Medium	A04.01	Abandonment of pastoral systems, lack of grazing	Inside

No pathways for the proposed development to result in impacts with regard to the listed threats and pressures were identified.

4.3.1.2 Qualifying Interests

4.3.1.2.1 *Otter (Lutra lutra)*

Detailed site-specific conservation objectives document are not available for this SAC. According to the site synopsis form the site holds a population of Otter, a species listed on Annex II of the E.U. Habitats Directive (NPWS, 2013).

4.3.1.2.2 **Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnionincanae, Salicionalbae)*

Detailed site-specific conservation objectives document are not available for this SAC. According to the site synopsis form Alluvial forests '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', (NPWS, 2013).

4.3.2 Lough Derg North-east shore SAC

This site lies 29.2km downstream of the proposed development site (via hydrological connectivity). The proposed works have the potential to cause deterioration in surface water quality during the construction, operational and decommissioning phase of the development potentially affecting downstream aquatic receptors potentially affecting the following QIs:

- Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* [7210]
- Alkaline fens [7230]
- Alluvial forests with Alnus glutinosa and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0]

The relevant QIs and the associated conservation objectives are presented in Table 4.5. The targets and attributes for these habitats, as described in the Site-specific Conservation Objectives document, were reviewed and considered in this assessment.

Table 4-5 Qualifying Interest and Conservation Objectives

Qualifying Interest	Conservation Objective
Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* [7210]	To maintain the favourable conservation condition of Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae** in Lough Derg, North-east Shore SAC
Alkaline fens [7230]	To maintain the favourable conservation condition of Alkaline fens in Lough Derg, North-east Shore SAC
Alluvial forests with Alnus glutinosa and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0]	To restore the favourable conservation condition of Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)* in Lough Derg, North-east Shore SAC

4.3.2.1 Review of site-specific pressures and threats

As per the Natura 2000 Data Form, the site-specific threats, pressures and activities with potential to effect on the SAC were reviewed and considered in relation to the proposed development. These are provided in Table 4-6.

Table 4-6 Site-specific threats, pressures and activities

Negative Impacts			
Rank	Threats and Pressures		Inside/Outside
L	M01.03	Flooding and rising precipitations	Inside
M	J02.01.03	Infilling of ditches, dykes, ponds, pools, marshes or pits	Inside
L	M01.01	Temperature changes (e.g. rise of temperature & extremes)	Inside
L	I02	Problematic native species	Inside
M	J02.10	Landfill, land reclamation and drying out, general	Inside
L	J02	Human induced changes in hydraulic conditions	Inside
M	H01.08	Diffuse pollution to surface waters due to household sewage and waste waters	Inside
H	I01	Invasive non-native species	Both
L	M01.02	Droughts and less precipitations	Inside
H	D01.01	Paths, tracks, cycling tracks	Inside
L	K02.01	Species composition change (succession)	Inside

Negative Impacts			
Rank	Threats and Pressures		Inside/Outside
H	D03.01.02	Piers / tourist harbours or recreational piers	Inside
M	G01	Outdoor sports and leisure activities, recreational activities	Inside
M	C01	Mining and quarrying	Inside
H	H01	Pollution to surface waters (limnic, terrestrial, marine & brackish)	Both
L	A04.01	Intensive grazing	Inside
H	K02.03	Eutrophication (natural)	Inside
L	A10.01	Removal of hedges and copses or scrub	Inside
M	A08	Fertilisation	Both

Rank: H = high, M = medium, L = low. i = inside, o = outside, b = both

Pathways for impact with regard to 'Pollution to surface waters (limnic, terrestrial, marine and brackish)' were identified. No pathways for impact with regard to any site-specific threats, pressures and activities were identified.

4.3.2.2 Qualifying Interests

4.3.2.2.1 *Calcareous fens with Cladium mariscus and species of the Caricion davallianae [7210]*

According to the site-specific conservation objectives document calcareous fens with Cladium mariscus and species of the Caricion davallianae* has not been mapped in detail for Lough Derg, North-east Shore SAC and thus the total current area of the qualifying priority habitat in the SAC is unknown (NPWS, 2019). Cladium fen (habitat code 7210) occurs occasionally along lake margins in the SAC in association with the Annex I habitat Alkaline fens (habitat code 7230) and swamp vegetation also. The habitat is particularly well-developed at the sheltered bays of Lough Derg around the Portumna Forest Park area and immediately north of Kilgarvan Quay.

4.3.2.2.2 *Alkaline fens [7230]*

According to the site-specific conservation objectives document alkaline fen has not been mapped in detail for Lough Derg, North-east Shore SAC and thus the total current area of the qualifying habitat in the SAC is unknown (NPWS, 2019). The habitat occurs frequently along lake margins in the SAC, often in association with the Annex I habitat Calcareous fens with *Cladium mariscus* and species of the

Caricion davallianae (7210*), common reed (*Phragmites australis*) beds and other swamp vegetation. The habitat is particularly well-represented at the edge of Portumna Forest Park.

4.3.2.2.3 *Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0]*

According to the site-specific conservation objectives document alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)** in Lough Derg, North-east Shore SAC is known to occur on the lakeshore at Kylenamelly, in parts of Portumna Forest Park and around Bounla Island (NPWS, 2019). As part of the National Survey of Native Woodlands (NSNW), Perrin et al. (2008) surveyed and mapped the habitat within the sub-sites Bounla Island (NSNW site code 1950), including the island and adjacent lakeshore, and Rinmaher Wood (1614), which is within Portumna Forest Park. The area of alluvial woodland mapped by Perrin et al. (2008) is 11.15ha. As part of the Native Woodland Scheme (NWS), the habitat was surveyed and mapped at Kylenamelly (Flanagan and Browne, 2002), comprising 6.57ha. Map 4 shows the surveyed areas classified as 91E0* (17.72ha). According to the site-specific conservation objectives document further unsurveyed areas of the habitat may be present within the SAC, particularly along low-lying areas of the lakeshore.

4.3.3 Middle Shannon Callows SPA

There is hydrological connectivity between the proposed development and this SPA via watercourses within the site boundary which discharge to the River Shannon, including the Madden's Derry stream, Grants Island Stream, Mullaghakaraun bog, Feeghroe/Mountcarteret stream and several small tributary streams of the Little Cloghan River.

The proposed works have the potential to cause deterioration of water quality during the construction, and decommissioning phase of the development potentially affecting the downstream SCI

- ‘Wetland and Waterbirds’.

On a precautionary basis, a potential pathway for indirect effects was identified in the form of bird disturbance, displacement and collision risk potentially affecting the following species:

- golden plover
- whooper swan
- black-headed gull
- lapwing
- wigeon
- Black Tailed Godwit

The relevant SCIs and their associated conservation objectives are presented in Table 4.7

Table 4-7 SCIs and Conservation Objectives

Special Conservation Interest (SCI)	Conservation Objective
Golden plover	Detailed conservation objectives are not available for this site. These SCI species have the generic conservation objective: ‘*To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA’.*
Whooper swan	
Black-headed gull	
Lapwing	
Wigeon	

Black Tailed Godwit	
Wetland and Waterbirds	*'To maintain or restore the favourable conservation condition of the wetland habitat at Middle Shannon Callows SPA as a resource for the regularly-occurring migratory waterbirds that utilise it.'*

4.3.3.1 Review of site-specific pressures and threats

As per the Natura 2000 Data Form, the site-specific threats, pressures and activities with potential to impact on the SPA were reviewed and considered in relation to the proposed development. These are provided in Table 4-8.

Table 4-8 Site-specific threats, pressures and activities

Negative Impacts			
Rank	Threats and Pressures		Inside/Outside
Low	F03.01	Hunting	Inside
High	D01.05	Bridge, viaduct	Inside
Low	A08	Fertilisation	Inside
High	A04	Grazing	Inside
High	G01.01	Nautical sports	Inside
High	E01	Urbanised areas, human habitation	Outside
Low	A04.03	Abandonment of pastoral systems, lack of grazing	Inside
Low	D01.01	Paths, tracks, cycling tracks	Inside
Medium	F02.02	Professional active fishing	Inside
Medium	A08	Fertilisation	Outside
Medium	G01.02	Walking, horseriding and non-motorised vehicles	Inside

No pathways for the proposed development to result in impacts with regard to the listed threats and pressures were identified.

4.3.3.2 Special Conservation Interests

The following relevant information on the special conservation interests of Middle Shannon Callows SPA has been extracted from the site synopsis (NPWS, 2012).

> '*The Middle Shannon Callows qualifies as a site of international importance as it regularly supports in excess of 20,000 wintering waterbirds (23,656 – four year mean peak for four of the winters between 1995/96 and 1999/2000). The site also supports internationally important populations of Whooper Swan (305 – five year mean peak for the period 1995/96 to 1999/2000) and Black-tailed Godwit (485 – four year mean peak for four of the winters between 1995/96*

and 1999/2000). Four further species of wintering waterbird occur in numbers of national importance, i.e. Wigeon (3,059), Golden Plover (4,133), Lapwing (13,240) and Black-headed Gull (1,209) – all figures are four year mean peaks for four of the winters between 1995/96 and 1999/2000.

The Shannon Callows is the largest site monitored as part of I-WeBS and many parts of it are inaccessible on the ground. Annual monitoring of the wintering waterbirds of the Shannon Callows is undertaken by aerial surveys in January/February with some areas also covered by ground counts. The importance of the site for some species may have been underestimated if count coverage missed the brief spring peaks for these species, e.g. peak counts of Lapwing (23,409) and Black-tailed Godwit (1,096) recorded in the baseline period (1995/96 to 1999/2000) have been considerably higher than the four-year means'.

4.3.4 River Little Brosna Callows SPA

A potential pathway for indirect effects was identified in the form of bird disturbance, displacement and collision risk potentially affecting the following species:

- black-headed gull
- whooper swan
- lapwing
- golden plover
- wigeon
- black-tailed godwit
- teal
- shoveler

The relevant SCIs and their associated conservation objectives are presented in Table 4.9.

Table 4-9 SCIs and Conservation Objectives

Special Conservation Interest (SCI)	Conservation Objective
Golden plover	Detailed conservation objectives are not available for this site. These SCI species have the generic conservation objective: *'To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA'.*
Whooper swan	
Black-headed gull	
Lapwing	
Wigeon	
Black tailed godwit	
Teal	
Shoveler	

4.3.4.1 Review of site-specific pressures and threats

As per the Natura 2000 Data Form, the site-specific threats, pressures and activities with potential to impact on the SPA were reviewed and considered in relation to the proposed development. These are provided in Table 4-10.

Table 4-10 Site-specific threats, pressures and activities

Negative Impacts			
Rank	Threats and Pressures		Inside/Outside
Low	F02.03	Leisure fishing	Inside
Medium	A04	Grazing	Inside
Low	E01.03	Dispersed habitation	Outside
Low	A08	Fertilisation	Inside
Medium	A08	Fertilisation	Outside
Medium	F03.01	Hunting	Inside
Medium	A03	Mowing / cutting of grassland	Inside
Low	D01.01	Paths, tracks, cycling tracks	Outside

No additional pathways for impact with regard to the listed threats and pressures were identified.

4.3.4.2 Special Conservation Interests

The following relevant information on the special conservation interests of Middle Shannon Callows SPA has been extracted from the site synopsis (NPWS, 2012).

> '*The River Little Brosna Callows is an internationally important site for wintering waterfowl, being notable both for numbers and diversity of species. The populations of Golden Plover (10,577 – 3 year mean peak from aerial surveys between 1995/96 and 1999/2000) are of international importance.*
>
> *Seven species have populations of national importance, i.e. Whooper Swan (122), Wigeon (8,116), Teal (2,683), Pintail (130), Shoveler (164), Lapwing (6,552) and Black-headed Gull (1,939) – all figures are 4 year mean peaks between 1995/96 and 1999/2000 except Lapwing (3 year mean peak from aerial surveys between 1995/96 and 1999/2000) and Black-headed Gull (2 year mean peak for 1999/2000 and 2000/01). The populations of Wigeon, Teal and Golden Plover are consistently among the largest in the country'.*

4.3.5 Lough Derg (Shannon) SPA

Following an extremely precautionary principle, the proposed works have the potential to cause deterioration in surface water quality during the construction, operational and decommissioning phase of the development potentially affecting 'Wetland and Waterbirds [A999]' habitat. This site is located 29.2km downstream of the site of the proposed development (surface water distance).

The relevant SCIs and their associated conservation objectives are presented in Table 4-11.

Table 4-11 SCIs and Conservation Objectives

Special Conservation Interest (SCI)	Conservation Objective
Wetland and Waterbirds	Detailed conservation objectives are not available for this site. These SCI species have the generic conservation objective: *'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.*

4.3.5.1 Review of site-specific pressures and threats

As per the Natura 2000 Data Form, the site-specific threats, pressures and activities with potential to impact on the SPA were reviewed and considered in relation to the proposed development. These are provided in Table 4-12.

Table 4-12 Site-specific threats, pressures and activities

Negative Impacts			
Rank	**Threats and Pressures**		**Inside/Outside**
Medium	F02.03	Leisure fishing	Inside
Medium	F03.01	Hunting	Inside
High	A08	Fertilisation	Outside
High	G01.01	Nautical sports	Inside

No pathways for the proposed development to result in impacts with regard to the listed threats and pressures were identified.

4.3.5.2 Wetland and Waterbirds

The following relevant extracts have been taken from the NPWS site synopsis and Natura 2000 Data form for the SPA;

> *"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.*
>
> *Lough Derg is of importance for both breeding and wintering birds. The islands support nationally important breeding colonies of Sterna hirundo, Phalacrocorax carbo, Podiceps cristatus and probably Aythya fuligula. It is a traditional site for nesting Larus ridibundus but there is no recent survey information.*

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 particularly important for diving ducks, with nationally important populations of Aythya fuligula and Bucephala clangula occurring. Cygnus olor also has a population of national importance, whilst a range of other species occur in lesser numbers, including Cygnus cygnus, Anas crecca, Fulica atra and Vanellus vanellus. A flock of Anser albifrons flavirostris has traditionally used the site, where they feed on grassy islands, but birds have seldom been recorded in recent years.

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'.

4.3.6 EPA River Catchments and Watercourses

The proposed development site is located within four sub-catchments the eastern and mid sections of the site lie within the Brosna 080 sub-catchment and the Brosna 070 sub-catchment, whilst the most westerly extent of the development site lies within the Shannon 040 sub-catchment and the Shannon 030 sub-catchment.

The development site has a number of watercourses that flow within and adjacent to the site, including the Madden's Derry stream, Grants Island Stream, Mullaghakaraun bog, Feeghroe/Mountcarteret stream and several small tributary streams of the Little Cloghan river.

The EPA Envision map viewer was consulted on 10th February 2019 regarding the water quality status of the watercourses which run adjacent to the Study Area. The Biotic Index of Water Quality (BIWQ) was developed in Ireland by the Environmental Protection Agency (EPA). Q-values are assigned using a combination of habitat characteristics and structure of the macro-invertebrate community within the waterbody. Individual macro-invertebrate families are classified according to their sensitivity to organic pollution and the Q-value is assessed based primarily on their relative abundance within a sample. The EPA sampling station result provides a baseline against which any water quality changes occurring in the future can be measured.

A number of tributaries of the Rapemills River, occur in the western section of the development site, including the Feeghroe/Mountcarteret stream and the Mullaghakaraun bog stream.

The Feeghroe/Mountcarteret stream flows in a north-westerly direction from the western part of the development site. This river discharges to the Rapemills river approximately 3.2km downstream. This watercourse was surveyed in 1987 at survey station 'Rapemills - Lusmagh Br (Survey code: RS25R010500)', approximately 4.2km downstream of the development site and had Q value score of 'Q3-Q4 – Moderate'.

The Little Cloghan River flows in a north-westerly direction along the boundary of the eastern section of the site. A number of first order tributary streams of the Little Cloghan River, originate in the western section of the development site, including the Feeghroe/Mountcarteret stream, the Mullaghakaraun bog stream and the Derrymullin and Loughderry stream. The Little Cloghan River was surveyed in 1999 at survey station 'Little (Cloghan) - Crancreagh Bridge (Survey code: RS25L010100)' and had Q value score of 'Q 2 – Q3 Poor'. This river was again surveyed in 2017 approximately 1km downstream at survey station 'Bridge 2km SW of Cloghan' RS25L010200 and had a Q value score of Q4 – Q5 – High.

The Stonestown stream and the Black Brook flow through the north-eastern section of the site partially along the site boundary, before discharging to the Silver River, approximately 300m downstream.

The Silver River was surveyed in 1987 at survey station 'Silver (Kilcormac) - Millbrook Bridge (Survey code: RS25S020600)', 2.8km downstream of the development site and had Q value score of 'Q4 – Good'.

River Basin Management Plans (RBMPs) have been published for all River Basin Districts in Ireland in accordance with the requirements of the Water Framework Directive. The Water Framework Directive Status Report 2010 - 2015, published by the Environmental Protection Agency (EPA).

The Silver River and its tributaries within the site has been assessed as 'at risk', downstream of Derrinlough Briquette factory and 'review' upstream of this point. The Little (Cloghan) River has been assessed as 'at risk', from the confluence of the Gortnafira stream and the Glenaboy River. The Rapemills River and its tributaries have been assessed as 'review'. The Little Cloghan River Waterbody WFD status 2010- 2015 status of 'Moderate', downstream of Derrinlough Briquette Factory and its status is unassigned upstream of this point. The Silver River and its tributaries within the site has a 'Moderate' status.

4.4 Ecological Survey results

4.4.1 Habitat survey

The habitats on the site of the Proposed Project were the subject of a detailed survey and assessment by Bord na Móna ecologists and a habitat map was produced of the entire landholding at the Clongawny and Drinagh bogs. This habitat mapping and assessment was undertaken following the Bord na Móna habitat classification scheme and was cross referenced with '*A Guide to Habitats in Ireland*' (Fossitt, 2000). The Proposed Project covers only a section of the twobogs but the habitats within the entirety of both bogs are described in this section. The habitat descriptions in this section are based on the Bord na Móna habitat assessments undertaken in 2014 and detailed vegetation surveys undertaken by MKO in 2018 and 2019.

The study area comprises two large cutover raised bogs with remnant uncut bog at various locations at the edges of the site. Some areas of the site have been out of commercial peat production by Bord na Móna for a period of time and thus vegetation has regenerated over much of these areas. Other large areas within the southwest, northwest and southeast were in active peat extraction in 2019.

The main habitat types on the site included woodlands and scrub (dominated by birch), secondary dry heath type communities on cutover bog (dominated by Ling heather), poor fen and bare peat with some open water communities and grasslands (alongside railway tracks). These habitats occur in intimate mosaics throughout the study area as is shown in Figure 4.1a and Figure 4.1b. There are also some remnant areas of uncut raised bog within the study area. However, these areas occur outside of the development footprint. Detailed habitat and botanical survey details are provided in Chapter 6 (Biodiversity) of the EIAR accompanying this application. Habitat maps (Figures 4.1a and Figure 4.1b), as prepared by Bord na Móna ecologists, show the location and relative cover of the habitats recorded within the study area at a high level.

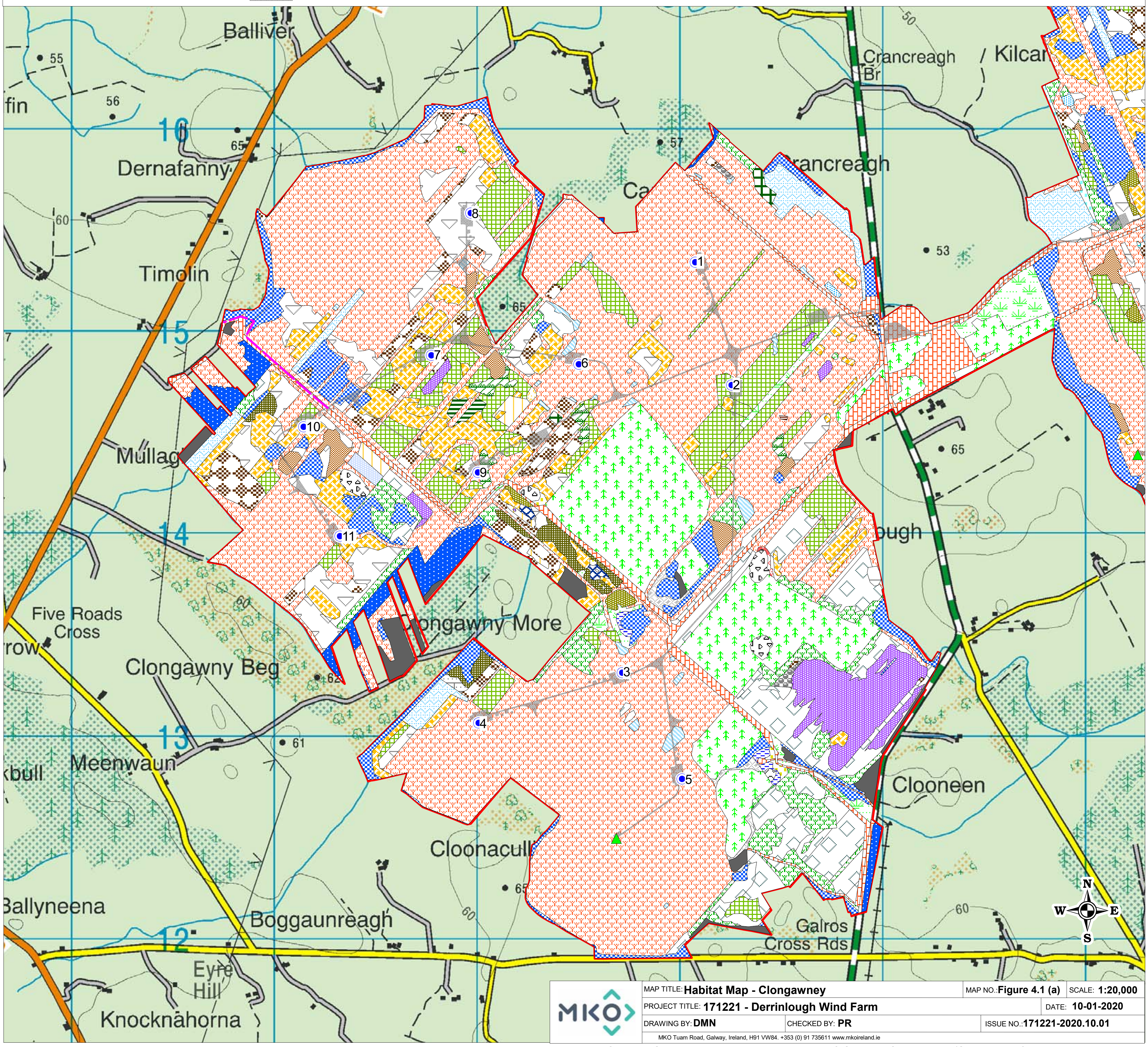
Waterbodies within the proposed development site including drainage ditches, open waterbodies and streams/watercourses classified as lowland depositing rivers provide hydrological connectivity with downstream designated sites and are further described in this section. Watercourses within the study area are mapped on Figure 2.1, indicating hydrological connectivity with downstream EU Sites.

Habitat Map

Vegetation communities occurring on Cutover Bog (PB4)

- Acid oligotrophic lakes (FL2)
- Acid oligotrophic lakes (FL2), Poor fen and flush (PF2) mosaic
- Acid oligotrophic lakes (FL2), Reed and large sedge swamp (FS1) mosaic
- Buildings and artificial surfaces (BL3)
- Conifer plantation (WD4)
- Cutover bog (PB4)
- Cutover bog (PB4) pioneering Dry Heath (HH), Poor fen (PF2), Scrub (WS1) mosaic
- Cutover Bog (PB4), Bog woodland (WN7)
- Cutover bog (PB4), Exposed sand, gravel or till (ED1) mosaic
- Cutover bog (PB4), Pioneering Dry Heath (HH)
- Cutover bog (PB4), Pioneering Dry Heath (HH), Dry grassland (GS1) mosaic
- Cutover bog (PB4), pioneering Dry Heath (HH), Poor fen and flush (PF2) mosaic
- Cutover bog (PB4), pioneering Dry Heath (HH), Scrub (WS1) mosaic
- Cutover bog (PB4), Poor fen (PF2), Dry grassland (GS1) mosaic
- Cutover bog (PB4), Poor fen (PF2), Reed and large sedge swamps (FS1) mosaic
- Cutover bog (PB4), Poor fen and flush (PF2) mosaic
- Cutover bog (PB4), Scrub (WS1), Dry calcareous and neutral grassland (GS1)
- Cutover bog (PB4), Scrub (WS1), Poor fen and flush (PF2) mosaic
- Cutover bog (PB4), Wet grassland (GS4) mosaic
- Cutover bog (PB4), Wet grassland (GS4), Poor fen and flush (PF2) mosaic
- Dense bracken (HD1)
- Depositing/lowland rivers (FW2)
- Dry calcareous and neutral grassland (GS1)
- Dry calcareous and neutral grassland (GS1), Poor fen and flush (PF2) mosaic
- Dry calcareous and neutral grassland (GS1), Recolonising bare ground (ED3)
- Dry meadows and grassy verges (GS2)
- Dry-humid acid grassland (GS3)
- Hedgerow (WL1)
- Improved grassland (GA1)
- Mixed broad-leaved woodland (WD1)
- Oak-Ash-Hazel woodland (WN2)
- Other artificial lakes and ponds (FL8)
- Poor fen and flush (PF2)
- Raised bog (PB1)
- Recently-planted woodland (WS2)
- Recolonising bare ground (ED3)
- Reed and large sedge swamps (FS1)
- Reed and large sedge swamps (FS1), Poor fen and flush (PF2) mosaic
- Refuse and other waste (ED5)
- Rich fen and flush (PF1)
- Scrub (WS1)
- Scrub (WS1), Dry grassland (GS2), pioneering Dry heath (HH)
- Scrub (WS1), Poor fen and flush (PF2) mosaic
- Scrub (WS1), Wet grassland (GS4) mosaic
- Scrub (WS1), Wet grassland (GS4), Poor fen and flush (PF2) mosaic
- Wet grassland (GS4)
- Wet grassland (GS4), Poor fen and flush (PF2) mosaic

- EIAR Site Boundary
- Proposed Site Infrastructure
- Proposed Anemometry Mast Location
- Proposed Amenity Pathways



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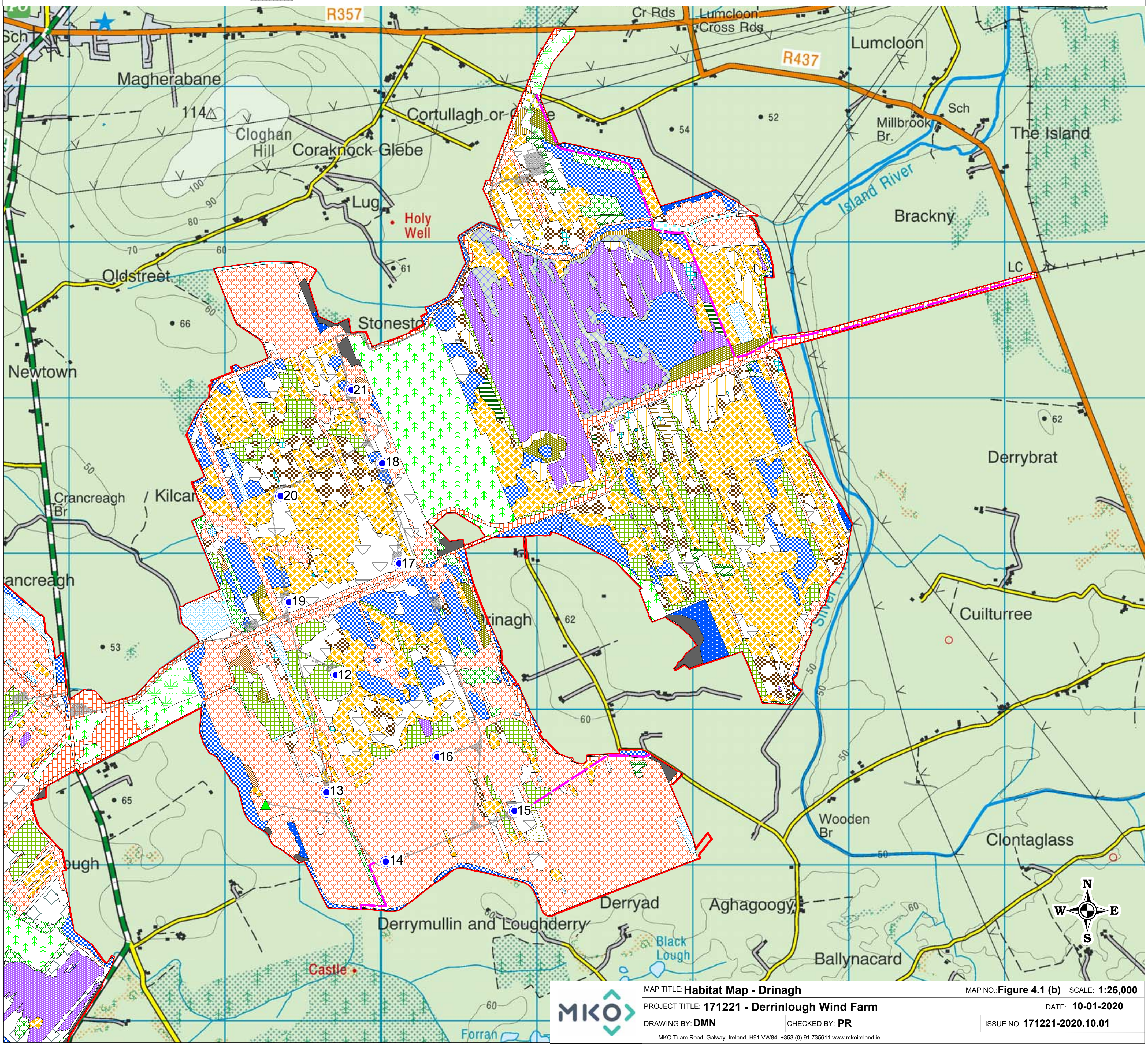
Habitat Map

Vegetation communities occurring on Cutover Bog (PB4)

- Acid oligotrophic lakes (FL2)
- Acid oligotrophic lakes (FL2), Poor fen and flush (PF2) mosaic
- Acid oligotrophic lakes (FL2), Reed and large sedge swamp (FS1) mosaic
- Buildings and artificial surfaces (BL3)
- Conifer plantation (WD4)
- Cutover bog (PB4)
- Cutover bog (PB4) pioneering Dry Heath (HH), Poor fen (PF2), Scrub (WS1) mosaic
- Cutover Bog (PB4), Bog woodland (WN7)
- Cutover bog (PB4), Exposed sand, gravel or till (ED1) mosaic
- Cutover bog (PB4), Pioneering Dry Heath (HH)
- Cutover bog (PB4), Pioneering Dry Heath (HH), Dry grassland (GS1) mosaic
- Cutover bog (PB4), pioneering Dry Heath (HH), Poor fen and flush (PF2) mosaic
- Cutover bog (PB4), pioneering Dry Heath (HH), Scrub (WS1) mosaic
- Cutover bog (PB4), Poor fen (PF2), Dry grassland (GS1) mosaic
- Cutover bog (PB4), Poor fen (PF2), Reed and large sedge swamps (FS1) mosaic
- Cutover bog (PB4), Poor fen and flush (PF2) mosaic
- Cutover bog (PB4), Scrub (WS1), Dry calcareous and neutral grassland (GS1)
- Cutover bog (PB4), Scrub (WS1), Poor fen and flush (PF2) mosaic
- Cutover bog (PB4), Wet grassland (GS4) mosaic
- Cutover bog (PB4), Wet grassland (GS4), Poor fen and flush (PF2) mosaic
- Dense bracken (HD1)
- Depositing/lowland rivers (FW2)
- Dry calcareous and neutral grassland (GS1)
- Dry calcareous and neutral grassland (GS1), Poor fen and flush (PF2) mosaic
- Dry calcareous and neutral grassland (GS1), Recolonising bare ground (ED3)
- Dry meadows and grassy verges (GS2)
- Dry-humid acid grassland (GS3)
- Hedgerow (WL1)
- Improved grassland (GA1)
- Mixed broad-leaved woodland (WD1)
- Oak-Ash-Hazel woodland (WN2)
- Other artificial lakes and ponds (FL8)
- Poor fen and flush (PF2)
- Raised bog (PB1)
- Recently-planted woodland (WS2)
- Recolonising bare ground (ED3)
- Reed and large sedge swamps (FS1)
- Reed and large sedge swamps (FS1), Poor fen and flush (PF2) mosaic
- Refuse and other waste (ED5)
- Rich fen and flush (PF1)
- Scrub (WS1)
- Scrub (WS1), Dry grassland (GS2), pioneering Dry heath (HH)
- Scrub (WS1), Poor fen and flush (PF2) mosaic
- Scrub (WS1), Wet grassland (GS4) mosaic
- Scrub (WS1), Wet grassland (GS4), Poor fen and flush (PF2) mosaic
- Wet grassland (GS4)
- Wet grassland (GS4), Poor fen and flush (PF2) mosaic

EIAR Site Boundary | Proposed Site Infrastructure | Proposed Anemometry Mast Location | Proposed Amenity Pathways



MKO	MAP TITLE: Habitat Map - Drinagh	MAP NO.: Figure 4.1 (b)	SCALE: 1:26,000
	PROJECT TITLE: 171221 - Derrinlough Wind Farm		DATE: 10-01-2020
	DRAWING BY: DMN	CHECKED BY: PR	ISSUE NO.: 171221-2020.10.01
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Drainage Channels (FW4)

The study area is extensively drained with channels that run through the site. The majority of the drains within the site, subject to the most recent industrial harvesting, are devoid of vegetation and have a poor structure (Plate 4.1). In the areas where the drains are surrounded by dense woodland and scrub, the vegetation within them is sparse and the substrate comprises of bare silt. In the areas where there is less cover of trees, many of the drains support dense macrophytes including reedmace, horsetails (*Equisetum spp.*) and common reed (*Phragmites australis*).

Plate 4-1 Example of artificial drainage ditches that occur throughout the site, with little vegetation, dominated mainly by marsh arrowgrass and bog cottongrass.

Open Waterbodies

The large open waterbodies occurring within the study area have formed following the use of these areas for active peat extraction. The large waterbodies occurring within the eastern portion of the study area (Drinagh) have been created by drain blocking (BNM, 2016) and have been assessed as artificially created Acid oligotrophic lake (FL2). The waterbodies are generally shallow and fringed by reedbeds, poor fen and birch dominated woodland. Plate 4.2 provides an example of the large waterbody occurring within the northeast of the study area.

Plate 4-2 Example of open water Acid oligotrophic lake occurring within the eastern portion of the study area (Drinagh)

Depositing Lowland Rivers (FW2)

The following streams occur within the proposed development site; Feeghroe River (EPA code: 25F41), Mullaghkaraun Stream (25M48), Whigsborough Stream (25W43), Derrinlough Stream (25I29) (Plate 4-3), Little Cloghan River (25L01) (Plate 4-4), Silver River (25S02), Madden's Derry Stream (25M776), Stonestown Stream (25S55) and Grants Island Stream (25Y47), all classified as depositing lowland rivers. These watercourses were surveyed in detail, the results of the aquatic surveys are provided in the aquatic survey report, Appendix 4. Hydrological connectivity between these watercourses is illustrated in Figure 2.1.

Plate 4-3 The Derrinlough Stream upstream of the N62 road crossing

Plate 4-4 The Little Cloghan River approx. 0.4km downstream of the Derrinlough Peat Briquette Factory.

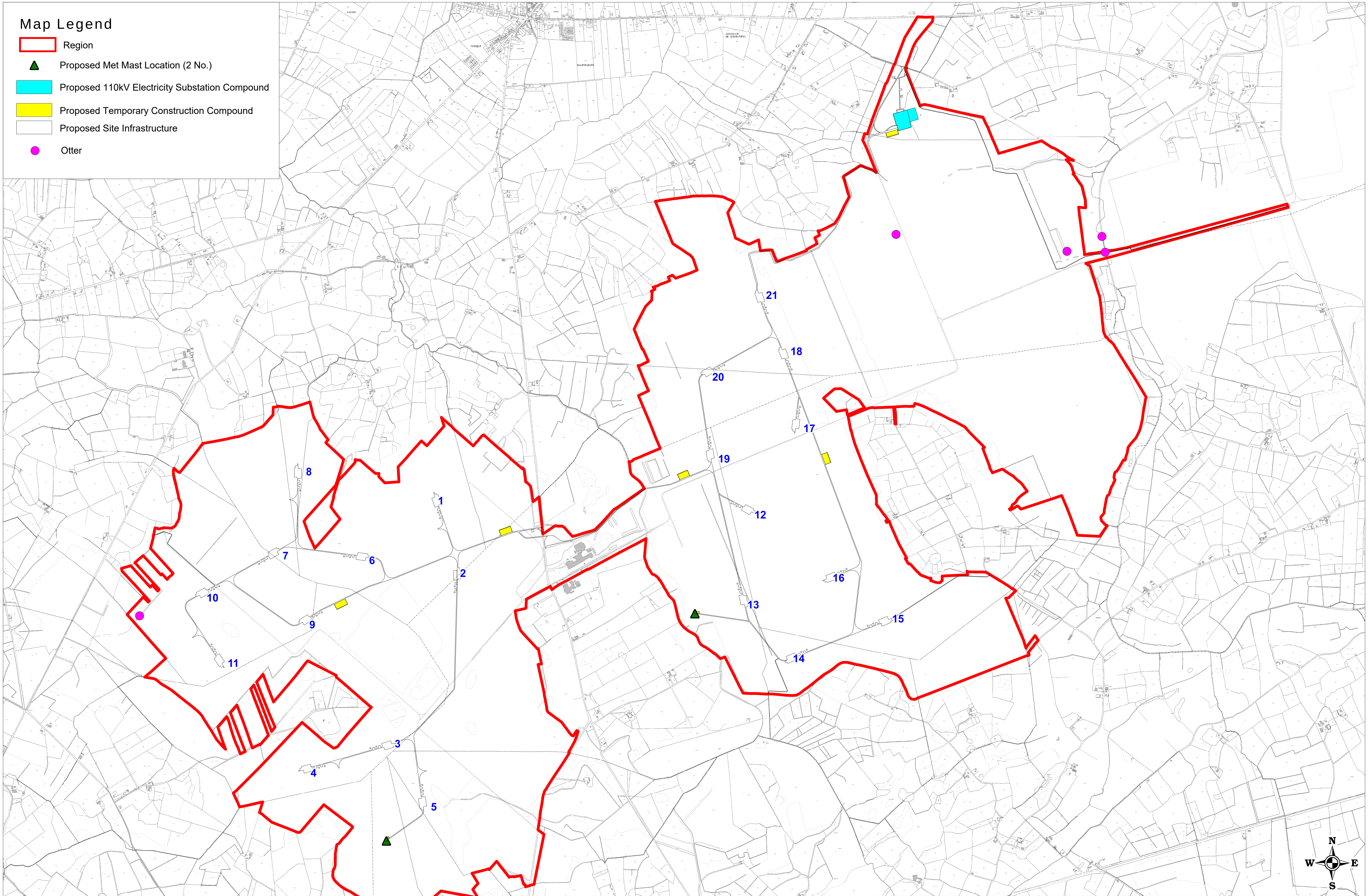
4.4.2 Invasive species

No non-native invasive species listed under the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2015) were recorded during the site visit.

4.4.3 Faunal Surveys

4.4.3.1 Otter

Signs, predominantly sightings of individual animals, of otter were recorded within the study area and downstream of the site of the proposed development (Figure 4.2). The main watercourse/larger artificial drainage channels were assessed as providing suitable commuting and foraging habitat for the species. The majority of the drainage ditches within the study area are small and provide low value habitat for otter. These peat drainage ditches were assessed as having low suitability for commuting or foraging otter as they are small, highly modified channels of low fisheries value. Some of the larger waterbodies recorded within the site were identified as providing suitable habitat for the species. No signs of otter were recorded during the dedicated fisheries assessment or kick sampling of the watercourses surrounding the study area (Triturus Environmental Ltd, 2019). It is noted that the watercourses on the site do provide connectivity with more sensitive aquatic habitats downstream including the River Shannon, which are likely to provide suitable habitat for this species.



MAP TITLE: Otter Records		MAP NO.: Figure 4.2	SCALE: 1:28,000
PROJECT TITLE: 171221 - Derrinlough Wind Farm NIS			DATE: 11-02-2020
DRAWING BY: DMN	CHECKED BY: PR	ISSUE NO.: 171221-2020.02.11	

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4.4.3.2 Birds

Results of the bird surveys are provided in this section. Detailed maps and raw data are provided in Chapter 7:Ornithology of the EIAR that was prepared in support of this application.

4.4.3.2.1 *Golden Plover*

Vantage Point Surveys

Golden plover were recorded in flight on 33 occasions during Vantage Point Surveys (see Appendix 7-4, Figure 7.1.2 of the EIAR). Twenty-three of the 33 flights occurred within the potential collision risk zone for turbine swept area. All observations of golden plover occurred during the winter months (October – April), only a few observations occurred during April which was likely to be from a lingering wintering population.

Fourteen of the 33 flights were recorded during the 2017/2018 winter season, while the remaining 19 observations occurred during the 2018/2019 winter season (October – April). Observations ranged from flocks of three to 220 birds. Six of the 33 flights were of flocks of golden plover observed more than 500m to the east of the proposed turbines over the Drinagh wetlands. Much of the golden plover flight activity is associated with a discrete few areas of suitable habitat or involved birds traveling between these areas (See Appendix 7-4, Figure 7.1.2 of the EIAR).

In addition to the 33 observations of birds in flight, there were also three observations of birds which were not seen in flight. On the 9th of January 2018, a flock of golden plover were heard calling while in flight during a survey at VP6 to the north of the site, these birds were not seen. On the 25th of October 2017, a flock of 16 golden plover were observed roosting on bare peat within the development site and also within 500m of the proposed turbines. On the 15th of January 2018, a flock of 30 golden plover were observed resting on bare peat within the proposed development site and also within 500m of the proposed turbines.

Breeding Bird Surveys

Golden plover were recorded on eight occasions during Breeding Bird Surveys (see Appendix 7-4, Figure 7.3.1 of the EIAR). Seven of the eight observations occurred during April 2018. The remaining observation occurred on the 9th of April 2019 as a flock of 60 birds were recorded travelling over the site. No evidence of breeding activity was recorded. All observations are likely to be associated with a lingering wintering population. Observations ranged from a pair of birds to a flock of 110 birds.

Four observations consisted of flocks roosting on areas of cutover bog, while the remaining four observations consisted of flocks in flight travelling over the development site.

Winter Transect/Waterfowl Surveys

Golden plover were only recorded on eight occasions during Winter Transect/Waterfowl Surveys (see Appendix 7-4, Figure 7.7.2 of the EIAR). Five of the eight observations occurred during October 2018, while a single bird was seen foraging at an area of flooded cutover bog, to the north of the development site at Noggus bog on the 23rd of May 2019. Five observations occurred onsite and within 500m of the proposed turbine locations, within the Clongawny side of the development site. On the 3rd of October 2018 a flock of 46 birds were recorded in flight over the Drinagh wetlands to the east of proposed turbines. On the 5th of October 2018 a flock of ten golden plover were recorded roosting on an area of cutover bog in the northeast corner of the development site around the Stonestown area, more than 500m from the nearest proposed turbine. The largest flock recorded within the Clongawny section of the development site during these surveys was a flock of four birds.

Migratory Bird Surveys

Golden plover were observed on 22 occasions during Migratory Bird Surveys between September 2018 and September 2019 (see Appendix 7-4, Figure 7.8.2 of the EIAR). Nineteen of the 22 observations consisted of birds recorded in flight over the Shannon and adjacent grasslands, with evidence recorded of birds travelling to or from the direction of the development site. In addition, there were three observations of flocks of 70 – 550 birds recorded in flight around the Little Brosna River and Dovegrove Callows SPA to the south of the development site. None of these three observations indicate that these birds were coming from or going to the proposed development area. Numbers recorded during Migratory Bird Surveys ranged from a flock of three birds to a flock of 2,000 birds.

Incidental Observations

There was one incidental observation of golden plover between October 2017 and September 2019. On the 10th of December 2018, golden plover was recorded as an incidental during a Hen Harrier Roost Survey at HHVP6.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7-7 and Appendix 7-5 of the accompanying EIAR.

- **2014/15 Winter Season:** Golden plover were recorded flying over or within Clongawny Bog (west of briquette factory) on six dates during the 2014/15 winter season in small to large flocks (maximum 400 birds). This species was also recorded on six dates at Drinagh Bog (east of briquette factory), again in small to large flocks (maximum 62 birds). Most observations of this species were of birds travelling over the site and not utilising areas within Derrinlough for roosting or feeding on a regular basis.
- **2015/16 Winter Season:** Golden plover were recorded flying over or within Clongawny Bog on four dates during the 2015/16 winter season in small to large flocks (maximum 120 birds). This species was also recorded on seven dates at Drinagh Bog but with much larger flocks observed (maximum 345 birds).
- **2016/17 Winter Season:** Golden plover were recorded flying over or within Clongawny Bog on four dates during the 2016/17 winter season in small to large flocks (maximum 600 birds). Birds were much more frequently recorded at Drinagh Bog, observed on ten dates throughout the winter in small to large flocks (maximum flock of c.1,000 birds).
- **2017 Breeding Season:** Golden plover were recorded once during the 2017 breeding season as a flock of c.40 birds flew over Clongawny bog on the 21st of April.

4.4.3.2.2 *Whooper Swan*

Vantage Point Surveys

Whooper swan were recorded in flight on 62 occasions during Vantage Point Surveys (see Appendix 7-4, Figure 7.1.1 of the EIAR). Twenty- nine observations occurred during the 2018/2019 winter season, between October 2018 and December 2018. The maximum flock size recorded during the 2018/2019 winter season was eight birds. The remaining 33 observations occurred during the 2017/2018 winter season, between October 2017 and February 2018. The maximum flock size recorded during the

2017/2018 winter season was 227 birds. All records of large whooper swan flocks from the 2017/2018 winter season were associated with birds roosting at the Drinagh wetlands, more than 500m east of the nearest turbine. Only seven of the 62 observations occurred within the potential collision risk zone of swept turbines.

Twenty-seven of the 62 flights occurred within 500m of the proposed turbine layout. Thirty-one observations were noted by the surveyor as birds travelling over the proposed development site. Thirty-one observations were of birds landing or flying from areas of flooded cutover bog (see Appendix 7-4, Figure 7.1.1 of the EIAR).

In addition to the 62 observations of birds in flight, there were also thirteen observations of whooper swan either heard calling but not seen or observed roosting, feeding and or preening on flooded areas of cutover bog. Observations ranged from a pair to a flock of 163 birds. On the 13th of December 2017 a flock of 163 whooper swan were recorded preening on ponds to the east of the Drinagh wetlands, while a flock of 61 birds were also recorded roosting at the Drinagh wetlands on the same day.

Winter Transect/Waterfowl Surveys

Whooper swan were recorded on 53 occasions during Winter Transect/Waterfowl Surveys (see Appendix 7-4, Figure 7.7.1 of the EIAR). Fifty-two of the 53 observations occurred between October 2018 and March 2019, while there was one observation from September 2019. Numbers recorded ranged from individuals to a maximum flock of 24 birds.

Five distinct roosting/foraging areas for whooper swan were recorded within one kilometre of the development site, three of which were within proximity of the development footprint, while birds were also recorded at the Drinagh wetlands and Noggus which is located to the north of the proposed development boundary. The majority of all roosting and foraging activity occurred around the Drinagh wetlands to the east of turbines with 21 observations in this area including all observations of large flocks (see Figure 7.7.1.1 in Appendix 7-4 of the EIAR).

In addition, there were five observations of whooper swan recorded during winter transect surveys from the 2017/18 winter season. All five observations occurred around the Drinagh Wetlands east of the turbines. Three observations occurred during a survey on the 11th of November 2017 while there were two further observations from the 25th of January 2018.

Migratory Bird Surveys

Whooper Swan were only recorded on eleven occasions during Migratory Bird Surveys along the River Shannon and Little Brosna River between September 2018 and September 2019 (see Appendix 7-4, Figure 7.8.1 of the EIAR). No evidence of birds commuting between the proposed development and the River Shannon or Little Brosna River was recorded. Only four of the eleven observations consisted of birds seen flying in the general direction to or from the proposed development site, while the remaining seven observations consisted of birds seen in flight over the Shannon to the north of Banagher. Numbers recorded ranged from a pair to a flock of 29.

Incidental Observations

There were two incidental observations of whooper swan during Hen Harrier Roost Surveys. On the 26th of October 2018 during a survey at HHVP6 a flock of eight swans were seen travelling towards the development site. On the 21st of March 2019 during a survey at HHVP3 a flock of eight swans were seen roosting on a flooded area of cutover bog at Derrybrat to the east of turbines. There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7-7 and Appendix 7-5 of the EIAR. Relevant records pertaining to Whooper Swan are outlined below.

- **2014/15 Winter Season:** Whooper swan were recorded flying over or within Clongawny Bog (west of briquette factory) on six dates during the 2014/15 winter season in small flocks (maximum eight birds). This species was more regularly recorded at Drinagh Bog (east of briquette factory), observed on 13 dates through the winter though again mostly in small numbers (>10 birds). A flock of 50+ swans was present on the 12^{th} of November 2014.
- **2015/16 Winter Season:** Whooper swan were recorded flying over or within Clongawny Bog on three dates during the winter season in small flocks (maximum eight birds). Birds were more regularly recorded at Drinagh Bog, observed on six dates through the winter though again mostly in small numbers (maximum 11 birds).
- **2016 Breeding Season:** A single whooper swan was present from the 12^{th} of April to at least the 9^{th} of May 2016. While not appearing injured, the bird may have suffered an injury to prevent it from migrating to the breeding grounds.
- **2016/17 Winter Season:** Whooper swan were recorded flying over or within Clongawny Bog on four dates during the winter season in small flocks (maximum eight birds). Birds were much more frequently recorded at Drinagh Bog, observed on several dates throughout the winter in larger flocks (up to 33 birds in November, but in separate flocks of no greater than ten birds per group).

4.4.3.2.3 *Black-headed Gull*

Vantage Point Surveys

Black-headed gull were recorded in flight on 217 occasions during Vantage Point Surveys (see Appendix 7-4, Figure 7.1.11 of the EIAR). Two-hundred and four of these observations occurred during the core breeding season months between April and July. One-hundred and thirty-three of these observations occurred during the 2018 breeding season, while the remaining 71 observations occurred during the 2019 breeding season (April – July).

Only thirteen observations occurred outside of the core breeding season months for this species. Nine of these observations occurred during a VP survey on the 1^{st} of March 2019. One observation occurred in August 2018, one in November 2018, one in February 2019 and one observation in August 2019. These observations are all likely to be associated with a lingering or an early establishing breeding population. Breeding activity was recorded within the development site in both 2018 and 2019.

Observations ranged from individuals to a flock of 40 birds. In total 86 of the recorded flights occurred within the Potential Collision Height (PCH).

Breeding Bird Surveys

Black-headed gull were recorded on 49 occasions during Breeding Bird Surveys (see Appendix 7-4, Figure 7.3.8 of the EIAR). There were 27 observations from the 2018 breeding season while there were 22 observations during 2019 Breeding Bird Surveys. Eight observations indicated breeding activity as birds were seen and heard calling defending breeding territories or establishing breeding colonies. Twelve observations related to birds recorded roosting or foraging on flooded areas of cutover bog. Thirty-one observations related to birds recorded flying over the development site.

On the 2^{nd} of May 2018, 300 black-headed gull were recorded in the early stages of establishing a breeding colony on an island in an area of flooded cutover bog to the east of the briquette factory within the development site. Nest scraps and territorial behaviour were recorded. However, the site was abandoned approximately a week later. There were also an additional five probable black-headed gull breeding territories onsite or within 500m of the development site. There was one probable breeding pair in the Clooneen area, three probable breeding pairs west of the briquette factory and one probable breeding to the east of the briquette factory.

In 2019, six breeding pairs of black-headed gull were recorded onsite or within 500m the development area. Two breeding pairs were recorded within the Clooneen area, three breeding pairs were recorded within an area of flooded bog just west of the briquette factory and VP4, while there was also one possible breeding pair within the Drinagh wetlands. Furthermore, a slightly smaller breeding colony than that seen in 2018, established itself on Noggus bog, further details are provided in subsequent paragraphs.

Six distinctive breeding areas were identified across the combined 2018 and 2019 Breeding Bird Surveys (see Appendix 7-4, Figure 7.3.8.1 of the EIAR).

Winter Transect/Waterfowl Surveys

Black-headed gull were recorded on 14 occasions during Winter Transect/Waterfowl Surveys (see Appendix 7-4, Figure 7.7.8 of the EIAR). Thirteen observations occurred between the 28th of April and 23rd of May 2019. On the 25th of February 2019 a pair of gulls were recorded around the Clooneen flooded area. There were three further observations of black-headed gull around this location between March and May 2019 as flock sizes of between five and eight birds were recorded roosting around the flooded area. A pair of black-headed gull were recorded at the Drinagh wetlands to the east of the proposed turbines on the 28th of March 2019. The remaining nine observations were related to a colony of approximately 150 birds attempting to establish a breeding colony and roosting at an area of flooded cutover bog, at Noggus northeast of the development site. Birds within the colony were recorded incubating eggs during surveys in late May.

Migratory Bird Surveys

Black-headed gull were recorded on seven occasions during Migratory Bird Surveys between September 2018 and September 2019 (see Appendix 7-4, Figure 7.8.7 of the EIAR). Six of the seven observations occurred during the 2018/19 winter season between October 2018 and February 2019, while there was one observation of a flock of ten birds recorded in flight over the Shannon on the 6th of August 2019. Three observations consisted of birds recorded in flight around the Dovegrove Callows SPA to the south of the development site, between October 2018 and January 2019. The remaining four observations all occurred along the River Shannon, to the north of Banagher, between February 2019 and August 2019. Flock sizes recorded ranged from 5 birds – 70 birds. No evidence of birds travelling to or from the direction of the development site was recorded during these surveys.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7-7 and Appendix 7-5 of the EIAR.

- **2014/15 Winter Season:** Black-headed gull was recorded on three occasions at Clongawny Bog during the 2014/15 winter season surveys. All three observations occurred between February and March 2015 with individuals seen in breeding plumage and indicating early breeding displays and territorial behaviour at an area of flooded bog. This species was observed twice at Drinagh Bog, as small flocks were seen in flight over the site in March 2015. There was no evidence of breeding activity recorded at Drinagh Bog

- **2015/16 Winter Season:** Black-headed gull was recorded twice at Clongawny Bog during the 2015/16 winter season surveys. Observations occurred between February and March 2016 with individuals seen in breeding plumage and indicating early breeding displays and territorial behaviour at an area of flooded bog. This species was observed once at Drinagh Bog, as three birds were seen on a spit in the Drinagh wetlands on the 21st of March 2016.
- **2016 Breeding Season:** Breeding black-headed gull were recorded on three occasions at Clongawny Bog during the 2016 breeding season surveys. Peak numbers were recorded on the 9th of May 2016 as c.160 birds were observed with c.60 of which apparently on nests at Clooneen wetland. On the 22nd of June only c.20 gulls were present, including four fledged young. A number of nests/chicks may have been lost due to flooding caused by heavy seasonal rains. Breeding black-headed gull were also recorded at Drinagh Bog. Territorial birds were present in April and May with c.10 birds sitting on apparent nests on an island within the Drinagh wetlands. Birds had departed and abandoned breeding attempts in this area by June.
- **2016/17 Winter Season:** Black-headed gull was recorded once at Clongawny Bog during the 2016/17 winter season surveys. A flock of 36 gulls were observed in breeding plumage at Clooneen wetland on the 28th of March 2017, in breeding plumage and indicating early breeding displays and territorial behaviour. This species was not recorded at Drinagh Bog during the 2016/17 winter season.
- **2017 Breeding Season:** A breeding black-headed gull was recorded at Clooneen during the 2017 breeding season with a peak count of c.30 occupied nests on the 11th of May. By early June numbers had dropped to no more than c.15 nests, before the breeding colony abandoned the areas entirely by 22nd June, with only adult birds remaining. Fluctuating water levels and predation are both believed to have contributed to the failure of the colony. Breeding black-headed gull were also recorded at Drinagh Bog. Thirteen territorial birds were present at the Drinagh wetlands in April with a single occupied nest seen in early May. These birds had departed this area by the start of June 2017.

4.4.3.2.4 *Lapwing*

Vantage Point Surveys

Lapwing were recorded in flight on 195 occasions during Vantage Point Surveys. One-hundred and twenty-one of these observations occurred during the core breeding season months between April and August (see Figure 7.1.10a, Appendix 7-4 of the EIAR). Forty-one observations occurred during the 2018 breeding season, while the remaining 80 observations occurred during the 2019 breeding season (April - August). Eighty-one of the 121 observations from breeding season months occurred within 500m of the proposed turbines. Most observations were of breeding birds (pairs or individuals) observed in flight below the potential collision height (i.e. below 25m). The majority of the observations during breeding season surveys occurred within 500m of the proposed turbines to the west of the briquette factory.

There were 74 observations of lapwing during non-breeding season months (September – March) (see Figure 7.1.10b, Appendix 7-4 of the EIAR). Twenty-seven observations occurred during the 2017/18 non-breeding season (October – March) while 47 observations occurred during the 2018/19 non-breeding season, between September 2018 and March 2019. The maximum flock size recorded during VP surveys from the non-breeding season (September – March) was 206 birds. The majority of flight activity from the winter seasons was of large flocks flying over the development site. Only 22 of the 74 observations from the winter months occurred within 500m of the proposed turbines. The majority of flight activity occurred more than 500m from the proposed turbines around VP1 to the south and VP5 and VP6 to the northeast.

In addition to the 195 observations of birds in flight, there were six observations (seen or heard) of non-flying birds. Five of the six observations consisted of birds roosting and or feeding during non-breeding season months, while a lapwing was heard calling on numerous occasions throughout a survey at VP3 on the 16th of April 2019 but was not seen.

Breeding Bird Surveys

Lapwing were recorded on 98 occasions during Breeding Bird Surveys (see Appendix 7-4, Figure 7.3.7 of the EIAR). There were 52 observations from the 2018 breeding season while there were 46 observations of lapwing during 2019 Breeding Bird Surveys.

Fifty-five of the 98 observations related to birds breeding, displaying, calling or pairs recorded in areas of suitable breeding habitat. Forty-three observations related to birds recorded flying over the site or roosting on wet areas of bog, with no evidence of breeding activity recorded. Twenty-one of these were of individual birds while the remainder consisted predominantly of pairs with some observations also of small flocks (3 – 35 birds).

There were 16 breeding territories within the development site or within 500m of the development boundary during 2018 Breeding Bird Surveys. In addition, there was one breeding pair at Derrybrat more than 2km to the east of the development infrastructure.

In 2019 there were 16 breeding territories recorded onsite or within 500m of the development boundary. In addition, there were three pairs at Derrybrat, more than 2km east of the development infrastructure, and ten lapwing pairs at Noggus, to the north of the site. The location of all 2018 breeding lapwing territories is provided in Figure 7.3.6.1, while the 2019 breeding territories are provided in Figure 7.3.6.2 in Appendix 7-4 of the EIAR.

Winter Transect/Waterfowl Surveys

Lapwing were recorded on 50 occasions during Winter Transect/Waterfowl Surveys (see Appendix 7-4, Figure 7.7.7 of the EIAR). Twenty-four observations occurred during the 2018/19 non-breeding season between August 2018 and February 2019, while there were 25 observations during the core 2019 breeding season months (March – May). In addition, there was a single observation of a flock of 17 lapwing roosting within the Drinagh wetlands during a survey in September 2019. The majority of observations from the winter months occurred around the Drinagh wetlands, while there were nine observations within the development site, including the Clooneen wetland and flooded areas of cutover bog to the west and east of the Briquette factory.

On the 27th of November 2018 two large flocks of 350 birds and 250 birds were both recorded roosting on areas around the Drinagh wetlands to the east of the proposed turbines. Furthermore, a flock of 400 birds were recorded flying over the Drinagh wetland on the 5th of November 2018. Large numbers of wintering lapwing are therefore dependant on the Drinagh wetland for foraging and roosting.

Only six of the 25 observations from the core breeding season (March – May) occurred onsite or within 500m of the development site. The vast majority of observations from the breeding season months occurred offsite around Noggus bog and Derrybrat to the northeast and east of the development infrastructure respectively.

On the 23rd of May 2019 a lapwing pair with three recently hatched chicks were recorded foraging around a flooded area at Noggus to the northeast of the development site. On the 27th of May 2019 a breeding pair were recorded incubating at a scrape/nest with four eggs at Derrybrat bog, to the east of the development infrastructure, before being disturbed by the surveyor and alarm calling.

Nineteen observations involved birds roosting on flooded areas of cutover bog. Eight observations related to breeding activity between March and May 2019.

In addition, there were 60 observations of lapwing during winter transect surveys from the 2017/18 winter season. Twelve observations occurred around the Clongawny area in the western section of the development site during a survey in January 2018. The remaining 48 observations occurred around the Drinagh Wetlands in the east of the development site. Forty-five observations occurred during a survey on the 11th of November 2017 while there were three observations from the 21st of March 2018.

Migratory Bird Surveys

Lapwing were recorded on 24 occasions during Migratory Bird Surveys between September 2018 and September 2019 (see Appendix 7-4, Figure 7.8.6 of the EIAR). Twenty observations occurred during the 2018/19 winter season between October 2018 and February 2019, while there was one observation of lapwing from August 2019 and three observations from September 2019. Twenty of the 24 observations consisted of birds recorded in flight over the Shannon, predominantly to the north of Banagher where the Grand Canal and River Brosna meet the Shannon. There was no indication during any of these observations that birds were travelling to or from the direction of the development site.

In addition, there were four observations of flocks of 4 – 500 birds recorded in flight around the Little Brosna River and Dovegrove Callows SPA to the south of the development site. None of the observations in this area indicated that these birds were coming from or going to the proposed development site.

Incidental Observations

There were eight incidental observations of lapwing recorded across various surveys between October 2017 and September 2019. Four of which occurred during Crane dusk surveys in March 2019 close to VP4. There were two observations on the 7th of March and two observations on the 14th of March. There were two observations of a pair of lapwing recorded flying and calling while in flight over a flooded area at Noggus bog to the northeast of the development site, during a breeding raptor survey on the 16th of May 2018. On the 26th of June 2018, the surveyor made a casual observation prior to commencing a survey, of a flock of approximately 15 lapwing feeding and or roosting around the Drinagh Wetland within the north-eastern section of the development site, with no evidence of breeding activity observed. On the 21st of March 2019 an individual lapwing was recorded calling while in flight at Derrybrat to the east of the development infrastructure during a Hen Harrier Roost Survey at HHVP3.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7-7 and Appendix 7-5 of the EIAR.

- **2014/15 Winter Season:** Lapwing was recorded frequently at Clongawny Bog during the 2014/15 winter season surveys, although a number of these observations were off-site including observations of flocks of c.135 and c.200 birds. Records of lapwing on-site included six observations of flocks of 40 – 100 birds. In addition, a lone lapwing was seen on an area of flooded cutover bog in February and March apparently holding a breeding territory. Lapwing were also frequently recorded at Drinagh Bog during the 2014/15 winter season, although many of these observations consisted of small parties flying across the site. A maximum flock size of 228 birds were seen at the Drinagh wetlands on the 13th of February 2015.
- **2015/16 Winter Season:** Lapwing was recorded on four dates during the 2015/16 winter season surveys at Clongawny Bog. Flock sizes recorded ranged from three to 120 birds. On the 20th of March 2016 three birds were on an area of flooded cutover bog with territorial/breeding behaviour observed. Lapwing was recorded more

frequently at Drinagh Bog during the 2015/16 winter surveys, although many of the records were of relatively small parties flying across the site. On the 26th of September a flock of c.800 – 1,000 birds were seen circling high over the Drinagh wetlands before landing. In addition, an estimated 3-4 pairs of breeding/territorial lapwing were present at the Drinagh wetlands in March 2016.

- **2016 Breeding Season:** Lapwing was observed on four dates at Clongawny Bog during the 2016 breeding season, with evidence of breeding recorded on three of these dates. There were four active breeding lapwing pairs at Drinagh Bog in late March 2016. It is considered that at least three of these pairs probably bred but the success rate is unknown. In addition, there was a non-breeding flock of c.90 birds recorded on the 23rd of June.
- **2016/17 Winter Season:** Lapwing was recorded on six dates during the 2016/17 winter season surveys at Clongawny Bog, with flocks sizes ranging between two and c.800 birds. On the 28th of March a pair were seen at an area of flooded bog indicating territorial/breeding behaviour. Lapwing was recorded more frequently at Drinagh Bog during the 2016/17 winter surveys, although many of the records were of relatively small parties flying across the site. Flock sizes recorded ranged from c.50 to c.700 birds, which were mostly recorded around the Drinagh wetlands.
- **2017 Breeding Season:** Two pairs of territorial/breeding lapwing were recorded at Clongawny Bog in April and early May. While the birds were still present into June, no further evidence of breeding activity was observed during this period. Likewise, at Drinagh Bog, two active breeding lapwing pairs were observed in April and May 2017, although breeding appeared to have failed for both pairs by late May. In addition, a flock of c.370 non-breeding birds were seen at the Drinagh wetlands on the 28th of September.

4.4.3.2.5 *Shoveler*

Vantage Point Surveys

Shoveler were only recorded twice during Vantage Point Surveys between October 2017 and September 2019 (see Appendix 7-4, Figure 7.1.16 of the EIAR). Both observations occurred during the same survey at VP8 near Drinagh wetlands on the 25th of April 2019. A male was recorded in flight and landing on the flooded area near VP8, before two males and a female were recorded leaving the area and flying west towards the development site approximately one hour later.

Both flights occurred in excess of 1.5km from the nearest proposed turbine and were recorded flying below the potential lowest rotor swept height.

Breeding Bird Surveys

Shoveler were only recorded once during Breeding Bird Surveys (see Appendix 7-4, Figure 7.3.13 of the EIAR). On the 10th of April 2019 a flock of four birds were flying over an area of cutover bog, on the eastern edge of the Drinagh wetlands, more than one kilometre from the nearest proposed turbine.

Winter Transect/Waterfowl Surveys

Shoveler were recorded on five occasions during Winter Transect/Waterfowl Surveys (see Appendix 7-4, Figure 7.7.14 of the EIAR). All five observations occurred between the 2nd of January and 3rd of May 2019. Three observations occurred at Noggus bog, to the northeast of the development site where birds were recorded roosting on flooded areas of bog. On the 29th of April 2019 a single duck was recorded roosting on an area of flooded bog at Derrybrat, more than 2km to the east of the development infrastructure. The remaining observation occurred near the area of flooded bog at Clooneen. A flock of five shoveler were recorded.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7-7 and Appendix 7-5 of the EIAR.

- **2016 Breeding Season:** Shoveler was recorded twice during breeding season surveys at Drinagh Bog. On the 12th of April 2016 a pair were seen in an area of suitable breeding habitat at the Drinagh wetland, while only one bird was present in early May. This species was not recorded at Clongawny Bog.
- **2017 Breeding Season:** Shoveler was recorded once during breeding season surveys at Drinagh Bog. On the 8th of May 2017 a pair were seen in an area of suitable breeding habitat at the Drinagh wetland. This species was not recorded at Clongawny Bog.

4.4.3.2.6 *Wigeon*

Vantage Point Surveys

Wigeon were not recorded during Vantage Point Surveys between October 2017 and September 2019.

Winter Transect/Waterfowl Surveys

Wigeon were recorded on ten occasions during Winter Transect/Waterfowl Surveys (see Appendix 7-4, Figure 7.7.16 of the EIAR). Numbers recorded ranged from an individual duck to a flock of 35 birds. Nine of the ten observations occurred between October 2018 and March 2019, while an individual duck was recorded during a survey on the 27th of September 2019. Only one observation occurred within the development site or 500m of the proposed turbines. On this occasion a flock of 19 birds were recorded on the 9th of January 2019. Three observations occurred around the Drinagh wetlands to the east of the proposed turbines, while the remaining six observations occurred around Noggus bog, more to the northeast of the development site. At Noggus, birds were recorded roosting and foraging.

Migratory Bird Surveys

Wigeon were only recorded twice during Migratory Bird Surveys between September 2018 and September 2019 (see Appendix 7-4, Figure 7.8.9 of the EIAR). On the 26th of November 2018 a flock of 16 birds were recorded travelling over the Shannon, to the west of the development site. On the 29th of January 2019 a flock of 90 birds were seen in flight over the Dovegrove Callows SPA to the south of the development site. No evidence of birds travelling to or from the direction of the development site was recorded during these surveys.

There were no additional observations of this species during any of the other comprehensive surveys.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7-7 and Appendix 7-5 of the EIAR.

- **2014/15 Winter Season:** Wigeon was recorded on one occasion during winter season surveys at Clongawny Bog, as a flock of five birds were recorded on the 19th of November. A flock of sixty wigeon were also observed on Drinagh Bog, at the Drinagh wetlands, on the 27th of December 2015.

- **2015/16 Winter Season:** Wigeon was recorded on one occasion at Clongawny Bog during winter season surveys, as a pair of birds were seen in flight over the site on the 20th of October. Wigeon were more frequently recorded at Drinagh Bog, with observations occurring on four dates with a maximum flock of 33 birds recorded.
- **2016/17 Winter Season:** Wigeon was recorded on three surveys dates at Drinagh Bog during winter season surveys, with a maximum flock of 22 birds recorded on the Drinagh wetlands on the 8th of December 2016.

4.4.3.2.7 *Teal*

Vantage Point Surveys

Teal were recorded in flight on three occasions during Vantage Point Surveys (see Figure 7.1.24, Appendix 7-4 of the EIAR). All three flights occurred more than 500m from the proposed turbines locations around the Drinagh wetlands to the east of the proposed turbines. None of the flights occurred within the potential collision risk zone. One flight occurred during a survey at VP8 in December 2018, while the other two observations occurred during the core breeding season between May and July 2019.

In addition, there was also on observation of a flock of four teal seen feeding on a flooded area of cutover bog within the Drinagh wetlands on the 10th of January 2018.

Winter Transect/Waterfowl Surveys

Teal were recorded on 24 occasions during winter transect surveys from the 2017/18 winter season. Seven observations occurred around Clongawny to the west of the briquette factory, while there were 17 observations around the Drinagh Wetlands east of the proposed turbines. Six observations at Drinagh occurred during a survey on the 11th of November 2017 while there were eleven observations from the 25th of January 2018. At Clongawny, three observations occurred in November 2017 while there four observations in January 2018.

There were no observations of teal during the MKO Winter Transect/Waterfowl surveys from the 2018/19 winter season.

Incidental Observations

There was only one incidental observation of teal recorded between October 2017 and September 2019. On the 12th of February 2019 a teal was heard calling around dusk, but not seen after a Vantage Point Survey at VP3.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7-7 and Appendix 7-5 of the EIAR.

- **2014/15 Winter Season:** Teal were recorded on a regular basis at Clongawny Bog during the 2014/15 winter season, with observations mostly of small flocks (>10 birds) and with a peak count of c.65 birds on the 19th of December. Teal were regularly recorded at Drinagh Bog during winter surveys, with a peak count of 22 birds on the 23rd of January 2015.
- **2015/16 Winter Season:** Teal were recorded on five dates at Clongawny Bog, with observations mostly of small flocks and with a peak count of 28 birds on the 20th of

October. Teal were only recorded on two dates in December at Drinagh Bog, with a flock of ten and a flock of 25 birds observed.

- **2016 Breeding Season:** A group of five teal were recorded on a flooded area at Clongawny Bog on the 21st of September 2016. A flock of twelve teal were flushed during a survey at Drinagh Bog on the 4th of September 2016.
- **2016/17 Winter Season:** Teal were recorded on five dates at Clongawny Bog, with observations mostly of small flocks and with a peak count of 28 birds on the 12th of November. Teal were recorded in small numbers throughout the winter at Drinagh Bog, with a maximum flock of c.60 birds recorded on the 8th of December 2016.
- **2017 Breeding Season:** Teal were recorded on three dates at Clongawny Bog between August and September, with observations consisting of small flocks (maximum of seven birds). A pair of teal were observed at Drinagh Bog in April 2017 but were not seen in subsequent visits.

4.4.3.2.8 *Black tailed Godwit*

Vantage Point Surveys

Black-tailed godwit were only recorded once during Vantage Point Surveys (see Figure 7.1.25, Appendix 7-4 of the EIAR). On the 6th of August 2019 a flock of five black-tailed godwit were seen in flight travelling over the Drinagh wetlands to the east of the proposed turbines. The observation occurred more than 500m east of the proposed turbine locations and was outside any potential collision risk zone.

Incidental Observations

There were six incidental observations of black-tailed godwit recorded between October 2017 and September 2019. All six observations occurred during Migratory Bird Surveys between March and September 2019. Flocks ranging from 140 to 350 birds were seen on five occasions during surveys at CMVP5 along the Shannon in March 2019. In addition, a flock of four birds were seen at the Shannon Callows during a survey at CMVP3 in September 2019.

Additional Records (October 2014 – September 2017)

Field surveys were undertaken by Biosphere Environmental Services (BES) between October 2014 and September 2017 in the form of Vantage Point surveys and walked transects. Results and detailed survey summaries are provided in Appendix 7-7 and Appendix 7-5 of the EIAR.

- **2015/16 Winter Season:** A single black-tailed godwit was recorded on migration at Drinagh Bog on the 21st of March 2016.

5. SUMMARY OF MEASURES IN PLACE TO PREVENT ANY ADVERSE EFFECTS ON EUROPEAN SITES

5.1 Potential for Direct Effects on the European Sites

The development site lies entirely outside of the boundaries of EU designated sites and therefore there is no potential for direct impact on any EU site.

5.2 Potential for Indirect Effects on the European Sites

5.2.1 Deterioration of Water Quality

There is hydrological connectivity between the proposed development and downstream European Sites via watercourses within the site boundary which ultimately discharge to the River Shannon, including the Madden's Derry stream, Grants Island Stream, Mullaghakaraun Bog, Feeghroe/Mountcarteret Stream and several small tributary streams of the Little Cloghan River (Figure 2.1).

The proposed works have the potential to cause deterioration in surface water quality during the construction, operational and decommissioning phase of the development due to the release of pollutants including suspended solids and hydrocarbons, potentially affecting the following QIs/SCIs, in the absence of mitigation:

- River Shannon Callows SAC
  - Otter *Lutra lutra*
  - *Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno- Padion, Alnionincanae, Salicionalbae*)

- Lough Derg North-east Shore SAC
  - Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* [7210]
  - Alkaline fens [7230]
  - Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0]

- Middle Shannon Callows SPA
  - Wetlands and Waterbirds [A999]

- Lough Derg (Shannon) SPA
  - Wetlands and Waterbirds [A999]

5.2.1.1 Construction and Operation mitigation

The pathway that would allow potential impacts to occur was considered in the design of the project. The environmental management framework to be adhered to during the construction phase of the development including comprehensive detail regarding site set up, pollution prevention and hydrocarbon management and incorporates the mitigating principles to ensure no adverse impact on the integrity of European Sites as outlined in Chapter 9 of the EIAR and in the CEMP for the proposed development which is attached in Appendix 3.

Extensive mitigation measures for the protection of water quality will be adhered to during the construction phase of the development and are outlined in Section 3.5 of this report, the CEMP (Appendix 3) and the Hydrology and Hydrogeology Chapter of the EIAR (Appendix 2), included in this application.

5.2.2 Bird Disturbance

A potential pathway for indirect effects in the form of bird disturbance was identified, potentially affecting the following SPAs:

- Middle Shannon Callows SPA
  - golden plover
  - whooper swan
  - black-headed gull
  - lapwing
  - wigeon
  - black tailed godwit

- River Little Brosna Callows SPA
  - black-headed gull
  - whooper swan
  - lapwing
  - golden plover
  - wigeon
  - black-tailed godwit
  - teal
  - shoveler

This section describes the measures that are in place to mitigate adverse negative effects associated with the Proposed Development on avian receptors. Effects on avian receptors have been addressed in two ways:

- Design of the Proposed Development.
- Management of the development phases.

5.2.2.1 Mitigation by Design

The project design has followed the basic principles outlined below to eliminate the potential for significant effects on avian receptors:

- The proposed development has been deliberately designed to avoid the most sensitive areas for birds within the study area. This includes the Drinagh Wetlands. (Note: the amenity pathway in this area follows the route of an existing track)
- Sensitive hydrological features will be avoided where possible, by application of suitable buffer zones (i.e. 50m to main watercourses, and 10m to main drains). All of the key proposed development areas are located significantly away from the delineated 50m watercourse buffer zones with the exception of the upgrading of the existing watercourse crossing, new drain crossing and upgrades to existing site access tracks.
- Hard standing areas have been designed to the minimum size necessary to accommodate the turbine model that is selected.

- The proposed substation and associated grid connection route will be located entirely within the development site boundary. The proposed wind farm would be connected to the national electricity grid through the existing Dallow/Portlaoise/Shannonbridge 110 kV line which traverses the north-eastern section of the site. These areas have been subjected to detailed bird surveys across the two-year survey period.

5.2.2.2 Mitigation During Construction, Operation and Decommissioning

The following section describe the mitigation and best practise measures to be implemented during each phase of the Proposed Development.

5.2.2.3 Construction Phase Mitigation

The following measures are proposed for the construction phase:

- A Construction and Environmental Management Plan (CEMP) has been prepared. The CEMP will be in place prior to the start of the construction phase. The CEMP is included as an Appendix 3.
- During the construction phase, noise limits, noise control measures, hours of operation (i.e. dusk and dawn is high faunal activity time) and selection of plant items will be considered in relation to disturbance of birds.
- Plant machinery will be turned off when not in use.
- All plant and equipment for use will comply with the Construction Plant and Equipment Permissible Noise Levels Regulations 1996 (SI 359/1996) and other relevant legislation.
- An Ecological Clerk of Works (ECoW) will be appointed. Duties will include:
  - Undertake a pre-construction transect/walkover bird survey to ensure that significant effects on breeding birds will be avoided.
  - Inform and educate on-site personnel of the ornithological and ecological sensitivities within the Proposed Development site.
  - Oversee management of ornithological and ecological issues during the construction period and advise on ornithological issues as they arise.
  - Provide guidance to contractors to ensure legal compliance with respect to protected species onsite.
  - Liaise with officers of consenting authorities and other relevant bodies with regular updates in relation to construction progress.

5.2.2.4 Decommissioning Phase Mitigation

The following measures are proposed for the decommissioning phase:

- During the decommissioning phase, disturbance limitation measures will be as per the construction phase.
- Plant machinery will be turned off when not in use.
- All plant and equipment for use will comply with the Construction Plant and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations 2001 (S.I. No. 632 of 2001).

6. ASSESSMENT OF POTENTIAL SIGNIFICANT EFFECTS

The potential for significant effects on each of the individual Qualifying Interests (QIs) and Special Conservation Interests (SCIs) that were identified as being at risk of potential effects in the AA Screening Report are assessed in this section in view of the Conservation Objectives of those habitats and species.

6.1 River Shannon Callows SAC

This European Site is 2.3km from the proposed development site, the proposed development is outside of the SAC boundary. There is hydrological connectivity between the proposed development and this SAC via watercourses within the site boundary which discharge to the River Shannon, including the Madden's Derry stream, Grants Island Stream, Mullaghakaraun bog, Feeghroe/Mountcarteret stream and several small tributary streams of the Little Cloghan river.

The proposed works have the potential to cause deterioration in surface water quality during the construction, operational and decommissioning phases of the development due to the release of pollutants including suspended solids and hydrocarbons. These effects could occur in the form of release of suspended solids during the large scale earthworks that will be required to facilitate the construction of turbine bases and other infrastructure, the release of hydrocarbons to the rivers during construction. Deterioration could also occur during operation as there is the potential for the faster run off of waters from the proposed hard standing areas within the site, which could lead to erosion and bank disturbance. These impacts could potentially affect the following downstream aquatic habitats and supporting habitats for aquatic fauna:

- *Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno- Padion, Alnionincanae, Salicionalbae*)
- *Lutra lutra* (Otter) [1355]

6.1.1 *Lutra lutra* (Otter) [1355]

The identified pathways for effect are deterioration in water quality during the construction, operational and decommissioning phases of the development, potentially resulting in deterioration of downstream otter habitat. Pollution could lead to a reduction in prey availability if fish and aquatic invertebrates are affected.

A comprehensive search for otter was undertaken along the drainage ditches and watercourses within and adjacent to the site, which were surveyed 150m upstream and downstream of the proposed development, including a 10m riparian buffer. Signs, predominantly sightings of individual animals, of otter were recorded within the study area and downstream of the site of the proposed project. No holts or couches were recorded.

No detailed Conservation Objectives are available for River Shannon Callows SAC. However, targets and attributes for the conservation of this QI species are available in detailed Conservation Objectives for other SACs (Blackwater River (Cork/Waterford SAC). Such targets and attributes are representative of factors considered in the conservation of the QI species in other areas and were considered in the preparation of this assessment.

Site specific conservation objectives documents are not available for this site. The conservation objective for this QI 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'*

An assessment of the proposed development against the nominated attributes and targets for this species is provided in Table 6.1 below.

Table 6-1 Targets and attributes associated with the conservation objectives for Otter

Attribute	Target	Assessment
Distribution	No significant decline	There will be no decline in the extent of terrestrial or freshwater habitat associated with the proposed development. There will be no works within 2.3km of the SAC. There will be no instream works in significant watercourses and all major infrastructure will be located over 50m from any significant watercourse, and a 10m buffer of main drains. A range of mitigation measures, outlined in Section 3.5 of this report, in the hydrology chapter of the accompanying EIAR (Appendix 2) and in the accompanying CEMP (Appendix 3) are in place to avoid water pollution within any European Site during construction, operation or decommissioning. There is no impact pathway which could lead to a decline in the distribution of this species associated with the proposed development.
Extent of terrestrial habitat	No significant decline	There will be no decline in the extent of terrestrial or freshwater habitat associated with the proposed development. There will be no instream works and all major infrastructure will be located over 50m from any significant watercourse. A range of mitigation measures, outlined in Section 3.5 of this report, in the hydrology chapter of the accompanying EIAR (Appendix 2) and in the accompanying CEMP (Appendix 3) are in place to avoid water pollution within any European Site during construction, operation or decommissioning.
Extent of marine habitat	No significant decline	
Extent of freshwater (river) habitat	No significant decline	
Extent of freshwater (lake) habitat	No significant decline	
Couching sites and holts	No significant decline	No couches or holts were identified within the development site boundary and none were identified in the vicinity of the proposed works. The proposed development is not located in any European Site and thus there will be no decline in couching or holt sites associated with the proposed development.
Fish biomass available	No significant decline	There will be no decline in availability of fish biomass associated with the proposed development. Pathways that would allow impacts to occur including deterioration in water quality were considered in the design of the proposed development.

Attribute	Target	Assessment
		A range of mitigation measures, outlined in Section 3.5 of this report, in the hydrology chapter of the accompanying EIAR (Appendix 2) and in the accompanying CEMP (Appendix 3) are in place to avoid water pollution within any European Site during construction
Barrier to connectivity	No significant increase	The proposed development will not result in any barrier to connectivity within or outside the SAC.

6.1.2 *Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno- Padion, Alnionincanae, Salicion albae*)

The identified pathways for effect are deterioration in water quality during the construction, operational and decommissioning phase of the proposed development. Following the precautionary principle, there is potential for water pollution to result in deterioration of the substrate on which this habitat is formed and potential impediment of ground flora and regeneration of tree and shrub species.

No detailed Conservation Objectives are available for River Shannon Callows SAC. However, targets and attributes for the conservation of this QI habitat are available in detailed Conservation Objectives for other SACs (Lough Derg North East Shore SAC). Such targets and attributes are representative of factors considered in the conservation of the QI habitat in other areas and were considered in the preparation of this assessment.

Site specific conservation objectives documents are not available for this site. The conservation objective for this QI 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'*

An assessment of the proposed development against the nominated attributes and targets for this habitat is provided in Table 6.2 below.

Table 6-2 Targets and attributes associated with the conservation objectives for Alluvial forests

Attribute	Target	Assessment
Habitat area	Area stable or increasing, subject to natural processes.	This habitat was not identified within or adjacent to the proposed development site during the surveys and no works are proposed within 2.3km of the SAC. A range of mitigation measures, outlined in Section 3.5 of this report, in the hydrology chapter of the accompanying EIAR (Appendix 2) and in the accompanying CEMP (Appendix 3) are in place to avoid water pollution within any European Site during construction, operational and decommissioning phases. Taking into consideration the preventative measures to avoid impact, it can be concluded that the proposed development will not result in any impacts which could adversely affect the extent of this habitat within the SAC.
Habitat distribution	No decline.	
Woodland Size	Area stable or increasing. Where topographically possible, "large" woods at least 25ha in size and “small” woods at least 3ha in size.	

Attribute	Target	Assessment
		There will be no alteration to any alluvial forest habitat within the SAC in terms of size, habitat area or distribution associated with the proposed development.
Woodland structure: cover and height	Diverse structure with a relatively closed canopy containing mature trees; subcanopy layer with semi-mature trees and shrubs; and well-developed herb layer	Following the implementation of mitigation as described above, any potential pathway for effect on this habitat is robustly blocked. There will be no alteration to the woodland structure of Alluvial forests within the SAC as a result of the proposed development.
Woodland Structure: community diversity and extent	Maintain diversity and extent of community types	
Woodland structure: natural regeneration	Seedlings, saplings and pole age-classes occur in adequate proportions to ensure survival of woodland canopy	
Hydrological regime: Flooding Depth/height of water table	Appropriate hydrological regime necessary for maintenance of alluvial vegetation	Following the implementation of mitigation as described above, any potential pathway for effect on this habitat is robustly blocked.There will be no alteration to the hydrological regime as a result of the proposed development.
Woodland structure: dead wood	At least 30m³/ha of fallen timber greater than 10cm diameter; 30snags/ha; both categories should include stems greater than 40cm diameter (greater than 20cm diameter in the case of alder)	There will be no alteration to the woodland structure of Alluvial forests within the SAC as a result of the proposed development.
Woodland structure: veteran trees	No decline	
Woodland structure: indicators of local distinctiveness.	No decline	
Vegetation composition: native tree cover	No decline. Native tree cover not less than 95%.	Following the implementation of mitigation as described above, any potential pathway for effect on this habitat is robustly blocked. There will be no alteration to the vegetation composition of Alluvial forests within the SAC as a result of the proposed development.
Vegetation composition: typical species	A variety of typical native species present, depending on woodland type, including alder (*Alnus glutinosa*), willows (*Salix* spp.) and, locally, oak (*Quercus robur*) and ash (*Fraxinus excelsior*).	
Vegetation composition: negative indicator species	Negative indicator species, particularly non-native invasive species, absent or under control.	

6.1.3 Determination

Following an examination, evaluation and analysis, in light of best scientific knowledge, and, on the basis of objective information, having taken into account the relevant mitigation measures, it can be concluded that the proposed development will not have an adverse impact on The River Shannon Callows SAC.

6.2 Lough Derg, North-east Shore SAC

This site lies 29.2km downstream of the proposed development site (via hydrological connectivity). The proposed works have the potential to cause deterioration in surface water quality during the construction, operational and decommissioning phases of the development due to the release of pollutants including suspended solids and hydrocarbons. These effects could occur in the form of release of suspended solids during the large scale earthworks that will be required to facilitate the construction of turbine bases and other infrastructure, the release of hydrocarbons to the rivers during construction. Deterioration could also occur during operation as there is the potential for the faster run off of waters from the proposed hard standing areas within the site, which could lead to erosion and bank disturbance. These impacts could potentially affect the following downstream aquatic habitats:

Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* [7210]

- Alkaline fens [7230]
- Alluvial forests with Alnus glutinosa and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0]

6.2.1 Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* [7210]

The identified pathways for effect are deterioration in water quality during the construction, operational and decommissioning phase of the proposed development, potentially affecting this downstream habitat. Following the precautionary principle, there is potential for water pollution to result in deterioration of the substrate on which this habitat is formed and potential impediment of ground flora and regeneration of sedge and reed species that predominate in this habitat.

The conservation objective for this habitat is:

> *'To maintain the favourable conservation condition of Calcareous fens with Cladium mariscus and species of the Caricion davallianae* in Lough Derg, North-east Shore SAC.'*

Targets and attributes for the conservation of this habitat are available in the detailed Conservation Objective document (NPWS, 2018). The targets and attributes for this habitat have been reviewed and considered in relation to the current development and are described in Table 6.3.

Table 6-3 Assessment of development against targets and attributes of calcareous fens

Attribute	Target	Assessment
Habitat area	Area stable or increasing, subject to natural processes	This habitat was not identified within or adjacent to the proposed development site during the surveys and no works will take place within 29km of the SAC. A range of mitigation measures, outlined in Section 3.5 of this report, in the hydrology chapter of the accompanying EIAR (Appendix
Habitat distribution	No decline, subject to natural processes	

Attribute	Target	Assessment
		2) and in the accompanying CEMP (Appendix 3) are in place to avoid water pollution in European Sites during the construction, operational and decommissioning phase. Taking into consideration the preventative measures to avoid impact, it can be concluded that the proposed development will not result in any impacts which could adversely affect the extent of this habitat within the SAC. There will be no alteration to any calcareous fen habitat within the SAC in terms of size, habitat area or distribution associated with the proposed development.
Ecosystem function: peat formation	Maintain active peat formation, where appropriate	Following the implementation of mitigation, the pathway for any effect on this habitat is robustly blocked such that there is no potential for alteration to the ecosystem function of this habitat within the SAC associated with the proposed development. Following the implementation of mitigation, there will be no alteration to the hydrology of this habitat due to the proposed development. There will be no deterioration in water quality as a result of the proposed development. A range of mitigation measures, outlined in Section 3.5 of this report, in the hydrology chapter of the accompanying EIAR (Appendix 2) and in the accompanying CEMP (Appendix 3) are in place to avoid water pollution in any European Sites during the construction, operational and decommissioning phase. Taking into consideration the preventative measures to avoid impact, it can be concluded that the proposed development will not result in any impacts which could adversely affect the extent of this habitat within the SAC.
Ecosystem function: hydrology - groundwater levels	Maintain, or where necessary restore, appropriate natural hydrological regimes necessary to support the natural structure and functioning of the habitat	
Ecosystem function: hydrology - surface water flow	Maintain, or where necessary restore, as close as possible to natural or semi-natural, drainage conditions	
Ecosystem function: water quality	Maintain appropriate water quality, particularly pH and nutrient levels, to support the natural structure and functioning of the habitat	
Vegetation composition: typical species	Maintain adequate cover of typical species, including brown mosses and vascular plants	Following the implementation of mitigation as described above, any potential pathway for effect on this habitat is robustly blocked. The proposed development will have no impact on the ecological process that influence the vegetation composition of this habitat.
Vegetation composition: native negative indicator species	Cover of native negative indicator species at insignificant levels	
Vegetation composition: non-native species	Cover of non-native species less than 1%	
Vegetation composition: trees and shrubs	Cover of scattered native trees and shrubs less than 10%	

Attribute	Target	Assessment
Physical structure: disturbed bare ground	Cover of disturbed bare ground not more than 10%. Where tufa is present, disturbed bare ground not more than 1%	
Indicators of local distinctiveness	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	

6.2.2 Alkaline fens [7230]

The identified pathways for effect are deterioration in water quality during the construction, operational and decommissioning phase of the proposed development, potentially affecting this downstream habitat. Following the precautionary principle, there is potential for water pollution to result in deterioration of the substrate on which this habitat is formed and potential impediment of ground flora and regeneration of the species that predominate in this habitat.

The conservation objective for this habitat is:

> *'To maintain the favourable conservation condition of Alkaline fens in Lough Derg, North-east Shore SAC.'*

Targets and attributes for the conservation of this habitat are available in the detailed Conservation Objective document (NPWS, 2018). The targets and attributes for this habitat have been reviewed and considered in relation to the proposed development and are described in Table 6.4.

Table 6-4 Assessment of development against targets and attributes of alkaline fens

Attribute	Target	Assessment
Habitat area	Area stable or increasing, subject to natural processes	This habitat was not identified within or adjacent to the proposed development site during the surveys and no works will take place within 29km of the SAC. A range of mitigation measures, outlined in Section 3.5 of this report, in the hydrology chapter of the accompanying EIAR (Appendix 2) and in the accompanying CEMP (Appendix 3) are in place to avoid water pollution in any European Site during the construction, operational and decommissioning phase. Taking into consideration the preventative measures to block any pathway for effect, it can be concluded that the proposed development will not result in any impact which could adversely affect the extent of this habitat within the SAC. There will be no alteration to any Alkaline fen habitat within the SAC in terms of size, habitat area or distribution associated with the proposed development.
Habitat distribution	No decline, subject to natural processes	

Attribute	Target	Assessment
Ecosystem function: Soil nutrients	Maintain soil pH and nutrient status within natural ranges	Following the implementation of mitigation as described above, any potential pathway for effect on this habitat is robustly blocked. There will be no alteration to the ecosystem function of this habitat within the SAC associated with the proposed development. There will be no alteration to the hydrology of this habitat due to the proposed development. There will be no deterioration in water quality as a result of the proposed development. A range of mitigation measures, outlined in Section 3.5 of this report, in the hydrology chapter of the accompanying EIAR (Appendix 2) and in the accompanying CEMP (Appendix 3) are in place to avoid water pollution within any European Site during the construction, operational and decommissioning phase.
Ecosystem function: peat formation	Maintain active peat formation, where appropriate	
Ecosystem function: hydrology - groundwater levels	Maintain, or where necessary restore, appropriate natural hydrological regimes necessary to support the natural structure and functioning of the habitat	
Ecosystem function: hydrology - surface water flow	Maintain, or where necessary restore, as close as possible to natural or semi-natural, drainage conditions	
Ecosystem function: water quality	Maintain appropriate water quality, particularly pH and nutrient levels, to support the natural structure and functioning of the habitat	
Community diversity	Maintain variety of vegetation communities, subject to natural processes	Following the implementation of mitigation as described above, any potential pathway for effect on this habitat is robustly blocked. The proposed development will have no impact on the ecological process that influence the vegetation composition of this habitat. The proposed development will have no impact on the ecological process that influence the vegetation composition or physical structure of this habitat.
Vegetation composition: Brown mosses	Maintain adequate cover of typical brown moss species	
Vegetation composition: typical vascular plants	Maintain adequate cover of typical vascular plant species	
Vegetation composition: native negative indicator species	Cover of native negative indicator species at insignificant levels.	
Vegetation composition: non-native species	Cover of non-native species less than 1%	
Vegetation composition: native trees and shrubs	Cover of scattered native trees and shrubs less than 10%	
Vegetation composition: soft rush and common reed cover	Total cover of soft rush *(Juncus effusus)* and common reed *(Phragmites australis)* less than 10%	
Vegetation structure: litter	Total cover of litter not more than 25%	
Physical structure: disturbed bare ground	Cover of disturbed bare ground not more than 10%.	
Physical structure: tufa formations	Disturbed proportion of vegetation cover where tufa is present is less than 1%	

Attribute	Target	Assessment
Indicators of local distinctiveness	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	

6.2.3 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0]

The identified pathways for effect are deterioration in water quality during the construction, operational and decommissioning phase of the proposed development. Following the precautionary principle, there is potential for water pollution to result in deterioration of the substrate on which this habitat is formed and potential impediment of ground flora and regeneration of tree and shrub species.

The conservation objective for this habitat is:

> *'To restore the favourable conservation condition of Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)* in Lough Derg, North-east Shore SAC.'*

Targets and attributes for the conservation of this habitat are available in the detailed Conservation Objective document (NPWS, 2018). The targets and attributes for this habitat have been reviewed and considered in relation to the current development and are described in Table 6.5.

Table 6-5 Assessment of development against targets and attributes of Alluvial Woodland

Attribute	Target	Assessment
Habitat area	Area stable or increasing, subject to natural processes.	This habitat was not identified within or adjacent to the proposed development site during the surveys and no works are proposed in the vicinity of the SAC. A range of mitigation measures, outlined in Section 3.5 of this report, in the hydrology chapter of the accompanying EIAR (Appendix 2) and in the accompanying CEMP (Appendix 3) are in place to avoid water pollution within any European Site during construction, operational and decommissioning phases. Taking into consideration the preventative measures to avoid impact, it can be concluded that the proposed development will not result in any impacts which could adversely affect the extent of this habitat within the SAC. There will be no alteration to any alluvial forest habitat within the SAC in terms of size, habitat area or distribution associated with the proposed development.
Habitat distribution	No decline.	
Woodland Size	Area stable or increasing. Where topographically possible, "large" woods at least 25ha in size and "small" woods at least 3ha in size.	

Attribute	Target	Assessment
Woodland structure: cover and height	Diverse structure with a relatively closed canopy containing mature trees; subcanopy layer with semi-mature trees and shrubs; and well-developed herb layer	Following the implementation of mitigation as described above, any potential pathway for effect on this habitat is robustly blocked. There will be no alteration to the woodland structure of Alluvial forests within the SAC as a result of the proposed development.
Woodland Structure: community diversity and extent	Maintain diversity and extent of community types	
Woodland structure: natural regeneration	Seedlings, saplings and pole age-classes occur in adequate proportions to ensure survival of woodland canopy	
Hydrological regime: Flooding Depth/height of water table	Appropriate hydrological regime necessary for maintenance of alluvial vegetation	Following the implementation of mitigation as described above, any potential pathway for effect on this habitat is robustly blocked. There will be no alteration to the hydrological regime as a result of the proposed development.
Woodland structure: dead wood	At least 30m³/ha of fallen timber greater than 10cm diameter; 30snags/ha; both categories should include stems greater than 40cm diameter (greater than 20cm diameter in the case of alder)	Following the implementation of mitigation as described above, any potential pathway for effect on this habitat is robustly blocked. There will be no alteration to the woodland structure of Alluvial forests within the SAC as a result of the proposed development.
Woodland structure: veteran trees	No decline	
Woodland structure: indicators of local distinctiveness.	No decline	
Vegetation composition: native tree cover	No decline. Native tree cover not less than 95%.	Following the implementation of mitigation as described above, any potential pathway for effect on this habitat is robustly blocked. There will be no alteration to the vegetation composition of Alluvial forests within the SAC as a result of the proposed development.
Vegetation composition: typical species	A variety of typical native species present, depending on woodland type, including alder (*Alnus glutinosa*), willows (*Salix* spp.) and, locally, oak (*Quercus robur*) and ash (*Fraxinus excelsior*).	
Vegetation composition: negative indicator species	Negative indicator species, particularly non-native invasive species, absent or under control.	

6.2.4 Determination

Following an examination, evaluation and analysis, in light of best scientific knowledge, and, on the basis of objective information, having taken into account the relevant mitigation measures, it can be concluded that the proposed development will not have an adverse impact on The Lough Derg North East Shore SAC.

6.3 Lough Derg (Shannon) SPA

This site lies 29.2km downstream of the proposed development site (via hydrological connectivity). The proposed works have the potential to cause deterioration in surface water quality during the construction, operational and decommissioning phases of the development due to the release of pollutants including suspended solids and hydrocarbons. These effects could occur in the form of release of suspended solids during the large-scale earthworks that will be required to facilitate the construction of turbine bases and other infrastructure, the release of hydrocarbons to the rivers during construction. Deterioration could also occur during operation as there is the potential for the faster run off of waters from the proposed hard standing areas within the site, which could lead to erosion and bank disturbance. These impacts could potentially affect the following SCI:

- Wetland and Waterbirds [A999]

6.3.1 Wetland and Waterbirds [A999]

The identified pathways for effect are deterioration in water quality and therefore habitat quality during the construction, operational and decommissioning phase of the development. Following the precautionary principle, this could potentially affect food availability and the nesting/foraging value of the wetland habitat.

The conservation objective for this SCI is:

> *'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'.*

An assessment of the proposed development against the attributes and targets for this SCI habitat is provided in Table 6.6 below.

Table 6-6 Targets and attributes associated with the site-specific conservation objectives for Wetland and Waterbirds [A999].

Attribute	Target	Assessment
Habitat area	The permanent area occupied by wetland habitat should be stable other than that occurring from natural patterns of variation.	There will be no direct loss or decrease in wetland habitat associated with the proposed development as the footprint of the development is entirely outside of the boundary of the SPA. The potential for indirect habitat loss as a result of deterioration in water quality during the construction, operational phase and decommissioning phase was considered. Deterioration of water quality could potentially lead to adverse impacts on of food availability and nesting/foraging habitat. A range of mitigation measures, outlined in Section 3.5 of this report, in the hydrology chapter of the accompanying EIAR (Appendix 2) and in the accompanying CEMP (Appendix 3) are in place to avoid water pollution in any European Site during the

Attribute	Target	Assessment
		construction, operational and decommissioning phase. Taking into consideration the preventative measures to avoid impact, it can be concluded that the proposed development will not result in any impacts which could adversely affect the extent of this habitat within the SPA. There will be no deterioration in the condition of downstream wetland habitat and therefore no reduction in habitat area as a result of the proposed development.

6.3.2 Determination

Following an examination, evaluation and analysis, in light of best scientific knowledge, and, on the basis of objective information, having taken into account the relevant mitigation measures, it can be concluded that the proposed development will not have an adverse impact on The Lough Derg (Shannon) SPA.

6.4 Middle Shannon Callows SPA

This European Site is located 2.3km from the development site and the proposed development is outside of the SPA boundaries. There is hydrological connectivity between the proposed development and the SPA via watercourses within the site boundary which discharge to the River Shannon, including the Madden's Derry stream, Grants Island Stream, Mullaghakaraun bog, Feeghroe/Mountcarteret Stream and several small tributary streams of the Little Cloghan River.

The proposed works have the potential to cause deterioration of water quality during the construction, operational and decommissioning phase of the development These effects could occur in the form of release of suspended solids during the large-scale earthworks that will be required to facilitate the construction of turbine bases and other infrastructure, the release of hydrocarbons to the rivers during construction. Deterioration could also occur during operation as there is the potential for the faster run off of waters from the proposed hard standing areas within the site, which could lead to erosion and bank disturbance. These impacts could potentially affect the following SCI:

- ‘Wetland and Waterbirds [A999]

On a precautionary basis, a potential pathway for indirect effects was identified in the form of bird disturbance, displacement and collision risk potentially affecting the following species:

- golden plover
- whooper swan
- black-headed gull
- lapwing
- wigeon
- Black Tailed Godwit

6.4.1 Wetland and Waterbirds

No detailed Conservation Objectives are available for the Middle Shannon Callows SPA. The effect on wetland habitats is fully assessed in the preceding section in relation to the Lough Derg North East Shore SPA, which has detailed Conservation Objectives. The pathway for effect is via the same watercourses and the measures that are in place to block them are the same. To avoid repetition, please refer to Table 6.6 for the assessment of the effect of the proposed development on downstream Wetland and Waterbirds. All pathways for effect on this SCI of the Middle Shannon Callows SPA have been robustly blocked and there is no potential for effect thereon.

6.4.2 Golden Plover

A potential pathway for indirect effects was identified in the form of bird disturbance, displacement and collision risk on Golden Plover. A full assessment of the effects of the proposed wind farm on Golden Plover is provided in Chapter 7: Ornithology of the EIAR. An assessment of the effects in relation to the SPA populations is provided in this NIS. No evidence that the golden plover that were recorded on the site were part of an SPA population was recorded during the extensive survey work that was undertaken. However, following the precautionary principle an assessment of the impacts of the proposed development on the local population has been undertaken in this NIS.

Table 6-7 Impact Assessment - Golden Plover [A999].

Analysis of potential effects on Golden Plover	
Disturbance and Displacement	Whilst wintering golden plover were regularly recorded on the site of the proposed development, no evidence of the birds on the site travelling to or from the surrounding SPAs was recorded. Specific migratory vantage point surveys were undertaken to determine any connection between the birds recorded on the site and the SPA populations. No such link was established. However, following the precautionary principle, an assessment of disturbance and displacement of the local population of this species has been undertaken in this NIS. This species was not regularly recorded utilising habitats within the site boundary for roosting or foraging. Significant areas of suitable roosting and foraging habitat for the species occur in the wider landscape and will be retained. A study by (Pearce-Higgins et al. 2009) found reduced use of habitat surrounding operating turbines, to within 200m of the turbine base. A review of 29 other studies suggests Golden Plover will approach wind turbines to an average distance of 175 m in non-breeding season (Hötker et al. 2006). Furthermore, post-construction monitoring at 15 upland wind farms showed no significant decline in populations post construction (Pearce-Higgins et al. 2012). There are extensive areas of suitable habitat in the wider area should any potential displacement effect occur. Significant displacement effects are not anticipated on any golden plover. Given that no link between the birds on the site and SPA populations was identified and the lack of significant effect on the local populations, adverse effects on the integrity of any SPA population can be excluded.
Collision	As discussed above, no evidence of the golden plover on the site being part of an SPA population was identified during any of the surveys undertaken. However, following the precautionary principle an assessment of collision risk has been undertaken in this NIS. The species was recorded flying within the potential collision risk zone during VP surveys. A “Random” collision risk analysis has been undertaken and full details are provided in Appendix 7-6 of the EIAR.

Analysis of potential effects on Golden Plover	
	The collision risk has been calculated at a rate of 14.9 collisions per year. Annual mortality of adult golden plover has been calculated at 27% per annum (Sandercock, 2003). If 14.9 collisions were to occur per year, it would mean that the losses at the proposed wind farm would increase the annual mortality for the county population (i.e. 15,898 birds as referenced in Chapter 7 of the EIAR) by 0.35%. The predicted collision risk is therefore negligible (>1%) in the context of the county population of the species. Given that no significant effects on the local population of golden plover and that no connection between this population and the SPA population was identified, no adverse effects on the integrity of any SPA population are anticipated regarding collision risk.

No detailed Conservation Objectives are available for Middle Shannon Callows SPA. However, targets and attributes for the conservation of this SCI species are available in detailed Conservation Objectives for other SPAs (Blackwater River (Blackwater Estuary SPA)). Such targets and attributes are representative of factors considered in the conservation of the SCI species in other areas and were considered in the preparation of this assessment.

Site specific conservation objectives documents are not available for this site. The conservation objective for this QI is:

> '*To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests of this SPA*'

An assessment of the proposed development against the nominated attributes and targets for this species is provided in Table 6-8 below.

Table 6-8 Targets and attributes associated with the nominated conservation objectives for Golden Plover.

Attribute	Target	Assessment
Population trend	Long term population trend stable or increasing	No significant effect on the local population of golden plover is predicted. No evidence of any significant connection between the population of golden plover on the site and those within the SPA was identified during the extensive surveys undertaken. There is no potential for the proposed development to adversely affect the population trend within the SPA.
Distribution	There should be no significant decrease in the range, timing and intensity of use of areas by Golden Plover, other than that occurring from natural patterns of variation.	No works will be undertaken within 2.3km of the SPA. The proposed development will not adversely affect the distribution of the species within the SPA.

6.4.3 Whooper Swan

A potential pathway for indirect effects was identified in the form of bird disturbance, displacement and collision risk on Whooper Swan. A full assessment of the effects of the proposed wind farm on Whooper Swan is provided in Chapter 7: Ornithology of the EIAR. An assessment of the effects in relation to the SPA populations is provided in this NIS. No evidence that the whooper swan that were recorded on the site were part of an SPA population was recorded during the extensive survey work that was undertaken. However, following the precautionary principle an assessment of the impacts of the proposed development on the local population has been undertaken in this NIS.

Table 6-9 Impact Assessment - Whooper Swan

Analysis of potential effects on Whooper Swan	
Disturbance and Displacement	Whilst wintering whooper swan were regularly recorded on the site of the proposed development, no evidence of the birds on the site regularly travelling to or from the surrounding SPAs was recorded. Specific migratory vantage point surveys were undertaken to determine any connection between the birds recorded on the site and the SPA populations. No such link was established and it is likely that the birds are not significantly linked to any SPA population. However, following the precautionary principle, an assessment of disturbance and displacement of the local population of this species has been undertaken in this NIS. The largest flocks of whooper swan were recorded during the 2017/18 winter season (max. site count 227). These flocks were concentrated in the Drinagh wetlands. A similar pattern of occurrence was recorded during the subsequent winter season (2018/19). The turbine layout avoids the Drinagh wetlands and a 900m buffer has been retained between the wetland site and the nearest proposed turbine. This exceeds the 600m zone of sensitivity for this species as identified in McGuinness et. al 2015. Additional literature has identified exclusion from habitat around operating wind turbines as a displacement effect which can impact the availability of supporting habitat for whooper swan (Larsen & Clausen 2002). In some cases, disturbance distances of up to 300 m from wind energy installations have been cited (Percival 2003). Observations of swan non- breeding activity (i.e. consistent with the current project) from eight European studies have given a mean minimum disturbance distance of 150 m from the base of wind turbines (Hötker et al. 2006). As stated above, all turbines are located over 900m from the Drinagh Wetlands. The proposed amenity trail is the only infrastructure located in proximity to Drinagh. The trail follows an existing track at this location and no significant displacement is predicted. During the winter of 2018/19, small numbers of birds (Max 19 recorded on one occasion) were occasionally recorded roosting/foraging at three locations which overlap with the development footprint (see Figure 7.7.1.1 in Appendix 7-4 of the EIAR). Whooper Swan are an opportunistic species and studies have shown that species may not remain loyal to specific areas of suitable habitat (Boland & Crowe 2012; Boland et al. 2010). Any potential construction related displacement will be temporary and insignificant. This is due to the nature of the species, the sympathetic design of the development and the proposed retention, and preservation of key habitat areas for the species in the wider area. Significant displacement effects are not anticipated on any whooper swan. Given that no link between the birds on the site and SPA populations was identified and the lack of significant effect on the local populations, adverse effects on the integrity of any SPA population can be excluded.
Collision	As discussed above, no link between the whooper swan on the site and those of an SPA population was identified during any of the surveys undertaken.

Analysis of potential effects on Whooper Swan	
	However, following the precautionary principle, an assessment of collision risk of the local population of this species has been undertaken in this NIS. The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7-6 of the EIAR. The collision risk has been calculated at a ratio of 0.21 collisions per year or one bird every 6.3 years. Annual mortality of adult whooper swan has been calculated at 20% per annum (Brazil, 2003). If 0.21 collisions were to occur per year, it would mean that the losses at the proposed wind farm would increase the annual mortality of the county population (i.e. 489) by 0.21%. The predicted collision risk is therefore negligible (>1%) in the context of recorded population. No significant effects are anticipated regarding collision risk at any geographical scale. Significant colision effects are not anticipated on any whooper swan. Given that no link between the birds on the site and SPA populations was identified and the lack of significant effect on the local populations, adverse effects on the integrity of any SPA population can be excluded.

No detailed Conservation Objectives are available for Middle Shannon Callows SPA. However, targets and attributes for the conservation of this SCI species are available in detailed Conservation Objectives for other SPAs (River Shannon and River Fergus Estuaries SPA). Such targets and attributes are representative of factors considered in the conservation of the SCI species in other areas and were considered in the preparation of this assessment.

Site specific conservation objectives documents are not available for this site. The conservation objective for this QI 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*'

An assessment of the proposed development against the nominated attributes and targets for this species is provided in Table 6-10 below.

Table 6-10 Targets and attributes associated with the nominated conservation objectives for Whooper Swan

Attribute	Target	Assessment
Population trend	Long term population trend stable or increasing	No significant effect on the local population of whooper swan is predicted. No evidence of any significant connection between the population of whooper swan on the site and those within the SPA was identified during the extensive surveys undertaken. There is no potential for the proposed development to adversely affect the population trend within the SPA.
Distribution	There should be no significant decrease in the range, timing and intensity of use of areas by whooper	No works will be undertaken within 2.3km of the SPA. The proposed development will not adversely affect the distribution of the species within the SPA.

Attribute	Target	Assessment
	swan, other than that occurring from natural patterns of variation.	

6.4.4 Black-headed Gull

A potential pathway for indirect effects was identified in the form of bird disturbance, displacement and collision risk on Black Headed Gull. A full assessment of the effects of the proposed wind farm on Black-headed Gull is provided in Chapter 7: Ornithology of the EIAR. An assessment of the effects in relation to the SPA populations is provided in this NIS. No evidence that the black headed gull that were recorded on the site were part of an SPA population was recorded during the extensive survey work that was undertaken. However, following the precautionary principle an assessment of the impacts of the proposed development on the local population has been undertaken in this NIS.

Table 6-11 Impact Assessment - Black Headed Gull

Analysis of potential effects on Black Headed Gull	
Disturbance and Displacement	Wintering black headed gull were rarely recorded on the site of the proposed development. The breeding population was resident with birds breeding in the area and on the surrounding Noggus Bog to the north. No evidence of breeding birds travelling to or from SPAs to the site was recorded and no link between the breeding populations and any SPA was established. However, following the precautionary principle, an assessment of disturbance and displacement of the local population of this species has been undertaken in this NIS. Whilst there is a large breeding population in the general area, no active breeding colony was recorded within the development site during the 2 years of comprehensive surveys that form the core dataset used in this this assessment. Only slight disturbance and displacement impacts are predicted on the local breeding population. No connection has been made between these birds and those breeding in the surrounding SPAs and no adverse effect on any SPA population is predicted.
Collision	As discussed above, no link between the breeding black headed gull populations on the site and those of an SPA population was identified during any of the surveys undertaken. The species was recorded flying within the potential collision risk zone during VP surveys. A “Random” collision risk analysis has been undertaken and full details are provided in Appendix 7-6 of the EIAR. The number of individuals within proximity of the development site was estimated to be 300 birds, while it has been estimated that there are c.126 birds in the wider area using the National Seabird 2000 survey data (see Section **Error! Reference source not found.** for more detail). If 1.97 collisions were to occur per year, it would mean that the losses at the proposed wind farm would increase the annual mortality of the local breeding population (i.e. c.426 birds) by 4.62%. The predicted collision risk is therefore *low* (i.e. 1-5% increase) in the context of the local breeding black-headed gull population. No adverse effects on the integrity of any SPA population are anticipated regarding collision risk.

No detailed Conservation Objectives are available for Middle Shannon Callows SPA. However, targets and attributes for the conservation of this SCI species are available in detailed Conservation Objectives for other SPAs (Ballymacoda Bay SPA). Such targets and attributes are representative of factors considered in the conservation of the SCI species in other areas and were considered in the preparation of this assessment.

Site specific conservation objectives documents are not available for this site. The conservation objective for this QI 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*'

An assessment of the proposed development against the nominated attributes and targets for this species is provided in Table 6.12 below.

Table 6-12 Targets and attributes associated with the nominated conservation objectives for Black-headed gull.

Attribute	Target	Assessment
Population trend	Long term population trend stable or increasing	No significant effect on the local population of black headed gull is predicted. No evidence of any significant connection between the population of black headed gull on the site and those within the SPA was identified during the extensive surveys undertaken. There is no potential for the proposed development to adversely affect the population trend within the SPA.
Distribution	There should be no significant decrease in the range, timing and intensity of use of areas by black-headed gull, other than that occurring from natural patterns of variation.	No works will be undertaken within 2.3km of the SPA. The proposed development will not adversely affect the distribution of the species within the SPA.

6.4.5 Lapwing

A potential pathway for indirect effects was identified in the form of bird disturbance, displacement and collision risk on Lapwing. A full assessment of the effects of the proposed wind farm on Lapwing is provided in Chapter 7: Ornithology of the EIAR. An assessment of the effects in relation to the SPA populations is provided in this NIS. No evidence that the Lapwing that were recorded on the site were part of an SPA population was recorded during the extensive survey work that was undertaken. However, following the precautionary principle an assessment of the impacts of the proposed development on the local population has been undertaken in this NIS.

Table 6-13 Impact Assessment - Lapwing

Analysis of potential effects on Lapwing	
Disturbance and Displacement	This SPA is designated for the protection of wintering Lapwing. This species was not observed to regularly utilise any areas of the development site during winter months but was primarily recorded travelling over the site. Specific migratory vantage point surveys were undertaken to determine any connection between the birds recorded on the site and the SPA populations. No such link was established, and it is likely that the birds are not significantly linked to any SPA population. However, following the precautionary principle, an assessment of disturbance and displacement of the local population of this species has been undertaken in this NIS. The majority of flight activity occurred more than 500m from the proposed turbines and was associated with the Clooneen wetland and the Stonestown wetland to the northeast. There are extensive areas of suitable habitat in the wider area, outside any potential displacement buffer, should any potential displacement effect occur. No significant disturbance and displacement impacts are predicted on the local wintering population. No connection has been made between these birds and those in the surrounding SPAs and no adverse effect on any SPA population is predicted.
Collision	As discussed above, no link between the wintering Lapwing population populations on the site and those of an SPA population was identified during any of the surveys undertaken. The species was recorded flying within the potential collision risk zone during VP surveys. A “Random” collision risk analysis has been undertaken and full details are provided in Appendix 7-6 of the EIAR. The collision risk has been calculated at a ratio of 3.55 collisions per year. Annual mortality of adult lapwing has been calculated at 29.5% per annum (Peach et al., 1994). If 3.55 collisions were to occur per year, it would mean that the losses at the proposed wind farm would increase the annual mortality of the County population (i.e. 11,265 birds) by 0.11%. The predicted collision risk is therefore negligible in the context of the county population. No adverse effect on the integrity of any SPA population is predicted.

No detailed Conservation Objectives are available for Middle Shannon Callows SPA. However, targets and attributes for the conservation of this SCI species are available in detailed Conservation Objectives for other SPAs (River Shannon and River Fergus Estuaries SPA). Such targets and attributes are representative of factors considered in the conservation of the SCI species in other areas and were considered in the preparation of this assessment.

Site specific conservation objectives documents are not available for this site. The conservation objective for this QI 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’*

An assessment of the proposed development against the nominated attributes and targets for this species is provided in Table 6.14 below.

Table 6-14 Targets and attributes associated with the nominated conservation objectives for Lapwing

Attribute	Target	Assessment
Population trend	Long term population trend stable or increasing	No significant effect on the local population of lapwing is predicted. No evidence of any significant connection between the population of lapwing on the site and those within the SPA was identified during the extensive surveys undertaken. There is no potential for the proposed development to adversely affect the population trend within the SPA.
Distribution	There should be no significant decrease in the range, timing and intensity of use of areas by Lapwing, other than that occurring from natural patterns of variation.	No works will be undertaken within 2.3km of the SPA. The proposed development will not adversely affect the distribution of the species within the SPA.

6.4.6 Wigeon

Wigeon were only recorded on ten occasions during extensive surveys between October 2017 and September 2019. Numbers recorded ranged from an individual duck to a flock of 35 birds, which does not correspond to numbers of County Importance. This species was only recorded on a single occasion within 500m of a proposed turbine. Nineteen birds were recorded on this occasion.

Numbers of ecological significance were not recorded. The development site is not of significance to the species. However, following the precautionary principle and for consistency with the other sections of this NIS, an assessment of the effects in relation to the SPA populations is provided in this NIS. No evidence that the wigeon that were recorded on the site were part of an SPA population was recorded during the extensive survey work that was undertaken. However, following the precautionary principle an assessment of the impacts of the proposed development on the local population has been undertaken in this NIS.

Table 6-15 Impact Assessment - Wigeon

Analysis of potential effects on Wigeon	
Disturbance and Displacement	Wigeon were only recorded on ten occasions during extensive surveys between October 2017 and September 2019. Numbers recorded ranged from an individual duck to a flock of 35 birds. The site is not of significance for this species and following the extensive surveys undertaken, this species was not identified as a Key Ornithological Receptor. The potential for adverse effects on the SPA population as a result of disturbance can be excluded.
Collision	No flights were recorded during VP surveys. Collision risk modelling therefore cannot be carried out. The collision risk of this species, within the accuracy levels available to the assessment, is zero.

No detailed Conservation Objectives are available for Middle Shannon Callows SPA. However, targets and attributes for the conservation of this SCI species are available in detailed Conservation Objectives for other SPAs (River Shannon and River Fergus Estuaries SPA). Such targets and attributes are representative of factors considered in the conservation of the SCI species in other areas and were considered in the preparation of this assessment.

Site specific conservation objectives documents are not available for this site. The conservation objective for this QI 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'*

An assessment of the proposed development against the nominated attributes and targets for this species is provided in Table 6-16 below.

Table 6-16 Targets and attributes associated with the nominated conservation objectives for wigeon

Attribute	Target	Assessment
Population trend	Long term population trend stable or increasing	No significant effect on the local population of wigeon is predicted. No evidence of any significant connection between the population of wigeon on the site and those within the SPA was identified during the extensive surveys undertaken. There is no potential for the proposed development to adversely affect the population trend within the SPA.
Distribution	There should be no significant decrease in the range, timing and intensity of use of areas by Wigeon, other than that occurring from natural patterns of variation.	No works will be undertaken within 2.3km of the SPA. The proposed development will not adversely affect the distribution of the species within the SPA.

6.4.7 Black tailed godwit

Black tailed godwit was only recorded on one occasion during the extensive two-year survey period, consisting of a small flock in flight over the Drinagh wetlands to the east of the development infrastructure. The development site is not of significance to the species. However, following the precautionary principle and for consistency with the other sections of this NIS, an assessment of the effects in relation to the SPA populations is provided in this NIS. No evidence that the black tailed godwit that were recorded on the site were part of an SPA population was recorded during the extensive survey work that was undertaken. However, following the precautionary principle an assessment of the impacts of the proposed development on the local population has been undertaken in this NIS.

Table 6-17 Impact Assessment – Black tailed godwit

Analysis of potential effects on Black tailed godwit	
Disturbance and Displacement	Black tailed godwit was only recorded on one occasion during the extensive two-year survey period. The site is not of significance for this species and following the extensive surveys undertaken, this species was not identified as a Key Ornithological Receptor. The potential for adverse effects on the SPA population as a result of disturbance can be excluded.
Collision	No flights were recorded during VP surveys. Collision risk modelling therefore cannot be carried out. The collision risk of this species, within the accuracy levels available to the assessment, is zero.

No detailed Conservation Objectives are available for Middle Shannon Callows SPA. However, targets and attributes for the conservation of this SCI species are available in detailed Conservation Objectives for other SPAs (River Shannon and River Fergus Estuaries SPA). Such targets and attributes are representative of factors considered in the conservation of the SCI species in other areas and were considered in the preparation of this assessment.

Site specific conservation objectives documents are not available for this site. The conservation objective for this QI 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'*

An assessment of the proposed development against the nominated attributes and targets for this species is provided in Table 6.18 below.

Table 6-18 Targets and attributes associated with the nominated conservation objectives for black tailed godwit

Attribute	Target	Assessment
Population trend	Long term population trend stable or increasing	No significant effect on the local population of black tailed godwit is predicted. No evidence of any significant connection between the population of black tailed godwit on the site and those within the SPA was identified during the extensive surveys undertaken. There is no potential for the proposed development to adversely affect the population trend within the SPA.
Distribution	There should be no significant decrease in the range, timing and intensity of use of areas by Wigeon, other than that occurring from natural patterns of variation.	No works will be undertaken within 2.3km of the SPA. The proposed development will not adversely affect the distribution of the species within the SPA.

6.4.8 Determination

Following an examination, evaluation and analysis, in light of best scientific knowledge, and, on the basis of objective information, having taken into account the relevant mitigation measures, it can be concluded that the proposed development will not have an adverse impact on Middle Shannon Callows SPA.

6.5 River Little Brosna Callows SPA

This European Site is located 4.48km from the development site and the proposed development is outside of the SPA boundaries. There is no hydrological connectivity between the proposed development and the SPA .

On a precautionary basis, a potential pathway for indirect effects was identified in the form of bird disturbance, displacement and collision risk potentially affecting the following species:

- golden plover
- whooper swan
- black-headed gull
- lapwing
- Shoveler
- wigeon
- Teal
- Black Tailed Godwit

6.5.1 Golden Plover

A potential pathway for indirect effects was identified in the form of bird disturbance, displacement and collision risk on Golden Plover. A full assessment of the effects of the proposed wind farm on Golden Plover is provided in Chapter 7: Ornithology of the EIAR. An assessment of the effects in relation to the SPA populations is provided in this NIS. No evidence that the golden plover that were recorded on the site were part of an SPA population was recorded during the extensive survey work that was undertaken. However, following the precautionary principle an assessment of the impacts of the proposed development on the local population has been undertaken in this NIS.

Table 6-19 Impact Assessment - Golden Plover.

Analysis of potential effects on Golden Plover	
Disturbance and Displacement	Whilst wintering golden plover were regularly recorded on the site of the proposed development, no evidence of the birds on the site travelling to or from the surrounding SPAs was recorded. Specific migratory vantage point surveys were undertaken to determine any connection between the birds recorded on the site and the SPA populations. No such link was established. However, following the precautionary principle, an assessment of disturbance and displacement of the local population of this species has been undertaken in this NIS. This species was not regularly recorded utilising habitats within the site boundary for roosting or foraging. Significant areas of suitable roosting and foraging habitat for the species occur in the wider landscape and will be retained. A study by (Pearce-Higgins et al. 2009) found reduced use of habitat surrounding operating turbines, to within 200m of the turbine base. A review of 29 other studies suggests Golden Plover will approach wind turbines to an average distance of 175 m in non-breeding season (Hötker et al. 2006). Furthermore, post-construction monitoring at 15 upland wind farms showed no significant decline in populations post construction (Pearce-Higgins et al. 2012). There are extensive areas of suitable habitat in the wider area should any potential displacement effect occur. Significant displacement effects are not anticipated on any golden plover. Given that no link between the birds on the site and SPA populations was identified and the lack of significant effect on the local populations, adverse effects on the integrity of any SPA population can be excluded.
Collision	As discussed above, no evidence of the golden plover on the site being part of an SPA population was identified during any of the surveys undertaken. However, following the precautionary principle an assessment of collision risk has been undertaken in this NIS. The species was recorded flying within the potential collision risk zone during VP surveys. A “Random” collision risk analysis has been undertaken and full details are provided in Appendix 7-6 of the EIAR. The collision risk has been calculated at a rate of 14.9 collisions per year. Annual mortality of adult golden plover has been calculated at 27% per annum (Sandercock, 2003). If 14.9 collisions were to occur per year, it would mean that the losses at the proposed wind farm would increase the annual mortality for the county population (i.e. 15,898 birds as referenced in Chapter 7 of the EIAR) by 0.35%. The

Analysis of potential effects on Golden Plover	
	predicted collision risk is therefore negligible (>1%) in the context of the county population of the species. Given that no significant effects on the local population of golden plover and that no connection between this population and the SPA population was identified, no adverse effects on the integrity of any SPA population are anticipated regarding collision risk.

No detailed Conservation Objectives are available for the River Little Brosna Callows SPA. However, targets and attributes for the conservation of this SCI species are available in detailed Conservation Objectives for other SPAs (Blackwater River (Blackwater Estuary SPA)). Such targets and attributes are representative of factors considered in the conservation of the SCI species in other areas and were considered in the preparation of this assessment.

Site specific conservation objectives documents are not available for this site. The conservation objective for this QI is:

> '*To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests of this SPA*'

An assessment of the proposed development against the nominated attributes and targets for this species is provided in Table 6.20 below.

Table 6-20 Targets and attributes associated with the nominated conservation objectives for Golden Plover.

Attribute	Target	Assessment
Population trend	Long term population trend stable or increasing	No significant effect on the local population of golden plover is predicted. No evidence of any significant connection between the population of golden plover on the site and those within the SPA was identified during the extensive surveys undertaken. There is no potential for the proposed development to adversely affect the population trend within the SPA.
Distribution	There should be no significant decrease in the range, timing and intensity of use of areas by Golden Plover, other than that occurring from natural patterns of variation.	No works will be undertaken within 4.5km of the SPA. The proposed development will not adversely affect the distribution of the species within the SPA.

6.5.2 Whooper Swan

A potential pathway for indirect effects was identified in the form of bird disturbance, displacement and collision risk on Whooper Swan. A full assessment of the effects of the proposed wind farm on Whooper Swan is provided in Chapter 7: Ornithology of the EIAR. An assessment of the effects in relation to the SPA populations is provided in this NIS. No evidence that the whooper swan that were recorded on the site were part of an SPA population was recorded during the extensive survey work that was undertaken. However, following the precautionary principle an assessment of the impacts of the proposed development on the local population has been undertaken in this NIS.

Table 6-21 Impact Assessment - Whooper Swan

Analysis of potential effects on Whooper Swan	
Disturbance and Displacement	Whilst wintering whooper swan were regularly recorded on the site of the proposed development, no evidence of the birds on the site regularly travelling to or from the surrounding SPAs was recorded. Specific migratory vantage point surveys were undertaken to determine any connection between the birds recorded on the site and the SPA populations. No such link was established, and it is likely that the birds are not significantly linked to any SPA population. However, following the precautionary principle, an assessment of disturbance and displacement of the local population of this species has been undertaken in this NIS. The largest flocks of whooper swan were recorded during the 2017/18 winter season (max. site count 227). These flocks were concentrated in the Drinagh wetlands. A similar pattern of occurrence was recorded during the subsequent winter season (2018/19). The turbine layout avoids the Drinagh wetlands and a 900m buffer has been retained between the wetland site and the nearest proposed turbine. This exceeds the 600m zone of sensitivity for this species as identified in McGuinness et. al 2015. Additional literature has identified exclusion from habitat around operating wind turbines as a displacement effect which can impact the availability of supporting habitat for whooper swan (Larsen & Clausen 2002). In some cases, disturbance distances of up to 300 m from wind energy installations have been cited (Percival 2003). Observations of swan non- breeding activity (i.e. consistent with the current project) from eight European studies have given a mean minimum disturbance distance of 150 m from the base of wind turbines (Hötker et al. 2006). As stated above, all turbines are located over 900m from the Drinagh Wetlands. The proposed amenity trail is the only infrastructure located in proximity to Drinagh. The trail follows an existing track at this location and no significant displacement is predicted. During the winter of 2018/19, small numbers of birds (Max 19 recorded on one occasion) were occasionally recorded roosting/foraging at three locations which overlap with the development footprint (see Figure 7.7.1.1 in Appendix 7-4 of the EIAR). Whooper Swan are an opportunistic species and studies have shown that species may not remain loyal to specific areas of suitable habitat (Boland & Crowe 2012; Boland et al. 2010). Any potential construction related displacement will be temporary and insignificant. This is due to the nature of the species, the sympathetic design of the development and the proposed retention, and preservation of key habitat areas for the species in the wider area. Significant displacement effects are not anticipated on any whooper swan. Given that no link between the birds on the site and SPA populations was identified and the lack of significant effect on the local populations, adverse effects on the integrity of any SPA population can be excluded.
Collision	As discussed above, no link between the whooper swan on the site and those of an SPA population was identified during any of the surveys undertaken.

Analysis of potential effects on Whooper Swan	
	However, following the precautionary principle, an assessment of collision risk of the local population of this species has been undertaken in this NIS. The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7-6 of the EIAR. The collision risk has been calculated at a ratio of 0.21 collisions per year or one bird every 6.3 years. Annual mortality of adult whooper swan has been calculated at 20% per annum (Brazil, 2003). If 0.21 collisions were to occur per year, it would mean that the losses at the proposed wind farm would increase the annual mortality of the county population (i.e. 489) by 0.21%. The predicted collision risk is therefore negligible (>1%) in the context of recorded population. No significant effects are anticipated regarding collision risk at any geographical scale. Significant collision effects are not anticipated on any whooper swan. Given that no link between the birds on the site and SPA populations was identified and the lack of significant effect on the local populations, adverse effects on the integrity of any SPA population can be excluded.

No detailed Conservation Objectives are available for the River Brosna Callows SPA. However, targets and attributes for the conservation of this SCI species are available in detailed Conservation Objectives for other SPAs (River Shannon and River Fergus Estuaries SPA). Such targets and attributes are representative of factors considered in the conservation of the SCI species in other areas and were considered in the preparation of this assessment.

Site specific conservation objectives documents are not available for this site. The conservation objective for this QI 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*'

An assessment of the proposed development against the nominated attributes and targets for this species is provided in Table 6-22 below.

Table 6-22 Targets and attributes associated with the nominated conservation objectives for whooper swan

Attribute	Target	Assessment
Population trend	Long term population trend stable or increasing	No significant effect on the local population of whooper swan is predicted. No evidence of any significant connection between the population of whooper swan on the site and those within the SPA was identified during the extensive surveys undertaken. There is no potential for the proposed development to adversely affect the population trend within the SPA.
Distribution	There should be no significant decrease in the range, timing and intensity of use of areas by whooper	No works will be undertaken within 4.5km of the SPA. The proposed development will not adversely affect the distribution of the species within the SPA.

Attribute	Target	Assessment
	swan, other than that occurring from natural patterns of variation.	

6.5.3 Black-headed Gull

A potential pathway for indirect effects was identified in the form of bird disturbance, displacement and collision risk on Black Headed Gull. A full assessment of the effects of the proposed wind farm on Black-headed Gull is provided in Chapter 7: Ornithology of the EIAR. An assessment of the effects in relation to the SPA populations is provided in this NIS. No evidence that the black headed gull that were recorded on the site were part of an SPA population was recorded during the extensive survey work that was undertaken. However, following the precautionary principle an assessment of the impacts of the proposed development on the local population has been undertaken in this NIS.

Table 6-23 Impact Assessment - Black Headed Gull

Analysis of potential effects on Black Headed Gull	
Disturbance and Displacement	Wintering black headed gull were rarely recorded on the site of the proposed development. The breeding population was resident with birds breeding in the area and on the surrounding Noggus Bog to the north. No evidence of breeding birds travelling to or from SPAs to the site was recorded and no link between the breeding populations and any SPA was established. However, following the precautionary principle, an assessment of disturbance and displacement of the local population of this species has been undertaken in this NIS. Whilst there is a large breeding population in the general area, no active breeding colony was recorded within the development site during the 2 years of comprehensive surveys that form the core dataset used in this this assessment. Only slight disturbance and displacement impacts are predicted on the local breeding population. No connection has been made between these birds and those breeding in the surrounding SPAs and no adverse effect on any SPA population is predicted.
Collision	As discussed above, no link between the breeding black headed gull populations on the site and those of an SPA population was identified during any of the surveys undertaken. The species was recorded flying within the potential collision risk zone during VP surveys. A “Random” collision risk analysis has been undertaken and full details are provided in Appendix 7-6 of the EIAR. The number of individuals within proximity of the development site was estimated to be 300 birds, while it has been estimated that there are c.126 birds in the wider area using the National Seabird 2000 survey data (see Section **Error! Reference source not found.** for more detail). If 1.97 collisions were to occur per year, it would mean that the losses at the proposed wind farm would increase the annual mortality of the local breeding population (i.e. c.426 birds) by 4.62%. The predicted collision risk is therefore *low* (i.e. 1-5% increase) in the context of the local breeding black-headed gull population. No adverse effects on the integrity of any SPA population are anticipated regarding collision risk.

No detailed Conservation Objectives are available for River Little Brosna Callows SPA. However, targets and attributes for the conservation of this SCI species are available in detailed Conservation

Objectives for other SPAs (Ballymacoda Bay SPA). Such targets and attributes are representative of factors considered in the conservation of the SCI species in other areas and were considered in the preparation of this assessment.

Site specific conservation objectives documents are not available for this site. The conservation objective for this QI 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*'

An assessment of the proposed development against the nominated attributes and targets for this species is provided in Table 6.24 below.

Table 6-24 Targets and attributes associated with the nominated conservation objectives for Black-headed gull.

Attribute	Target	Assessment
Population trend	Long term population trend stable or increasing	No significant effect on the local population of black headed gull is predicted. No evidence of any significant connection between the population of black headed gull on the site and those within the SPA was identified during the extensive surveys undertaken. There is no potential for the proposed development to adversely affect the population trend within the SPA.
Distribution	There should be no significant decrease in the range, timing and intensity of use of areas by black-headed gull, other than that occurring from natural patterns of variation.	No works will be undertaken within 4.5km of the SPA. The proposed development will not adversely affect the distribution of the species within the SPA.

6.5.4 Lapwing

A potential pathway for indirect effects was identified in the form of bird disturbance, displacement and collision risk on Lapwing. A full assessment of the effects of the proposed wind farm on Lapwing is provided in Chapter 7: Ornithology of the EIAR. An assessment of the effects in relation to the SPA populations is provided in this NIS. No evidence that the Lapwing that were recorded on the site were part of an SPA population was recorded during the extensive survey work that was undertaken. However, following the precautionary principle an assessment of the impacts of the proposed development on the local population has been undertaken in this NIS.

Table 6-25 Impact Assessment - Lapwing

Analysis of potential effects on Lapwing	
Disturbance and Displacement	This SPA is designated for the protection of wintering Lapwing. This species was not observed to regularly utilise any areas of the development site during winter months but was primarily recorded travelling over the site. Specific migratory vantage point surveys were undertaken to determine any connection between the birds recorded on the site and the SPA populations. No such link was established, and it is likely that the birds are not significantly linked to any SPA population. However, following the precautionary principle, an assessment of disturbance and displacement of the local population of this species has been undertaken in this NIS. The majority of flight activity occurred more than 500m from the proposed turbines and was associated with the Clooneen wetland and the Stonestown wetland to the northeast. There are extensive areas of suitable habitat in the wider area, outside any potential displacement buffer, should any potential displacement effect occur. No significant disturbance and displacement impacts are predicted on the local wintering population. No connection has been made between these birds and those in the surrounding SPAs and no adverse effect on any SPA population is predicted.
Collision	As discussed above, no link between the wintering Lapwing population populations on the site and those of an SPA population was identified during any of the surveys undertaken. The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7-6 of the EIAR. The collision risk has been calculated at a ratio of 3.55 collisions per year. Annual mortality of adult lapwing has been calculated at 29.5% per annum (Peach et al., 1994). If 3.55 collisions were to occur per year, it would mean that the losses at the proposed wind farm would increase the annual mortality of the County population (i.e. 11,265 birds) by 0.11%. The predicted collision risk is therefore negligible in the context of the county population. No adverse effect on the integrity of any SPA population is predicted.

No detailed Conservation Objectives are available for River Little Brosna Callows SPA. However, targets and attributes for the conservation of this SCI species are available in detailed Conservation Objectives for other SPAs (River Shannon and River Fergus Estuaries SPA). Such targets and attributes are representative of factors considered in the conservation of the SCI species in other areas and were considered in the preparation of this assessment.

Site specific conservation objectives documents are not available for this site. The conservation objective for this QI 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*'

An assessment of the proposed development against the nominated attributes and targets for this species is provided in Table 6.26 below.

Table 6-26 Targets and attributes associated with the nominated conservation objectives for Lapwing

Attribute	Target	Assessment
Population trend	Long term population trend stable or increasing	No significant effect on the local population of lapwing is predicted. No evidence of any significant connection between the population of lapwing on the site and those within the SPA was identified during the extensive surveys undertaken. There is no potential for the proposed development to adversely affect the population trend within the SPA.
Distribution	There should be no significant decrease in the range, timing and intensity of use of areas by Lapwing, other than that occurring from natural patterns of variation.	No works will be undertaken within 4.5km of the SPA. The proposed development will not adversely affect the distribution of the species within the SPA.

6.5.5 Wigeon

Wigeon were only recorded on ten occasions during extensive surveys between October 2017 and September 2019. Numbers recorded ranged from an individual duck to a flock of 35 birds, which does not correspond to numbers of County Importance. This species was only recorded on a single occasion within 500m of a proposed turbine. Nineteen birds were recorded on this occasion.

Numbers of ecological significance were not recorded. The development site is not of significance to the species. However, following the precautionary principle and for consistency with the other sections of this NIS, an assessment of the effects in relation to the SPA populations is provided in this NIS. No evidence that the wigeon that were recorded on the site were part of an SPA population was recorded during the extensive survey work that was undertaken. However, following the precautionary principle an assessment of the impacts of the proposed development on the local population has been undertaken in this NIS.

Table 6-27 Impact Assessment - Wigeon

Analysis of potential effects on Wigeon	
Disturbance and Displacement	Wigeon were only recorded on ten occasions during extensive surveys between October 2017 and September 2019. Numbers recorded ranged from an individual duck to a flock of 35 birds. The site is not of significance for this species and following the extensive surveys undertaken, this species was not identified as a Key Ornithological Receptor. The potential for adverse effects on the SPA population as a result of disturbance can be excluded.
Collision	No flights were recorded during VP surveys. Collision risk modelling therefore cannot be carried out. The collision risk of this species, within the accuracy levels available to the assessment, is zero.

No detailed Conservation Objectives are available for River Little Brosna Callows SPA. However, targets and attributes for the conservation of this SCI species are available in detailed Conservation Objectives for other SPAs (River Shannon and River Fergus Estuaries SPA). Such targets and attributes are representative of factors considered in the conservation of the SCI species in other areas and were considered in the preparation of this assessment.

Site specific conservation objectives documents are not available for this site. The conservation objective for this QI 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*'

An assessment of the proposed development against the nominated attributes and targets for this species is provided in Table 6.28 below.

Table 6-28 Targets and attributes associated with the nominated conservation objectives for wigeon

Attribute	Target	Assessment
Population trend	Long term population trend stable or increasing	No significant effect on the local population of wigeon is predicted. No evidence of any significant connection between the population of wigeon on the site and those within the SPA was identified during the extensive surveys undertaken. There is no potential for the proposed development to adversely affect the population trend within the SPA.
Distribution	There should be no significant decrease in the range, timing and intensity of use of areas by Wigeon, other than that occurring from natural patterns of variation.	No works will be undertaken within 4.5km of the SPA. The proposed development will not adversely affect the distribution of the species within the SPA.

6.5.6 Shoveler

Shoveler were not recorded within 500m of the proposed turbine locations. Numbers of ecological significance were not recorded. The development site is not of significance to the species. However, following the precautionary principle and for consistency with the other sections of this NIS, an assessment of the effects in relation to the SPA populations is provided in this NIS. No evidence that the shoveler that were recorded on the site were part of an SPA population was recorded during the extensive survey work that was undertaken. However, following the precautionary principle an assessment of the impacts of the proposed development on the local population has been undertaken in this NIS.

Table 6-29 Impact Assessment - Shoveler

Analysis of potential effects on Shoveler	
Disturbance and Displacement	Shoveler were not recorded within 500m of the proposed turbine locations. The site is not of significance for this species and following the extensive surveys undertaken, this species was not identified as a Key Ornithological Receptor. The potential for adverse effects on the SPA population as a result of disturbance can be excluded.
Collision	No flights were recorded during VP surveys. Collision risk modelling therefore cannot be carried out. The collision risk of this species, within the accuracy levels available to the assessment, is zero.

No detailed Conservation Objectives are available for River Little Brosna Callows SPA. However, targets and attributes for the conservation of this SCI species are available in detailed Conservation Objectives for other SPAs (River Shannon and River Fergus Estuaries SPA). Such targets and attributes are representative of factors considered in the conservation of the SCI species in other areas and were considered in the preparation of this assessment.

Site specific conservation objectives documents are not available for this site. The conservation objective for this QI 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'*

An assessment of the proposed development against the nominated attributes and targets for this species is provided in Table 6.30 below.

Table 6-30 Targets and attributes associated with the nominated conservation objectives for shoveler

Attribute	Target	Assessment
Population trend	Long term population trend stable or increasing	No significant effect on the local population of shoveler is predicted. No evidence of any significant connection between the population of shoveler on the site and those within the SPA was identified during the extensive surveys undertaken. There is no potential for the proposed development to adversely affect the population trend within the SPA.
Distribution	There should be no significant decrease in the range, timing and intensity of use of areas by Wigeon, other than that occurring from natural patterns of variation.	No works will be undertaken within 4.5km of the SPA. The proposed development will not adversely affect the distribution of the species within the SPA.

6.5.7 Teal

A potential pathway for indirect effects was identified in the form of bird disturbance and displacement on teal. A full assessment of the effects of the proposed wind farm on Lapwing is provided in Chapter 7: Ornithology of the EIAR. An assessment of the effects in relation to the SPA populations is provided in this NIS. No evidence that the teal that were recorded on the site were part of an SPA population was recorded during the extensive survey work that was undertaken. However, following the precautionary principle an assessment of the impacts of the proposed development on the local population has been undertaken in this NIS.

Table 6-31 Impact Assessment - Teal

Analysis of potential effects on Teal	
Disturbance and Displacement	Specific migratory vantage point surveys were undertaken to determine any connection between the birds recorded on the site and the SPA populations. No such link was established, and it is likely that the birds are not significantly linked to any SPA population. However, following the precautionary principle, an assessment of disturbance and displacement of the local population of this species has been undertaken in this NIS. The majority of teal were observed at the Drinagh wetlands to the east of proposed turbine locations. The dominant habitat onsite is cutover bog this habitat is considered to provide sub-optimal foraging habitat for teal. The proposed amenity trail is the only infrastructure located in proximity to Drinagh. The trail follows an existing track at this location and no significant displacement is predicted No significant disturbance and displacement impacts are predicted on the local wintering population. No connection has been made between these birds and those in the surrounding SPAs and no adverse effect on any SPA population is predicted.
Collision	No flights were recorded during VP surveys. Collision risk modelling therefore cannot be carried out. The collision risk of this species, within the accuracy levels available to the assessment, is zero.

No detailed Conservation Objectives are available for River Little Brosna Callows SPA. However, targets and attributes for the conservation of this SCI species are available in detailed Conservation Objectives for other SPAs (River Shannon and River Fergus Estuaries SPA). Such targets and attributes are representative of factors considered in the conservation of the SCI species in other areas and were considered in the preparation of this assessment.

Site specific conservation objectives documents are not available for this site. The conservation objective for this QI 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'*

An assessment of the proposed development against the nominated attributes and targets for this species is provided in Table 6.32 below.

Table 6-32 Targets and attributes associated with the nominated conservation objectives for teal

Attribute	Target	Assessment
Population trend	Long term population trend stable or increasing	No significant effect on the local population of teal is predicted. No evidence of any significant connection between the population of teal on the site and those within the SPA was identified during the extensive surveys undertaken. There is no potential for the proposed development to adversely affect the population trend within the SPA.
Distribution	There should be no significant decrease in the range, timing and intensity of use of areas by Wigeon, other than that occurring from natural patterns of variation.	No works will be undertaken within 4.5km of the SPA. The proposed development will not adversely affect the distribution of the species within the SPA.

6.5.8 Black tailed godwit

Black tailed godwit was only recorded on one occasion during the extensive two-year survey period, consisting of a small flock in flight over the Drinagh wetlands to the east of the development infrastructure. The development site is not of significance to the species. However, following the precautionary principle and for consistency with the other sections of this NIS, an assessment of the effects in relation to the SPA populations is provided in this NIS. No evidence that the black tailed godwit that were recorded on the site were part of an SPA population was recorded during the extensive survey work that was undertaken. However, following the precautionary principle an assessment of the impacts of the proposed development on the local population has been undertaken in this NIS.

Table 6-33 Impact Assessment – Black tailed godwit

Analysis of potential effects on Black tailed godwit	
Disturbance and Displacement	Black tailed godwit was only recorded on one occasion during the extensive two-year survey period. The site is not of significance for this species and following the extensive surveys undertaken, this species was not identified as a Key Ornithological Receptor. The potential for adverse effects on the SPA population as a result of disturbance can be excluded.
Collision	No flights were recorded during VP surveys. Collision risk modelling therefore cannot be carried out. The collision risk of this species, within the accuracy levels available to the assessment, is zero.

No detailed Conservation Objectives are available for River Little Brosna Callows SPA. However, targets and attributes for the conservation of this SCI species are available in detailed Conservation Objectives for other SPAs (River Shannon and River Fergus Estuaries SPA). Such targets and attributes are representative of factors considered in the conservation of the SCI species in other areas and were considered in the preparation of this assessment.

Site specific conservation objectives documents are not available for this site. The conservation objective for this QI 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*'

An assessment of the proposed development against the nominated attributes and targets for this species is provided in Table 6.34 below.

Table 6-34 Targets and attributes associated with the nominated conservation objectives for black tailed godwit

Attribute	Target	Assessment
Population trend	Long term population trend stable or increasing	No significant effect on the local population of black tailed godwit is predicted. No evidence of any significant connection between the population of black tailed godwit on the site and those within the SPA was identified during the extensive surveys undertaken. There is no potential for the proposed development to adversely affect the population trend within the SPA.
Distribution	There should be no significant decrease in the range, timing and intensity of use of areas by Wigeon, other than that occurring from natural patterns of variation.	No works will be undertaken within 4.5km of the SPA. The proposed development will not adversely affect the distribution of the species within the SPA.

6.5.9 Determination

Following an examination, evaluation and analysis, in light of best scientific knowledge, and, on the basis of objective information, having taken into account the relevant mitigation measures, it can be concluded that the proposed development will not have an adverse impact on River Little Brosna Callows SPA.

6.6 Conclusion of Impact Assessment

Following an examination, evaluation and analysis, in light of best scientific knowledge and the conservation objectives of the site, and, on the basis of objective information, having taken into account the relevant mitigation measures, it can be concluded that the proposed development will not have an adverse impact on any European Site.

It will not prevent the QIs/SCIs of any European Sites from achieving favourable conservation status in the future as defined in Article 1 of the EU Habitats Directive. A definition of Favourable Conservation Status is provided below:

> *'conservation status of a species means the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations within the territory referred to in Article 2;*

The conservation status will be taken as 'favourable' 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.'*

Based on the above, it can be concluded in view of best scientific knowledge, on the basis of objective information that the Proposed Development will not adversely affect the Qualifying Interests/Special Conservation Interests associated with any European Designated Sites including in particular the following:

- River Shannon Callows SAC
- Lough-Derg North-east Shore SAC
- Middle Shannon Callows SPA
- River Little Brosna Callows SPA
- Lough Derg (Shannon) SPA

7. IN COMBINATION EFFECTS

A search and review in relation to plans and projects that may have the potential to result in cumulative and/or in-combination impacts on European Sites was conducted. This assessment focuses on the potential for cumulative in-combination effects on the European Sites where potential for adverse effects was identified at the screening stage (Appendix 1). This included a review of online Planning Registers, development plans and other available information and served to identify past and future plans and projects, their activities and their predicted environmental effects.

7.1 Development context – Ecological Plans and Policies

The following development plans been reviewed and taken into consideration as part of this assessment:

- Offaly County Development Plan 2014- 2020

The review focused on policies and objectives that relate to Natura 2000 sites and natural heritage. Policies and objectives relating to sustainable land use were also reviewed.

Table 7-1 Review of land use and spatial plans

Offaly County Development plan 2014 -2020	
Key Policies/Issues/Objectives Directly Related to European Sites In The Zone of Influence	**Assessment of Potential Impact on European Sites**
NHP-01: It is Council policy to prohibit any development that would be harmful to or that would result in a significant deterioration of habitats and/or disturbance of species in a Special Protection Area (SPA), Special Area of Conservation (SAC) and candidate Special Area of Conservation (cSAC), Natural Heritage Area (NHA) and Proposed Natural Heritage Area (pNHA) **NHP-08:** It is Council policy to protect, conserve and enhance the county's biodiversity and natural heritage including wildlife (flora and fauna), habitats, landscapes and/or landscape features of importance to wildlife or which play a key role in the conservation and management of natural resources such as water. **NHP-11:** It is Council policy to conserve, protect and enhance where possible wildlife habitats such as rivers, streams, canals, lakes, and associated wetlands including reed-beds and swamps, ponds, springs, bogs, fens, trees, woodlands and scrub, hedgerows and other boundary types such as stone walls and ditches which occur outside of designated areas providing a network of habitats and corridors essential for wildlife to flourish. **NHP-12:** It is Council policy to ensure that peatland areas, which are designated for protection under international and national legislation, are conserved and managed appropriately to conserve their ecological, archaeological, cultural and educational significance. **NHP-22:** It is Council policy to encourage, pursuant to Article 10 of the Habitats Directive, the management of features of the landscape, such as traditional field boundaries, important for the ecological coherence of the Natura 2000 site(s) network and essential for the migration, dispersal and genetic exchange of wild species **NHP-24:** It is Council policy to protect, conserve and enhance the county's biodiversity and natural heritage including wildlife (flora and fauna), habitats, landscapes and / or landscape features of importance to wildlife or which play a key role in the conservation and management of natural resources such as water.	The Development plan was comprehensively reviewed, with particular reference to Policies and Objectives that relate to the Natura 2000 network and other natural heritage interests. No potential for cumulative impacts when considered in conjunction with the current proposal were identified. There will be no impact on designated sites as a result of deterioration in water quality. Best practice preventative measures will be implemented to avoid effects on water quality, as outlined in section 3.5 of this report, the hydrology chapter (Appendix 2) and in the CEMP (Appendix 3). There will be no adverse effects on sensitive aquatic receptors listed as QIs/SCIs of European Sites, as a result of deterioration in water quality. There will be no impact on European designated sites as a result of the proposed development. The development will not affect the conservation status of any QI species or habitat or SCI species of any EU designated site. The development will not prevent the QIs/SCIs of the European Sites from achieving favourable conservation status in the future as defined in Article 1 of the EU Habitats Directive.

Offaly County Development plan 2014 -2020	
Key Policies/Issues/Objectives Directly Related to European Sites In The Zone of Influence	Assessment of Potential Impact on European Sites
NHO-01: It is an objective of the Council to ensure that any development proposal in the vicinity of, or affecting a designated site, complies with the provisions relating Appropriate Assessment and SEA requirements and the Council will consult with the appropriate statutory environmental authority in this regard.	No potential for cumulative impacts when considered in conjunction with the current proposal were identified. There will be no impact on designated sites as a result of deterioration in water quality. Best practice preventative measures will be implemented to avoid effects on water quality, as outlined in section 5 of this report, the hydrology chapter (Appendix 2) and in the CEMP (Appendix 3). There will be no adverse effects on sensitive aquatic receptors listed as QIs/SCIs of European Sites, as a result of deterioration in water quality. There will be no impact on European designated sites as a result of the proposed development. The development will not affect the conservation status of any QI species or habitat or SCI species of any EU designated site. The development will not prevent the QIs/SCIs of the European Sites from achieving favourable conservation status in the future as defined in Article 1 of the EU Habitats Directive.
NHO-02: It is an objective of the Council to conserve and protect the natural heritage of the county and to conserve and protect European and National designated sites within the county including Special Protection Areas (SPAs), Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSACs), Natural Heritage Areas (NHAs), Proposed Natural Heritage Areas (pNHAs), Ramsar Sites, Statutory Nature Reserves, Biogenetic Reserves and Wildfowl Sanctuaries.	

7.2 Other Projects

The potential for the proposed development to contribute to a cumulative impact on European Sites was considered. The online planning systems for Offaly County Council and An Bord Pleanála were consulted on the 20/01/2020.

Furthermore, the cumulative impact assessment considered all potential significant cumulative effects arising from all land uses in the vicinity of the proposed development. These include ongoing agricultural practices, and drainage/maintenance works/programmes. Overall, the proposed development has been designed to mitigate impacts on the environment and particularly water, and a suite of mitigation measures is set out in section 5 of this report and in the CEMP accompanying this application. The mitigation measures set out in section 5 and the CEMP have been developed to ensure that significant cumulative affects do not arise during construction, operational or decommissioning phases of the proposed development.

7.2.1 Applications Within the Proposed Wind Farm Site

A review of Offaly County Council Planning Register shows that there were a number of planning applications lodged in relation to works carried out by An Bord na Mona and Telecommunication masts. The applications outlined in Table 7.2 were identified within the site boundary:

Table 7-2 Applications within the Proposed Wind Farm Site

Pl. Ref:	Applicant	Description	Decision
Pl.Ref.88/274	Bord na Móna	Application made by Bord na Móna for new weighbridge and weighbridge office. The planning Authority granted conditional permission on the 23rd of November 1998.	Grant; 23.11.1998
Pl. Ref. 01/132	Eircell	Application made by Eircell for a telecommunications support structure, antennae and equipment shelter. The planning Authority granted conditional permission on the 23rd of May 2002.	Grant; 23.05.2002
Pl.Ref.07/1235	Vodafone Ireland Ltd	Application made by Vodafone Ireland Ltd for retention of an existing 30 metre high telecommunications support structure, antennas, equipment container and associated equipment within a fenced compound and access track. The development forms part of Vodafone Ireland Limited's existing gsm and broadband telecommunications network. The planning Authority granted conditional permission on the 10th of June 2014.	Grant; 10.06.2014
Pl.Ref.13/69	Vodafone Ireland Ltd.	Application made by Vodafone Ireland Ltd for retention of an existing 30 metre	Grant; 04.08.2013

Pl. Ref:	Applicant	Description	Decision
		high telecommunications support structure with antennas, equipment container and associated equipment within a fenced compound and access track. the development forms part of Vodafone Ireland Limited's existing gsm and 3g broadband telecommunications network. The planning Authority granted conditional permission on the 4th of August 2013.	
Pl.Ref.14/251	Bord na Móna Plc	Application made by Bord na Móna PLC for the construction of a new workshop building, measuring approximately 190 m2. this building will be used to carry out minor maintenance works on peat haulage stock including locomotives and wagons. external works are to include a concrete paved yard area, with surface water run-off draining through an oil-interceptor. an on-site treatment system is to be constructed to cater for foul water run-off. external fencing and public lighting is proposed immediately outside the proposed building. access to the site will be by the existing access to the briquette factory, off the n62 Cloghan-Birr road. this application relates to a development which comprises or is for the purposes of an activity requiring an integrated pollution prevention and control licence (Boora group EPA IPC licence no. p0500-01). The planning Authority granted conditional permission on the 4th of August 2013.	Grant; 04.08.2013
Pl.Ref.17/155	Bord na Móna Powergen Ltd	Application made by Bord na Móna Powergen limited for erection of a guyed wind monitoring mast, with instruments, up to 100m in height. the purpose of the proposed mast is to assess the suitability of the company's adjacent lands for wind farm development. The planning Authority granted conditional permission on the 4th of August 2013.	Grant; 04.08.2013

7.2.2 Applications in the Vicinity of the Proposed Wind Farm Site

The majority of planning applications in the immediate vicinity of the proposed wind farm site are related to the provision and/or alteration of one-off housing and agricultural developments. Where relevant these have been considered in the design of the project and are considered within this assessment but are of a nature and scale such that significant cumulative effects are not anticipated, when considered alongside the proposed development:

There are a number of commercial and utility developments in the wider area that have been granted planning permission which include the following.

- **19.PA0015**: Permission granted by An Bord Pleanála to Lumcloon Energy Ltd. for a gas fired electricity generating station capable of producing up to a maximum of 350MW approximately under the provisions of the Strategic Infrastructure Development (SID) process. Site is located 5.5 kilometres east of Cloghan.
- **Pl Ref. 06/295**: Planning application made by Nordale Enterprises Ltd. for the construction of new single storey building (1,285sqm) in existing yard behind existing building. The Planning Authority granted conditional permission for the development on the 17th of August 2006.
- **Pl Ref. 09/399**: Planning application made by McGill Environmental Systems (Ireland) Ltd. for the construction of a compost manufacturing facility, office building, biocycle treatment unit and all associated site works. The Planning Authority refused permission on the 21st of May 2010 and was subsequently refused again on appeal by An Bord Pleanála on the 9th of December 2010.
- **Pl Ref. 12/65**: Planning application made by Galetech Energy Developments Ltd for the erection of an anemometer mast. The Planning Authority granted permission for the development on the 22nd of June 2012.
- **Pl Ref. 17/194**: Planning application made by Lumcloon Energy Limited for the development of an energy storage facility designed to provide 100MW of system support services to the electricity grid The Planning Authority granted conditional permission for the proposed development on the 25th of July 2017. This permission was subsequently superseded by **Pl. Ref. 19/55** in an application by the same applicant for alterations to development of an energy storage facility designed to provide 100mw of system support services to the electricity grid at Lumcloon, Cloghan, Co. Offaly in lieu of that granted under planning permission 17/194. The Planning Authority granted conditional permission for the development on the 7th of August 2019.
- **Pl Ref. 18/230**: Planning application made by Galetech Energy Developments Cloghan Limited for the installation of approximately 12.5km of 38 kV electricity transmission line from the permitted (wind farm) substation (Offaly County Council Pl Ref. 14/188 and An Bord Pleanála Ref. PL 119.244053) in the townland of Stonestown, County Offaly to the existing electricity substation in the townland of Clondallow, County Offaly. The Planning Authority refused permission on the 27th of February, 2019, and the application is currently on appeal with An Bord Pleanála under 304056-19.
- **Pl. Ref.19/555** - Planning application made by Galetech Energy Developments Cloghan Limited for the installation of approximately 8 kilometres of underground electricity line with a capacity of up to 38kv from the permitted (wind farm) substation (Offaly county council planning register reference 14/188 and An Bord Pleanála reference Pl 19.244053 and Offaly county council planning register reference 19/22 -permission granted for technical amendments to substation) in the townland of Stonestown, to the permitted Derrycarney electricity substation in the townland of Lumcloon, County Offaly. The planning authority granted permission for the development on 24th January 2020.

7.2.3 Other Wind Farm Sites

Within the wider area there have been a number of planning applications for windfarm developments (comprising two or more turbines) lodged within a 20-kilometre radius of the EIAR study area. These planning applications are outlined in Table 7.3.

Table 7-3 Other Wind Farm Sites within 20km of the proposed development

Ref	Applicant	Description	Decision*
Pl.Ref.02/734	New Energy Technologies Ltd	Windfarm of 5no turbine generators, 1 meteorological mast, associated access roads and control building	Grant; 30.10.2002
Pl.Ref.07/1595	Gaelectric Developments Ltd	Construction of a windfarm of 3no turbines (hub height not exceeding 85m, blade diameter not exceeding 80m), electrical substation building, 1no meteorological pole (not exceeding 80m), construction extension and upgrade of internal site tracks and associated works.	Refused; 30.10.2008
Pl.Ref.10/130	Gaelectric Developments Ltd	Construction of a wind farm consisting of 2no wind turbines (hub height not exceeding 85m, blade diameter not exceeding 82.4m), an electrical substation building, construction extension and upgrade of internal site tracks and associated works.	Grant; 02.07.2010
Pl.Ref.12/293	Galetech Energy Developments Ltd	Erection of 10 no. wind turbines each with a hub height of up to 110m and a rotor diameter of up to 120m, with an overall maximum tip height of up to 170m and all associated site development works including 1 no. temporary site compound area, turbine foundations, crane hardstanding's, access tracks, underground cabling site entrance off the N62, the construction of a 38kV switch room and control facility (85.5sqm) with associated equipment and compound area enclosed by 2.4m high palisade fence.	Grant; Subsequent refusal from An Bord Pleanála 23.12.2013.
Pl.Ref.14/188	Galetech Energy Developments Cloghan Ltd	Permission is sought for a period of 10 years for the erection of 9no. wind turbines each with a hub height of up to 100m, a typical rotor diameter of 103m (overall maximum tip height of up to 150m) and all associated site development works including 1 no. temporary site compound area (697 sq.m),	Grant; Subsequent Grant from An Bord Pleanála 27.11.2016.

Ref	Applicant	Description	Decision*
		turbine foundations, crane hardstandings, access tracks, underground cabling, upgrades to existing site entrance off the n62, the construction of a 38kv switch room and control facility (94 sq.m) with associated equipment and compound area enclosed by a 2.4m high palisade fence.	
Pl.Ref.15/44	Meenwaun Wind Farm Ltd	Permission is sought for a period of 10 years for the construction of a wind farm comprising up to 5no. turbines with a maximum tip height of up to 169m and associated turbine foundations, hardstanding areas and drainage, 1 no. permanent meteorological mast up to 80m in height, tree felling, a stream crossing =, upgrading of existing and provision of new site tracks and associated drainage, provision of new site entrance, 1 no. borrow pit and associated ancillary infrastructure, underground electricidal cabling and associated communications cabling between the turbines and proposed onsite substation and existing substation at Dallow, temporary developments/works associated with the construction phase including 1 no. temporary construction site compound and associated ancillary infrastructure.	Grant 22.04.2015; Subsequent grant by An Bord Pleanála 21.10.2015.
Pl.Ref.5123496	Trevor and Georgina Armitage	3no 1MW wind turbines, service roadways and control house	Grant; 24.06.2001
Pl.Ref.5123495	Nigel and Robert Alexander	5no 1MW wind turbines, service roadways and control house	Grant; 24.05.2001

**all granted by Planning Authority unless otherwise stated*

Where the potential for the proposed development to result in adverse effects on European Sites on its own was identified, there was potential for it to contribute to in combination effects when considered in combination with other plans and projects. In the absence of mitigation, the potential for the proposed development to contribute to in combination effects on water quality within downstream the following SACs and SPAs:

- River Shannon Callows SAC
- Lough-Derg North-east Shore SAC
- Middle Shannon Callows SPA

- Lough Derg (Shannon) SPA

In addition, and following the precautionary principle, the proposed development has the potential to contribute to disturbance and displacement effects on the following SPAs:

- River Little Brosna Callows SPA
- Middle Shannon Callows SPA

Following the implementation of the best practice measures outlined in section 5 of this report, in the hydrology chapter of the EIAR accompanying this application (Appendix 2) and in the CEMP (Appendix 3), all potential impact pathways have been blocked. There is therefore no potential for the proposed development to contribute to any in-combination impact on EU Designated Sites in combination with other plans and projects.

7.3 Conclusion of Cumulative Assessment

Following an examination, evaluation and analysis, in light of best scientific knowledge and the conservation objectives of the site, and, on the basis of objective information, having taken into account the relevant mitigation measures, it can be concluded that the proposed development will not have an adverse impact on Any European Site and cannot contribute to any cumulative or in-combination effect when considered alongside any other plan or project.

In the review of the projects that was undertaken, no connection, that could potentially result in additional or cumulative impacts was identified. Neither was there any potential for different (new) impacts resulting from the combination of the various projects and plans in association with the proposed development.

8. CONCLUDING STATEMENT

This NIS has provided an assessment of all potential direct or indirect adverse effects on European Sites

Where the potential for any adverse effect on any European Site has been identified, the pathway by which any such effect may occur has been robustly blocked through the use of avoidance, appropriate design and mitigation measures as set out within this report and its appendices. The measures ensure that the construction, and operation of the proposed development does not adversely affect the integrity of any European sites.

Following an examination, evaluation and analysis, in light of best scientific knowledge and the conservation objectives of the site, and, on the basis of objective information, having taken into account the relevant mitigation measures, it can be concluded that the proposed development will not have an adverse impact on any European Sites], either alone or in combination with other plans or projects.

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APPENDIX 1

APPROPRIATE ASSESSMENT SCREENING REPORT

Planning and
Environmental
Consultants

Appropriate Assessment Screening Report

Derrinlough Wind Farm

DOCUMENT DETAILS

Client:	**Bord Na Mona**
Project Title:	**Derrinlough Wind Farm**
Project Number:	**171221**
Document Title:	**Appropriate Assessment Screening Report**
Document File	**AASR – F – 2020.02.18 – 171221**
Prepared By:	**MKO** **Tuam Road** **Galway** **Ireland** **H91 VW84**

MKO
Planning and
Environmental
Consultants

Rev	Status	Date	Author(s)	Approved By
01	Final	18/02/2020	JOS	PR

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1. INTRODUCTION

MKO has been appointed to provide the information necessary to allow the competent authority to conduct an Article 6(3) Screening for Appropriate Assessment of a proposed wind energy development and all associated infrastructure at Derrinlough and adjacent townlands, located on Clongawny and Drinagh Bogs which are part of the Boora bog group in Co. Offaly.

Screening for Appropriate Assessment is required under Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and Part XAB of the Planning and Development Act 2000, as amended. Where it cannot be excluded that a project or plan, either alone or in combination with other projects or plans, would have a significant effect on a European Site then same shall be subject to an appropriate assessment of its implications for the site in view of the site's conservation objectives. The current project is not directly connected with, or necessary for, the management of any European Site consequently the project has been subject to the Appropriate Assessment Screening process.

The data underpinning this AA Screening Report was obtained through a desk study and field surveys undertaken in 2018 and 2019. Using this data, MKO has assessed the potential for the proposed development to result in significant effects on European sites in the absence of any best practice, mitigation or preventative measures.

This Appropriate Assessment Screening Report has been prepared in compliance with Part XAB of the Planning and Development Acts 2000 – 2019, the Planning and Development Regulation 2001 - 2019 and relevant jurisprudence of the European and Irish Courts. It was also prepared in accordance with the European Commission's *Assessment of Plans and Projects Significantly affecting Natura 2000 Sites: Methodological Guidance on the provisions of Article 6(3) and 6(4) of the Habitats Directive 92/43/EEC* (EC, 2002),*Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC* (EC, 2018) as well as the Department of the Environment's *Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities* (December 2009, amended 11February2010) where relevant.

In addition to the guidelines referenced above, the following relevant documents were also considered in the preparation of this report:

1. *Council of the European Commission (1992) Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Official Journal of the European Communities. Series L 20, pp. 7-49.*
2. *EC (2000) 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.*
3. *EC (2007) Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC – Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence. Opinion of the commission.*
4. *EC (2013) Interpretation Manual of European Union Habitats. Version EUR 28. European Commission.*
5. *CIEEM (2018) Guidelines for Ecological Impact Assessment.*

1.1 Appropriate Assessment

1.1.1 Screening for Appropriate Assessment

Screening is the process of determining whether an Appropriate Assessment is required for a plan or project. Under Part XAB of the Planning and Development Act, 2000, as amended, screening must be carried out by the Competent Authority. As per Section 177U of the Planning and Development Act, 2000, as amended '*A screening for appropriate assessment shall be carried out by the competent authority to assess, in view of best scientific knowledge, if that Land use plan or proposed development, individually or in combination with another plan or project is likely to have a significant effect on the European site*'. The Competent Authority's determination as to whether an Appropriate Assessment is required must be made on the basis of objective information and should be recorded. The Competent Authority may request information to be supplied to enable it to carry out screening.

Consultants or project proponents may provide for the competent authority, the information necessary for them to determine whether an Appropriate Assessment is required and provide advice to assist them in the Article 6(3) Appropriate Assessment Screening decision.

Where it cannot be excluded beyond reasonable scientific doubt at the Screening stage, that a proposed plan or project, individually or in combination with other plans and projects, would have a significant effect on the conservation objectives of a European site, an Appropriate Assessment is required.

Where an Appropriate Assessment is required, the Competent Authority may require the applicant to prepare a Natura Impact Statement.

The term Natura Impact Statement (NIS) is defined in legislation[1]. An NIS, where required, should present the data, information and analysis necessary to reach a definitive determination as to 1) the implications of the plan or project, alone or in combination with other plans and projects, for a European site in view of its conservation objectives, and 2) whether there will be adverse effects on the integrity of a European site. The NIS should be underpinned by best scientific knowledge, objective information and by the precautionary principle.

This Article 6(3) Appropriate Assessment Screening Report has been prepared in compliance with the provisions of section 177U of the Planning and Development Act 2000 as amended.

1.1.2 Statement of Authority

This report has been prepared by David McNicholas and Pat Roberts (B.Sc. Environmental Science, MCIEEM). Pat has over 14 years' experience in ecological management and assessment. David McNicholas has over 9 years' professional ecological consultancy experience and is a full member of the Chartered Institute of Ecology and Environmental Management. The baseline ecological surveys were undertaken by David McNicholas (BSc., MSc., MCIEEM), Sarah Mullen (BSc., PhD), James Owens (BSc., MSc.), Dr. Úna Nealon, Laoise Kelly (B.Sc), Julie O'Sullivan (BSc, MSc), John Hehir and Paddy Manley (B.Sc). (CIEEM). Úna Nealon's primary expertise lies in bat ecology. She completed her PhD with the Centre for Irish Bat Research, examining the impacts of wind farms on Irish bat species. James has over 4 years' consultancy experience and is a competent expert in undertaking ecological surveys. Sarah has over 4 years' professional ecological consultancy experience and a PhD on plant pollinator interactions in semi-natural grasslands. Laoise Kelly, Julie O'Sullivan, Paddy Manley and

[1] As defined in Section 177T of the Planning and Development Act, 2000 as amended, an NIS means a statement, for the purposes of Article 6 of the Habitats Directive, of the implications of a proposed development, on its own and in combination with other plans and projects, for a European site in view of its conservation objectives. It is required to include a report of a scientific examination of evidence and data, carried out by competent persons to identify and classify any implications for the European site in view of its conservation objectives

John Hehir all assisted in the gathering of baseline data at the proposed development site. They have relevant academic qualifications and are competent experts in undertaking the ecological surveys in which they were involved.

1.1.3 Data Collected to Carry Out Assessment

In preparation of the report, the following sources were used to gather information:

- Review of NPWS Site Synopses, Conservation Objectives for the European Sites
- Review of 2019, 2013 and 2007 EU Habitats Directive (Article 17) Reports.
- Review of online web-mappers: National Parks and Wildlife Service (NPWS), EPA, Water Framework Directive (WFD),
- Review of specially requested records from the NPWS Rare and Protected Species Database for the hectads which overlap with the study area.
- Review of OS maps and aerial photographs of the site of the proposed project.
- Review of relevant databases including National Biodiversity Ireland Database and available literature of previous surveys conducted in the area.
- Review of other plans and projects within the area.
- MKO field assessments and bird surveys carried out between 2017 and 2019 and as provided in full in the EIAR and NIS.

2. DESCRIPTION OF THE PROPOSED DEVELOPMENT

2.1 Site Location

The proposed development, known as Derrinlough Wind Farm is located on Clongawny and Drinagh Bogs which are part of the Boora bog group in Co. Offaly. The Boora bog group is regulated by the Environmental Protection Agency (EPA) under IPC Licence Register No. P0500-01. The site location is shown in Figure 2.1.

The two bogs have a total area of approximately 2,360 hectares. Combined they are approximately 6km long in a north/south direction and 9km wide in an east/west direction at their widest point. The closest settlements to the site are Cloghan which is located approximately 2km to the north and Fivealley which is located approximately 2.5km to the south. Other settlements and towns in the area include Banagher (circa. 3km west), Ferbane (circa. 6km north), Birr (circa 7km south-west) and Shannonbridge (circa. 15km north-west). The townlands within which the site lies are listed in Table 1.1 of Chapter 1.

2.2 Characteristics of the Proposed Development

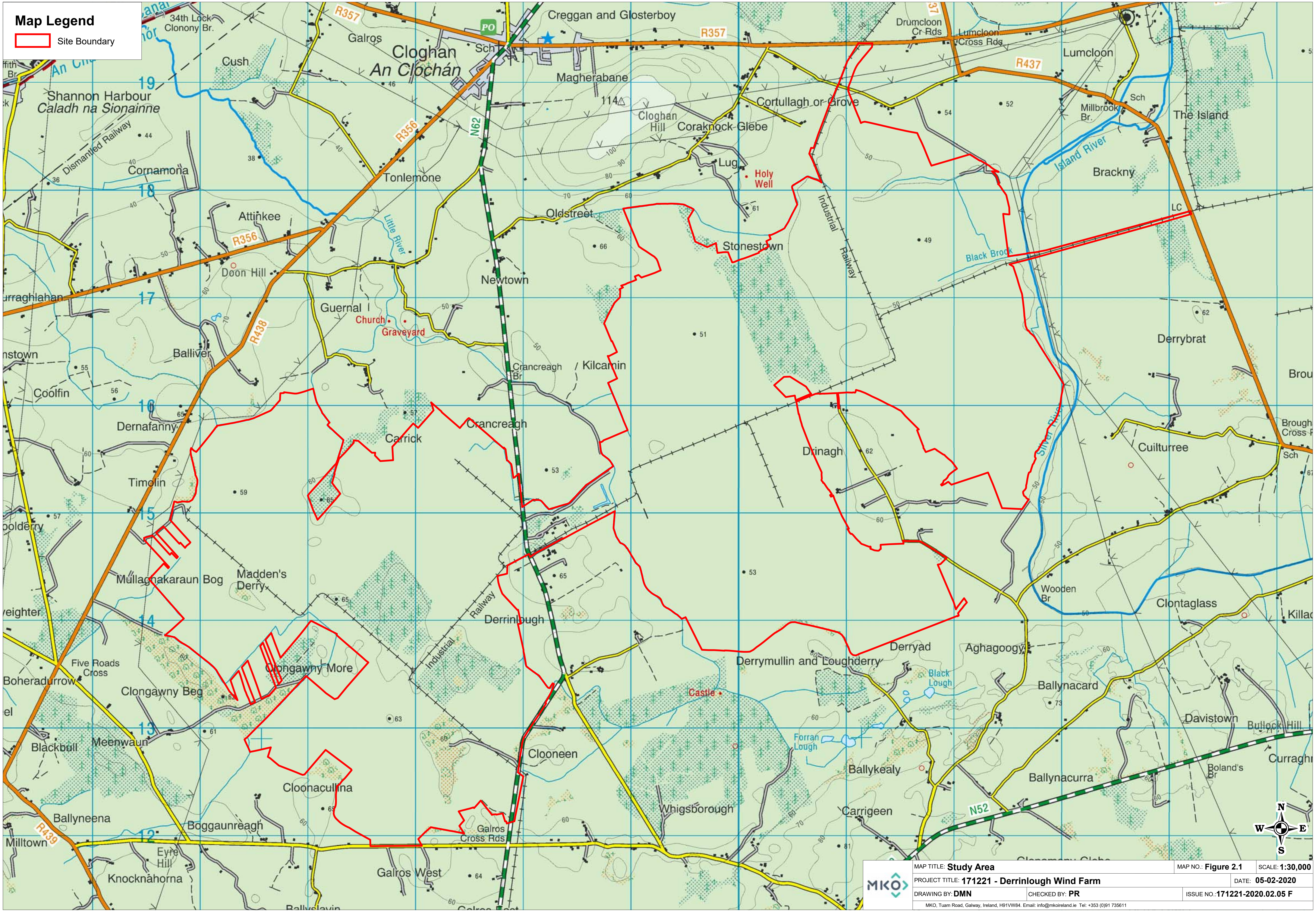
2.2.1 Description of the Project

The Proposed Development comprises:

1. 21 No. wind turbines with an overall blade tip height of up to 185 metres and all associated hard-standing areas.
2. 2 No. permanent Anemometry Masts up to a height of 120 metres.
3. Provision of new and upgraded internal site access roads, passing bays, amenity pathways, amenity carpark and associated drainage.
4. 2 No. permanent underpasses in the townland of Derrinlough. One underpass will be located beneath the N62 and one will be located beneath an existing Bord na Móna rail line.
5. 1 No. 110 kV electrical substation, which will be constructed in the townland of Cortullagh or Grove. The electrical substation will have 2 No. control buildings, associated electrical plant and equipment and a wastewater holding tank.
6. 5 No. temporary construction compounds, in the townlands of Clongawny More, Derrinlough, Derrinlough/Crancreagh, Drinagh and Cortullagh or Grove.
7. All associated underground electrical and communications cabling connecting the turbines to the proposed electrical substation.
8. 2 No. temporary security cabins at the main construction site entrances in the townland of Derrinlough.
9. All works associated with the connection of the proposed wind farm to the national electricity grid, which will be to the existing Dallow/Portlaoise/Shannonbridge 110 kV line.
10. Removal of existing meteorological mast.
11. Upgrade of existing access and temporary improvements and modifications to existing public road infrastructure to facilitate delivery of abnormal loads including locations on the N52 and N62; construction access for delivery of construction materials at locations on the N62 and R357; operational access onto L7009 in the townland of Cortullagh or Grove and amenity access off R357 and L7005.
12. All associated site works and ancillary development including signage.
13. A 10-year planning permission and 30-year operational life from the date of commissioning of the entire wind farm.

The planning application for the proposed wind farm includes connection to the national electricity grid. All elements of the proposed project as listed above, including grid connection and any works required on public roads to accommodate turbine delivery, have been considered.

This application seeks a ten-year planning permission and 30-year operational life from the date of commissioning of the entire wind farm.



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3. IDENTIFICATION OF RELEVANT EUROPEAN SITES

3.1 Identification of the European Sites within the Likely Zone of Impact

The following methodology was used to establish which European Sites are within the Likely Zone of Impact of the proposed development:

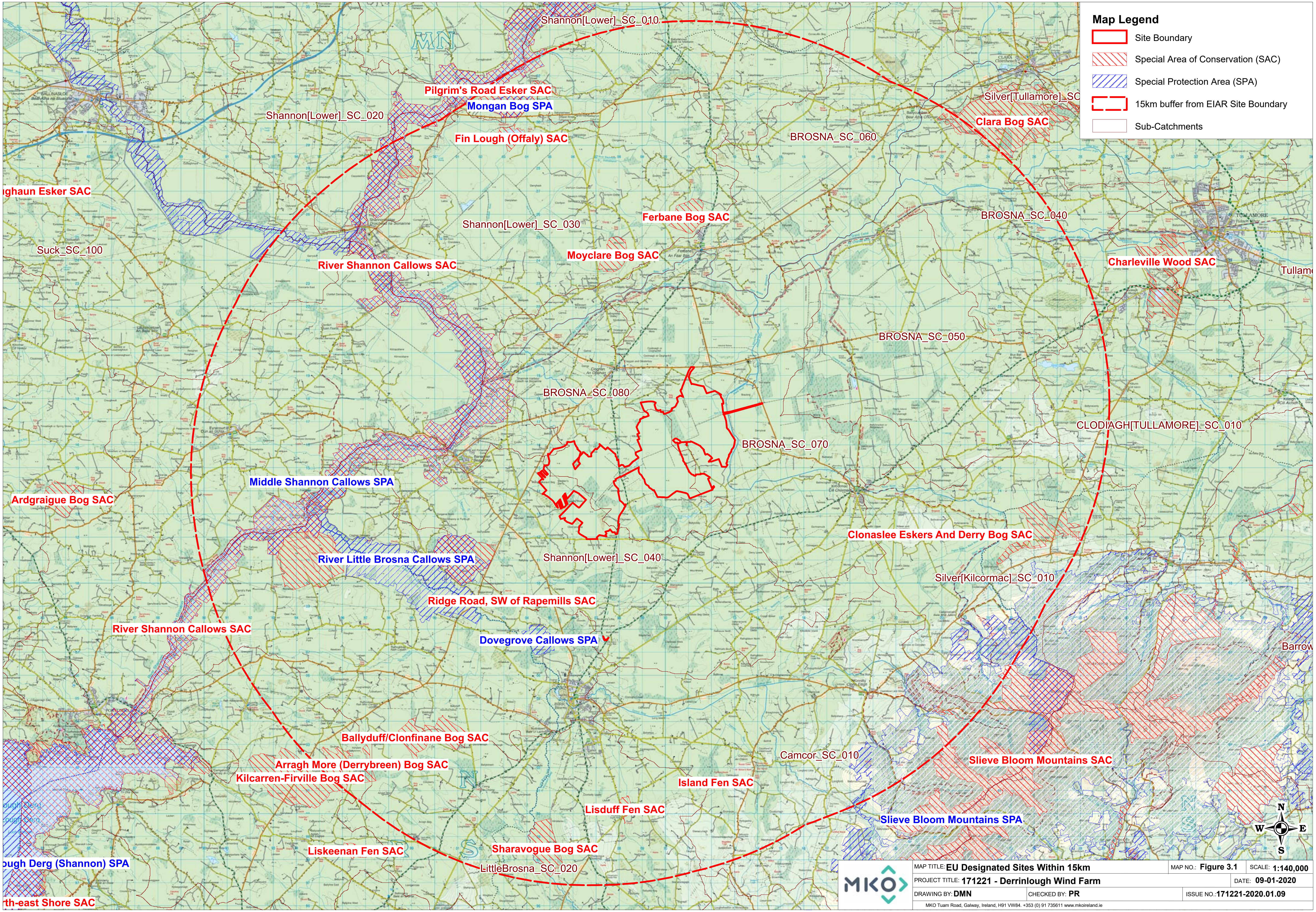
- Initially the most up to date GIS spatial datasets for European designated sites and water catchments were downloaded from the NPWS website (www.npws.ie) and the EPA website (www.epa.ie) on the 07/01/2020. The datasets were utilised to identify European Sites which could feasibly be affected by the proposed development.
- All European Sites within a distance of 15km surrounding the development site were identified and are shown on Figure 3.1. In addition, the potential for connectivity with European Sites at distances of greater than 15km from the proposed development was also considered in this initial assessment. In this case, potential connectivity with a European Site that is located at a distance of over 15km from the proposed development was identified. This was identified following review of aerial photography and hydrological catchment mapping as described above. Other European Sites that were located over 15 km from the proposed development were excluded as no pathway for significant effect was identified.
- The catchment mapping was used to establish or discount potential hydrological connectivity between the site of the proposed development and any European Sites. The hydrological catchments are also shown in Figure 3.1.
- Table 3.1 provides details of all relevant European Sites as identified in the preceding steps and assesses which are within the likely Zone of Impact.
- The results of the extensive bird surveys carried out between September 2017 and September 2019 were consulted in the course of this screening exercise and provided information on whether the birds recorded on the site could potentially be associated with any European Site.
- The site synopses and conservation objectives of these sites, as per the NPWS website (www.npws.ie), were consulted and reviewed at the time of preparing this report. Figure 3.1 shows the location of the proposed development in relation to all European sites within 15km of the proposed development.
- Where potential pathways for Significant Effect such as habitat or hydrological connectivity are identified, the site is included within the Likely Zone of Impact.

3.2 Assessment of Potential for Significant Effects on European Sites

This Appropriate Assessment Screening Report considers any potential for likely direct or indirect impacts of the proposed development, both alone and in combination with other plans and projects, on European Sites by virtue of the following criteria: size and scale, land-take, distance from the European Site or key features of the site, resource requirements, emissions, excavation requirements, transportation requirements and duration of construction, operation and decommissioning were considered in this screening assessment.

Table 3.1 below identifies which European Sites are located within the Zone of Likely Impact and identifies pathways by which impacts may occur. All European Sites that are within the Zone of Likely Impact are Screened In following the precautionary principle and assessed within the Natura Impact Statement. In addition, the individual pathways by which effects may occur are identified in Table 3.1 below. Where there is no potential for significant effects on individual Qualifying Interests or Special

Conservation Interests (QI or SCI), this is identified in the table and these features are not considered further in the AA Screening Report (AASR) or Natura Impact Statement (NIS).



MAP TITLE: EU Designated Sites Within 15km	MAP NO.: Figure 3.1	SCALE: 1:140,000	
PROJECT TITLE: 171221 - Derrinlough Wind Farm		DATE: 09-01-2020	
DRAWING BY: DMN	CHECKED BY: PR	ISSUE NO.: 171221-2020.01.09	

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Table 3-1 Identification of Designated Sites within the Likely Zone of Impact and assessment of potential for significant effects

European Sites and distance from proposed development	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 07/01/2020)	Conservation Objectives	Likely Zone of Impact Determination and assessment of potential for significant effect
Special Area of Conservation (SAC)			
River Shannon Callows SAC Distance from wind farm site: 2.3km	• *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) [6410] • Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*) [6510] • Limestone pavements [8240] • Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0] • *Lutra lutra* (Otter) [1355]	This site has the generic conservation objective; *'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,'* (NPWS, version 6, 2018).	This European Site is 2.3km to the north-west of the development site, at its closest point. The proposed development is located entirely outside of the SAC boundary. There is hydrological connectivity between the proposed development and this SAC via watercourses within the site boundary which discharge to the River Shannon, which is designated as the SAC at this point. The proposed works have the potential to cause deterioration in surface water quality during the construction, operational and decommissioning phase of the development potentially affecting the following aquatic QIs: • Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0] • *Lutra lutra* (Otter) [1355] **This SAC is therefore within the likely zone of impact and following the precautionary principle the potential for significant effect on the above QIs exists. Further assessment is required.**

European Sites and distance from proposed development	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 07/01/2020)	Conservation Objectives	Likely Zone of Impact Determination and assessment of potential for significant effect
			Effects on the following QIs can be excluded due to the terrestrial nature of the habitats/species, the distance from the proposed works area and the absence of a complete source-pathway-receptor chain: • Limestone pavements [8240] • Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*) [6510] Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) [6410]
All Saints Bog and Esker SAC Distance from wind farm site: 3.2km	• Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites) [6210] • Active raised bogs [7110] • Degraded raised bogs still capable of natural regeneration [7120] • Depressions on peat substrates of the *Rhynchosporion* [7150] • Bog woodland [91D0]	Detailed conservation objectives for this site (Version 1, March 2016) were reviewed as part of the assessment and are available at www.npws.ie	This European Site is located 3.2km west of the proposed development site. The proposed development is located entirely outside of the SAC boundary. There is hydrological connectivity between the proposed development site and this SAC via tributaries that discharge to the Rapemills River, which flows along the north-eastern boundary of the SAC. However, having reviewed the Site-Specific Conservation Objective Document for the SAC, it is clear that there is no connectivity with any of the QIs. None of them border the river and Map number 6 of the document shows all habitats to drain into the river and to be located at a significantly higher elevation than it. **There is no potential for significant effect on this European Site and it is not located within the Zone of Likely Impact and no further assessment is required.**

European Sites and distance from proposed development	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 07/01/2020)	Conservation Objectives	Likely Zone of Impact Determination and assessment of potential for significant effect
Ridge Road, SW of Rapemills SAC Distance from wind farm site: 4km	• Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (*important orchid sites) [6210]	Detailed conservation objectives for this site (Version 1, June 2018) were reviewed as part of the assessment and are available at www.npws.ie	This European Site is 4km to the north-west of the development site, at its closest point. The proposed development is located entirely outside of the SAC boundary. No hydrological connection between the site of the proposed development and the SAC was identified. In addition, the QI habitat is terrestrial in nature. No pathway for significant effect on this European Site was identified. **There is no potential for significant effect on this European Site and it is not located within the Zone of Likely Impact and no further assessment is required**
Moyclare Bog SAC Distance from wind farm site: 5.4km	• Active raised bogs [7110] • Degraded raised bogs still capable of natural regeneration [7120] • Depressions on peat substrates of the *Rhynchosporion* [7150]	Detailed conservation objectives for this site (Version 1, November 2015) were reviewed as part of the assessment and are available at www.npws.ie	This European Site is 5.4km to the north of the proposed development site, at its closest point. The proposed development is located entirely outside of the SAC boundary. This site is in a separate hydrological catchment. No hydrological connection between the site of the proposed development and the SAC was identified. No pathway for significant effect on this European Site was identified. **There is no potential for significant effect on this European Site and it is not located within the Zone of Likely Impact and no further assessment is required**

European Sites and distance from proposed development	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 07/01/2020)	Conservation Objectives	Likely Zone of Impact Determination and assessment of potential for significant effect
Ferbane Bog SAC Distance from wind farm site: 6.1km	• Active raised bogs [7110] • Degraded raised bogs still capable of natural regeneration [7120] • Depressions on peat substrates of the *Rhynchosporion* [7150]	Detailed conservation objectives for this site (Version 1, November 2015) were reviewed as part of the assessment and are available at www.npws.ie	This European Site is 5.4km to the north of the proposed development site, at its closest point. The proposed development is located entirely outside of the SAC boundary. This site is in a separate hydrological catchment. No hydrological connection between the site of the proposed development and the SAC was identified. No pathway for significant effect on this European Site was identified. **There is no potential for significant effect on this European Site and it is not located within the Zone of Likely Impact and no further assessment is required**
Redwood Bog SAC Distance from wind farm site: 8.9km	• Active raised bogs [7110] • Degraded raised bogs still capable of natural regeneration [7120] • Depressions on peat substrates of the *Rhynchosporion* [7150]	Detailed conservation objectives for this site (Version 1, December 2015) were reviewed as part of the assessment and are available at www.npws.ie	This European Site is 8.9km to the west of the proposed development site, at its closest point. The proposed development is located entirely outside of the SAC boundary. This site is in a separate hydrological catchment. No hydrological connection between the site of the proposed development and the SAC was identified. No pathway for significant effect on this European Site was identified. **There is no potential for significant effect on this European Site and it is not located within the Zone of Likely Impact and no further assessment is required**
Ballyduff/Clonfinane Bog SAC	• Active raised bogs [7110]	Detailed conservation objectives for this site (Version 1, November 2015) were	The proposed development is located entirely outside of the SAC boundary.

European Sites and distance from proposed development	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 07/01/2020)	Conservation Objectives	Likely Zone of Impact Determination and assessment of potential for significant effect
Distance from wind farm site: 9.8km	• Degraded raised bogs still capable of natural regeneration [7120] • Depressions on peat substrates of the *Rhynchosporion* [7150] • Bog woodland [91D0]	reviewed as part of the assessment and are available at www.npws.ie	This site is in a separate hydrological catchment. No hydrological connection between the site of the proposed development and the SAC was identified. No pathway for significant effect on this European Site was identified. **There is no potential for significant effect on this European Site and it is not located within the Zone of Likely Impact and no further assessment is required**
Lisduff Fen SAC Distance from wind farm site: 11.2km	• Petrifying springs with tufa formation (*Cratoneurion*) [7220] • Alkaline fens [7230] • *Vertigo geyeri* (Geyer's Whorl Snail) [1013]	Detailed conservation objectives for this site (Version 1, November 2019) were reviewed as part of the assessment and are available at www.npws.ie	This European Site is 11.2km to the south-east of the proposed development site, at its closest point. The proposed development is located entirely outside of the SAC boundary. This site is in a separate hydrological catchment. No hydrological connection between the site of the proposed development and the SAC was identified. No pathway for significant effect on this European Site was identified. **There is no potential for significant effect on this European Site and it is not located within the Zone of Likely Impact and no further assessment is required**
Island Fen SAC Distance from wind farm site: 11.3km	• *Juniperus communis* formations on heaths or calcareous grasslands [5130] • Alkaline fens [7230]	Detailed conservation objectives for this site (Version 1, October 2018) were reviewed as part of the assessment and are available at www.npws.ie	This European Site is 11.3km to the south-east of the proposed development site, at its closest point. The proposed development is located entirely outside of the SAC boundary. This site is in a separate hydrological catchment. No hydrological connection between the site of the proposed

European Sites and distance from proposed development	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 07/01/2020)	Conservation Objectives	Likely Zone of Impact Determination and assessment of potential for significant effect
			development and the SAC was identified. No pathway for significant effect on this European Site was identified. **There is no potential for significant effect on this European Site and it is not located within the Zone of Likely Impact and no further assessment is required**
Sharavogue Bog SAC Distance from wind farm site: 12.2km	• Active raised bogs [7110] • Degraded raised bogs still capable of natural regeneration [7120] • Depressions on peat substrates of the *Rhynchosporion* [7150]	Detailed conservation objectives for this site (Version 1, November 2015) were reviewed as part of the assessment and are available at www.npws.ie	This European Site is 12.2km to the south-west of the proposed development site, at its closest point. The proposed development is located entirely outside of the SAC boundary. This site is in a separate hydrological catchment. No hydrological connection between the site of the proposed development and the SAC was identified. No pathway for significant effect on this European Site was identified. **There is no potential for significant effect on this European Site and it is not located within the Zone of Likely Impact and no further assessment is required**
Fin Lough (Offaly) SAC Distance from wind farm site: 12.2km	• Alkaline fens [7230] • *Vertigo geyeri* (Geyer's Whorl Snail) [1013]	Detailed conservation objectives for this site (Version 1, February 2019) were reviewed as part of the assessment and are available at www.npws.ie	This European Site is 12.2km to the north of the proposed development site, at its closest point. The proposed development is located entirely outside of the SAC boundary. This site is in a separate hydrological catchment. No hydrological connection between the site of the proposed development and the SAC was identified. No pathway for significant effect on this European Site was identified.

European Sites and distance from proposed development	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 07/01/2020)	Conservation Objectives	Likely Zone of Impact Determination and assessment of potential for significant effect
			There is no potential for significant effect on this European Site and it is not located within the Zone of Likely Impact and no further assessment is required
Clonaslee Eskers and Derry Bog SAC Distance from wind farm site: 12.4km	• Alkaline fens [7230] • *Vertigo geyeri* (Geyer's Whorl Snail) [1013]	Detailed conservation objectives for this site (Version 1, February 2019) were reviewed as part of the assessment and are available at www.npws.ie	This European Site is 12.4km to the east of the proposed development site, at its closest point. The proposed development is located entirely outside of the SAC boundary. This site is in a separate hydrological catchment. No hydrological connection between the site of the proposed development and the SAC was identified. No pathway for significant effect on this European Site was identified. **There is no potential for significant effect on this European Site and it is not located within the Zone of Likely Impact and no further assessment is required** **This site is not in the zone of likely impact, and no further assessment is required.**
Arragh More (Derrybreen) Bog SAC Distance from wind farm site: 12.9km	• Degraded raised bogs still capable of natural regeneration [7120]	This site has the generic conservation objective; *'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,'* (NPWS, version 6, 2018).	This European Site is 12.9km to the west of the proposed development site, at its closest point. The proposed development is located entirely outside of the SAC boundary. This site is in a separate hydrological catchment. No hydrological connection between the site of the proposed development and the SAC was identified. No pathway for significant effect on this European Site was identified.

European Sites and distance from proposed development	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 07/01/2020)	Conservation Objectives	Likely Zone of Impact Determination and assessment of potential for significant effect
			There is no potential for significant effect on this European Site and it is not located within the Zone of Likely Impact and no further assessment is required
Mongan Bog SAC Distance from wind farm site: 13.3km	• Active raised bogs [7110] • Degraded raised bogs still capable of natural regeneration [7120] • Depressions on peat substrates of the *Rhynchosporion* [7150]	Detailed conservation objectives for this site (Version 1, April 2016) were reviewed as part of the assessment and are available at www.npws.ie	This European Site is 13.3km to the north of the proposed development site, at its closest point. The proposed development is located entirely outside of the SAC boundary. This site is in a separate hydrological catchment. No hydrological connection between the site of the proposed development and the SAC was identified. No pathway for significant effect on this European Site was identified. **There is no potential for significant effect on this European Site, it is not located within the Zone of Likely Impact and no further assessment is required**
Pilgrim's Road Esker SAC Distance from wind farm site: 13.3km	• Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (*important orchid sites) [6210]	Detailed conservation objectives for this site (Version 1, July 2018) were reviewed as part of the assessment and are available at www.npws.ie	This European Site is 13.3km to the north of the development site, at its closest point. The proposed development is located entirely outside of the SAC boundary. This site is in a separate hydrological catchment. No hydrological connection between the site of the proposed development and the SAC was identified. No pathway for significant effect on this European Site was identified.

European Sites and distance from proposed development	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 07/01/2020)	Conservation Objectives	Likely Zone of Impact Determination and assessment of potential for significant effect
			There is no potential for significant effect on this European Site, it is not located within the Zone of Likely Impact and no further assessment is required
Slieve Bloom Mountains SAC Distance from wind farm site: 13.5km	• Northern Atlantic wet heaths with *Erica tetralix* [4010] • Blanket bogs (* if active bog) [7130] • Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0]	Detailed conservation objectives for this site (Version 1, September 2016) were reviewed as part of the assessment and are available at www.npws.ie	This European Site is 13.5km to the north of the proposed development site, at its closest point. The proposed development is located entirely outside of the SAC boundary. This site is in a separate hydrological catchment. No hydrological connection between the site of the proposed development and the SAC was identified. No pathway for significant effect on this European Site was identified. **There is no potential for significant effect on this European Site, it is not located within the Zone of Likely Impact and no further assessment is required**
Kilcarren-Firville Bog SAC Distance from wind farm site: 13.6km	• Active raised bogs [7110] • Degraded raised bogs still capable of natural regeneration [7120] • Depressions on peat substrates of the *Rhynchosporion* [7150]	Detailed conservation objectives for this site (Version 1, January 2016) were reviewed as part of the assessment and are available at www.npws.ie	This European Site is 13.6km to the south-west of the proposed development site, at its closest point. The proposed development is located entirely outside of the SAC boundary. This site is in a separate hydrological catchment. No hydrological connection between the site of the proposed development and the SAC was identified. No pathway for significant effect on this European Site was identified.

European Sites and distance from proposed development	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 07/01/2020)	Conservation Objectives	Likely Zone of Impact Determination and assessment of potential for significant effect
			There is no potential for significant effect on this European Site, it is not located within the Zone of Likely Impact and no further assessment is required
Lough Derg, North-east Shore SAC (002241) Distance from wind farm site: 19km (29.2km via surface water)	• *Juniperus communis* formations on heaths or calcareous grasslands [5130] • *Calcareous fens with Cladium mariscus and species of the Caricion davallianae [7210]* • Alkaline fens [7230] • Limestone pavements [8240] • Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-padion, Alnion incanae, Salicion albae*) [91E0] • *Taxus baccata* woods of the British Isles [91J0]	Detailed conservation objectives for this site (Version 1, April 2019) were reviewed as part of the assessment and are available at www.npws.ie	This European Site is located 29.2km downstream of the proposed development site, via surface water connectivity. The proposed development is located entirely outside the SAC There is distant hydrological connectivity with this SAC and therefore following an extremely precautionary principle, the proposed works have the potential to result in some effect on water quality within it. Whilst it is highly unlikely that any water pollution caused by the proposed development could result in significant effects on the SAC, this potential has been considered in this Screening report. Water pollution associated with the construction, operational and decommissioning phases of the development could potentially affect the following QI habitats: • Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* [7210] • Alkaline fens [7230] • Alluvial forests with Alnus glutinosa and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0] **This SAC is therefore within the likely zone of impact and following the precautionary principle the potential for**

European Sites and distance from proposed development	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 07/01/2020)	Conservation Objectives	Likely Zone of Impact Determination and assessment of potential for significant effect
			significant effect on the above QIs exists. Further assessment is required. The potential for significant effects on the following QI habitats was excluded as they are terrestrial in nature and no pathway for impact was identified: • *Juniperus communis* formations on heaths or calcareous grasslands [5130] • Limestone pavements [8240] • *Taxus baccata* woods of the British Isles [91J0]
Clara Bog SAC (000572) Distance from wind farm site: 14.75km	› Semi-natural dry grasslands and scrubland facies on calcareous substrates › *(Festuco-Brometalia) (*important orchid sites)* [6210] › Active raised bogs *[7110]* › Degraded raised bogs still capable of natural regeneration [7120] › Depressions on peat substrates of the *Rhynchosporion* [7150] › Bog woodland [91D0]	Detailed conservation objectives for this site (Version 1, April 2016) were reviewed as part of the assessment and are available at www.npws.ie	This European Site is 14.75km to the north-east of the proposed development site, at its closest point. The proposed development is located entirely outside of the SAC boundary. This site is in a separate hydrological catchment. No hydrological connection between the site of the proposed development and the SAC was identified. No pathway for significant effect on this European Site was identified. **There is no potential for significant effect on this European Site, it is not located within the Zone of Likely Impact and no further assessment is required**
Special Protection Area (SPA)			
Middle Shannon Callows SPA (004096)	• Whooper Swan *(Cygnus Cygnus)* [A038] • Wigeon *(Anas penelope)* [A050] • Corncrake *(Crex crex)* [A122]	This site has the generic conservation objective:	There is hydrological connectivity between the proposed development and this SPA via watercourses within the site boundary which discharge to the River Shannon

European Sites and distance from proposed development	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 07/01/2020)	Conservation Objectives	Likely Zone of Impact Determination and assessment of potential for significant effect
2.3 km to the west of the development site.	• Golden Plover *(Pluvialis apricaria)* [A140] • Lapwing *(Vanellus vanellus)* [A142] • Black-tailed Godwit *(Limosa Limosa)* [A156] • Black-headed Gull *(Larus ridibundus)* [A179] • Wetland and Waterbird [A999]	"To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests of this SPA." This site also has a second conservation objective: "To maintain or restore the favourable conservation condition of the wetland habitat at Middle Shannon Callows SPA as a resource for the regularly-occurring migratory waterbirds that utilise it." (NPWS (2018) Conservations objectives for Middle Shannon Callow SPA [004096]. Generic version 6.0)	The proposed works have the potential to cause deterioration of water quality during the construction, operation and decommissioning phase of the development potentially affecting the downstream SCI 'Wetland and Waterbirds'. The proposed development site is within the core foraging distance or provides suitable habitat for the following SCI species that were recorded during the extensive bird surveys undertaken at the site between 2017 and 2019. • golden plover • black-headed gull • whooper Swan • lapwing • wigeon • black-tailed godwit A potential pathway for effects was identified in the form of disturbance, displacement and collision risk to the aforementioned species. The potential for significant effects on these SCI species cannot be excluded and further assessment is required. **This SPA is therefore within the likely zone of impact and following the precautionary principle the potential for significant effect on the above SCIs exists. Further assessment is required.**

European Sites and distance from proposed development	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 07/01/2020)	Conservation Objectives	Likely Zone of Impact Determination and assessment of potential for significant effect
			Corncrake was not recorded during these surveys. No potential for significant effects on these species was identified.
All Saints Bog SPA (004103) 2.69 km southwest of the development site.	• Greenland White-fronted Goose *(Anser albifrons flavirostris)* [A395]	This site has the generic conservation objective: "To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests of this SPA." (NPWS (2018) Conservations objectives for All Saints Bog SPA [004103]. Generic version 6.0)	The proposed development site is within the core foraging distance of Greenland White-fronted Goose (5-8km) as per Scottish Natural Heritage Guidelines (SNH, 2016). However, the site synopsis for this SPA states that this SPA was formerly used by part of the internationally important Greenland White-fronted Goose population and "In recent years, however, there has been little or no use of All Saints by the geese following a general trend of less usage of raised bogs in favour of grassland sites". This species was not recorded during the extensive surveys undertaken between 2017 – 2019. There is no potential for significant effect on this species. **There is no potential for significant effect on this European Site, it is not located within the Zone of Likely Impact and no further assessment is required**
Dovegrove Callows SPA (004137) 4.21 km to the south of the development site.	• Greenland White-fronted Goose *(Anser albifrons flavirostris)* [A395]	This site has the generic conservation objective: "To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests of this SPA."	The proposed development site is within the core foraging distance of Greenland White-fronted Goose (5-8km) as per Scottish Natural Heritage Guidelines (SNH, 2016). However, this species was not recorded during the extensive suite of bird surveys undertaken between September 2017 – September 2019. There is no potential for significant effect on this species.

European Sites and distance from proposed development	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 07/01/2020)	Conservation Objectives	Likely Zone of Impact Determination and assessment of potential for significant effect
		(NPWS (2018) Conservations objectives for Dovegrove Callows SPA [004137]. Generic version 6.0)	**There is no potential for significant effect on this European Site, it is not located within the Zone of Likely Impact and no further assessment is required**
River Little Brosna Callows SPA (004086) 4.48 km to the southwest of the development site.	• Whooper Swan *(Cygnus Cygnus)* [A038] • Wigeon *(Anas penelope)* [A050] • Teal *(Anas creca)* [A052] • Pintail *(Anas acuta)* [A054] • Shoveler *(Anas clypeata)* [A056] • Golden Plover *(Pluvialis apricaria)* [A140] • Lapwing *(Vanellus vanellus)* [A142] • Black-tailed Godwit *(Limosa Limosa)* [A156] • Black-headed Gull *(Larus ridibundus)* [A179] • Greenland White-fronted Goose *(Anser albifrons flavirostris)* [A395] • Wetland and Waterbird [A999]	This site has the generic conservation objective: "To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests of this SPA." This site also has a second conservation objective: "To maintain or restore the favourable conservation condition of the wetland habitat at River Little Brosna Callows SPA as a resource for the regularly-occurring migratory waterbirds that utilise it." (NPWS (2018) Conservations objectives for Middle Shannon Callow SPA [004086]. Generic version 6.0)	This SPA is in a separate water catchment with no hydrological connectivity to the development site. There is no potential for pollution related impacts to Wetland [A999] habitat. The proposed development site is within the core foraging distance or provides suitable habitat for the following SCI species that were recorded during the extensive bird surveys undertaken at the site between 2017 and 2019. • Whooper swan • Black headed gull • golden plover • wigeon • lapwing • black-tailed godwit • teal • shoveler A potential pathway for effects was identified in the form of disturbance, displacement and collision risk to the aforementioned species. The potential for significant effects on these SCI species cannot be excluded and further assessment is required.

European Sites and distance from proposed development	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 07/01/2020)	Conservation Objectives	Likely Zone of Impact Determination and assessment of potential for significant effect
			This SPA is therefore within the likely zone of impact and following the precautionary principle, the potential for significant effect on the above SCIs exists. Further assessment is required. Greenland white fronted goose and pintail were not recorded during these surveys. No potential for significant effects on these species was identified.
Slieve Bloom Mountains SPA (004160) 11.64 km to the southeast of the development site.	• Hen Harrier *(Circus cyaneus)* [A082]	This site has the generic conservation objective: "To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests of this SPA." (NPWS (2018) Conservations objectives for Slieve Bloom Mountains SPA [004160]. Generic version 6.0)	The proposed development site is outside the core foraging distance of hen harrier (Core range of 2km, with maximum range of 10km) as per Scottish Natural Heritage Guidelines (SNH, 2016). **This SPA is therefore not within the likely zone of impact, and no further assessment is required.**
River Suck Callows SPA (004097) 12.30 km northwest of the development site.	• Whooper Swan (Cygnus Cygnus) [A038] • Wigeon (Anas penelope) [A050] • Golden Plover (Pluvialis apricaria) [A140] • Lapwing (Vanellus vanellus) [A142] • Greenland White-fronted Goose (Anser albifrons flavirostris) [A395] • Wetlands and Waterbirds [A999]	This site has the generic conservation objective: "To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests of this SPA."	The proposed development site is outside the core foraging distance of whooper swan (5km), golden plover (3km), Greenland white-fronted goose (5-8km) as per Scottish Natural Heritage Guidelines (SNH, 2016). The development is located outside the identified zone of sensitivity of lapwing (800m as per McGuinness et.al. (2015)).

European Sites and distance from proposed development	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 07/01/2020)	Conservation Objectives	Likely Zone of Impact Determination and assessment of potential for significant effect
		This site also has a second conservation objective: "To maintain or restore the favourable conservation condition of the wetland habitat at River Suck Callows SPA as a resource for the regularly-occurring migratory waterbirds that utilise it." (NPWS (2018) Conservations objectives for River Suck Callow SPA [004097]. Generic version 6.0)	No zone of sensitivity has been described in Mc Guinness et.al (2015) for wigeon as this species is not identified as particularly vulnerable to wind energy development due to their flight behavior or habitat requirements. There is no potential for pollution to the wetland habitat, as this site is hydrologically upstream in the Shannon catchment. **There is no potential for significant effect on this European Site, it is not located within the Zone of Likely Impact and no further assessment is required.**
Mongan Bog SPA 13.3km	› Greenland White-fronted Goose *(Anser albifrons flavirostris)* [A395]	This site has the generic conservation objective: '*To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA*,' (NPWS, version 6, 2018).	The proposed development is located outside the potential core foraging range of the SCI species (5-8km) (SNH Guidelines, 2016) and it was not recorded during the bird surveys undertaken. **There is no potential for significant effect on this European Site, it is not located within the Zone of Likely Impact and no further assessment is required.**
Lough Derg (Shannon) SPA 19km (29.2km via surface water)	• Cormorant (Phalacrocorax carbo) [A017] • Tufted Duck (Aythya fuligula) [A061] • Goldeneye (Bucephala clangula) [A067] • Common Tern (Sterna hirundo) [A193] • Wetland and Waterbirds [A999]	This site has the generic conservation objective: *To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA*.' (NPWS Generic version 6.0, 2018)	There is downstream hydrological connectivity between the proposed wind farm and this SPA Due to the intervening distance between the development site and the SPA potential effects to the SCI bird species in terms of disturbance, displacement and collision risk can be excluded

European Sites and distance from proposed development	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 07/01/2020)	Conservation Objectives	Likely Zone of Impact Determination and assessment of potential for significant effect
		There is a second conservation objective for this site: *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.*	Following an extremely precautionary principle, the proposed works have the potential to cause deterioration in surface water quality during the construction, operation and decommissioning phase of the development potentially affecting 'Wetland [A999]' habitat. **This SPA is therefore within the likely zone of impact and following the precautionary principle the potential for significant effect on the above SCIs exists. Further assessment is required.**

3.3 European Sites with the Potential to be Significantly Affected by the Proposed Development

The following European Sites have the potential to be significantly affected by the proposed development:

River Shannon Callows SAC

There is hydrological connectivity between the proposed development and this SAC via watercourses within and adjacent to the site boundary that flow to the River Shannon. The proposed works have the potential to cause deterioration in surface water quality through the run-off of silt, hydrocarbons, cementitious material and other pollutants during the construction, operational and decommissioning phase of the development potentially affecting the following habitats and species:

- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0]
- *Lutra lutra* (Otter) [1355]

Lough Derg, North-east Shore SAC

This site lies 29.2km downstream of the proposed development site (via hydrological connectivity). Following the precautionary principle, the proposed works have the potential to cause deterioration in surface water quality through the run off of silt, hydrocarbons, cementitious material and other pollutants during the construction, operational and decommissioning phase of the development potentially affecting the following habitats and species:

- Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* [7210]
- Alkaline fens [7230]
- Alluvial forests with Alnus glutinosa and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0]

Middle Shannon Callows SPA

There is hydrological connectivity between the proposed development and this SPA via watercourses within and adjacent to the site boundary that flow to the River Shannon. The proposed works have the potential to cause deterioration in surface water quality through the run-off of silt, hydrocarbons, cementitious material and other pollutants during the construction, operational and decommissioning phase of the development potentially affecting the downstream SCI:

- 'Wetland and Waterbirds'

This proposed development is within the core foraging distance or provides suitable habitat for a number of the SCI species of this SPA. On a precautionary basis, a potential pathway for significant effect was identified in the form of bird disturbance and displacement as a result of construction activity. In addition, the potential for collision risk associated with the operation of the turbines was identified. The SCI species that are potentially affected by the proposed development are listed below:

- golden plover
- whooper swan
- black-headed gull
- lapwing
- wigeon
- black tailed godwit

River Little Brosna Callows SPA

There is no hydrological connectivity between the proposed development and this SPA and no potential for effects on habitats as a result of deterioration in water quality within the SPA. The proposed development is within the core foraging distance or provides suitable habitat for a number of the SCI species of this SPA. On a precautionary basis, a potential pathway for significant effect was identified in the form of bird disturbance and displacement as a result of construction activity. In addition, the potential for collision risk associated with the operation of the turbines was identified. The SCI species that are potentially affected by the proposed development are listed below:

- black-headed gull
- whooper swan
- lapwing
- golden plover
- wigeon
- black-tailed godwit
- teal
- shoveler

Lough Derg (Shannon) SPA

There is no potential for disturbance, displacement or collision risk effects on SCI species as a result of any stage of the proposed development as it is 19km (29.2km via surface water connectivity) from the proposed development site, via surface water connectivity.

Following the precautionary principle, the proposed works have the potential to cause deterioration in surface water quality through the run off of silt, hydrocarbons, cementitious material and other pollutants during the construction, operational and decommissioning phase of the development potentially affecting the following SCI:

- 'Wetland and Waterbirds [A999]' habitat.

3.4 Likely Cumulative Impact of the Proposed Works on European Sites, in-combination with other plans and projects

Where the potential for significant effects on European Sites has been identified in the preceding sections of this document, there is potential for the proposed development to result in cumulative effect. This potential is addressed in the NIS that accompanies this application.

Where no pathway for effect on a particular European Site was identified, there is no potential for cumulative effects on that site and no further assessment is required.

4. ARTICLE 6(3) APPROPRIATE ASSESSMENT SCREENING STATEMENT AND CONCLUSIONS

4.1 Concluding Statement

Following an examination, analysis and evaluation of the relevant data and information set out within this Screening Report, it cannot be excluded beyond reasonable scientific doubt, in view of best scientific knowledge, on the basis of objective information and in light of the conservation objectives of the relevant European sites, that the proposed development, individually or in combination with other plans and projects, would be likely to have a significant effect on the following sites:

- River Shannon Callows SAC
- Lough Derg, North-east Shore SAC
- Middle Shannon Callows SPA
- River Little Brosna Callows SPA
- Lough Derg (Shannon) SPA

As a result, an Appropriate Assessment is required, and a Natura Impact Statement shall be prepared in respect of the proposed development in order to assess whether the proposed development will adversely impact the integrity of these European Sites.

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APPENDIX 2

EIAR HYDROLOGY CHAPTER

9. HYDROLOGY AND HYDROGEOLOGY

9.1 Introduction

9.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by MKO to carry out an assessment of the potential significant effects of the proposed wind farm development on water aspects (hydrology and hydrogeology) of the receiving environment.

The objectives of the assessment are:

- Produce a baseline study of the existing water environment (surface water and groundwater) in the area of the proposed wind farm development and associated works;
- Identify likely significant effects of the proposed development on surface water and groundwater during construction, operational and decommissioning phases of the development;
- Identify mitigation measures to avoid, reduce or offset significant negative effects;
- Assess significant residual effects; and
- Assess cumulative effects of the proposed development and other local developments.

9.1.2 Statement of Authority

Hydro-Environmental Services (HES) are a specialist hydrological, hydrogeological and environmental practice which delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford.

Our core areas of expertise and experience include upland hydrology and windfarm drainage design. We routinely complete impact assessments for hydrology and hydrogeology for a large variety of project types.

This chapter of the EIAR was prepared by Michael Gill and Adam Keegan.

Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 18 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland. He has substantial experience in surface water drainage design and SUDs design and surface water/groundwater interactions. For example, Michael has worked on the EIS for Oweninny WF, Cloncreen WF, and Yellow River WF, and over 100 other wind farm-related projects.

Adam Keegan is a hydrogeologist with two years of experience in the environmental sector in Ireland. Adam has been involved in Environmental Impact Assessment Reports (EIARs) for numerous projects including wind farms, grid connections, quarries and small housing developments. Adam holds an MSc in Hydrogeology and Water Resource Management. Adam has worked on several wind farm EIAR projects, including Croagh WF, Lyrenacarriga WF (SID), Cleanrath WF, Carrownagowan WF (SID), and Fossy WF.

9.1.3 Scoping and Consultation

The scope for this chapter of the EIAR has also been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process and the List of Consultees is outlined in Section 2.6 of this EIAR. Matters raised by Consultees in their responses with respect to the water environment are summarised in Table 9.1 below.

Table 9.1: Summary of Water Environment Related Scoping Responses

Consultee	Description	Addressed in Section
Geological Survey of Ireland (GSI)	• Assessment of Geohazards required, including peat stability, and groundwater flooding. • GSI have identified 3 local County Geological Sites, Crancreagh Mushroom Rock; Derrinlough Mushroom Rock; and, Drinagh Mushroom Rock. • Assessment of groundwater characteristics/resources and groundwater protection required. • Assessment of mineral resources and aggregates required.	Refer to Chapter 8: Land, Soils and Geology (Appendix 8.1) for a Geotechnical and Peat Stability Assessment. Flooding is addressed in Section 0. Groundwater assessment addressed at Section 9.3.8, Section 9.3.9, Section 9.3.10, Section 9.3.15, Section 9.5.3.2, Section 9.5.3.8, and Section 9.5.3.9. Refer to Chapter 8: Land, Soils and Geology for assessment of aggregate resources.
Department of Culture Heritage and Gaeltacht	• Where archaeological material is to be preserved in-situ, empirical measurements into the future hydrology of the site will be required, e.g. by mean of the use of dip wells (piezometers).	This issue related to Archaeology, but the type of potential monitoring is hydrological.
Department of Agriculture, Food and the Marine	• A response was received but mainly related to felling works.	As felling works does not form a part of this proposal no response is provided.

9.1.4 Relevant Legislation

This chapter of the EIAR is prepared in accordance with the requirements of of the Environmental Impact Assessment legislation outlined in Chapter 1: Introduction

The requirements of the following legislation are also complied with:

- S.I. No. 349 of 1989: European Communities (Environmental Impact Assessment) Regulations, and subsequent Amendments (S.I. No. 84 of 1994, S.I. No. 101 of 1996, S.I. No. 351 of 1998, S.I. No. 93 of 1999, S.I. No. 450 of 2000 and S.I. No. 538 of 2001, S.I. 134 of 2013 and the Minerals Development Act 2017), the Planning and Development Act, and S.I. 600 of 2001 Planning and Development Regulations and subsequent Amendments. These instruments implement EU Directive 85/337/EEC and subsequent amendments, on the assessment of the effects of certain public and private projects on the environment;
- S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations, resulting from EU Directive 78/659/EEC on the Quality of Fresh Waters Needing Protection or Improvement in order to Support Fish Life;

- S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy) and S.I. No. 722 of 2003 European Communities (Water Policy) Regulations which implement EU Water Framework Directive (2000/60/EC) establishing a framework for the Community action in the field of water policy and provide for implementation of 'daughter' Groundwater Directive (2006/118/EC) on the protection of groundwater against pollution and deterioration. Since 2000 water management in the EU has been directed by the Water Framework Directive (2000/60/EC) (as amended by Decision No. 2455/2011/EC; Directive 2008/32/EC; Directive 2008/105/EC; Directive 2009/31/EC; Directive 2013/39/EU; Council Directive 2013/64/EU; and Commission Directive 2014/101/EU ("**WFD**"). The WFD was given legal effect in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003);
- S.I. No. 684 of 2007: Waste Water Discharge (Authorisation) Regulations 2017, resulting from EU Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive);S.I. No. 106 of 2007: European Communities (Drinking Water) Regulations 2007and S.I. No. 122 of 2014: European Communities (Drinking Water) Regulations 2014, arising from EU Directive 98/83/EC on the quality of water intended for human consumption (the "Drinking Water Directive") and EU Directive 2000/60/EC;
- S.I. No. 9 of 2010: European Communities Environmental Objectives (Groundwater) Regulations 2010 (as amended by S.I. No. 389/2011; S.I. No. 149/2012; S.I. No. 366/2016; the Radiological Protection (Miscellaneous Provisions) Act 2014; and S.I. No. 366/2016); and,
- S.I. No. 296 of 2009: The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (as amended by S.I. No. 355 of 2018)

9.1.5 Relevant Guidance

The Hydrology and Hydrogeology chapter of the EIAR is carried out in accordance with guidance oytlined in Chapter 1: Introduction the guidance contained in the following:

- Institute of Geologists Ireland (2013): Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;
- National Roads Authority (2005): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters;
- Scottish Natural Heritage (2010): Good Practice During Wind Farm Construction;
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note);
- PPG5 – Works or Maintenance in or Near Watercourses (UK Guidance Note);
- CIRIA (Construction Industry Research and Information Association) (2006): Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006);
- CIRIA 2006: Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors (CIRIA C532, 2006).

9.2 Methodology

9.2.1 Desk Study

A desk study of the proposed development site, third party turbary lands and surrounding area was completed prior to the undertaking of field mapping and walkover assessments. The desk study involved collecting all relevant geological, hydrological, hydrogeological and meteorological data for the area. This included consultation of the following:

- Bord na Móna databases on peat depth and drainage;
- Environmental Protection Agency databases (www.epa.ie);
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks and Wildlife Services Public Map Viewer (www.npws.ie);
- Water Framework Directive Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 15 (Geology of Galway-Offaly). Geological Survey of Ireland (GSI, 2003);
- Geological Survey of Ireland (2003) – Banagher Groundwater Body Initial Characterization Report, and Clara GWB Initial Characterization Report;
- OPW Indicative Flood Maps (www.floodinfo.ie);
- Environmental Protection Agency – "Hydrotool" Map Viewer (www.epa.ie);
- CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie); and,
- Department of Environment, Community and Local Government on-line mapping viewer (www.myplan.ie).

9.2.2 Baseline Monitoring and Site Investigations

A hydrological walkover survey, including detailed drainage mapping and baseline monitoring/sampling, was undertaken by HES between the 5th and 9th April 2019, and again between 9th and 11th September 2019. HES staff have undertaken ~60-man hours of site work. Geotechnical ground investigations and a peat stability assessment were also undertaken by Fehily Timoney & Company (FT) during 2019. The combined geological and hydrogeological dataset collated by HES and FT has been used in the preparation of this EIAR Chapter.

In summary, all site investigations to address the Hydrology and Hydrogeology chapter of the EIAR included the following:

- Walkover surveys and hydrological mapping of the site and the surrounding area were undertaken whereby water flow directions and drainage patterns were recorded;
- A total of 319 peat probes were undertaken by FT & HES in 2019 to determine the thickness and geomorphology of the blanket peat overlying the site;
- A Geotechnical and Peat Stability Assessment was undertaken by FT (Dec 2019a);
- Trial pitting by FT across the site at 69 no. locations;
- A total of 41 no. gouge core sample points were undertaken by HES across the site to investigate peat and mineral soil lithology;
- Field hydrochemistry measurements (electrical conductivity, pH, dissolved oxygen and temperature) and surface water flow measurements were taken to determine the origin and nature of surface water flows surrounding the site;
- A flood risk assessment for the proposed development has been undertaken by HES; and,
- A total of 20 no. surface water samples were taken to determine the baseline water quality of the primary surface waters originating from the proposed development site.

9.2.3 Impact Assessment Methodology

The guideline criteria (EPA, August 2017) for the assessment of likely significant effects require that likely effects are described with respect to their extent, magnitude, type (i.e. negative, positive or neutral) probability, duration, frequency, reversibility, and transfrontier nature (if applicable). The descriptors used in this environmental impact assessment are those set out in the EPA (2017) Glossary of effects as shown in Chapter 1 of this EIAR.

In addition to the above methodology, the sensitivity of the water environment receptors was assessed on completion of the desk study and baseline study. Levels of sensitivity which are defined in Table 9.2 are used to assess the potential effect that the proposed development may have on them.

Table 9.2 Receptor Sensitivity Criteria (Adapted from www.sepa.org.uk)

Sensitivity of Receptor	
Not sensitive	Receptor is of low environmental importance (e.g. surface water quality classified by EPA as A3 waters or seriously polluted), fish sporadically present or restricted). Heavily engineered or artificially modified and may dry up during summer months. Environmental equilibrium is stable and is resilient to changes which are considerably greater than natural fluctuations, without detriment to its present character. No abstractions for public or private water supplies. GSI groundwater vulnerability “Low” – “Medium” classification and “Poor” aquifer importance.
Sensitive	Receptor is of medium environmental importance or of regional value. Surface water quality classified by EPA as A2. Salmonid species may be present and may be locally important for fisheries. Abstractions for private water supplies. Environmental equilibrium copes well with all natural fluctuations but cannot absorb some changes greater than this without altering part of its present character. GSI groundwater vulnerability “High” classification and “Locally” important aquifer.
Very sensitive	Receptor is of high environmental importance or of national or international value i.e. NHA or SAC. Surface water quality classified by EPA as A1 and salmonid spawning grounds present. Abstractions for public drinking water supply. GSI groundwater vulnerability “Extreme” classification and “Regionally” important aquifer

9.3 Receiving Environment

9.3.1 Site Description and Topography

The Derrinlough Wind Farm site (“the site”) which is a Bord na Móna peat bog is a combination of two bogs, Clongawny to the west and Drinagh to the east, split by the N62 which runs north-south. The site is located approximately 2km to the south of the village of Cloghan and 7km northeast of Birr in County Offaly. The total site area is approximately 2,360 ha (~23.67km^2).

The Bord na Móna Derrinlough Peat Briquette Factory is located between the two bogs, along the N62 on the eastern side of the road. This plant processes the peat from a number of bogs in the midlands into briquettes and consists of the factory and a number of ancillary buildings. A site compound (known as Clongawny Tea Centre) relating to the currently ceased peat harvesting works exists close to the main site entrance on the western bog site (Clongawny). The majority of the overall site comprises heavily drained cutover raised bog. A number of active industrial rail lines intersect Clongawny and

Drinagh bogs and these railways service the adjacent bogs and the Bord na Móna Derrinlough Peat Briquette Factory.

The topography of the development site is relatively flat with an elevation range of between approximately 53 and 62mOD (metres above Ordnance Datum). Along the majority of the site boundaries, a ~1-2m high peat headland exists which is a remnant of the original bog. These headlands and in some areas remnant peat banks create a boundary berm, forming a basin effect within the extraction areas of the overall bogs. There are some areas of higher ground at the centre and southwest of Clongawny bogs and these are covered with conifer forestry.

The surface of Clongawny bog is drained by a network of northeast / southwest orientated drains that are typically spaced every 15 to 20m. Larger arterial drains run northwest-southeast which connect the smaller field drains. On the western Clongawny bog, these drains typically slope gently towards perimeter settlement ponds and surface water outfalls. Surface water outflows from Clongawny bog are located at the north and north-eastern edges, and also at the south and southwestern boundaries of the site. All bar the northern outfall are drained by gravity.

The surface of Drinagh bog is drained by a network of north / south orientated drains that are typically spaced every 15 to 20m. Larger arterial drains run north-south also, and these connect the smaller field drains. Surface water outflows from Drinagh bog are located at the northwest and southeast. Both outfalls are drained by gravity.

A site location map is included as Figure 1.1.

9.3.2 Water Balance

Long term rainfall and evaporation data was sourced from Met Éireann. The 30-year annual average rainfall recorded at the Banagher rainfall station, located ~4.5km west of the site are presented in Table 9.3.

Table 9.3 Local Average long-term Rainfall Data (mm)

Station		X-Coord		Y-Coord		Ht (MAOD)		Opened		Closed		
Edenderry		200,400		216,000		37		1928		N/A		
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
80	59	65	54	60	62	58	84	75	85	79	82	842

The closest synoptic station where the average potential evapotranspiration (PE) is recorded is at Birr, approximately 10km south of the site. The long-term average PE for this station is 445mm/yr. This value is used as a best estimate of the site PE. Actual Evaporation (AE) at the site is estimated as 422mm/yr (which is 0.95 × PE).

The effective rainfall (ER) represents the water available for runoff and groundwater recharge. The ER for the site is calculated as follows:

Effective rainfall (ER) = AAR – AE

= 842 mm/yr – 422mm/yr

ER = 420mm/yr

Based on groundwater recharge coefficient estimates from the GSI (www.gsi.ie) an estimate of 18mm/year average annual recharge is given for basin peat in this area (recharge coefficient of ~4%). This means that the hydrology of the site is characterised by very high surface water runoff rates and very low groundwater recharge rates. Therefore, conservative annual recharge and runoff rates for the site are estimated to be 17mm/yr and 403mm/yr respectively.

In addition to average rainfall data, extreme value rainfall depths are available from Met Éireann. A summary of various return periods and duration rainfall depths for the Derrinlough Wind Farm site are presented in Table 9.4

Table 9.4 Drinagh Return Period Rainfall depths (mm)

	Return Period (Years)			
Storm Duration	1	5	30	100
5 mins	3.8	6.6	13.9	17.1
15 mins	6.2	10.9	19.5	28.0
30 mins	7.8	12.3	22.9	32.0
1 hour	10	16.2	26.8	36.5
6 hours	18.6	27.2	40.4	51.5
12 hours	23.6	33.3	47.3	58.9
24 hours	30	40.6	55.5	67.3
2 days	37.1	48.6	63.9	75.8

9.3.3 Regional Hydrology

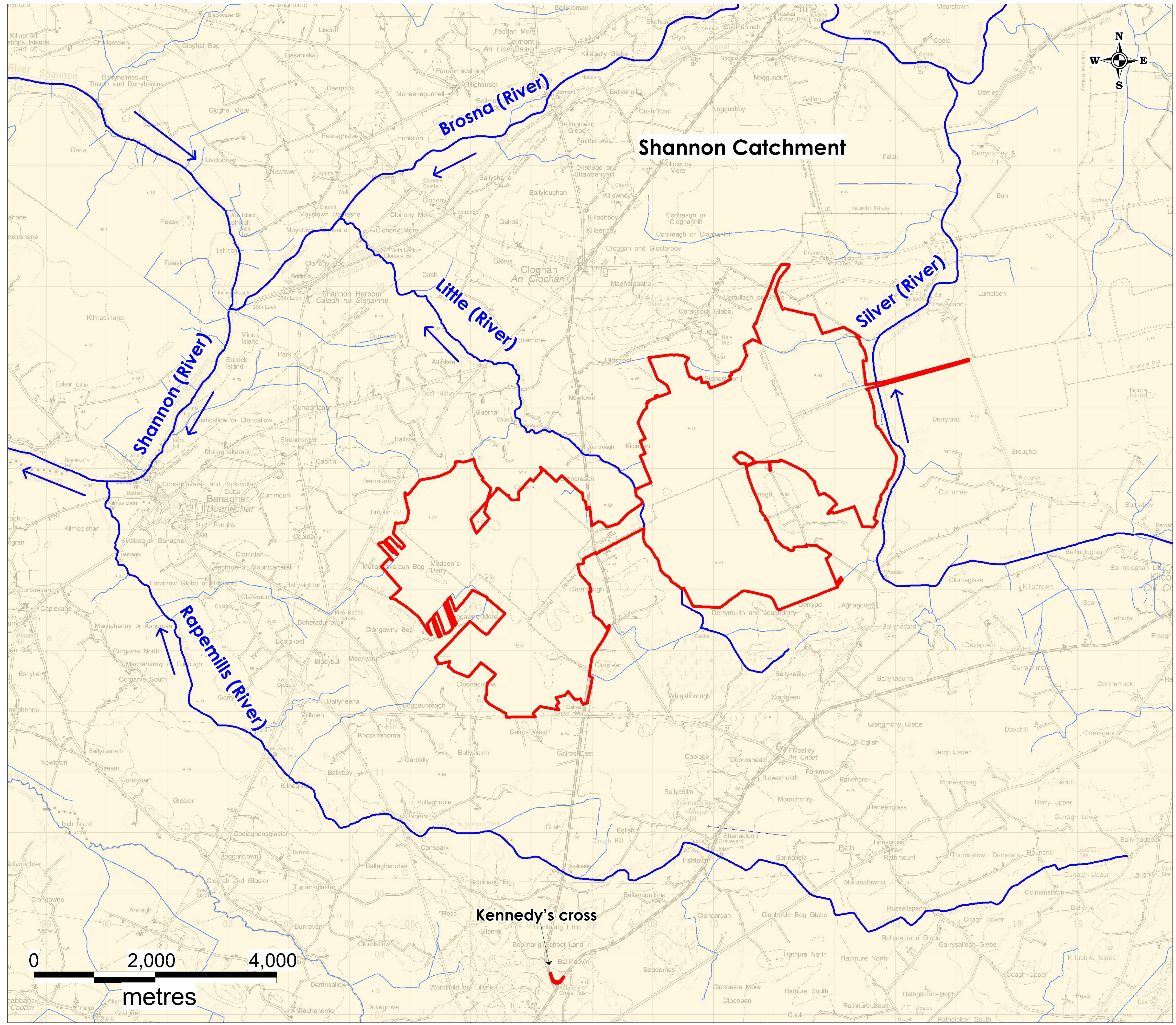
Regionally the proposed development site is located in the River Shannon surface water catchment (IE25_01) within Hydrometric Area 25 of the Shannon International River Basin District. A regional hydrology map is shown as Figure 9.1.

On a more local scale, the majority of the site is located in the Brosna river sub-catchment (Brosna_SC_080). The Little River flows in a northwesterly direction through the centre of the site and crosses the N62 ~1.5km north of the Derrinlough Briquette factory. The Little river discharges to the Brosna river at the confluence in the townland of Moytown Demense, ~5.5km northwest of the site. The Brosna then flows west, where it meets the River Shannon near Shannon Harbour.

The eastern side of the Drinagh bog is mapped within the Brosna_SC_070 sub-catchment. The Silver River flows north through this catchment, along the eastern boundary of the site. It flows north before joining the Brosna river ~3km southeast of Ferbane.

The western edge of the site, within the Clongawny bog, is drained by the Shannon lower sub-catchment (Shannon [Lower]_SC_040). A number of small tributaries flow west/southwest before joining the Rapemills river, which drains the sub-catchment. The Rapemills river then flows north for ~5.5km before entering the Shannon river just west of Banagher.

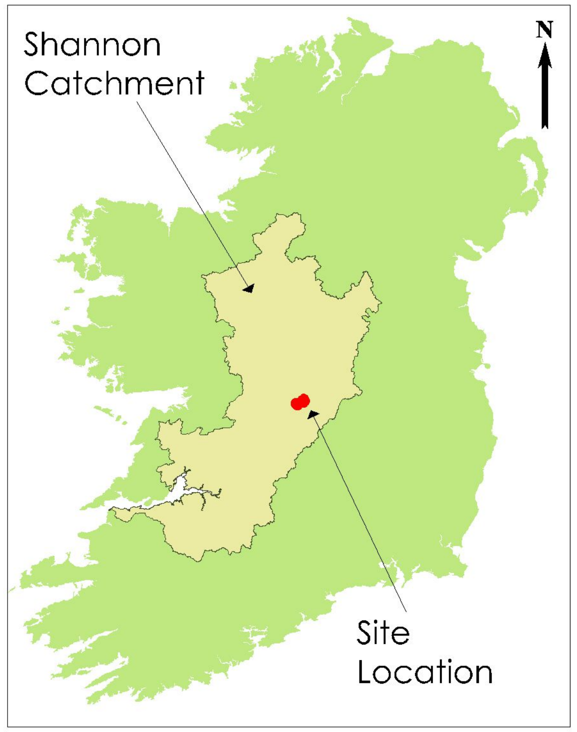
A local hydrology map is shown as Figure 9.2.



Legend

- EIAR Site Boundary
- Rivers
- Rivers / Streams
- Flow direction

Key Plan



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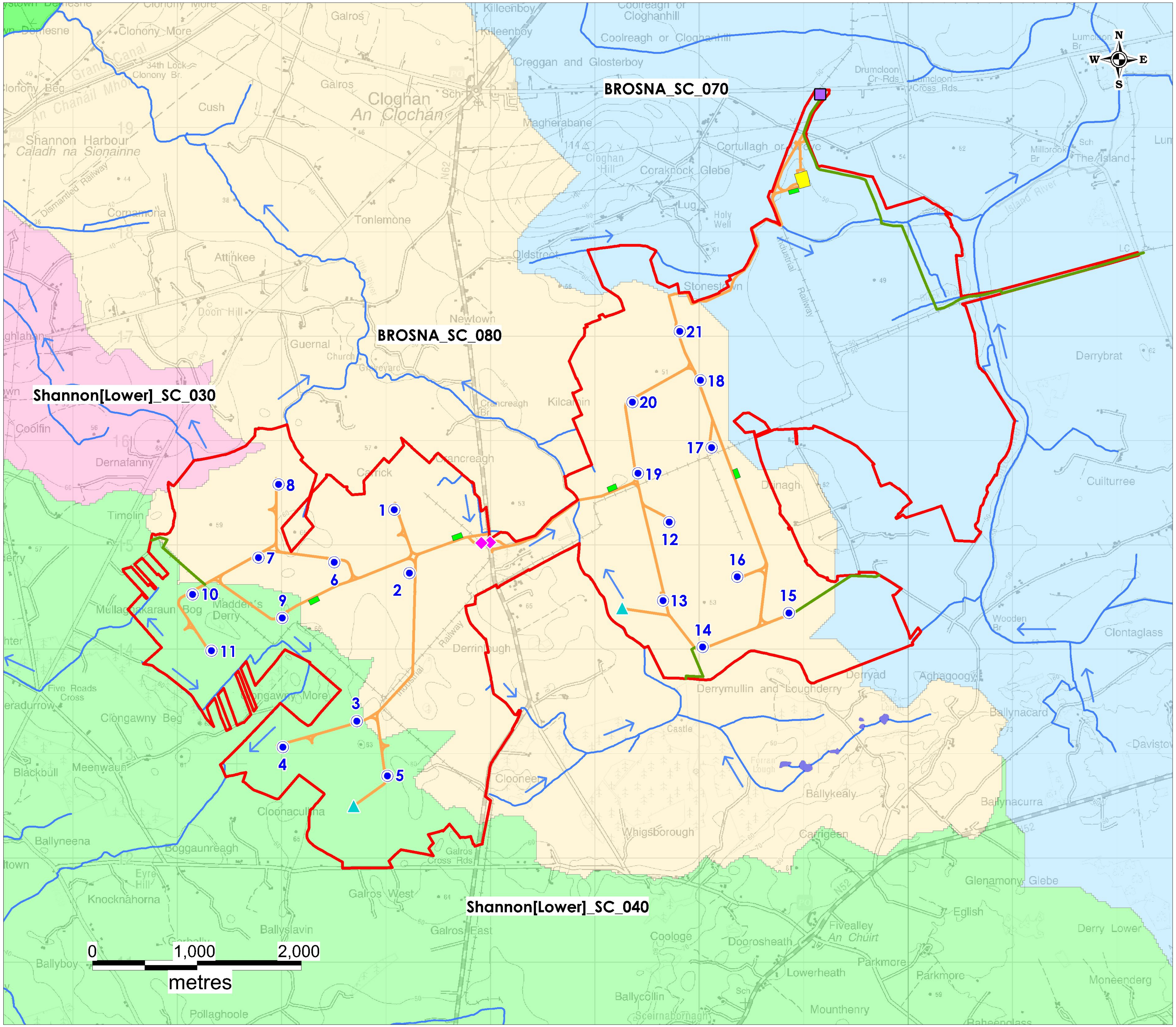
Client: Bord na Mona Powergen Ltd	
Job: Derrinlough WF, Co. Offaly	
Title: Regional Hydrology Map	
Figure No: 9.1	
Drawing No: P1463-0-0220-A3-901-00A	
Sheet Size: A3	Project No: P1463-0
Scale: 1:60,000	Drawn By: GD
Date: 07/02/2020	Checked By: MG



Legend

- EIAR Site Boundary
- Proposed Turbine Location
- Proposed Met Mast Location
- Proposed 110kV Electricity Substation Compound
- Proposed Temporary Construction Compound
- Proposed Amenity Link
- Proposed New Site Roads
- Proposed Visitor Car Park (Operational Phase)
- Proposed Underpass Locations
- Rivers
- Flow Direction

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Client: Bord na Mona Powergen Ltd

Job: Derrinlough, Co. Offaly

Title: Local Hydrology Map

Figure No: 9.2

Drawing No: P1463-0-0220-A3-902-00A

Sheet Size: A3	Project No: P1463-0
Scale: 1:35,000	Drawn By: GD
Date: 07/02/2020	Checked By: MG

9.3.4 Site Drainage

In general, the overall site area comprising the two bogs is relatively flat. The topography ranges from ~53 – 62 mOD, with gentle slopes in some locations.

The surface of Clongawny bog is drained by a network of northeast / southwest orientated drains that are typically spaced every 15 to 20m. Larger arterial drains run northwest-southeast which connect the smaller field drains. On the western Clongawny bog, these drains typically slope gently towards perimeter settlement ponds and surface water outfalls. Surface water outflows from Clongawny bog are located at the north and north-eastern edges, and also at the south and southwestern boundaries of the site. All bar the northern outfall are drained by gravity.

The surface of Drinagh bog is drained by a network of north / south orientated drains that are typically spaced every 15 to 20m. Larger arterial drains run north-south also, and these connect the smaller field drains. Surface water outflows from Drinagh bog are located at the northwest and southeast. Both outfalls are drained by gravity.

An existing site drainage map is shown within Figure 9.3.

There are 3 no. pumping stations across the two bogs (P15/006, P15/007, and P15/008). These are identified on the site drainage map (Figure 9.3). Max discharge from the pumping stations are designed to be below greenfield runoff rates and are rated for removal of rainfall events equivalent to 15mm in 1 hour (approx. -5yr return period).

Surface water draining/pumped from the site is routed via large settlement ponds prior to discharge to off-site drainage channels which flow into the local rivers (i.e. Little River and Silver river). A flow diagram of the existing drainage system is shown in Figure 9.4 below.

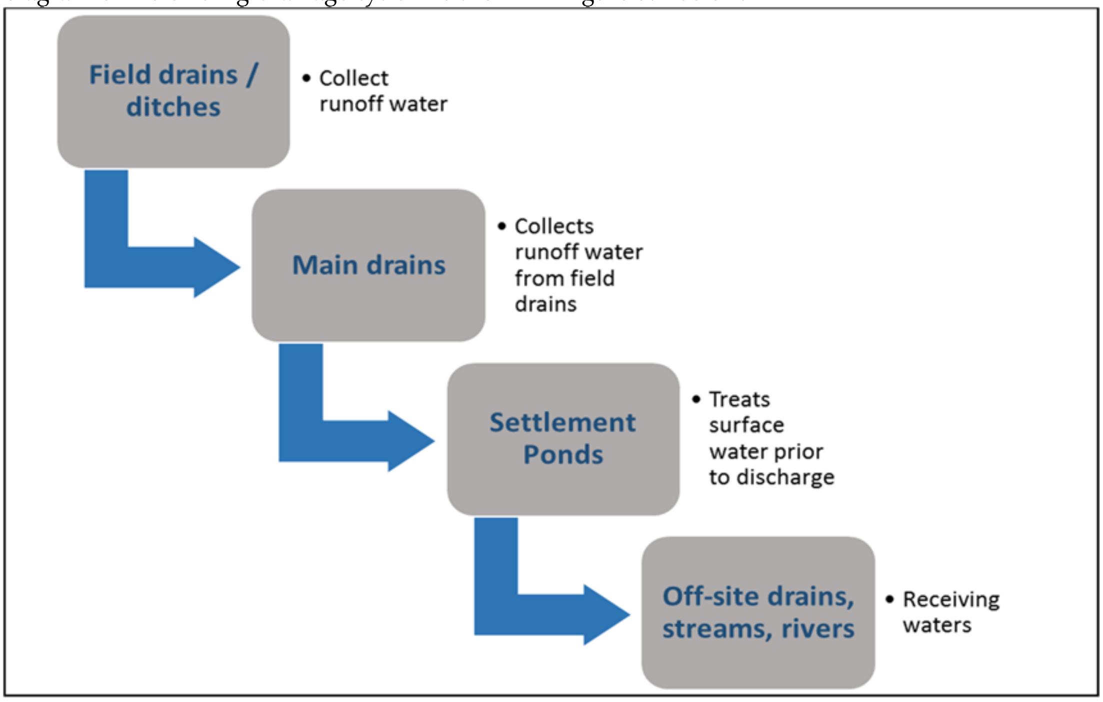
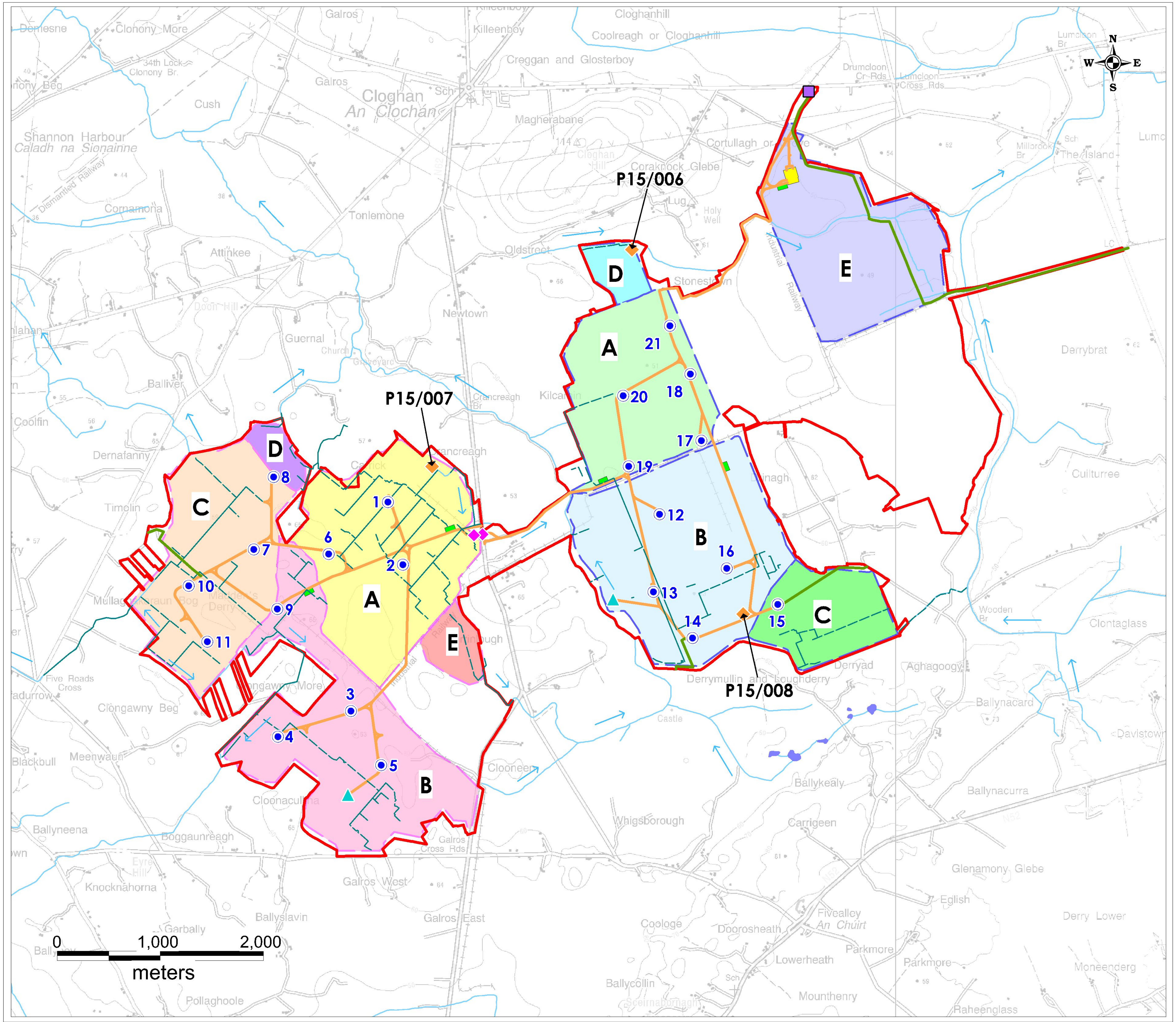


Figure 9.4: Process Flow Diagram for Existing Drainage System



Legend

- EIAR Site Boundary
- Proposed Turbine Location
- Proposed Met Mast Location
- Proposed 110kV Electricity Substation Compound
- Proposed Temporary Construction Compound
- Proposed Amenity Link
- Proposed New Site Roads
- Proposed Visitor Car Park (Operational Phase)
- Proposed Underpass Locations
- Pump Stations
- Piped drains
- Open drains
- Rivers/Streams
- River Flow Direction
- Lakes
- A-E Clongaway Bog Subcatchments
- A-E Drinagh Bog Subcatchments

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Client: Bord na Mona Powergen Ltd	
Job: Derrinlough, Co. Offaly	
Title: SiteDrainage Map	
Figure No: 9.3	
Drawing No: P1463-0-0220-A3-903-00A	
Sheet Size: A3	Project No: P1463-0
Scale: 1:35,000	Drawn By: GD
Date: 07/02/2020	Checked By: MG

9.3.5 Baseline assessment of site runoff

This section undertakes a long-term water balance assessment and surface water runoff assessment for the baseline conditions at the proposed development site.

The rainfall depths used in this water balance, are long term averages, are not used in the design of the sustainable drainage system for the wind farm.

The water balance calculations are carried out for the month with the highest average recorded rainfall minus evapotranspiration, for the current baseline site conditions (Table 9.5). It represents, therefore, the long-term average wettest monthly scenario in terms of volumes of surface water runoff from the site pre-wind farm development. The surface water runoff co-efficient for the site is estimated to be 96% based on the predominant peat coverage (refer to Section 9.3.2).

The highest long-term average monthly rainfall recorded at Banagher over 30 years occurred in the month of December, at 82mm. The average monthly evapotranspiration for the synoptic station at Birr over the same period in December was 2.7mm. The water balance presented in Table 9.6 indicates that a conservative estimate of surface water runoff for the site during the highest rainfall month is 2,008,454m^3/month or 64,798m^3/day for the proposed development site.

Table 9.5: Water Balance and Baseline Runoff Estimates for Wettest Month (December)

Water Balance Component	Depth (m)
Average December Rainfall (R)	0.082
Average December Potential Evapotranspiration (PE)	-0.007
(AE = PE x 0.95)	-0.0067
Effective Rainfall December (ER = R - AE)	0.0887
Recharge (4% of ER)	0.0035
Runoff (96% of ER)	0.0851

Table 9.6: Baseline Runoff for the Site

Study Area	Approx. Area (ha)	Baseline Runoff per Wettest month (m^3)	Baseline Runoff per day (m^3) in wettest month
Development Site	2,360	2,008,454	64,789

9.3.6 Flood Risk Assessment

This section presents an overview of the flood risk assessment undertaken for the proposed development. The full flood risk assessment report for the proposed Derrinlough Wind Farm is provided as Appendix 9.1.

To identify those areas as being at risk of flooding, OPW's indicative river and coastal flood map (www.floodmaps.ie), CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie) and historical mapping (i.e. 6" and 25" base maps) were consulted.

No recurring flood incidents within the site boundary were identified from OPW's indicative river and coastal flood map - Refer to Plate 9.1.

Identifiable map text on local available historical 6" or 25" mapping for the study area do not identify any lands that are "liable to flood".

Much of the site is mapped as "Benefiting Lands". Benefiting lands are defined as a dataset prepared by the Office of Public Works identifying land that might benefit from the implementation of Arterial (Major) Drainage Schemes (under the Arterial Drainage Act 1945, as amended) and indicating areas of land subject to flooding or poor drainage.

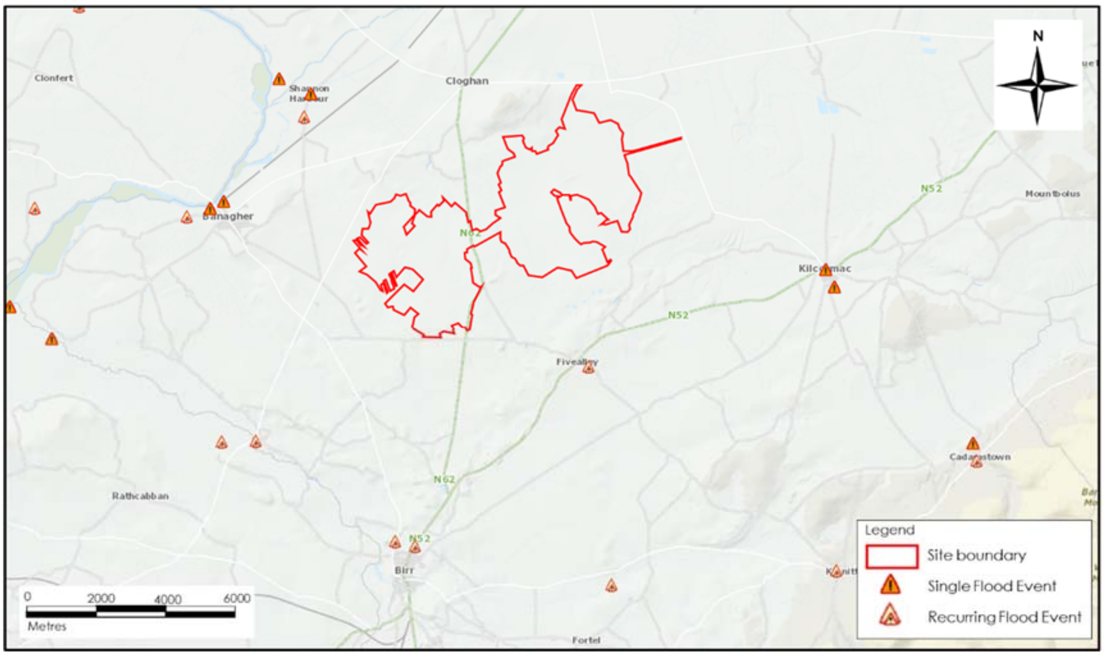


Plate 9.1: OPW's indicative river and coastal flood map.

The PFRA mapping (www.cfram.ie) shows the extents of the indicative 1 in 100-year flood zone which relates to fluvial (i.e. river) flood events (refer to Plate 9.2 below). The vast majority of the proposed development site is located outside of the 1 in 100-year flood zone (Flood Zone A) with the exception of a section on the north-eastern corner of the site and along the eastern and middle boundary of the proposed site. All proposed turbine locations and the access roads are outside of the fluvial indicative 1 in 100-year fluvial flood zone.

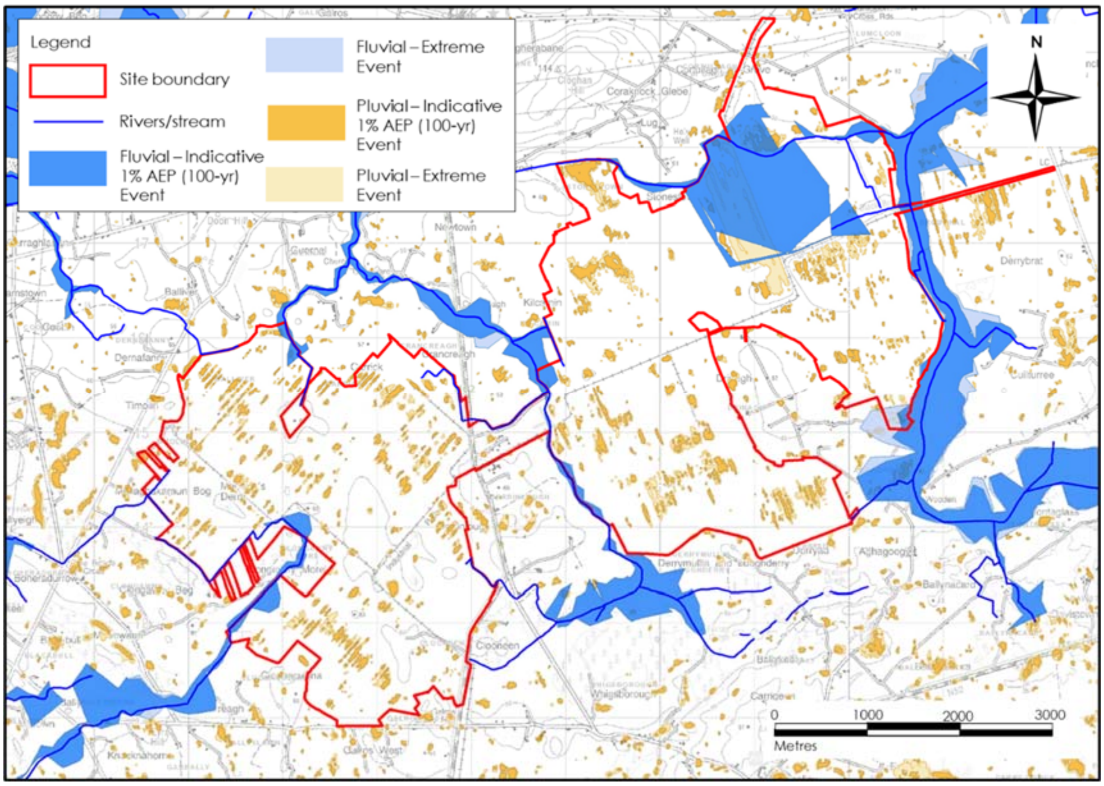


Plate 9.2: Local PFRA flood zone mapping

Also shown on the PFRA mapping is the indicative extent of pluvial flooding (i.e. flooding from rainfall ponding). As seen from Plate 9.2, pluvial flooding appears to occur along the main drainage channels within the site and this is as a result of surface water runoff backing up in the drainage routes when the capacity of the outfalls are exceeded.

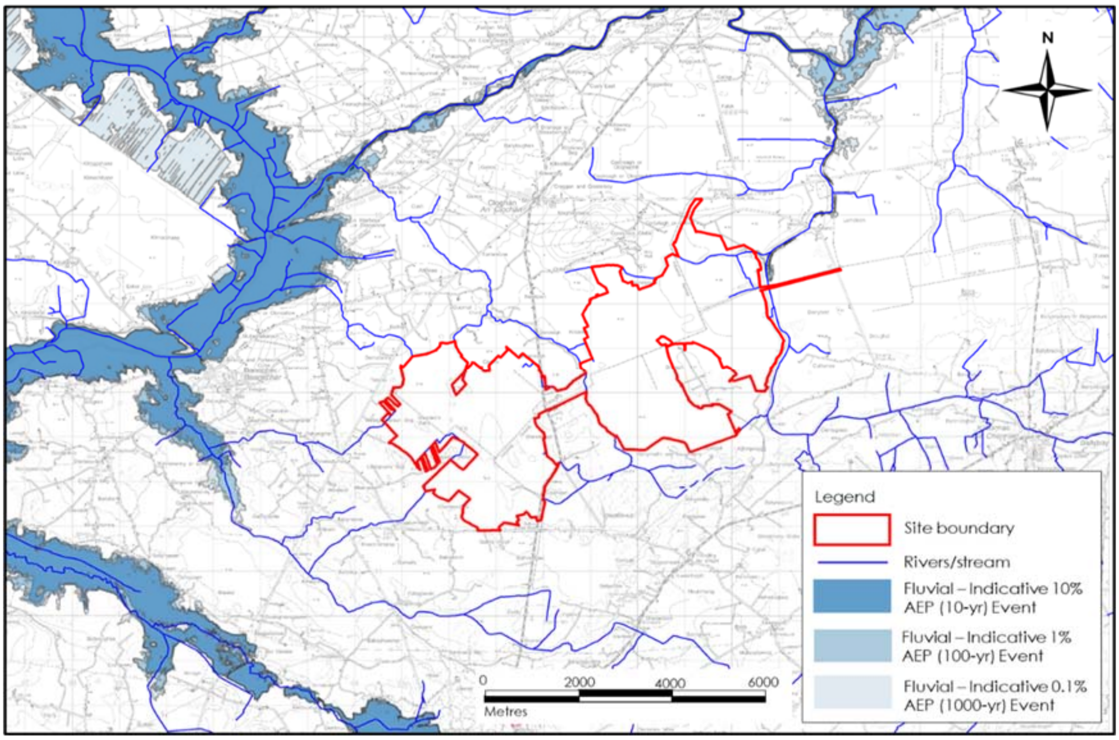


Plate 9.3: Local CFRAM flood zone mapping.

Where complete, the CFRAM OPW Flood Risk Assessment Maps are now the primary reference for flood risk planning in Ireland and supersede the PFRA maps. The proposed development site is not identified on the CFRAM flooding fluvial extent mapping, dated February 2015 as being located in either Flood Zone A or B. Therefore, according to CFRAMs the proposed development is located in Zone C, where the probability of flooding is low. This suggests that the site is suitable for the proposed development in terms of flood risk. The fluvial flood zones areas indicated on the CFRAM mapping are shown on Plate 9.3 above.

9.3.7 Surface Water Quality

Biological Q-rating data for EPA monitoring points on the Silver, Little and Rapemills rivers are shown in Table 9.7 below. Most recent data available (2004 to present) show that the Q-rating for the rivers range from 'Poor' to 'High' in the vicinity of the proposed development site.

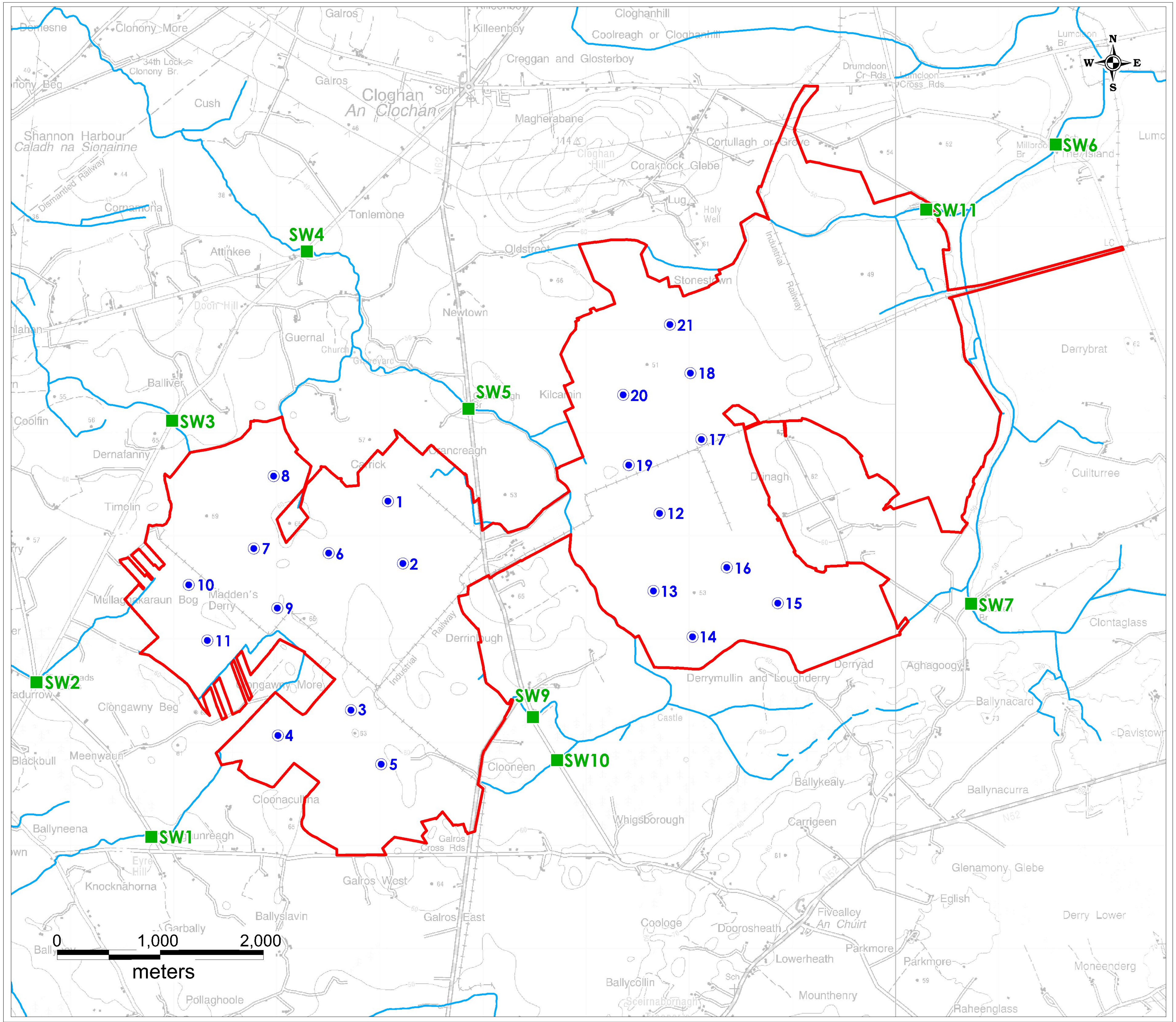
Table 9.7:EPA Water Quality Monitoring Q-Rating Values

Waterbody	Station ID	Easting	Northing	EPA Q-Rating Status
Silver River	RS25S020500	612676	714379	Q4 (Good)
Silver River	RS25S020600	613488	718807	Q4 (Good)
Little River	RS25L010100	607879	716251	Q2-3 (Poor)
Little River	RS25L010200	606245	717799	Q4-5 (High)
Little River	RS25L010400	604145	719835	Q4-5 (High)
Rapemills River	RS25R010300	604767	710225	Q3-4 (Moderate)

Field hydrochemistry measurements of electrical conductivity (µS/cm), pH (pH units), dissolved oxygen (mg/l) and temperature (°C) were taken within surface watercourses downstream of the proposed development (refer to Figure 9.5 for locations). The results are listed (along with estimated flows) in Table 9.8 and Table 9.9. The monitoring locations were typically small streams/rivers which drain towards the larger Shannon river to the north/northwest of the site.

Electrical conductivity (EC) values at the monitoring location ranged between 435 and 697µS/cm. This indicates that a considerable quantity of groundwater is mixing with the surface water runoff from the surface of Clongawny/Drinagh bogs. The source of the groundwater is most likely to be from the mineral subsoils that underlie the peat in this area. The mineral subsoils are likely to have become more exposed in places as a result of peat cutting and installation of drainage channels that extend below the peat layer and into the mineral soil.

The pH values were generally slightly basic, ranging between 7.46 and 8.27. Slightly acidic pH values of surface waters would be typical of peatland environments due to the decomposition of peat. However, the pH is likely higher due to the high temperatures and dry weather which preceded the monitoring.



Legend

EIAR Site Boundary

Proposed Turbine Location

Surface Water Sampling Locations

Rivers/Streams

Note:
Please note there is no sampling point 8.

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Client: Bord na Mona Powergen Ltd

Job: Derrinlough, Co. Offaly

Title: Surface Water Sampling Location Map

Figure No: 9.5

Drawing No: P1463-0-0220-A3-905-00A

Sheet Size: A3	Project No: P1463-0
Scale: 1:35,000	Drawn By: GD
Date: 07/02/2020	Checked By: MG

Table 9.8: Field Parameters - Summary of Surface Water Chemistry Measurements (03/04/2019)

Location ID	Easting	Northing	Temp °C	DO (mg/l)	EC (µS/cm)	pH	Flow (L/s)
SW1	604732	712118	7.4	10.58	624	7.9	200
SW2	603617	713616	7.4	8.96	449.9	7.75	20
SW3	604934	716153	8.7	10.59	527	7.46	-
SW4	606240	717795	8.5	11.75	679	8.19	240
SW5	607806	716268	9.6	8.61	645	7.97	400
SW6	613504	718833	7.3	11.2	653	8.08	1800
SW7	612682	714379	7.5	11.46	678	8.14	450
SW9	608433	713279	7.5	9.53	611	7.68	20
SW10	608669	712861	7.5	11.17	697	8.05	20
SW11	612248	718202	7.3	11.05	554	8.05	120

Table 9.9: Field Parameters - Summary of Surface Water Chemistry Measurements (09/04/2019)

Location ID	Easting	Northing	Temp °C	DO (mg/l)	EC (µS/cm)	pH	Flow (l/s)
SW1	604732	712118	12.2	9.44	596	7.92	150
SW2	603617	713616	11.1	8.39	435.5	8.04	20
SW3	604934	716153	10.4	10.99	537	7.53	10
SW4	606240	717795	11.0	11.6	661	8.27	200
SW5	607806	716268	10.7	9.52	630	7.79	400
SW6	613504	718833	10.2	11.03	638	8.05	1500
SW7	612682	714379	10.3	11.27	653	7.99	500
SW9	608433	713279	11.2	8.57	609	7.63	25
SW10	608669	712861	11.5	10.12	678	8.07	20
SW11	612248	718202	10.3	10.63	546	7.95	100

Surface water samples were also taken at these points for laboratory analysis. Results of the laboratory analysis are shown alongside relevant water quality regulations in Table 9.10 and Table 9.11 below. In addition, the European Communities Environmental Objectives (Surface Waters) Regulations (S.I. No. 272 of 2009) (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy) are shown in Table 9.12. Original laboratory reports are attached as Appendix 9.2.

Table 9.10: Analytical Results of HES Surface Water Samples (03/04/2019)

Parameter	EQS	Sample ID									
		SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW9	SW10	SW11
Total Suspended Solids (mg/L)	≤25(+)	<5	<5	<5	<5	<5	6	<5	<5	<5	12
Ammonia (mg/L)	≤0.065 to ≤ 0.04(*)	0.39	0.53	0.02	0.03	0.14	0.04	0.02	0.25	0.03	0.03
Nitrite NO_2 (mg/L)		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	≤ 0.035 to ≤0.025(*)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrogen (mg/L)	-	14.5	<5.0	12.8	14.3	20.2	20.8	31.8	12.9	17.6	20.4
Phosphorus (mg/L)	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chloride (mg/L)	-	20.6	21.3	35.3	29	30	21.6	21.3	30.3	37.5	21.1
BOD	≤ 1.3 to ≤ 1.5(*)	<2	<2	<2	<2	2	<2	<2	<2	<2	<2

(+) S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations, resulting from EU Directive 78/659/EEC on the Quality of Fresh Waters Needing Protection or Improvement in order to Support Fish Life

(*) S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).

Table 9.11: Analytical Results of HES Surface Water Samples (09/04/2019)

Parameter	EQS	Sample ID									
		SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW9	SW10	SW11
Total Suspended Solids (mg/L)	25(+)	<5	<5	<5	<5	<5	<5	<5	6	<5	<5
Ammonia (mg/L)	-≤0.065 to ≤ 0.04(*)	0.38	0.33	0.03	0.13	0.14	0.03	0.04	0.21	0.04	0.04
Nitrite NO_2 (mg/L)		0.12	<0.05	<0.05	<0.05	0.1	<0.05	<0.05	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	-≤ 0.035 to ≤0.025(*)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrogen (mg/L)	-	0.12	<0.05	<0.05	<0.05	0.1	<0.05	<0.05	<0.05	<0.05	<0.05
Phosphorus (mg/L)	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chloride (mg/L)	-	22	22.3	37.9	35.5	30.1	22.4	22.1	33	39.6	22.2
BOD	≤ 1.3 to ≤ 1.5(*)	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2

(+) S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations, resulting from EU Directive 78/659/EEC on the Quality of Fresh Waters Needing Protection or Improvement in order to Support Fish Life
(*) S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).

Total suspended solids ranged between <5 and 6mg/l. All results were therefore below the limits for both Salmonid and Cyprinid waters.

Ammonia N ranged between 0.02 and 0.53 mg/l, which is generally above the limits for both Salmonid waters and Cyprinid waters. SW1, SW2, SW5 and SW9 were above the limits during both sampling events, while SW4 was elevated on 09th April 2019. The remaining samples were at or below 0.04 mg/l. The presence of elevated ammonia is likely due to natural decomposition of peat.

BOD was less than 2mg/l in all samples, which is below the limits for both Salmonid and Cyprinid waters.

Nitrite ranged between <0.002 and 0.061mg/l and results were typically low which is what would be expected in a peatland environment. In comparison to the Water Framework Directive (2000/60/EC) limits for Salmonid and Cyprinid waters, there were four and one exceedances, respectively.

Nitrate ranged between <5.0 and 31.8 mg/l and results were typically between 10-20 mg/l which is what would be expected in a peatland environment.

In comparison to S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy) , 9 of 20 results for ammonia N exceeded both the “Good Status” and “High Status” threshold values.

In relation to ortho-phosphate, all samples were at least within the “High Status” with values of <0.02.

*Table 9.12: Chemical Conditions Supporting Biological Elements**

Parameter	Threshold Values (mg/L)
BOD	High status ≤ 1.3 (mean)
	Good status ≤ 1.5 mean
Ammonia-N	High status ≤ 0.04 (mean)
	Good status ≤0.065 (mean)
Orthophosphate	High status ≤0.025 (mean)
	High status ≤0.025 (mean)
	Good status ≤0.035 (mean)

* S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).

9.3.8 Hydrogeology

The Waulsortian limestones which are mapped to underlie the proposed development site are classified by the GSI (www.gsi.ie) as a Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Ll). The limestone bedrock in the area of the proposed development is covered by a substantial thickness of lacustrine and glacial deposits which in turn is overlain by cutaway/cutover peat. The glacial deposits will likely provide the dominant potential pathway for groundwater movement in the proposed development site especially where permeable tills or sands and gravels are present under peat and lacustrine deposits.

Groundwater vulnerability is mapped by the GSI as medium. Groundwater recharge is classified as low with a recharge coefficient of 4% mapped at the site.

Due to the presence of the overlying peat (which results in minimal recharge) and the bulk low permeability of the underlying lacustrine deposits, groundwater movement through the glacial deposits will be relatively slow unless higher permeability sands and gravels are present. Recharge is likely to be limited to the perimeter of the development site where the peat is thin or absent (the presence of peat will prevent rapid recharge to underlying regional groundwater systems). Based on topography and regional surface water drainage flows groundwater flow direction towards the east of the site is likely to be towards the Silver River, while the east of Clongawny bog and west of Drinagh bog likely drains towards the Little River, while the west of Clongawny bog likely drains towards the Rapemills River. A low groundwater gradient is expected.

There is a shallow water table in the peat layer across the site. This is perched and largely isolated from the underlying regional groundwater system (which occurs in underlying till and bedrock).

9.3.9 Groundwater Vulnerability

The vulnerability rating of the bedrock aquifer underlying site is classified as "Moderate" and this is consistent with the presence of basin peat underlain by a substantial depth of lacustrine SILT/CLAY and glacial deposits.

This means there is a low potential for groundwater dispersion and movement within the aquifer, therefore surface water bodies, such as drains and streams, are more vulnerable than groundwater at this site.

9.3.10 Groundwater Hydrochemistry

There is no groundwater quality data for the proposed wind farm site and groundwater sampling would generally not be undertaken for this type of development, as groundwater quality impacts would not be anticipated given the low potential for groundwater dispersion and movement within the aquifer as outlined in the preceding section.

Based on data from GSI on the Clara GWB, groundwaters in this area are typically very hard with a calcium-bicarbonate signature. Hardness generally ranges from 380 – 450 mg/l as $CaCO_3$, with high electrical conductivities (650 – 800 μ S/cm).

9.3.11 Water Framework Directive Water Body Status & Objectives

The River Basin Management Plan was adopted in 2018 and has amalgamated all previous river basin districts into one national river basin management district. The River Basin Management Plan (2018 - 2021) objectives, which have been integrated into the design of the proposed wind farm development, include the following:

- Ensure full compliance with relevant EU legislation;
- Prevent deterioration and maintain a 'high' status where it already exists;
- Protect, enhance and restore all waters with aim to achieve at least good status by 2021;
- Ensure waters in protected areas meet requirements; and,
- Implement targeted actions and pilot schemes in focused sub-catchments aimed at (1) targeting water bodies close to meeting their objectives and (2) addressing more complex issues that will build knowledge for the third cycle.

Our understanding of these objectives is that surface waters, regardless of whether they have 'Poor' or 'High' status, should be treated the same in terms of the level of protection and mitigation measures employed, i.e. there should be no negative change in status at all.

Strict mitigation measures (refer to Section 9.5.3 and 9.5.4) in relation to maintaining a high quality of surface water runoff from the development and groundwater protection will ensure that the status of both surface water and groundwater bodies in the vicinity of the site will be at least maintained (see below for WFD water body status and objectives) regardless of their existing status.

9.3.12 Groundwater Body Status

Local Groundwater Body (GWB) and Surface water Body (SWB) status reports are available for download from (www.wfdireland.ie)

The Clara GWB (IE_SE_G_116) underlies most of the development site. This GWB is assigned 'Good Status', which is defined based on the quantitative status and chemical status of the GWB. The Banagher GWB (IE_SH_G_040) underlies the extreme west of the site and is also assigned 'Good Status'.

9.3.13 Surface Water Body Status

A summary of the WFD status and risk result of Surface Water Bodies (SWBs) in which development is proposed (or immediately upstream of) are shown in Table 9.13 below.

The eastern section of the site is drained by the Silver River (IE_SH_25S020700) which achieved 'moderate' status under the WFD 2013-2018. The centre of the site is drained by the River Little (Cloghan) (IE_SH_25L010400) which achieved 'good' status. Both of these rivers flow generally north and discharge to the River Brosna (IE_SH_25B091200) which also achieved 'moderate' status. The Rapemills River which flows west of the site, in a northerly direction towards Banagher has not been assigned a status under the WFD.

Table 9.13: Summary WFD Information for Surface Water Bodies

SWB Code	Water Body	General Physico-Chemical Status	Fish status	Overall Status
IE_SH_25L010400	Little (Cloghan)	Good	Moderate	Moderate
IE_SH_25S020700	Silver	Pass	Moderate	Moderate
IE_SH_25B091200	Brosna	Pass	N/A	Good

9.3.14 Designated Sites and Habitats

Within the Republic of Ireland designated sites include National Heritage Areas (NHAs), Proposed National Heritage Areas (pNHAs), candidate Special Areas of Conservation (SAC) and Special Protection Areas (SPAs). Designated sites within the same surface water catchments as the proposed development site are listed below:

- Lough Coura pNHA (Site Code: 000909), directly south of proposed development site boundary;
- All Saints bog and esker SAC (Site Code: 000566) exists ~3.1km southwest of the proposed development site;
- All Saints bog SPA (Site Code: 004103) exists ~3.1km southwest of the proposed development site;
- Ridge Road, SW of Rapemills SAC (Site Code: 000919), 3.4km south-west of proposed development site;
- River Shannon Callows SAC (Site Code: 000216) exists ~2.3km northwest of the proposed development site this area is also listed as the Middle Shannon NHA; and,
- River Little Brosna Callows SPA (Site Code: 004086) is located ~5km southwest of the proposed site, as well as the River Little Brosna Callows NHA (Site Code: 000564), the SPA boundary also encompasses the area of the All Saints bog and esker.

The proposed development site is indirectly connected via surface water (hydrologically) to the River Shannon Callows SAC/Middle Shannon SPA, through the tributaries of the Shannon which flow north/northwest from the site (Silver, Little and Rapemills Rivers). There is no direct hydrological (surface water) connection to the All Saints bog and esker SAC as a hydraulic boundary exists between the proposed site and the SAC (i.e. the barrier is the River Rapemills). There is no direct hydrological connection to the Ridge Road SW of Rapemills SAC as a hydraulic boundary exists between the proposed site and the SAC (i.e. the barrier is the River Rapemills). There is also no direct hydrological connection to River Little Brosna Callows SPA / River Little Brosna Callows NHA as a hydraulic boundary exists between the proposed site and the SAC (River Rapemills). A summary of potential hydrological pathways (surface water connections) and hydrogeological pathways (groundwater connections) is included below as Table 9.14.

Designated sites in proximity to the proposed development site are listed below and shown on Figure 9.6. Other sites, outside of those listed above are considered to be remote from the proposed development, and as such due to physical and hydrological/hydrogeological separation cannot be affected (from a water perspective) by the proposed development. An impact assessment of these remaining listed sites is completed below at Section 9.5.3.8.

Table 9.14: Relative distances and connectivity to designated sites

Designated Site	Distance to European Site	Hydrological connectivity to European Sites	Groundwater connectivity to Designated / European Sites
Lough Coura pNHA	<1 km, and 320m from T14	No direct connection. Indirect connections exist via surface water (tributaries to Little River).	Groundwater connectivity will be limited due to; 1) significant separation exists to infrastructure development locations; 2) baseline conditions between pNHA and development locations is highly modified already (by drainage and forestry, and presence of N62 roads, and associated drainage); 3) differences in elevation, and 4) shallow depth of proposed works; 5) Groundwater flow is also likely to be towards the northwest in line with local surface water drainage systems; and, 6) the presence of the Little River to the east acting as a hydraulic boundary.
All Saints bog and Esker SAC / All Saints Bog SPA	~3.1km as crow flies	No direct connection. Indirect connections exist via surface water flows (tributaries to Rapemills river, and Rapemills river).	Groundwater connectivity will be limited due to; 1) separation distances; 2) presence of intermediate rivers acting as hydraulic boundaries; 3) differences in elevation; and, 4) shallow depth of proposed works.
Ridge Road, SW of Rapemills SAC	~3.43km at nearest point	No direct connection. Indirect connections exist via surface water flows (tributaries to Rapemills river, and Rapemills river).	Groundwater connectivity will be limited due to; 1) separation distances; 2) presence of intermediate river acting as hydraulic boundaries; 3) differences in elevation; and, 4) shallow depth of proposed works.
River Shannon Callows SAC / Middle Shannon Callows SPA	~2.3km to west along river channel	No direct connection.	Likely, but significant distance between the proposed development site and SAC/SPA, as well as presence

Designated Site	Distance to European Site	Hydrological connectivity to European Sites	Groundwater connectivity to Designated / European Sites
	~7.65km to northwest along river channel	Indirect connections exist via surface water (Little River, Island River, Brosna River, and tributaries to Rapemills river, and Rapemills river).	of several local streams and major rivers (groundwater likely to discharge to Little river, Island River, and Brosna River before reaching the River Shannon).
River Little Brosna Callows SPA / River Little Brosna Callows NHA	~5.5km to southwest as crow flies	No direct connection. No indirect connections exist via surface water.	Groundwater connectivity will be limited due to; 1) separation distances; 2) presence of intermediate rivers acting as hydraulic boundaries; 3) differences in elevation; and, 4) shallow depth of proposed works.

9.3.15 Water Resources

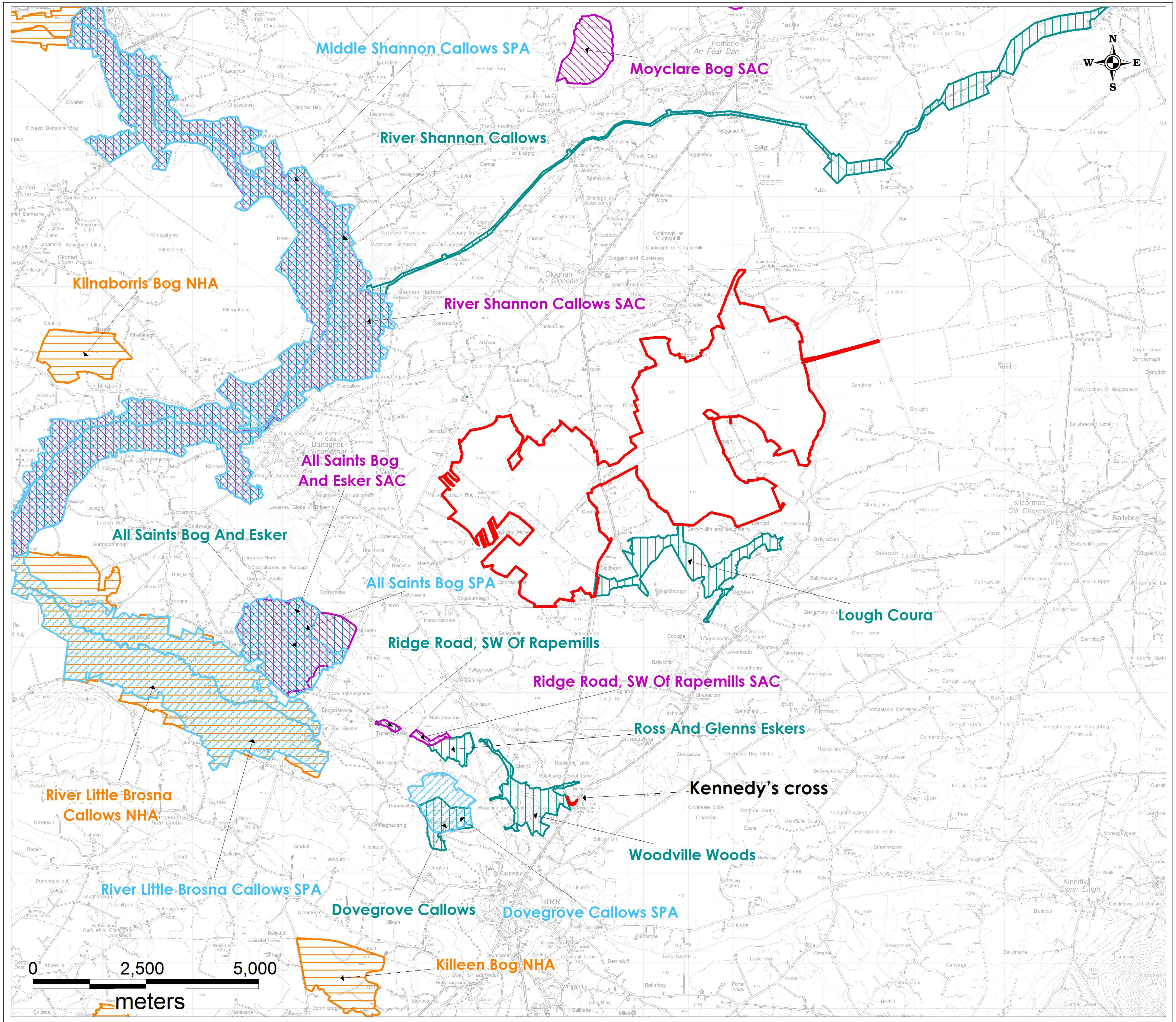
There is 1 no. mapped PWS (Banagher Public Water Supply Scheme) within 3 km of the site. The Banagher PWS is located west of the site, approximately 2 km southeast of Banagher. The mapped source protection zone for this GWS does not fall within the proposed development site boundary.

A search of private well locations (wells with location accuracy of 1–50m were only sought) was undertaken using the GSI well database (www.gsi.ie). 2 no. wells with an accuracy of 1–50m were mapped in the area of the proposed development site, which were mapped as belonging to Bord na Móna and Erin Peat, and are assumed to be water sources used in the production and manufacturing of the peat products. All the wells mapped in the area surrounding the site are mapped only to an accuracy of 1km and therefore assessing potential impacts on these wells cannot be undertaken in any reliable manner.

To overcome the poor accuracy problem of other GSI mapped wells (>50m accuracy) it is conservatively assumed (for the purpose of assessment only) that every private dwelling in the area (shown on Figure 9.7) has a well supply and this impact assessment approach is described further below. (Please note wells may or may not exist at each property, but our conservative rationale here is that it is better to assume a well may exist at each downgradient property and assess the potential impacts from the proposed development on such assumed wells, rather than make no assessment and find out later that groundwater wells do actually exist).

9.3.16 Receptor Sensitivity

Due to the nature of wind farm developments, being near surface construction activities, impacts on groundwater are generally negligible and surface water is generally the main sensitive receptor assessed during impact assessments. The primary risks to groundwater at the site would be from cementitious materials, hydrocarbon spillage and leakages, potential piling works, and construction of the proposed underpasses. These potential significant effects are assessed in Sections 9.5.3 and 9.5.4. Some of these are common potential impacts on all construction sites (such as road works and industrial sites).



Legend

- EIAR Site Boundary
- SPA
- SAC
- pNHA
- NHA

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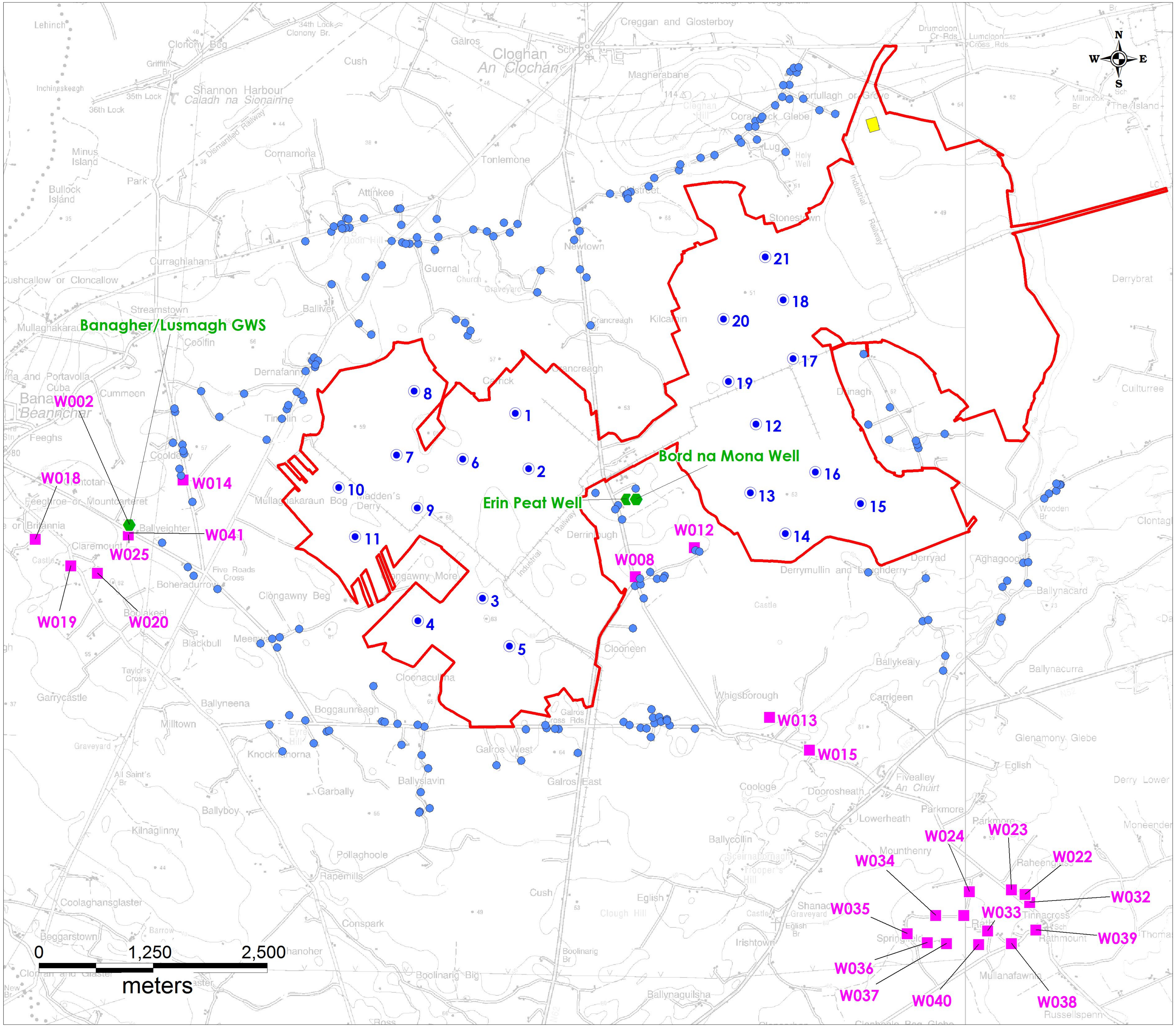
Client: Bord na Mona Powergen Ltd	
Job: Derrinlough, Co. Offaly	
Title: Designated Sites Map	
Figure No: 9.6	
Drawing No: P1463-0-0220-A3-906-00A	
Sheet Size: A3	Project No: P1463-0
Scale: 1:80,000	Drawn By: GD
Date: 07/02/2020	Checked By: MG



Legend

- EIAR Site Boundary
- Proposed Turbine Layout
- Proposed Substation
- Private Dwelling Locations
- GSi Mapped Wells
- Well Locations

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Client: Bord na Mona Powergen Ltd

Job: Derrinlough, Co. Offaly

Title: Local Well Locations Map

Figure No: 9.7

Drawing No: P1463-0-0220-A3-907-00A

Sheet Size: A3	Project No: P1463-0
Scale: 1:40,000	Drawn By: GD
Date: 07/02/2020	Checked By: MG

All potential contamination sources are to be carefully managed at the site during the construction and operational phases of the development and mitigation measures are proposed below (Sections 9.5.3 and 9.5.4) to deal with these potential impacts.

Based on criteria set out in Table 9.2 above, the Locally Important Aquifer can be classed as Sensitive to pollution. The majority of the site, however, is covered in cutover peat which in turn is underlain by silt dominated glacial deposits and these layers act as a protective cover to the underlying bedrock aquifer. The glacial deposits are not mapped as an aquifer, but they are likely to be used locally as a water supply and therefore they can also be classed as Sensitive to pollution. However, due to the presence of the peat and silt/clay layers (which have low permeability and act as a barrier to infiltration), any contaminants which may be accidentally released on-site are more likely to travel to nearby streams within surface runoff.

Comprehensive surface water mitigation and controls are outlined below to ensure protection of all downstream receiving waters. Mitigation measures will ensure that surface runoff from the developed areas of the site will be of a high quality and will therefore not impact on the quality of downstream surface water bodies. Any introduced drainage works at the site will mimic the existing drainage regime (refer to Section 9.5.4.1) thereby avoiding changes to flow volumes leaving the site via the existing outfalls.

9.4 Characteristics of the Proposed Development

The development comprises 21 no. wind turbines, 2 no. anemometry masts, new and upgraded site access roads, 2 no. permanent underpasses, a substation and associated connection to the national grid, temporary construction compounds. A full description of the proposed development is included in Chapter 4 of this EIAR.

9.4.1 Proposed Drainage Management

Runoff control and drainage management are key elements in terms of mitigation against impacts on surface water bodies. Two distinct methods will be employed to manage drainage water within the proposed development. The first method involves ‘keeping clean water clean’ by avoiding disturbance to existing drainage features, minimising any works in or around artificial drainage features, and diverting clean surface water flow around excavations, construction areas and temporary storage areas. The second method involves collecting any drainage waters from works areas within the site that might carry silt or sediment, and nutrients, to route them towards new proposed silt traps and settlement ponds (or stilling ponds) prior to controlled diffuse release into the existing drainage network. There will be no direct discharges to the existing drains.

During the construction phase, all runoff from works areas (i.e. dirty water) will be attenuated and treated to a high quality prior to being released. A schematic of the proposed site drainage management is shown as Plate 9.4 below. A detailed drainage plan showing the layout of the proposed drainage design elements is shown in Appendix 4.5 of the EIAR.

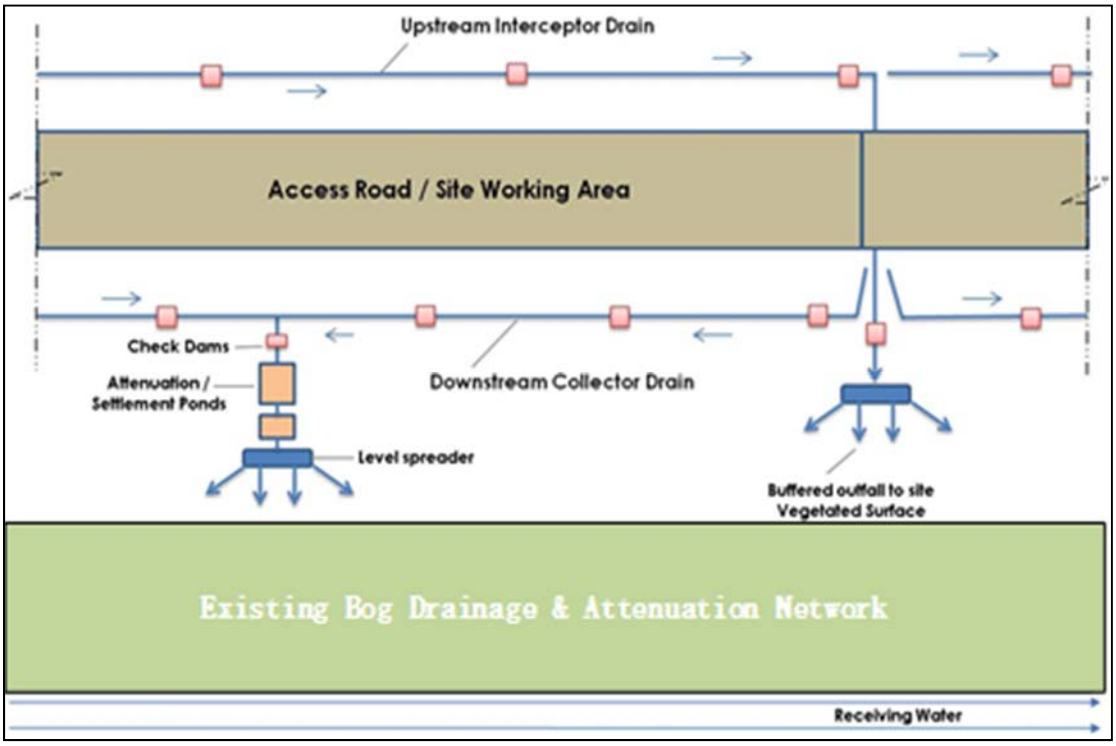


Plate 9.4: Schematic of Proposed Site Drainage Management

9.4.2 Development Interaction with the Existing Bog Drainage Network

The proposed wind farm drainage will not significantly alter the existing drainage regime at the site. Moreover, the proposed drainage system will be fully integrated into the existing bog drainage systems.

Existing field drains and main drains will be routed under/around access tracks using culverts as required.

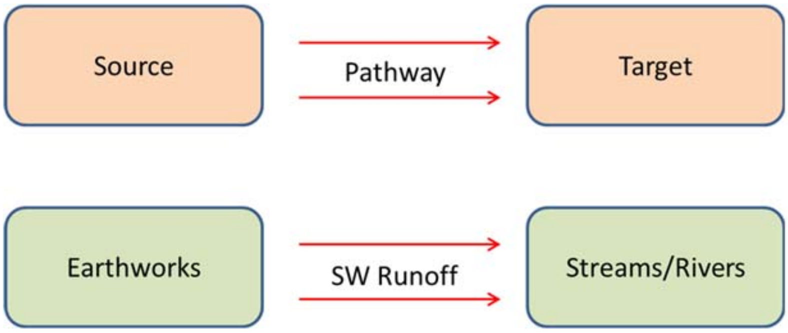
Runoff from access tracks, turbine bases, and developed areas (construction compounds, sub-stations, met masts) will be collected and treated in local (proposed) silt traps and settlement ponds and then discharged to existing peat field drains. From there this water will flow towards the relevant bog site boundaries in existing field drains and main drains, and then be treated further in the existing main (bog) settlement ponds prior to discharge from the proposed development site.

One of the proposed ecological aspects of the drainage design is to re-wet the site in small areas, where possible, to create wet areas as such wetland features which are good for overall site biodiversity. Ponding would occur in these areas to a very shallow depth, and only intermittently following heavy rainfall. No large open bodies of water are proposed, and where intermittent ponding occurs this will be broken up into small areas using peat berms.

9.5 Likely Significant Effects and Associated Mitigation Measures

9.5.1 Overview of Impact Assessment Process

The conventional source-pathway-target model (see below, top) was applied to assess potential impacts on downstream environmental receptors (see below, bottom as an example) as a result of the proposed wind farm development.



As outlined previously, where potential impacts are identified, the classification of impacts in the assessment follows the descriptors set out in the Glossary of effects (EPA, 2017) as outlined in Chapter 1 of this EIAR.

The descriptors used in this environmental impact assessment are those set out in the EPA (2017) Glossary of effects as shown in Chapter 1 of this EIAR.

The description process clearly and consistently identifies the key aspects of any potential impact source, namely its character, magnitude, duration, likelihood and whether it is of a direct or indirect nature.

In order to provide an understanding of the stepwise impact assessment process applied below (Section 9.5.3 and 9.5.4), we have presented below a summary guide that defines the steps (1 to 7) taken in each element of the impact assessment process (Table 9.15). The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model and the EPA impact descriptors are combined.

Using this defined approach, this impact assessment process is then applied to all wind farm construction and operation and decommissioning activities.

Table 9.15: Impact Assessment Process Steps

Step 1	Identification and Description of Potential Impact Source This section presents and describes the activity that brings about the potential impact or the potential source of pollution. The significance of effects is briefly described.	
Step 2	Pathway / Mechanism:	The route by which a potential source of impact can transfer or migrate to an identified receptor. In terms of this type of development, surface water and groundwater flows are the primary pathways, or for example, excavation or soil erosion are physical mechanisms by which potential impacts are generated.
Step 3	Receptor:	A receptor is a part of the natural environment which could potentially be impacted upon, e.g. human health, plant / animal species, aquatic habitats, soils/geology, water resources, water sources. The potential impact can only arise as a result of a source and pathway being present.
Step 4	Pre-mitigation Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impact before mitigation is put in place.
Step 5	Proposed Mitigation Measures:	Control measures that will be put in place to prevent or reduce all identified significant adverse impacts. In relation to this type of development, these measures are generally provided in two types: (1) mitigation by avoidance, and (2) mitigation by (engineering) design.
Step 6	Post-Mitigation Residual Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impacts after mitigation is put in place.
Step 7	Significance of Effects:	Describes the likely significant post-mitigation effects of the identified potential impact source on the receiving environment.

9.5.2 Do -Nothing Scenario

If the proposed development were not to proceed, the site would continue to be managed under the requirements of the relevant IPC licence, and existing commercial forestry, telecommunications and wind measurement would continue. The hydrology of the site would remain as it is described in the baseline characterisation. The rail lines that supply peat to Derrinlough Briquette Factory from other bogs adjacent to the proposed wind farm, will continue to be used until the manufacture of peat briquettes ceases.

When peat extraction activity ceases in the Boora Bog Group, a Rehabilitation Plan will be implemented in accordance with the IPC licence requirements, to environmentally stabilise the site through encouragement of re-vegetation of bare peat areas, with targeted active management being used to enhance re-vegetation and the creation of small wetland areas (if required).

9.5.3 Construction Phase - Likely Significant Effects and Mitigation Measures

9.5.3.1 Earthworks Resulting in Suspended Solids Entrainment in Surface Waters

Construction phase activities including access road construction, turbine base/hardstanding construction, construction compound construction, met mast construction, underpass construction, substation construction, cable route excavations, amenity paths construction (also refer to Section 9.5.3.10), turbine delivery route accommodation works, grid connection works (under and overground), entrance locations and amenity car park will require varying degrees of earthworks resulting in excavation of peat and mineral subsoil where present. Potential sources of sediment-laden water include:

- Drainage and seepage water resulting from excavations;
- Stockpiled excavated material providing a point source of exposed sediment; and,
- Erosion of sediment from emplaced site drainage channels.

These activities can result in the release of suspended solids to surface water and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality and fish stocks of downstream water bodies. Potential effects on all watercourses downstream of the site could be significant if not mitigated against.

Pathways: Drainage and surface water discharge routes.

Receptors: Down-gradient rivers and associated dependent ecosystems.

Pre-Mitigation Potential Impact: Negative, significant, indirect, temporary, medium probability effect.

Proposed Mitigation by Avoidance:

The key mitigation measure during the construction phase is the avoidance of sensitive hydrological features where possible, by application of suitable buffer zones (i.e. 50m to main watercourses, and 10m to main drains). All of the key proposed development areas are located significantly away from the delineated 50m watercourse buffer zones with the exception of the upgrading of the existing watercourse crossing, new drain crossing and upgrades to existing site access tracks. Additional control measures, which are outlined further on in this section, will be undertaken at these locations.

The large setback distance from sensitive hydrological features means that adequate room is maintained for the proposed drainage mitigation measures (discussed below) to be properly installed and operate effectively. The proposed buffer zone will:

- Avoid physical damage (river/stream banks and river/stream beds) to watercourses and associated release of sediment;
- Avoid excavations within close proximity to surface watercourses;
- Avoid the entry of suspended sediment from earthworks into watercourses; and,
- Avoid the entry of suspended sediment from the construction phase drainage system into watercourses, achieved in part by ending drain discharge outside the buffer zone and allowing percolation across the vegetation of the buffer zone.

In addition, and as outlined above the wind farm drainage system will link into the existing bog drainage system, and discharge from each of the bog sites via existing large settlement ponds, which are some distance from the proposed development footprint. As such, there is significant distance for wind farm related surface water to travel before it actually reaches the edge of the bogs and joins any receiving waters outside of the overall bog boundaries (Clongawny and Drinagh bogs).

Proposed Mitigation by Design:

Presented below are temporary and long-term drainage control measures that will be utilised during the construction phase of the wind farm. As stated above there is an existing drainage network at the site which comprises field drains, main drains and perimeter settlement ponds. The measures outlined below will be used in conjunction with the existing drainage network to ensure protection of all rivers and streams downstream of the proposed development site.

Source controls:

- Interceptor drains, vee-drains, diversion drains.
- Small working areas, covering temporary stockpiles, weathering off of side-cast peat/spoil, cessation of works in certain areas or other similar/equivalent or appropriate measures.

In-Line controls:

- Interceptor drains, vee-drains, temporary sumps/attenuation lagoons, sediment traps, pumping systems, settlement ponds, temporary pumping chambers, or other similar/equivalent or appropriates systems.

Treatment systems:

- Temporary sumps and attenuation ponds, temporary storage lagoons, sediment traps, and settlement ponds, and proprietary settlement systems such as "Siltbuster", and/or other similar/equivalent or appropriate systems.

There is an extensive network of drains already existing at the site, and these will be integrated and enhanced as required and used within the wind farm development drainage system. The key elements being the upgrading and improvements to water treatment elements, such as in-line controls and treatment systems, including silt traps and settlement ponds.

The main elements of interaction with existing drains will be as follows:

- Apart from interceptor drains, which will convey clean runoff water to the downstream drainage system, there will be no direct discharge (without treatment for sediment reduction, and attenuation for flow management) of runoff from the proposed wind farm drainage into the existing site drainage network where possible. This will reduce the potential for any increased risk of downstream flooding or sediment transport/erosion;
- Temporary silt traps will be placed in the existing drains downstream of construction works, and these will be diverted into proposed interceptor drains, or culverted under/across the works area;
- During the operational phase of the wind farm runoff from individual turbine hardstanding areas will be not discharged directly into the existing drain network but discharged locally at each turbine location through field drains, main drains, and existing settlement ponds;
- Buffered outfalls which will be numerous over the site will promote percolation of drainage waters across the bog surface and close to the point at which the additional runoff is generated, rather than direct discharge to the existing drains of the site;
- Velocity and silt control measures such as check dams, sandbags, oyster bags, straw bales, flow limiters, weirs, baffles, silt fences will be used during the upgrade construction works; and,

- Existing culverts will be lengthened where necessary to facilitate access road widening.

Water Treatment Train

If the discharge water from construction areas fails to be of a high quality then a filtration treatment system (such as a 'siltbuster' or similar equivalent treatment train (sequence of water treatment processes)) will be used to filter and treat all surface discharge water collected in the dirty water drainage system. This will apply for all of the construction phase.

Silt Fences:

Silt fences will be emplaced within drains down-gradient of all construction areas. Silt fences are effective at removing heavy settleable solids. This will act to prevent entry to the existing drainage network of sand and gravel-sized sediment, released from excavation of mineral sub-soils of glacial and glacio-fluvial origin and entrained in surface water runoff. Inspection and maintenance of these structures during construction phase is critical to their functioning to stated purpose. They will remain in place throughout the entire construction phase.

Silt Bags:

Silt bags will be used where small to medium volumes of water need to be pumped from excavations (e.g. the proposed underpass locations). As water is pumped through the bag, most of the sediment is retained by the geotextile fabric allowing filtered water to pass through.

Pre-emptive Site Drainage Management:

The works programme for the construction stage of the development will also take account of weather forecasts and predicted rainfall in particular. Large excavations and movements of peat/subsoil or peat stripping will be suspended or scaled back if heavy rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

The following forecasting systems are available and will be used on a daily/weekly basis, as required, to allow site staff to direct proposed and planned construction activities:

- General Forecasts: Available on a national, regional and county level from the Met Éireann website (www.met.ie/forecasts). These provide general information on weather patterns including rainfall, wind speed and direction but do not provide any quantitative rainfall estimates;
- MeteoAlarm: Alerts to the possible occurrence of severe weather for the next 2 days. Less useful than general forecasts as only available on a provincial scale;
- 3-hour Rainfall Maps: Forecast quantitative rainfall amounts for the next 3 hours but does not account for possible heavy localised events;
- Rainfall Radar Images: Images covering the entire country are freely available from the Met Éireann website (www.met.ie/latest/rainfall_radar.asp). The images are a composite of radar data from Shannon and Dublin airports and give a picture of current rainfall extent and intensity. Images show a quantitative measure of recent rainfall. A 3-hour record is given and is updated every 15 minutes. Radar images are not predictive; and,
- Consultancy Service: Met Éireann provide a 24-hour telephone consultancy service. The forecaster will provide interpretation of weather data and give the best available forecast for the area of interest.

Using the safe threshold rainfall values will allow planned works to be safely executed (from a water quality perspective) in the event of forecasting of an impending high rainfall intensity event.

Earthworks should be suspended if forecasting suggests any of the following is likely to occur:

- >10 mm/hr (i.e. high intensity local rainfall events);
- >25 mm in a 24-hour period (heavy frontal rainfall lasting most of the day); or,
- >half monthly average rainfall in any 7 days.

Prior to earthworks being suspended the following control measures should be completed:

- Secure all open peat/spoil excavations;
- Provide temporary or emergency drainage to prevent back-up of surface runoff; and,
- Avoid working during heavy rainfall and for up to 24 hours after heavy events to ensure drainage systems are not overloaded.

Management of Runoff from Peat and Subsoil Storage Areas:

It is proposed that excavated peat will be used for landscaping close to its original extraction point. During the initial placement of peat and subsoil, silt fences, straw bales and biodegradable geogrids will be used to control surface water runoff from the storage areas as required. 'Siltbuster' treatment trains will be employed if previous treatment is not to a high quality.

Timing of Site Construction Works:

Construction of the site drainage system will only be carried out during periods of low rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses. Construction of the drainage system during this period will also ensure that attenuation features associated with the drainage system will be in place and operational for all subsequent construction works.

Proposed Drainage and Water Quality Monitoring

An inspection and maintenance plan for the on-site drainage system will be prepared in advance of commencement of any works and will be included in the CEMP. Regular inspections of all installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended.

Any excess build-up of silt levels at dams, the settlement ponds, or any other drainage features that may decrease the effectiveness of the drainage feature, will be removed.

During the construction phase field testing (visual, supplemented with pH, electrical conductivity, temperature, dissolved oxygen and turbidity monitoring), sampling and laboratory analysis of a range of parameters[1] with relevant regulatory limits and EQSs will be undertaken for each primary watercourse, and specifically following heavy rainfall events (i.e. weekly, monthly and event-based).

Residual Effects: The potential for the release of suspended solids to watercourse receptors is a risk to water quality and the aquatic quality of the receptor. Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect is considered to be - Negative, imperceptible, indirect, temporary, low probability effect on downstream water quality and aquatic habitats.

Significance of Effects: For the reasons outlined above, no significant effects on the surface water quality are anticipated.

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[1] *example suite: pH (field measured), Electrical Conductivity (field measured), temperature (field measured), Dissolved Oxygen (field measured), Turbidity (NTU) (sonde measured), Flow (m/s), Total Suspended Solids (mg/l), Ammonia, Nitrite (NO_2) (mg/l), Ortho-Phosphate (P) (mg/l), Nitrate (NO_3) (mg/l), Phosphorus (unfiltered) (mg/l), Chloride (mg/l), and BOD (mg/l).*

9.5.3.2 Potential Impacts on Groundwater Levels during Excavation Works

No borrow pits are proposed at the site, so no associated dewatering works are proposed. Smaller scale temporary dewatering may occur at some excavations (i.e. turbine bases, cable trenches (underpass is dealt with separately below), and these have the potential to affect local groundwater levels. However, temporary reductions in groundwater levels by temporary dewatering will be very localised and of small magnitude due to the nature and permeability of the local peat and subsoil geology, which comprises moderate to low permeability lacustrine and glacial deposits.

The installation of turbine bases in the underlying glacial deposits is also likely to require some temporary dewatering arrangements, where deeper excavations occur. However, due to the dominance of moderate to low permeability glacial till subsoils and lacustrine deposits below the bogs the impacts on groundwater levels will be localized to the excavation and only for a temporary basis during the construction work. Water level impacts are unlikely to be significant beyond 50m from any excavation.

Pathway: Groundwater flow paths.

Receptor: Groundwater levels.

Pre-Mitigation Potential Impact: Slight, indirect, temporary, low probability effects on local groundwater levels.

Proposed Mitigation Measures by Design:

- There are large separation distances between proposed works and local houses, and associated water wells. The closest houses are at least 750m from proposed turbine bases.
- Similarly, main streams and rivers are at least 200-500m away from any turbine bases, and at these potential effects will be imperceptible; and,
- The proposed underground cable trench is designed to be shallow and will only be approximately 1.2m in depth. At this depth it will only potentially interact with shallow perched water within the peat profile. No interaction with deeper regional groundwater will occur. Therefore, re no impacts on the local groundwater table or flows are anticipated from this element of the development.

Residual Effects: Due to large separation distances between proposed development works and water wells and local stream and rivers, and the relatively shallow nature of the proposed works, and also the prevailing geology of the proposed development site the potential for water level drawdown impacts at receptor locations is considered negligible. The residual effect is considered to be - Imperceptible, indirect, temporary, low probability effects on local groundwater levels.

Significance of Effects: For the reasons outlined above, no significant effects on groundwater levels are anticipated.

9.5.3.3 Excavation Dewatering and Potential Impacts on Surface Water Quality

Groundwater seepages will likely occur in turbine base, substation and construction compound excavations, and these will create additional volumes of water to be treated by the runoff management system. In some areas, groundwater inflows may be more significant where lenses of sand and gravel are intercepted within the glacial till deposits.

Inflows will likely require management and treatment to reduce suspended sediments. No contaminated land was noted at the site and therefore pollution issues are not anticipated in this respect.

The main potential significant effects are as a result of turbidity and suspended solids on downstream surface water receptors. Poor water quality in downstream stream and rivers has the potential to affect aquatic habitats and species (e.g. fish and invertebrates).

Pathway: Overland flow and site drainage network.

Receptor: Down-gradient surface water bodies.

Pre-Mitigation Potential Impact: Negative, significant, indirect, temporary, low probability effects to surface water quality.

Proposed Mitigation by Design:

Management of excavation seepages and subsequent treatment prior to discharge into the drainage network will be undertaken as follows:

- Appropriate interceptor drainage, to prevent upslope surface runoff from entering excavations will be put in place;
- If required, pumping of excavation inflows will prevent build-up of groundwater in the excavation;
- The interceptor drainage will be discharged to the existing drainage system or onto the bog surface;
- The pumped water volumes will be discharged via volume and sediment attenuation ponds adjacent to excavation areas, or via specialist treatment systems such as a "Siltbuster" unit;
- There will be no direct discharge to the existing drainage network and therefore no risk of hydraulic loading or contamination will occur; and,
- Daily monitoring of excavations by a suitably qualified person will occur during the construction phase. If high levels of seepage inflow occur, excavation work should immediately be stopped, and a geotechnical assessment undertaken.

Residual Effects: The potential for the release of suspended solids to watercourse receptors is a risk to water quality and the aquatic quality of the receptor. Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect is considered to be - Imperceptible, indirect, temporary, low probability effects on local surface water quality and associated aquatic habitats.

Significance of Effects: For the reasons outlined above, no significant effects on the surface water quality are anticipated.

9.5.3.4 Underpass Dewatering and Potential Effects on Surface Water Quality and Groundwater Levels

Temporary dewatering may occur at the proposed underpass locations, and these have the potential to impact on local groundwater levels by drawdown. Drawdown in water levels can affect baseflow to rivers and streams, and water levels in local groundwater wells. Excavation depths will be in the order of ~3 to ~6.5m. Two underpasses are proposed, and these will require a limited works area and the duration of the installation works will be short (i.e. 4 to 8 weeks). The locations of the proposed underpasses are remote from surrounding houses, so potential impacts on groundwater wells is limited by large separation distances. Any temporary dewatering will be treated and discharged to local surface water so there will be temporary net loss in water volume reaching local streams and rivers. In addition, potential groundwater level effects via drawdown are limited due the local hydrogeological regime which comprises moderate to low permeability lacustrine and glacial deposits. It is likely that permanent drainage at the underpass locations will be by gravity to a local outfall.

In addition, during construction groundwater seepages will likely occur into the underpass construction areas and this will create additional volumes of water to be treated by the runoff management system.

During construction stage, groundwater inflows will likely require management and treatment to reduce suspended sediments. No contaminated land was noted at the site and therefore pollution issues are anticipated in this respect.

The recorded geology at the underpass locations (from trial pit TP/UP) include ~1.1m of peat over firm grey slightly gravelly SILT. A moderate groundwater inflow was recorded at 3.3mbgl. Slight to the east of the N62 (at trial pit TP/CSH2) peat depth was recorded at 0.3m, with firm grey gravelly clay forming the subsoil. No significant groundwater inflows were recorded at this location.

The installation of permanent underpasses in the underlying glacial deposits will require permanent dewatering/gravity drainage arrangements. However, due to the dominance of moderate to low permeability peats, glacial till subsoils and lacustrine deposits below at the underpass locations the impacts on groundwater levels due to these excavations will be localized to the underpass areas. Dewatering impacts will not extend far enough to impact on local sensitive receptors. Water level drawdown impacts are unlikely to be significant beyond 50m from the permanent underpass excavations.

Pathway: Groundwater levels, and flow to local surface water.

Receptor: Down-gradient surface water bodies, and groundwater levels.

Pre-Mitigation Potential Impact: Negative, significant, indirect, temporary, low probability effects to surface water quality. Imperceptible, direct, slight, long term, high probability effect on local groundwater levels.

Proposed Mitigation Measures for Water Quality Protection:

Management of excavation seepages and subsequent treatment prior to discharge into the drainage network will be undertaken as follows:

- Appropriate interceptor drainage, to prevent upslope surface runoff from entering excavations will be put in place;
- If required, pumping of excavation inflows will prevent build-up of water in the excavation;
- The interceptor drainage will be discharged to the existing drainage system or onto the bog surface;
- The pumped water volumes will be discharged via silt bags and settlement tanks/ponds to adjacent to excavation areas, or via specialist treatment systems such as a “Siltbuster” unit;
- There will be no direct discharge to the existing drainage network and therefore no risk of hydraulic loading or contamination will occur; and,
- Daily monitoring of excavations by a suitably qualified person will occur during the construction phase. If high levels of seepage inflow occur, excavation work should immediately be stopped, and a geotechnical assessment undertaken.

Residual Effects: Due to large separation distances between proposed underpass development works and local groundwater wells, and the relatively shallow nature of the proposed works, and also the prevailing geology of the proposed development site the potential for water level drawdown impacts from the two underpass construction locations at receptor locations is considered negligible. In addition, controls for water treatment prior to release to surface water will be implemented to ensure surface water quality will be maintained. The residual effect is considered to be - Imperceptible, indirect, temporary, low probability effects on local surface water quality. Imperceptible, direct, temporary, low probability effects on local groundwater levels.

Significance of Effects: For the reasons outlined above, no significant effects on the surface water quality or groundwater levels are anticipated.

9.5.3.5 Potential Release of Hydrocarbons during Construction and Storage

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons can cause significant pollution risk to groundwater, surface water and associated ecosystems, and to terrestrial ecology. In addition, the accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbons have a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. It is also a nutrient supply for adapted micro-organisms, which can rapidly deplete dissolved oxygen in waters, resulting in death of aquatic organisms.

Pathway: Groundwater flowpaths and site drainage network.

Receptor: Groundwater and surface water.

Pre-Mitigation Potential Impact: Negative, indirect, slight, short term, medium probability effect to local groundwater quality. Indirect, negative, significant, short term, low probability effect to surface water quality.

Proposed Mitigation Measures:

- All plant will be inspected and certified to ensure they are leak free and in good working order prior to use on site;
- On-site re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer or truck will be re-filled off site and will be towed/driven around the site to where machinery are located. The 4x4 jeep/fuel truck will also carry fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations;
- Fuels stored on site will be minimised. Any storage areas will be bunded appropriately for the fuel storage volume for the time period of the construction;
- The electrical control building will be bunded appropriately to the volume of oils likely to be stored and to prevent leakage of any associated chemicals and to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used will be regularly inspected for leaks and fitness for purpose;
- An emergency plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan. Spill kits will be available to deal with accidental spillages.

Residual Effect: The potential for the release of hydrocarbons to groundwater and watercourse receptors is a risk to surface water and groundwater quality, and also the aquatic quality of the surface water receptors. Proven and effective measures to mitigate the risk of releases of hydrocarbons have been proposed above and will break the pathway between the potential source and each receptor. The residual effect is considered to be - Negative, imperceptible, indirect, temporary, low probability effect on groundwater and surface water.

Significance of Effects: For the reasons outlined above, no significant effects on surface water or groundwater quality are anticipated.

9.5.3.6 Groundwater and Surface Water Contamination from Wastewater Disposal

Release of effluent from on-site temporary wastewater treatment systems has the potential to impact on groundwater and surface water quality if site conditions are not suitable for an on-site percolation unit. Impacts on surface water quality could affect fish stocks and aquatic habitats.

Pathway: Groundwater flowpaths and site drainage network.

Receptor: Down-gradient well supplies, groundwater quality and surface water quality.

Pre-mitigation Effect: Negative, significant, indirect, temporary, low probability effect to surface water quality. Negative, slight, indirect, temporary, low probability effect to local groundwater.

Proposed Mitigation Measures:

- During the construction phase, a self-contained port-a-loo with an integrated waste holding tank will be used at each of the site compounds, maintained by the providing contractor, and removed from site on completion of the construction works;
- Water supply for the site office and other sanitation will be brought to site and removed after use from the site to be discharged at a suitable off-site treatment location; and,
- No water or wastewater will be sourced on the site, nor discharged to the site.

Residual Effect: During the construction phase no water or wastewater will be sourced on the site, nor discharged to the site, therefore no residual effects are anticipated.

Significance of Effects: For the reasons outlined above, no significant effects on surface water or groundwater quality are anticipated.

9.5.3.7 Release of Cement-Based Products

Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative impacts on water quality. They generate very fine, highly alkaline silt (pH 11.5) that can physically damage fish by burning their skin and blocking their gills. A pH range of $\geq 6 \leq 9$ is set in S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations, with artificial variations not in excess of $\pm$ 0.5 of a pH unit. Entry of cement-based products into the site drainage system, into surface water runoff, and hence to surface watercourses or directly into watercourses represents a risk to the aquatic species and habitats. Peat ecosystems are dependent on low pH hydrochemistry. They are extremely sensitive to introduction of high pH alkaline waters into the system. Batching of wet concrete on site and washing out of transport and placement machinery are the activities most likely to generate a risk of cement-based pollution.

Pathway: Site drainage network.

Receptor: Surface water and peat water hydrochemistry.

Pre-Mitigation Potential Impact: Negative, moderate, indirect, short term, medium probability effect to surface water.

Proposed Mitigation Measures:

- No batching of wet-cement products will occur on site. Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will take place;

- Where possible pre-cast elements for culverts and concrete works will be used;
- No washing out of any plant used in concrete transport or concreting operations will be allowed on-site;
- Where concrete is delivered on site, only the chute will be cleaned, using the smallest volume of water possible. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Chute cleaning water is to be isolated in temporary lined wash-out pits located near proposed site compounds. These temporary lined wash-out pits will be removed from the site at the end of the construction phase;
- Will use weather forecasting to plan dry days for pouring concrete; and,
- Will ensure pour site is free of standing water and plastic covers will be ready in case of sudden rainfall event.

Residual Effect: The potential for the release of cement-based products or cement truck wash water to groundwater and watercourse receptors is a risk to surface water and groundwater quality, and also the aquatic quality of the surface water receptors. Proven and effective measures to mitigate the risk of releases cement-based products or cement truck wash water have been proposed above and will break the pathway between the potential source and each receptor. The residual effect is considered to be - Negative, imperceptible, indirect, short term, low probability impact.

Significance of Effects: For the reasons outlined above, no significant effects on surface water quality are anticipated.

9.5.3.8 Potential Impacts on Hydrologically Connected Designated Sites

The proposed development site is not located within any designated conservation site. As stated in Section 9.3.14 above, the proposed development site is located in the River Shannon regional catchment. Local designated sites, other than those listed in Table 9.14 are considered to be remote from the proposed development, and as such due to physical and hydrological and hydrogeological separation will not be affected by the proposed development. Local designated sites listed in Table 9.14 are assessed below with respect to hydrological connectivity and potential for significant hydrological and hydrogeological effects.

Pathway: Surface water flowpaths, and groundwater levels.

Receptor: Down-gradient water quality and groundwater levels at designated sites.

Impact Assessment – Lough Coura pNHA

Lough Coura pNHA is located to the south of the proposed development site, and it abuts the development site boundary along the southeast of Clongawny bog over ~450m, and again along the southern boundary of Drinagh bog over a distance of ~110m.

The baseline conditions of the land between the pNHA and development locations is highly modified already by drainage and forestry planting and associated drainage.

For the Clongawny bog area, the presence of the N62 road, the bog railway and their associated drainage provide a significant separation from that bog to the pNHA. Also, the nearest turbine is some 970m from the pNHA boundary (mitigation by design). There is a section of high ground between that turbine (T5) and the pNHA area. The proposed works at T5 are relatively shallow in nature and groundwater flow below Clongawny bog is likely, due to local topography and local drainage patterns, to be to the west and northwest away from Lough Coura pNHA

For the Drinagh bog area, the presence of existing bog drainage and drainage associated with local tributaries to the Little River also provide existing hydraulic boundaries to the pNHA. The nearest turbine is some 320m from the pNHA boundary (mitigation by design). The proposed works at T14 are relatively shallow in nature and groundwater flow below Drinagh bog is likely, due to local topography and local drainage patterns, to be to the west and northwest away from Lough Coura pNHA and towards the Little River.

For these various scientific (physical and hydrological) reasons, the potential for hydrological drawdown effects to occur at the pNHA as a result of the proposed wind farm development are negligible.

Impact Assessment – All Saints bog and Esker SAC / All Saints Bog SPA

There are surface water connections between the proposed development site and All Saints bog and Esker SAC / All Saints Bog SPA. These pathways could transfer poor quality surface water that may affect the designated sites. However, detailed mitigation measures for sediment control are outlined in Section 9.5.3.1. In addition, detailed mitigation measures for control of hydrocarbons during construction works are outlined in Section 9.5.3.5. Implementation of the mitigation measures will ensure protection of water quality in receiving waters.

There is also a significant separation distance between the proposed development site and All Saints bog and esker SAC (~3.7km to proposed T4 and T11, the two nearest turbines). Ground elevation at T4 and T11 are ~52mOD and ~54mOD respectively. Ground elevations at All Saints bog and esker SAC range between 35-42mOD. Excavation depths at the development site are in the order of ~3 to 6.5m and piling depths may be in the order of ~8 to 12m. The intermittent nature of the turbine locations (they are not continuous, but are separated by large tracks of open bog) and the large separation distance between the development site and All Saints bog and Esker SAC, and the presence of the intermediate hydraulic boundary (the Rapemills River), allows us to conclude using the physical and scientific data that there will be no significant hydrological or water quality impacts on All Saints bog and Esker SAC / All Saints bog SPA from the proposed wind farm development.

Impact Assessment – Ridge Road, SW of Rapemills SAC

There are no surface water connections between the proposed development site and Ridge Road, SW of Rapemills SAC.

There is also a significant separation distance between the proposed development site and Ridge Road, SW of Rapemills SAC (~4.13km to proposed T4, the nearest turbine). Ground elevation at T4 and T5 are ~53mOD and ~54mOD respectively. Ground elevations at Ridge Road, SW of Rapemills SAC range between 50-55mOD. Excavation depths at the development site are in the order of ~3 to 6.5m and piling depths may be in the order of ~8 to 12m. The intermittent nature of the turbine locations (they are not continuous, but are separated by large tracks of open bog) and the large separation distance between the development site and Ridge Road, SW of Rapemills SAC, and the presence of the intermediate hydraulic boundary (the Rapemills River), allows us to conclude using the physical and scientific data that there will be no significant hydrogeological or water quality impacts on Ridge Road, SW of Rapemills SAC from the proposed wind farm development.

Impact Assessment - River Shannon Callows SAC and Middle Shannon SPA

There are surface water connections between the proposed development site and River Shannon Callows SAC and Middle Shannon SPA. These pathways could transfer poor quality surface water that may affect the designated sites. However, detailed mitigation measures for sediment control are outlined in Section 9.5.3.1. And, detailed mitigation measures for control of hydrocarbons during construction works are outlined in Section 9.5.3.5. Implementation of the mitigation measures will ensure protection of water quality in receiving waters.

Groundwater from below the development site may also discharge as baseflow to the Little River, the Rapemills River (or its tributaries) and Brosna River before entering the River Shannon Callows SAC and Middle Shannon SPA. Groundwater quality and quantity will not be affected by the proposed development as outlined in Section 9.5.3.2, Section 9.5.3.5, Section 9.5.3.7, and Section 9.5.3.9.

Using these physical characteristics and by implementation of proven mitigation measures, we can conclude that there will be no significant hydrological or water quality impacts on River Shannon Callows SAC and Middle Shannon SPA from the proposed wind farm development.

Impact Assessment – River Little Brosna Callows SPA / River Little Brosna Callows NHA

There are no surface water connections between the proposed development site and the River Little Brosna Callows SPA / River Little Brosna Callows NHA, and therefore there is no likelihood of any significant effects arising in the absence of a hydrological link.

There is also a significant separation distance between the proposed development site and River Little Brosna Callows SPA / River Little Brosna Callows NHA (~5.5km as the crow flies). The Rapemills River forms an intermediate hydraulic boundary between the wind farm development and River Little Brosna Callows SPA / River Little Brosna Callows NHA sites. It is not physically possible, due to hydrological separation, for groundwater to flow below the Rapemills River and reach the River Little Brosna. Using these physical and topographical (i.e. scientific) data we can conclude that there will be no likely significant hydrological or water quality impacts on River Little Brosna Callows SPA / River Little Brosna Callows NHA from the proposed development.

Pre-Mitigation Potential Impact: No significant hydrological or hydrogeological effects on designated sites listed in Table 9.14 have been identified.

Residual Effects: For the reasons outlined above we consider there will be no residual effects on all designated sites listed in Table 9.14.

Significance of Effects: For the reasons outlined above, no significant impacts on any designated sites are anticipated.

9.5.3.9 Potential Effects on Local Groundwater Well Supplies

As stated in Section 9.3.8 above, the groundwater flow in the mineral soil deposits (silts, sands and gravels) beneath the peat at the proposed development site is expected to discharge into the Silver River, Rapemills River and the Little River. The most western edge of the site, within the Clongawny bog, likely discharges into the Rapemills river located to the west/southwest of the site. Groundwater flow within the centre of the site, near the N62, will flow towards the Little River, while groundwater flow towards the west of the site, within the Drinagh bog, will discharge towards the Silver River.

Using this conceptual model of groundwater flow, dwellings that are potentially located down-gradient of the proposed development footprint are identified and an impact assessment for these actual and potential well locations is undertaken.

As shown on Figure 9.7, there are a number of dwellings situated along the N62, along the R435 and other minor roads surrounding the Clongawny bog, as well as dwellings along the R437 and other minor roads surrounding the Drinagh bog.

The dwellings surrounding the Clongawny bog are downgradient of the Rapemills River and smaller tributaries, and it is expected that the majority of groundwater flow discharges to these waterbodies, as well as to the larger drainage ditches around the bog.

The Silver River flows along much of the eastern side of the Drinagh bog, and so acts as a hydraulic boundary for groundwater flow. The majority of the dwellings in this area are situated east of this boundary and therefore no impacts on groundwater flow are expected. The Little River flows along the western edge of the Drinagh bog parallel to the N62 and also acts as a hydraulic boundary and groundwater flow from the western edge of the Drinagh bog, the area of the site situated near the N62 and potentially the eastern edge of the Clongawny bog is also expected to discharge to the Little River.

The wind farm is designed so that it at least 750m from surrounding dwelling houses.

The closest proposed infrastructure up-gradient of the dwellings within the setback distance is shown in Table 9.16 below.

Table 9.16: Potential Private Wells Down-gradient of the Development Footprint

Development Footprint Location	Sub-catchment	Distance from Closest Private Dwelling (m)	Assessment
T10	Rapemills	916	Down-gradient, but large separation distance.
T2	Little	750	Across-gradient, but large separation distance.
T3	Little	750	Down-gradient, but large separation distance.
T20	Little	1,395	Down-gradient, but large separation distance.
Substation	Island River/Brosna	340	Down-gradient

Note:
1. Distance from closest turbine, compound, or substation (i.e. excavation/earthworks location). Access roads and the cable trench nor amenity path are not considered a potential risk due to the shallow nature of those works. The distances listed above are from the nearest wind farm infrastructure within the same surface water catchment as the dwelling.
2. Each dwelling is assumed to have an on-site private water well as outlined above (this is for assessment purposes only, wells may or may not actually exist).

The closest proposed infrastructure to these dwellings is the substation which has a setback distance of approximately 340m. Due to the shallow nature of the excavation works associated with the substation, no impacts on groundwater levels or local wells are anticipated.

There are 3 no. proposed turbines potentially upgradient of a private dwelling (well locations assumed but not confirmed). The closest upgradient turbine is over 750m away. Due to the nature of the foundation excavations and the use of cement, the potential impacts on closet down-gradient dwelling (and potential well) is assessed below.

Pathway: Groundwater flowpaths.

Receptor: Groundwater Supplies.

Pre-Mitigation Potential Impact: Negative, imperceptible, indirect, long term, low probability effect.

Impact Assessment

The risk to any potential well source down-gradient of a turbine location from potential contaminant release (i.e. sediment, hydrocarbons, and cement-based compounds) within any excavation at this separation distance is negligible (i.e. 750m). Due to the relatively low bulk permeability of mineral soils beneath the peat (i.e. predominately silts and clays with some interbedded gravels), the low recharge characteristics (due to the overlying peat) and the low groundwater gradients (flat topography), groundwater travel times are expected to be slow. The relatively low permeability and the diffuse nature of groundwater flow in the mineral soils would mean that a pollutant would take months/years to travel this distance as demonstrated below by means of the Darcy mean velocity equation:

$$q = k.i$$

$$v = q/ne$$

$$T = L / v$$

where:

q = specific discharge (m/day)

k = permeability m/day (a value of 20m/day for moderate to low permeability subsoils is used).

ne = porosity (a value of 0.025 is used for silts/clays).

i =slope of the water table in the subsoil can be estimated from on topography (a value of 0.005 is used down-gradient of the turbine (60mOD -55mOD)/1000m = 0.005).

v = Darcy velocity (m/day).

L = Distance (metres).

T = Time of travel (days)

Based on a groundwater flow velocity of 20m/day (2.3×10^{-4} m/s, conservative worst-case estimate), the time of travel (ToT) for a potential pollutant to flow from the development location to the closest dwelling house (i.e. 750m) would be in the order of 5 years. During this time any discharge would be assimilated and attenuated by natural groundwater flow and diluted by rainfall recharge. Also, any entrained sediment would be filtered within the low permeability subsoils. Therefore, the risk posed to potential well sources at this distance from potential spills and leaks from excavations is negligible.

In addition, there are proposed mitigation measures (outlined above) that will minimise and prevent potential groundwater contamination from hydrocarbons and other chemicals (refer to Sections 9.5.3.5, 9.5.3.6, and 9.5.3.7).

Residual Effects: For the reasons outlined in the impact assessment above (separation distances, and prevailing geology, topography and groundwater flow directions), we consider the residual effects to be - negative, imperceptible, indirect, long term, low probability effect in terms of quality or quantity.

Significance of Effects: For the reasons outlined above, no significant impacts on potential groundwater supplies are anticipated.

9.5.3.10 Potential Impacts of the Proposed Amenity Links

A total of approximately 18km of amenity pathways (including walkways and cycleways, and carpark) will be provided as part of the construction of the proposed development. The amenity pathways will be mainly located on the proposed internal road network. The roads will be re-purposed following construction to form the amenity pathways, in addition to being used for maintenance access during operation. The amenity pathways will have a gravel/crushed stone finish surface. Figure 4.30 outlines the final configuration of the internal roads with the cycleway included in the layout plan.

In addition, approximately 6.5 km of dedicated amenity pathways are proposed to provide access points/links into and out of the site as follows:

- Internal link to R437 allowing further access to Drinagh and Derrybrat to facilitate potential future connection to Lough Boora Parklands.
- Link from the R357 and L7009 providing connectivity to the local Stonestown and wider Cloghan area.
- Link to the L7005 providing connectivity to the local Drinagh area.
- Link to the Bord na Móna boundary in Clongawny West to facilitate potential future connection to the R438.
- Link to the Bord na Móna boundary in southwest Drinagh to facilitate potential future connection to the proposed Whigsborough Walkway.

In addition to the amenity pathway, a new public car park will be provided for recreational use during the operational stage. The car park will be located adjacent to the proposed access off the R357, immediately north of the proposed substation.

The amenity access points off the R357 and L7009 are discussed in Section 4.4.1. Only these access points will be available to public during the operational phase. As outlined in Section 4.3.3, amenity connectivity between Clongawny and Drinagh Bogs will be via an underpass beneath the N62 only.

Pathway: Extraction/excavation of soil/subsoil.

Receptor: Surface water quality and groundwater quality.

Pre-Mitigation Potential Impact: Negative, slight, indirect, low probability, short-term effect on surface water quality and groundwater quality.

Proposed Mitigation Measures:

Detailed mitigation measures for sediment control are outlined in Section 9.5.3.1. And, detailed mitigation measures for control of hydrocarbons during construction works are outlined in Section 9.5.3.5.

Residual Effect: For the reasons outlined in the impact assessment above, we consider the residual effects to be - Negative, imperceptible, indirect, low probability, short-term effect on surface water and groundwater quality.

Significance of Effects: For the reasons outlined above, no significant effects on surface water and groundwater quality are anticipated.

9.5.3.11 Potential Effects of the Proposed Haul Route Junction Works

A new temporary arrangement will be required at Kennedy’s Cross, located in the townland of Ballindown, (junction of the N52 and N62 National Secondary Roads), comprising construction of a new road across third party lands, to facilitate the delivery of turbine components and other abnormal loads. The proposed new road will measure approximately 160 metres in length and have a 6-metre running width.

Pathway: Extraction/excavation of soil/subsoil.

Receptor: Surface water quality and groundwater quality.

Pre-Mitigation Potential Impact: Negative, slight, indirect, low probability, temporary effect on surface water quality and groundwater quality.

Proposed Mitigation Measures:

Detailed mitigation measures for sediment control are outlined in Section 9.5.3.1. And, detailed mitigation measures for control of hydrocarbons during construction works are outlined in Section 9.5.3.5.

Residual Effect: Based on the implementation of proven mitigation, as outlined above, we consider the residual impacts to be - Negative, imperceptible, indirect, low probability, temporary effect on surface water and groundwater quality.

Significance of Effects: For the reasons outlined above, no significant effects on surface water and groundwater quality are anticipated.

9.5.4 Operational Phase - Likely Significant Effects and Mitigation Measures

9.5.4.1 Progressive Replacement of Natural Surface with Lower Permeability Surfaces

Progressive replacement of the peat or vegetated surface with impermeable surfaces could potentially result in an increase in the proportion of surface water runoff reaching the surface water drainage network. This could potentially increase runoff from the site and increase flood risk downstream of the development. In reality, the access roads will have a higher permeability than the underlying peat. However, it is conservatively assumed in this assessment that the proposed access roads and hardstands are impermeable. The assessed footprint comprises turbine bases and hardstandings, access roads, amenity links, site entrances, substation and temporary construction compounds. During storm rainfall events, additional runoff coupled with increased velocity of flow could increase hydraulic loading, resulting in erosion of watercourses and impact on aquatic ecosystems.

The emplacement of the proposed permanent development footprint, as described in Chapter 4 of the EIAR, (assuming emplacement of impermeable materials as a worst-case scenario) could result in an average total site increase in surface water runoff of approximately 1,213 m^3/month (Table 9.17). This represents a potential increase of approximately 0.06 % in the average daily/monthly volume of runoff from the site area in comparison to the baseline pre-development site runoff conditions (Table 9.6). This is a very small increase in average runoff and results from the naturally high surface water runoff rates and the relatively small area of the site being developed, the proposed total permanent development footprint being approximately 34.2ha, representing 1.45% of the total study area of ~2,360 ha.

Table 9.17: Baseline Site Runoff V Development Runoff

Development Type	Site Baseline Runoff/month (m^3)	Baseline Runoff/day (m^3)	Permanent Hardstanding Area (m^2)	Hardstanding Area 100% Runoff (m^3)	Hardstanding Area 96% Runoff (m^3)	Net Increase/month (m^3)	Net Increase/day (m3)	% Increase from Baseline Conditions (m^3)
Wind Farm	2,008,454	64,789	342,000	30,318	29,106	1,213	39	0.06%

The additional volume is low due to the fact that the runoff potential from the site is naturally high (96%). Also, the calculation assumes that all hardstanding areas will be impermeable which will not be the case as access tracks will be constructed of permeable stone aggregate. The increase in runoff from the proposed development will, therefore, be negligible. This is even before mitigation measures will be put in place.

Pathway: Site drainage network.

Receptor: Surface waters and dependent ecosystems.

Pre-Mitigation Potential Impact: Negative, slight, indirect, permanent, moderate probability effect on all downstream surface water bodies.

Proposed Mitigation by Design:

As the part of the proposed wind farm drainage design, it is proposed that runoff from the proposed infrastructure will be collected locally in new proposed silt traps, settlement ponds and vegetated buffer areas prior to release into the existing drainage network. The new proposed drainage measures will then create significant additional attenuation to what is already present. The operational phase drainage system will be installed and constructed in conjunction with the existing bog drainage network and will include the following:

- Interceptor drains will be installed up-gradient of all proposed infrastructure to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where suspended sediment could become entrained. It will then be directed to areas where it can be re-distributed into downstream field drains;
- Collectors drains will be used to gather runoff from access roads and turbine hardstanding areas of the site, likely to have entrained suspended sediment, and channel it to new local settlement ponds for sediment settling;
- On sections of access road transverse drains ('grips') will be constructed where appropriate in the surface layer of the road to divert any runoff off the road into swales/roadside drains;
- Check dams will be used along sections of access road drains to intercept silts at source. Check dams will be constructed from a 4/40mm non-friable crushed rock;
- Settlement ponds, emplaced downstream of access road sections and at turbine locations, will buffer volumes of runoff discharging from the drainage system during periods of high rainfall, by retaining water until the storm hydrograph has receded, thus reducing the hydraulic loading to existing drains;
- Settlement ponds will be designed in consideration of the greenfield runoff rate, existing bog settlement ponds will also buffer discharges from the two bog (Clongawny and Drinagh); and,
- Finally, all surface water runoff from the development will have to pass through the settlement ponds at the existing bog outfall locations.

Post-Mitigation Impact Assessment

As stated in Section 9.3.4 above there are existing surface water control measures at the bog which comprise high level bog surface drains, low level main drains and settlement ponds. All these existing drainage measures offer some surface water attenuation during rainfall events. However, as the part of the proposed wind farm drainage (which is outlined further in Section 9.4.1 and Section 9.4.2 above), it is proposed that runoff from the proposed infrastructure will be collected locally in new proposed silt traps, settlement ponds and vegetated buffer areas prior to release into the existing drainage network. The new proposed drainage measures will then in effect create significant additional attenuation to what is already present at the site. The net effect of this will be a reduction in the overall runoff coefficient of the bog as demonstrated by the use of the Rational Method in Table 9.18 below. Based on a conservative reduction in the runoff coefficient from 0.96 to 0.85 for the overall site, there would a potential 11.4% reduction in runoff volumes from the site. This assessment demonstrates that there will be no risk of exacerbated flooding down-gradient of the site as a result of the proposed wind farm development. The proposed development will in effect retain water within the bog for longer periods.

Table 9.18: Surface Water Runoff Assessment for Proposed Wind Farm Drainage

Site Area	C (1)	Area (m^2)	Rc (2)	100-Year 6hr Rainfall Depth (m)	Runoff Volume (m^3)	Total Site Runoff Volume (m^3)
Without Wind Farm Drainage Control						
Undeveloped Area	2.78	23,258,000	0.96	0.0515	1,149,876	1,167,489
Development Footprint	2.78	342,000	1.00	0.0515	17,613	
With Wind Farm Drainage Control						
Undeveloped Area	2.78	23,258,000	0.85	0.0515	1,018,119	1,034,851
Development Footprint	2.78	342,000	0.95	0.0515	16,732	
Estimated Potential Reduction in Site Runoff Volumes (%)						11.4%

Notes: 1 – Constant, 2- Runoff Coefficient

Residual Effect: With the implementation of the proposed wind farm drainage measures as outlined above, and based on the post-mitigation assessment of runoff, we consider that residual effect are - Negative, imperceptible, indirect, long-term, moderate probability effect on all downstream surface water bodies.

Significance of Effects: For the reasons outlined above, no significant effects on downstream flood risk is anticipated.

9.5.4.2 Runoff Resulting in Suspended Solids Entrainment in Surface Waters

During the operational phase, the potential for silt-laden runoff is much reduced compared to the construction phase. In addition, all permanent drainage controls will be in place and the disturbance of ground and excavation works will be complete. Some minor maintenance works may be completed, such as maintenance of site entrances, internal roads, hardstand areas and amenity pathways. These works would be of a very minor scale and would be very infrequent. Potential sources of sediment laden water would only arise from surface water runoff from small areas where new material is added during maintenance works

These minor activities could, however, result in the release of suspended solids to surface water and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality and fish stocks of downstream water bodies. Potential effects could be significant if not mitigated against.

During such maintenance works there is a small risk associated with release of hydrocarbons from site vehicles, although it is not envisaged that any significant refuelling works will be undertaken on site during the operational phase.

Pathways: Drainage and surface water discharge routes.

Receptors: Down-gradient rivers and associated dependent ecosystems.

Pre-Mitigation Potential Impact: Negative, slight, indirect, temporary, low probability effect.

Proposed Mitigation Measures:

Mitigation measures for sediment control are the same as those outlined in Section 9.5.3.1.

Mitigation measures for control of hydrocarbons during maintenance works are similar to those outlined in Section 9.5.3.5.

Residual Effects: With the implementation of the proposed wind farm drainage measures as outlined above, and based on the post-mitigation assessment of runoff, we consider that residual effect are - Negative, imperceptible, indirect, temporary, low probability effect on downstream water quality.

Significance of Effects: For the reasons outlined above, no significant effects on the surface water quality are anticipated.

9.5.4.3 Potential Effects on Local Groundwater Well Supplies from Operation of Abstraction Well at Proposed Substation

It is proposed to install a groundwater well adjacent to the substation in accordance with the Institute of Geologists Ireland, *Guide for Drilling Wells for Private Water Supplies* (IGI, 2007). The well will be flush to the ground and covered with a standard manhole. A pump house is not currently envisaged as an in-well pump will direct water to a water tank within the roof space of the control building (subject to final design). Bottled water will be supplied for drinking, if required. The proposed abstraction volume from the well will be small, as there will only be intermittent use of welfare facilities at the substation. For the purpose of our assessment we have assumed a worst-case abstraction of $1m^3$/week.

As presented in Table 9.16 above, the closest dwelling to the proposed substation location is ~340m. Based on this separation distance, and the very low abstraction rate proposed from the substation groundwater well, and also based on the type of underlying geology (limestone bedrock aquifer, (*c.f.* Section 9.3.8),

Pathway: Groundwater volume and water level drawdown.

Receptor: Local groundwater supplies.

Pre-Mitigation Potential Impact: Neutral, imperceptible, indirect, long-term, low probability effect on local groundwater volumes and water levels.

No mitigation is proposed, as the proposed abstraction is such a small volume.

Residual Effects: For the reasons outlined in the impact assessment above (separation distances, and prevailing geology), we consider the residual effects to be none.

Significance of Effects: For the reasons outlined above, no significant impacts on local groundwater supplies from operation of the proposed substation well are anticipated.

9.5.4.4 Assessment of Potential Health Effects

Potential health effects are associated with negative impacts (i.e. contamination) on public and private water supplies and potential flooding. There are no mapped public or group water scheme groundwater protection zones in the area of the proposed wind farm site. The Banagher PWS abstraction is located west of the site, approximately 2 km southeast of Banagher. The mapped source protection zone for this GWS does not fall within the proposed development site boundary. Notwithstanding this, the proposed site design and mitigation measures ensures that the potential for impacts on the groundwater environment are not significant

Flooding of property can cause inundation with contaminated flood water. Flood waters can carry waterborne disease and contamination/effluent. Exposure to such flood waters can cause temporary health issues. The Flood Risk Assessment has also shown that the risk of the proposed wind farm contributing to downstream flooding is also very low, as the long-term plan for the site is to retain and slow down drainage water within the existing site. On-site drainage control measures will ensure no downstream increase in flood risk.

9.5.5 Decommissioning Phase - Likely Significant Effects and Mitigation Measures

The potential impacts associated with decommissioning of the proposed development will be similar to those associated with construction but of a reduced magnitude, due to the reduced scale of the proposed decommissioning works in comparison to construction phase works.

During decommissioning, it may be possible to reverse or at least reduce some of the potential impacts caused during construction by rehabilitating construction areas such as turbine bases, hard standing areas.

This will be done by covering with peatland vegetation/scraw or poorly humified peat to encourage vegetation growth and reduce run-off and sedimentation. Other impacts such as possible soil compaction and contamination by fuel leaks will remain but will be of reduced magnitude. However, as noted in the Scottish Natural Heritage report (SNH) Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms (SNH, 2013) reinstatement proposals for a wind farm are made approximately 30 years in advance, so within the lifespan of the wind farm, technological advances and preferred approaches to reinstatement are likely to change. According to the SNH guidance, it is, therefore:

"best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm".

Some of the impacts will be avoided by leaving elements of the proposed development in place where appropriate. The substation will be retained by EirGrid. The turbine bases will be rehabilitated by covering with local topsoil/peat in order to regenerate vegetation which will reduce runoff and sedimentation effects. Internal roads will remain as amenity pathways. Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the construction phase mitigation measures.

No significant effects on the hydrological and hydrogeological environment are envisaged during the decommissioning stage of the proposed development.

9.5.6 Assessment of Cumulative Effects

A cumulative impact assessment was undertaken regarding other wind farm developments and non-wind farm developments located within a 20km radius and inside the River Shannon catchment. The wind farm developments assessed are listed in Table 9.19 below and are shown on Figure 9.8. Non-wind farm developments that have been assessed are listed in Section 2.5.

In terms of the potential impacts of developments on downstream surface water bodies (e.g. Sliver River, Rapemills River, Little River, Little Brosna River and River Shannon), the biggest risk is during the construction phase of the Proposed Development as this is the phase when earthworks and excavations will be undertaken at the sites. However, within 20km of the proposed site inside the River Shannon catchment, a high majority (54%) of the other windfarm developments are operational, therefore construction phase impacts with the proposed Derrinlough WF are not anticipated. It is also anticipated that the Cloghan wind farm will be built in advance of the proposed Derrinlough wind farm, and therefore the relative construction periods will not overlap. However, a worst-case scenario would be that the Cloghan wind farm and Derrinlough WF are constructed at the same time, and this is assessed below.

In terms of operational phase hydrological effects, the total number of turbines that could potentially be operating within a 20km radius of the site inside the River Shannon catchment is 43 no. (which includes 21 no. from the proposed Derrinlough WF). The total catchment area of the River Shannon within a 20km radius of the proposed site is ~1,384km^2 and therefore this equates to 1 turbine for approximately every ~32km^2 which would not be considered high density. Therefore, effects on catchment hydrology and water quality are not be expected.

The construction of the wind farm grid connection works will only require relatively localised excavation works within the site boundary and therefore will not contribute to any significant cumulative effects on the water environment.

Implementation of the proposed drainage mitigation during the construction phase (Section 9.5.3) will ensure there will be no cumulative significant adverse impacts on the water environment from the proposed development and other wind farm developments (including a concurrent construction of Cloghan wind farm) and non-wind farm developments within the River Shannon catchment. Non-wind projects also include exempted development such as OPW arterial and drainage maintenance works.

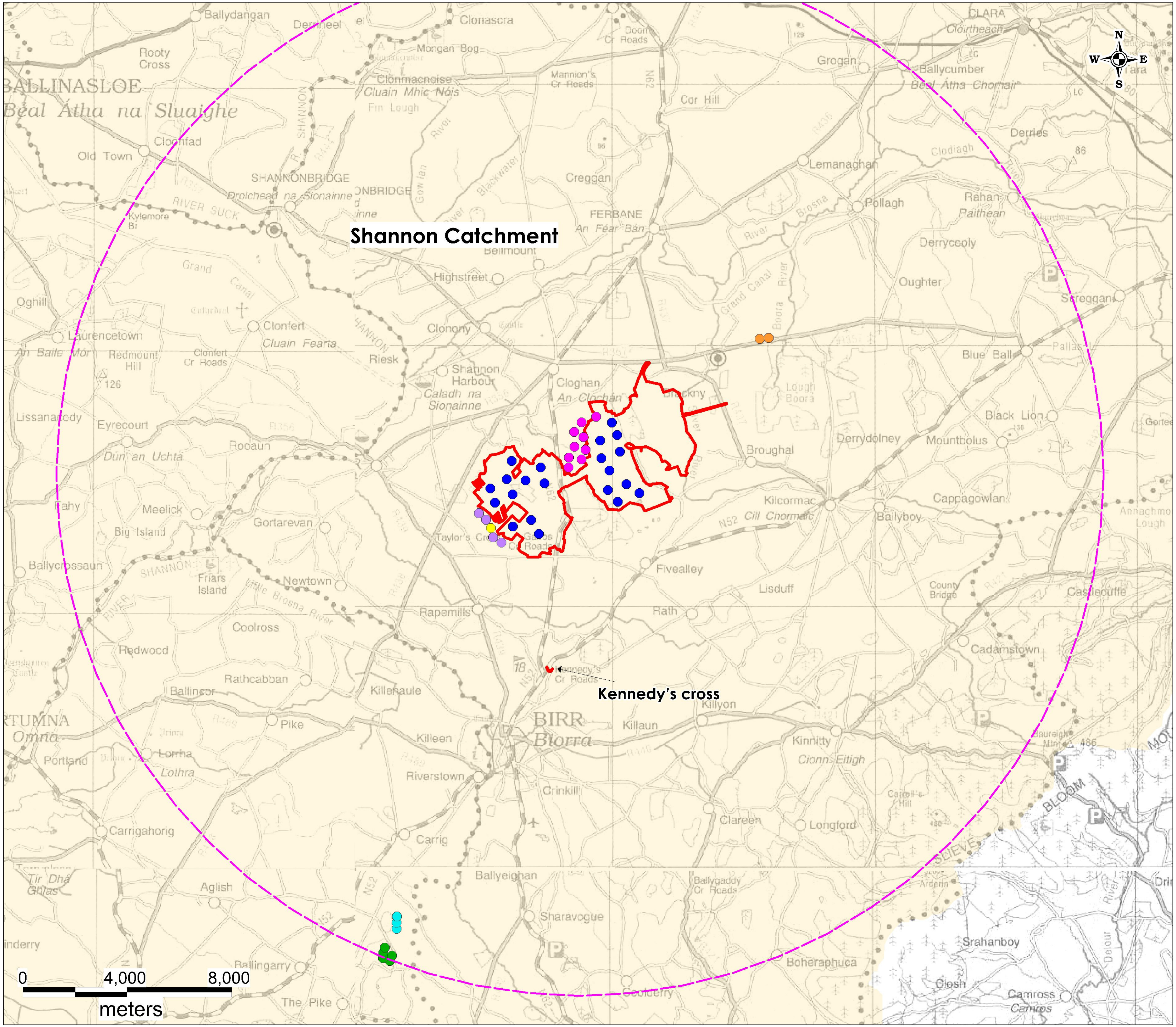
In terms of cumulative hydrological effects arising from elements of the Proposed Development no significant effects on water quality or flood flows are expected as they are all contained within the site and therefore will be within the wind farm drainage catchment where all construction water will be attenuated and treated as described above (Sections 9.5.3 and 9.5.4).

Table 9.19: Other Wind Farm Developments in the River Shannon catchment within a 20km radius of the site

Catchment Area	Wind Farm Name	Status	Potential No. of Turbines in Catchment
River Shannon	Skehanagh WF	5 no. Existing	5
	Carrig WF	3 no. Existing	3
	Meenwaun WF	4 no. Existing	4
	Meenwaun WF	1 no. Permitted	1
	Cloghan WF	9 no. Permitted	9
Potential Total			**22**

9.5.7 Post Consent Monitoring

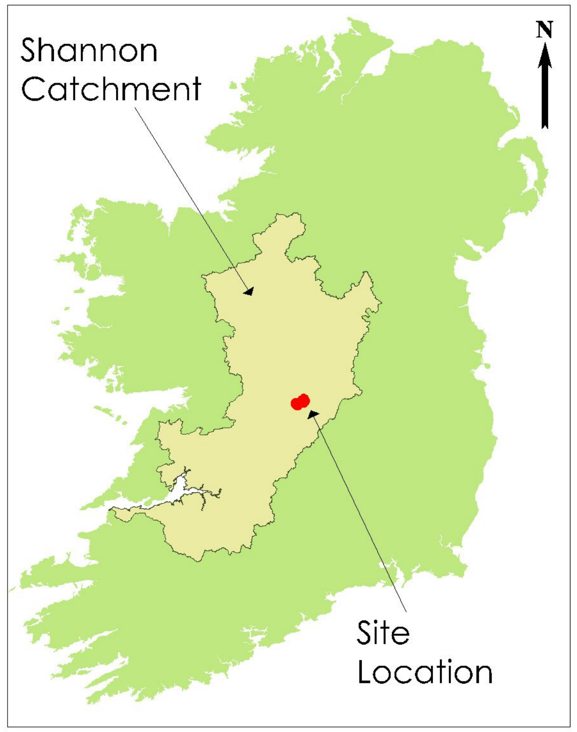
None required.



Legend

- EIAR Site Boundary
- Derrinlough WF (Proposed)
- Carrig WF (Existing)
- Cloghan WF (Permitted)
- Leabeg WF (Existing)
- Meenwaun WF (Existing)
- Meenwaun WF (Permitted)
- Skehanagh WF (Existing)
- 20km radius from the site

Key Plan



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Client: Bord na Mona Powergen Ltd	
Job: Derrinlough WF, Co. Offaly	
Title: Cumulative Assessment Map	
Figure No: 9.8	
Drawing No: P1463-0-0220-A3-908-00A	
Sheet Size: A3	Project No: P1463-0
Scale: 1:100,000	Drawn By: GD
Date: 07/02/2020	Checked By: MG

APPENDIX 3

CONSTRUCTION AND ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

Planning and Environmental Consultants

Construction and Environmental Management Plan

Derrinlough Wind Farm

DOCUMENT DETAILS

Client: **Bord na Móna Powergen Ltd.**

Project Title: **Derrinlough Wind Farm**

Project Number: **171221**

Document Title: **Construction and Environmental Management Plan**

Document File Name: **CEMP F – 2020.02.19 - 171221**

Prepared By:
MKO
Tuam Road
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Planning and Environmental Consultants

Rev	Status	Date	Author(s)	Approved By
01	Final	19/02/2020	EG/E Mc C	MW

Table of Contents

1. INTRODUCTION

This Construction and Environmental Management Plan (CEMP) has been developed by McCarthy Keville O' Sullivan Ltd. (MKO) on behalf of Bord na Móna Powergen Ltd., who intend to apply to An Bord Pleanála for planning permission to construct a wind energy development and all associated infrastructure at Derrinlough and adjacent townlands, Co. Offaly. The proposed development will be located on Clongawny and Drinagh Bogs which are part of the Boora bog group. The CEMP has been prepared in conjunction with the Environmental Impact Assessment Report (EIAR) which will accompany the planning application for the proposed development to be submitted to the competent authorities.

Should the project secure planning permission, the CEMP will be updated, in line with all conditions and obligations which apply to any grant of permission. The CEMP should be read in conjunction with the EIAR and planning drawings. The CEMP will also require updating by the selected contractor in order to identify, assess and satisfy the contract performance criteria as set out by the various stakeholders. The CEMP due to its structure and nature will also require constant updating and revision throughout the construction period as set out below. Therefore, this is a working document and will be developed further prior to and during the construction phase of the wind farm development.

Triggers for amendments to the CEMP will include:

- When there is a perceived need to improve performance in an area of environmental impact;
- As a result of changes in environmental legislation applicable and relevant to the project;
- Where the outcomes from auditing establish a need for change;
- Where Work Method Statements identify changes to a construction methodology to address high environmental risk; and
- As a result of an incident or complaint occurring that necessitates an amendment.

This report provides the environmental management framework to be adhered to during the pre-commencement, construction and operational phases of the Proposed Development and it incorporates the mitigating principles to ensure that the work is carried out in a way that minimises the potential for any environmental impacts to occur. This report has been prepared in accordance with the mitigation measures and commitments made in the EIAR and other planning documents for the Proposed Development.

This report is intended as a single, amalgamated document that can be used during the future phases of the project, as a single consolidated point of reference relating to all construction, environmental and drainage requirements for the Planning Authority, developer and contractors alike.

1.1 Scope of Construction and Environmental Management Plan

This report is presented as a guidance document for the construction of the proposed Derrinlough Wind Farm including connection to the national grid. Where the term 'site' is used in the CEMP it refers to all works associated with the proposed development enabling works. The CEMP outlines clearly the mitigation measures and monitoring proposals that are required to be adhered to in order to complete the works in an appropriate manner.

The report is divided into nine sections, as outlined below.

- Section 1 provides a brief introduction as to the scope of the report.

- Section 2 outlines the Site and Project details, detailing the targets and objectives of this plan along with providing an overview of construction methodologies that will be adopted throughout the project.
- Section 3 sets out details of the environmental controls to be implemented on site. Site drainage measures, peat stability monitoring measures and a waste management plan are also included in this section.
- Section 4 sets out a fully detailed implementation plan for the environmental management of the project outlining the roles and responsibilities of the project team.
- Section 5 outlines the Emergency Response Procedure to be adopted in the event of an emergency in terms of site health and safety and environmental protection.
- Section 6 consists of a summary table of all mitigation proposals to be adhered to during the project, categorised into three separate headings, 1) pre-commencement measures; 2) construction-phase measures and 3) operational-phase measures.
- Section 7 consists of a summary table of all monitoring requirements and proposals to be adhered to during the project, categorised into three separate headings, 1) pre-commencement measures; 2) construction-phase measures and 3) operational-phase measures.
- Section 8 sets out a programme for the timing of the works.
- Section 9 outlines the proposals for reviewing compliance with the provisions of this report.

2. SITE AND PROJECT DETAILS

2.1 Site Location and Description

The site of the Proposed Development is located on two bogs within the Boora Bog Group in West Offaly, namely Clongawny and Drinagh bog units. The site is located approximately 3.0 kilometres to the east of Banagher and approximately 7.0 kilometres to the northeast of Birr, Co. Offaly. The villages of Cloghan and Five Alley are located approximately 2.0 kilometres to the north and 2.5 kilometres to the south of the site, respectively.

The proposed development site area measures approximately 2,360 hectares. The site topography ranges between 65 metres above ordnance datum (mAOD) at its highest point to approximately 49 mAOD at its lowest point. The site measures approximately 6.0 kilometres in length from north to south, and approximately 9.0 kilometres from east to west, at its widest point. The Grid Reference co-ordinates for the approximate centre of the site are E208501, N214984.

The proposed grid connection forms part of the planning application. It is proposed to construct a 110kV substation within the site and to connect from here to the existing Dallow / Portlaoise / Shannonbridge 110 kV overhead line, located in the northwest of the site. Connection will be via either overhead line or underground cabling. The connection route measures approximately 280 metres in total.

The proposed development will require the construction of a short bypass, located just northeast of the existing junction between the N52 and N62 National Secondary Routes, for the purposes of abnormal load delivery. The bypass will measure approximately 160 metres and will only be in use during the turbine delivery stage of the proposed development. Gates will be installed at the junctions of the temporary road with the N52 and N62, respectively. These gates will be locked between scheduled turbine deliveries. Following the completion of the construction phase of the proposed development the gates will remain in-situ. The temporary turbine delivery access road will be closed, covered with a layer of topsoil and reseeded. It would only be used again in the event that an oversized delivery was required for wind turbine maintenance purposes.

2.2 Description of the Development

The planning application for the proposed wind farm includes connection to the national electricity grid. All elements of the proposed project, including grid connection and any works required on public roads to accommodate turbine delivery, have been considered.

This application seeks a ten-year planning permission and 30-year operational life from the date of commissioning of the entire wind farm.

The key components of the Proposed Development include the following:

- i. *21 No. wind turbines with an overall blade tip height of up to 185 metres and all associated hard-standing areas.*
- ii. *2 No. permanent Anemometry Masts up to a height of 120 metres.*
- iii. *Provision of new and upgraded internal site access roads, passing bays, amenity pathways, amenity carpark and associated drainage.*
- iv. *2 No. permanent underpasses in the townland of Derrinlough. One underpass will be located beneath the N62 and one will be located beneath an existing Bord na Móna rail line.*
- v. *1 No. 110 kV electrical substation, which will be constructed in the townland of Cortullagh or Grove. The electrical substation will have 2 No. control buildings, associated electrical plant and equipment and a wastewater holding tank.*

vi. *5 No. temporary construction compounds, in the townlands of Clongawny More, Derrinlough, Derrinlough/Crancreagh, Drinagh and Cortullagh or Grove.*
vii. *All associated underground electrical and communications cabling connecting the turbines to the proposed electrical substation.*
viii. *2 No. temporary security cabins at the main construction site entrances in the townland of Derrinlough.*
ix. *All works associated with the connection of the proposed wind farm to the national electricity grid, which will be to the existing Dallow/Portlaoise/Shannonbridge 110 kV line.*
x. *Removal of existing meteorological mast.*
xi. *Upgrade of existing access and temporary improvements and modifications to existing public road infrastructure to facilitate delivery of abnormal loads including locations on the N52 and N62; construction access for delivery of construction materials at locations on the N62 and R357; operational access onto L7009 in the townland of Cortullagh or Grove and amenity access off R357 and L7005.*
xii. *All associated site works and ancillary development including signage.*
xiii. *A 10-year planning permission and 30-year operational life from the date of commissioning of the entire wind farm.*

The proposed site layout showing individual elements of the development is shown in Figure 2.1 and in the Site Layout Drawings included with the application.

2.3 Targets and Objectives

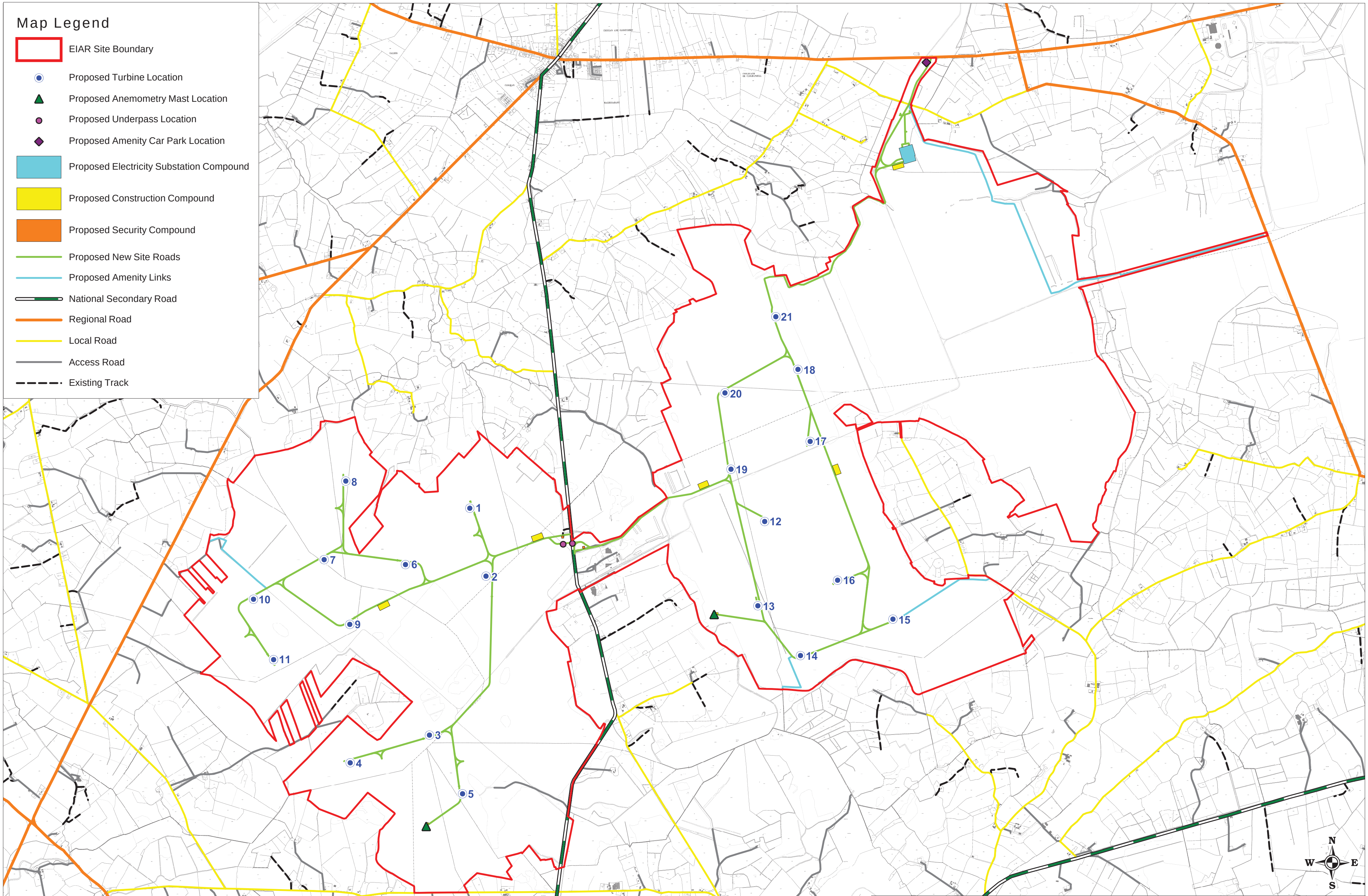
The construction phase works are designed to approved standards, which include specified materials, standards, specifications and codes of practice. The design of the project has considered environmental issues and this is enhanced by the works proposals.

The key site targets are as follows;

- Adopt a sustainable approach to construction and, ensure sustainable sources for materials supply where possible;
- Keeping all watercourses free from obstruction and debris;
- Avoidance of any pollution incident or near miss as a result of working around or close to existing watercourses and having emergency measures in place;
- Correct fuel storage and refuelling procedures to be followed;
- Air and noise pollution prevention to be implemented;
- Construction Methods and designs will be altered where it is found there is an adverse effect on the environment;
- Good waste management and house-keeping to be implemented;
- Using recycled materials if possible, e.g. excavated stone, soil and subsoil material;
- Avoidance of vandalism;
- Monitoring of the works and any adverse effects that it may have on the environment; and,
- Provide adequate environmental training and awareness for all project personnel.

The key site objectives are as follows;

- Keep impact of construction to a minimum on the local environment, watercourses, habitats and wildlife;
- Comply with all relevant water quality legislation;
- Ensure construction works and activities are completed in accordance with mitigation and best practice approach presented in the Environmental Report and associated planning documentation;



MAP TITLE: **Proposed Development Site Layout** | MAP NO.: **Figure 2.1** | SCALE: **1:30,000**

PROJECT TITLE: **171221 - Derrinlough Wind Farm EIAR** | OS SHEET NO.: **N/A** | DATE: **05-02-2020**

DRAWING BY: **Eoin McCarthy** | CHECKED BY: **Michael Watson** | ISSUE NO.: **171221-2020.02.05-F**

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- Ensure construction works and activities are completed in accordance with any planning conditions for the development;
- Ensure construction works and activities have minimal impact/disturbance to local landowners and the local community; and
- Ensure construction works and activities have minimal impact on the Natural Environment.

2.4 Construction Methodologies Overview

2.4.1 Introduction

An experienced main contractor will be appointed for the civil works for the construction phase of the Proposed Development. The appointed contractor for the works will be required to comply with this CEMP and any revisions made to this document in the preparation of method statements for the various elements of the construction phase of the proposed development. An overview of the proposed Construction Methodologies is provided below.

2.4.2 Overview of Proposed Construction Methodology

The proposed anticipated construction methodology is summarised under the following main headings:

- Proposed New Site Access Roads;
- Temporary Construction Compound;
- Site Drainage System;
- Proposed New Site Access Roads;
- Culvert crossings
- Crane Hardstands;
- Turbine and Anemometry Mast Foundations;
- Anemometry Mast Removal
- Electricity Substation and Control Buildings;
- Underpass;
- Cable Trenching;
- Grid Connection Cabling.

2.4.2.1 New Site Access Roads

There is approximately 29.3 km of new access roads to be installed at the site. In some areas across the site, floating roads will be required. The new access roads will be constructed as follows using both a floating road and excavated site road methodology both of which are summarised below.:

2.4.2.1.1 *Construction of New Floating Roads*

Floating access roads are the predominant road construction type proposed for the site and will be used in areas where the peat depth is in excess of 1m. The use of new floated access tracks will be limited on site to areas of flatter terrain i.e. typically less than 5 degree slope.

The general construction methodology for the construction of floating roads, as presented in FTC's Peat and Spoil Management Plan in Appendix 4.2, is summarised below. This methodology includes procedures that are to be included in the construction to minimise any adverse impact on peat stability.

1. *Prior to commencing floating road construction movement monitoring posts should be installed in areas where the peat depth is greater than 2.0m.*
2. *Floating road construction shall be to the line and level requirements as per design/planning conditions.*

3. *Base geogrid to be laid directly onto the existing peat surface along the line of the road in accordance with geogrid provider's requirements.*
4. *Construction of road to be in accordance with appropriate design from the designer.*
5. *The typical make-up of the new floated access road is up to 1,200mm of selected granular fill with 2 no. layers of geogrid with possibly the inclusion of a geotextile separator. This may vary depending on designer requirements.*
6. *Following the detailed design of the floated access roads it may be deemed necessary to include pressure berms either side of the access road in some of the deeper peat areas. The inclusion of a 5m wide pressure berm (typically 1m in height) either side of the access road will reduce the likelihood of potential bearing failures beneath the access road.*
7. *The finished road surface width will be approximately 6m (to be confirmed by the designer).*
8. *Stone delivered to the floating road construction shall be end-tipped onto the constructed floating road. Direct tipping of stone onto the peat shall not be carried out.*
9. *To avoid excessive impact loading on the peat due to concentrated end-tipping all stone delivered to the floating road shall be tipped over at least a 10m length of constructed floating road.*
10. *Where it is not possible to end-tip over a 10m length of constructed floating road then dumpers delivering stone to the floating road shall carry a reduced stone load (not greater than half full) until such time as end-tipping can be carried out over a 10m length of constructed floating road.*
11. *Following end-tipping a suitable bull-dozer shall be employed to spread and place the tipped stone over the base geogrid along the line of the road.*
12. *A final surface layer shall be placed over the floating road, as per design requirements, to provide a road profile and graded to accommodate wind turbine construction and delivery traffic.*

2.4.2.1.2 Construction of New Excavated Roads

The general construction methodology for the construction of excavated roads, as presented in the Peat and Spoil Management Plan (Appendix 4.2), is summarised below. This methodology includes procedures that are to be included in construction to minimise any adverse impact on peat stability.

1. *Prior to commencing the construction of the excavated roads movement monitoring posts should be installed in areas where the peat depth is greater than 2.0m.*
2. *Interceptor drains should be installed upslope of the access road alignment to divert any surface water away from the construction area.*
3. *Excavation of roads shall be to the line and level given in the design requirements. Excavation should take place to a competent stratum beneath the peat (as agreed with the site designer).*
4. *Road construction should be carried out in sections of approximately 50m lengths i.e. no more than 50m of access road should be excavated without re-placement with stone fill unless otherwise agreed with the site designer or resident engineer on site.*
5. *All excavated peat shall be placed/spread alongside the excavations.*
6. *Side slopes in peat shall be not greater than 1 (v): 2 or 3 (h). This slope inclination will be reviewed during construction, as appropriate. Where areas of weaker peat are encountered then slacker slopes will be required. Battering of the side slopes of the excavations should be carried out as the excavation progresses.*
7. *The surface of the finished excavated access road will be 1.2m above existing ground level.*
8. *A layer of geogrid/geotextile may be required at the surface of the competent stratum (to be confirmed by the designer).*
9. *At transitions between floating and excavated roads a length of road of about 10m shall have all peat excavated and replaced with suitable fill. The surface of this fill shall be graded so that the road surface transitions smoothly from floating to excavated roa.*

10. *Where slopes of greater than 5 degrees are encountered along with relatively deep peat (i.e. greater than 1.5m) and where it is proposed to construct the access road perpendicular to the slope contours it is best practice to start construction at the bottom of the slope and work towards the top, where possible. This method avoids any unnecessary loading to the adjacent peat and greatly reduces any risk of peat instability. It should be noted that slopes greater than 5 degrees are not envisaged on site.*
11. *A final surface layer shall be placed over the excavated road, as per design requirements, to provide a road profile and graded to accommodate wind turbine construction and delivery traffic.*

2.4.2.1.3 Upgrade of Existing Roads

This methodology includes procedures that are to be included in the construction to minimise any adverse impact on peat stability. The methodology is not intended to cover all aspects of construction such as drainage and environmental considerations.

1. *Access road construction shall be to the line and level requirements as per design/planning conditions.*
2. *For upgrading of existing excavated access tracks the following guidelines apply:*
    a. *Excavation of the widened section of access road should take place to a competent stratum beneath the peat (as agreed with the designer) and backfilled with suitable granular fill.*
    b. *Benching of the excavation may be required between the existing section of access road and the widened section of access road depending on the depth of excavation required.*
    c. *The surface of the existing access track should be overlaid with up to 500mm of selected granular fill.*
    d. *A layer of geogrid/geotextile may be required at the surface of the existing access track and at the base of the widened section of access road (to be confirmed by the designer).*
    e. *For excavations in peat, side slopes shall be not greater than 1 (v): 2 or 3 (h). This slope inclination should be reviewed during construction, as appropriate. Where areas of weaker peat are encountered then slacker slopes will be required.*
3. *For upgrading of existing access tracks constructed using a floated construction technique the following guidelines apply:*
    a. *The surface of the existing access track should be graded/tidied up prior to the placement any geogrid/geotextile, where necessary (to prevent damaging the geogrid/geotextile).*
    b. *Where granular fill has been used in the existing access track make-up, a layer of geogrid should be placed on top of the existing access track.*
    c. *The geogrid may be overlaid with up to 500mm of selected granular fill.*
    d. *Additional geogrid and granular fill may be required in certain sections of the works (to be confirmed by the designer).*
4. *Where the ground is sloping across a section of access road (side long ground) any road widening works required should be done on the upslope side of the existing access road, where possible.*
5. *At transitions between floating and existing excavated roads a length of road of about 10m shall have all peat excavated and replaced with suitable fill. The surface of this fill shall be graded so that the road surface transitions smoothly from floating to excavated road.*
6. *A final surface layer shall be placed over the existing access track, as per design requirements, to provide a road profile and graded to accommodate wind turbine construction and delivery traffic.*

2.4.2.2 Drainage System

The early establishment of temporary drainage facilities will manage the risk of impacts on watercourses on and adjacent to the site during construction. In addition, construction operations will adopt best working practices. The development of the site will need to be phased accordingly. The construction of the drainage will start from the downstream sections and progress upstream, connecting conveyance systems with other drainage features as each development phase progresses. They will therefore need to be designed with sufficient flexibility to respond to an early phase incoming flow during the construction phase.

Surface drainage design and management is summarised with in Section 3.2 below.

2.4.2.3 Temporary Construction Compound

There are five temporary construction compounds proposed for the site. The locations of the compounds are shown in Figure 2.1. The compounds will typically be constructed as follows:

- The area to be used as the compound will be marked out at the corners using ranging rods or timber posts. Drainage runs and associated settlement ponds (refer to Section 3.1.1 below) will be installed around the perimeter;
- The compound will be established using a similar technique as the construction of the excavated site roads as discussed above;
- Where required, a layer of geogrid will be installed and compacted layers of well graded granular material will be spread and lightly compacted to provide a hard area for site offices and storage containers;
- Areas within the compound will be constructed as site roads and used as vehicle hardstandings during deliveries and for parking;
- A bunded containment area will be provided within the compound for the storage of lubricants, oils and site generators etc.;
- If necessary the compound will be fenced and secured with locked gates, although fencing would only be utilised where significant risk of danger to third parties or vandalism is envisaged; and,
- Upon completion of the project the compound will be decommissioned by backfilling the area with the material arising during excavation, landscaping with peat material as required.
- During the construction phase, a self-contained port-a-loo with an integrated waste holding tank will be used on site for toilet facilities. This will be maintained by the service contractor as required and will be removed from the site on completion of the construction phase.
- The water supply to the site will be from a temporary water storage tank which will be filled using a mobile water tank which will source water locally as required.

2.4.2.4 Culvert Crossings on the Wind Farm Site

Culverts will be required where site roads, crane pads and turbine pads cross main bog drainage networks. Indicative locations of the culverts are shown on the drawings in Appendix 4.5 of the EIAR.

Culverts will be installed with a minimum internal gradient of 1% (1 in 100). Smaller culverts will have a smooth internal surface. Larger culverts may have corrugated surfaces which will trap silt and contribute to the stream ecosystem. Depending on the management of water on the downstream side of the culvert, large stone may be used to interrupt the flow of water. This will help dissipate its energy and help prevent problems of erosion. Smaller water crossings will simply consist of an appropriately sized pipe buried in the sub-base of the road at the necessary invert level to ensure ponding or pooling doesn't occur above or below the culvert and water can continue to flow as necessary.

All culverts will be inspected regularly to ensure they are not blocked by debris, vegetation or any other material that may impede conveyance. Any watercourse crossings required will be installed outside of the salmonid spawning season, October to June in any year, in accordance with Inland Fisheries Ireland best practice (IFI, 2016). This will ensure no potential impacts on salmonid spawning habitat.

All of the above works will be supervised by the Environmental Clerk of Works and the project hydrologist.

2.4.2.5 Crane Hardstands

All crane pads will be designed taking account of the loadings provided by the turbine manufacturer and will consist of a compacted stone structure. The crane hardstands will be constructed in a similar manner to the excavated site roads and will measure approximately to the turbine manufacturer's requirements. Where an excavated crane hardstand cannot be used due to the depth of peat, the hardstand will be supported by using reinforced concrete piles as per the methodology outlined for piled foundations summarised below. The position of the crane pads varies between turbine locations depending on topography, position of the site access road, and the turbine position.

2.4.2.6 Turbine and Anemometry Mast Foundations

The wind turbines and anemometry mast foundations will be a reinforced concrete base designed to Eurocode 2/BS8110. Foundation loads will be provided by wind turbine and mast supplier, and factors of safety will be applied to these in accordance with European design regulations. The turbine will be anchored to the foundation using a bolt assembly which shall be cast into the concrete. The anemometry mast is a free-standing structure which is also anchored to the reinforced concrete foundation. It is anticipated that the foundations for both the turbines and the anemometry mast will be either piled or ground bearing foundations and that the formation level of the turbine foundations will be on the lower mineral subsoil or bedrock. Bases will measure approximately 20 metres in diameter. They will likely be formed one metre below the base of the peat layer on stiff subsoil material or bedrock, or at a suitable level directed by the Geotechnical Engineer/Designer. The foundations will be constructed as follows:

- The extent of the excavation will be marked out and will include an allowance for trimming the sides of the excavation to provide a safe working area and slope batter;
- Where practical, the peat will be stripped over the area of the excavation and stored locally for reuse, the subsoil will be excavated and stored to one side for reuse during the landscaping around the finished turbine;
- No material will be removed from site and storage areas will be stripped of vegetation prior to stockpiling in line with best working practices;
- All groundwater and surface water arising from turbine base excavation will be pumped to the dirty water system prior to discharge from the works area;
- Soil excavation shall be observed by a qualified archaeologist in accordance with a scheme of archaeological monitoring to identify any significant remains as they come to light and,
- The foundations excavation will be raised to formation level by compacted layers of well graded granular material will be spread and compacted to provide a hard area for the turbine foundation.

Reinforced concrete piled foundations will be completed as follows:

- The extent of the excavation will be marked out and will include an allowance for trimming the sides of the excavation to provide a safe working area and slope batter;
- No material will be removed from site and placement areas will be stripped of vegetation prior to placement in line with best working practices;

- A piling platform for the piling rig will be constructed. This can be done in two ways depending on the bearing capacity of the underlying soil.
  - The first method is to lay geo-textile on the existing surface and a stone layer will then be placed on top of the geo-textile by an excavator and compacted in order to give the platform sufficient bearing capacity for the piling rig.
  - The second method is to excavate the soils to a suitable intermediate mineral subsoil and backfill to the formation level.
- The piling rig, fitted with an auger, will then bore through the soft material with a sleeve fitted around the auger to prevent the sidewalls of the peat from collapsing. The borehole is then extended to a suitable depth into the subsoil/bedrock.
- When the auger and the sleeve are removed high tensile steel cages will be lowered into the boreholes. These steel cages will extrude above the level of the top of the concrete pile.
- As the auger is removed concrete is pumped into the borehole.
- Reinforcing steel on the top of the pile will tie to the foundation base steel.

The procedure for standard excavated reinforced concrete bases as outlined below can be applied from here.

Standard excavated reinforced concrete bases will be completed as follows:

- A layer of concrete blinding will be laid approximately 75mm thick directly on top of the newly exposed formation, tamped and finished with a screed board to leave a flat level surface. The concrete should be protected from rainfall during curing and all surface water runoff from the curing concrete should be prevented from entering surface water drainage directly;
- High tensile steel reinforcement will be fixed in accordance with the designer's drawings & schedules. The foundation anchorage system will be installed, levelled and secured to the blinding using steel box section stools;
- Ductwork will be installed as required, and formwork erected around the steel cage and propped from the backside as required;
- he foundation anchorage system will be checked both for level and line prior to the concrete being installed in the base. These checks will be passed to turbine manufacturer for their approval;
- Concrete will be placed using a concrete pump and compacted when in the forms using vibrating pokers to the levels and profile indicated on the drawings. Upon completion of the concreting works the foundation base will be covered and allowed to cure;
- Steel shutters will be used to pour the circular chimney section;
- Earth wires will be placed around the base; and,
- The foundation will be backfilled with a cohesive material, where possible using the material arising during the excavation and landscaped using the vegetable soil set aside during the excavation.
- Soil, rock and other materials excavated during construction shall be managed in line with the recommendations/ best practice guidelines outlined in Section 4.3.12 of Chapter 4 of the EIAR.

2.4.2.7 Anemometry Mast Removal

There is an existing 100m high meteorological mast (Pl. Ref. 17/155) on Clongawny Bog which will be decommissioned, disassembled and removed from site as it will no longer be required due to the presence of the 2 No. new masts. The disassembly process will generally follow the sequencing shown below:

- Removal of Equipment: Equipment and monitors on the mast will be removed;
- Removal of hazardous materials: Electrical cabling, solar panels and other remaining electrical equipment;

- Disassembly and removal of Mast Structure;
- Removal of Groundworks: Ground anchors will either be dug up and removed or remain in situ;
- Source segregation of material fractions for construction and demolition waste collection by an appropriately authorised waste contractor, and;
- Transport of the construction and demolition waste materials to an appropriately authorised waste facility.

2.4.2.8 Electricity Substation and Control Buildings

The electricity substation and control buildings will be constructed within the site, as shown in Figure 2.1. The dimensions of the substation area will be set to meet the requirements and specifications of ESB Networks and the necessary equipment to safely and efficiently operate the Proposed Development.

The substation will be constructed by the following methodology:

- The area of the substation will be marked out using ranging rods or wooden posts.;
- Two Wind farm control buildings will also be built within the substation compound;
- The foundations will be excavated down to the level indicated by the project engineer. The foundations will be shuttered and poured with reinforced concrete. An anti-bleeding admixture will be included in the concrete mix;
- The substation will be constructed with masonry blockwork. The block work walls will be built up from the footings to DPC level and the floor slab constructed, having first located any ducts or trenches required by the follow on mechanical and electrical contractors;
- The block work will then be raised to wall plate level and the gables and internal partition walls formed. Scaffold will be erected around the outside of the building for this operation;
- Concrete roof slabs will be lifted into position using an adequately sized mobile crane;
- The timber roof trusses will then be lifted into position using a telescopic load all or mobile crane depending on site conditions. The roof trusses will then be felted, battened, tiled and sealed against the weather.
- The electrical equipment will be installed and commissioned.
- Steel palisade fencing will be erected around the substation and control building compound area.
- All wastewater from the staff welfare facilities in the control buildings will pass to a sealed storage tank. The wastewater will be transported off site by a waste management contractor holding valid waste collection permits under the Waste Management (Collection Permit) Regulations, 2007 (as amended).

The construction and components of the substation will be to Eirgrid specifications.

2.4.2.9 Underpass

Two permanent underpasses are proposed as part of the proposed development, the locations of which are as follows:

- Beneath the N62, immediately north of Derrinlough Briquette Factory.
- Beneath an existing Bord na Móna railway line in Clongawny Bog, immediately west of the N62 underpass.

Both underpasses will provide amenity connectivity between Clongawny and Drinagh Bogs and will also be used occasionally by vehicles for wind farm maintenance during the operational phase.

The underpasses will be approximately 35m in length, 4.5m wide and 4.5m high and will take the form of precast concrete box culverts which will be founded on an in-situ concrete base slab. As a worst-case, the structures may need to be underpinned by piles.

The method of construction proposed will ensure that the N62 will remain open during construction though traffic control will be required. It is envisaged that the structure will be completed in two phases, through single lane closure, in order to maintain traffic flow as follows:

- The site will be cleared and prepared for construction works. Material excavated will be stored locally for later reuse, where practicable.
- Temporary sheet piled walls will be installed to reduce the working width required and to provide protection and support to the excavations.
- One side of the existing road surface will be excavated to a depth of 6.5m.
- The required foundations for the precast concrete units will then be installed as required by the designers.
- A mobile telescopic crane will be required to lift the precast elements into place therefore temporary crane hardstands (approximately 25m x 10m) will be constructed on each side of the N62. Suitable laydown areas close to the excavation will also be required for storage of the precast elements upon delivery to site.
- The precast concrete box and wingwall sections will be placed in position by the telescopic crane. Elements of the installation may have to take place during off-peak periods and thus some limited night-time working is envisaged.
- Once the pre-cast elements are in place the area will be backfilled and the structural layers of the road will be built up.
- Road crash barriers will then be installed
- The above steps will be repeated for the other side of the road.
- The final road resurfacing (wearing course) will be installed and road edge protection will be completed.

Site drainage will be provided during the works to collect runoff which will be directed to a settlement pond.

A Traffic Management Plan will be implemented during the construction of the proposed development and will include for the construction of the underpass beneath the N62. This will be agreed prior to commencement of works with Offaly County Council and Transport Infrastructure Ireland (TII). The temporary traffic management arrangement will include some form of lane restrictions/road closures in order to construct the underpass.

The construction and components of the substation will be to Eirgrid specifications.

2.4.2.10 Cable Trenching

The transformer in each turbine is connected to the substation through a network of buried electrical cables. The ground is trenched typically using a mechanical excavator. The top layer of soil is removed and saved so that it is replaced on completion. The electrical cables from wind turbines to the substation will be run in ducts approximately 1.2m below the ground surface. On completion, the ground will be reinstated as previously described above.

A method statement for all internal cabling works will be prepared by the appointed contractor prior to the commencement of any construction

2.4.2.11 Grid Connection

The proposed wind farm will connect to the existing national grid via a substation, in the north-eastern part of the Drinagh bog, and associated grid connections. The proposed wind farm will connect to the national electricity grid via either 110 kV overhead line or 110 kV underground cable.

2.4.2.11.1 Underground Cabling

The proposed underground cable option will be facilitated through two cable interface masts under the existing Shannonbridge to Portlaoise 110 kV overhead line. The existing overhead line conductor will be terminated at these two new structures in order to facilitate the looped cabling. There will be a double circuit underground trenching arrangement which will consist of 6 No. 160mm diameter HDPE power cable ducts to be installed into an excavated trench. This trench will be typically 2000mm wide by 1250mm deep to facilitate cabling into the station and trenching to accommodate 6 No. 160mm diameter HDPE power cable ducting exiting the station and continuing back to the interface masts.

The ducts are protected by CBM4 lean-mix concrete with cable protection strip laid over the concrete, warning tape, protective plates (if required) and backfill material. The trench will form part of a newly constructed permanent access track which will be utilised for maintenance and inspection works for the underground cable. The transition of the cabling system from underground into Derrinlough 110 kV Substation will be facilitated via cable chair.

The following text outlines the methodology to be followed during trenching works:-

- Grade, smooth and trim trench floor when the required 1250mm depth and 2000mm width have been obtained. Any peat in cable trench to be removed and replaced with granular material.
- Place bedding layer of Cement Bound Granular Mixture B (CBGM B) material in accordance with the specification and compact it so that the compacted thickness is as per the ESB specification.
- Lay the bottom row of ducts in trefoil formation as detailed on the design drawings. Use spacers as appropriate to establish horizontal duct spacing. Fit a secure cap / bung to the end of each duct run to prevent the ingress of dirt or water.
- Carefully surround and cover ducts with CBGM B in accordance with the design drawings and specifications and thoroughly compact without damaging ducts.
- Place cable protection strips on compacted CBGM B directly over the ducts.
- Lay the top row of ducts onto the freshly compacted CBGM B including the cable protection strips above the bottom row of ducts. Place a secure cap at the end of each duct to prevent the ingress of dirt or water.
- Carefully surround and cover ducts with CBGM B material in accordance with the drawings and thoroughly compact without damaging ducts.
- Place red cable protection strip on top of compacted CBGM B over each set of ducts as shown on the drawings.
- Place and thoroughly compact CBGM B material or Clause 804 backfill or soil backfill as specified and place warning tape at the depth shown on the drawings.
- For concrete and asphalt/bitmac road sections, carry out immediate permanent reinstatement in accordance with the specification and to the approval of the local authority.
- For unsurfaced/grass sections, backfill with suitable excavated material to ground level leaving at least 100 mm topsoil or match existing level at the top to allow for seeding or replace turves as per the specification of the local authority or landowner.
- Clean and test the ducts in accordance with the specification by pulling through a brush and mandrel. Install 12 mm polypropylene draw rope in each duct and seal all ducts using robust duct end seals fitted with rope attachment eyes in preparation for cable

installation at a later date. Excavated material will be stored close to the trench and utilised throughout the works.

2.4.2.11.2 Overhead Lines

The proposed design for the 110kV Looped line from the existing overhead line will require two new Loop In towers which will be constructed under the existing Shannonbridge – Portlaoise 110kV OHL. The existing OHL conductor will be terminated at these two interface structures in order to facilitate an OHL loop into Derrinlough 110kV Substation via lattice angle towers, terminal towers and onto gantry dropper's arrangement. The existing conductor will be removed between the loop in towers with the new connection looped through to the new Derrinlough 110kV Substation.

The new Loop In structure locations have been selected based on ground surveys, ground profiles, allowable angles and ruling span checks.

The following section outlines the methodology to be followed during construction works of the new Loop In tower structures which will be constructed underneath the existing 110 kV overhead line;

- The Steel lattice tower sites are scanned for underground services such as cables etc. Consultation with the landowner will help to identify services / constraints and ensure there are no unidentified services in the area.
- For each leg of 6 No. towers (24 in total) a foundation c.3m x 3.6m x 3.6m is excavated and the formation levels (depths) will be checked by the onsite foreman. The excavated material will be temporarily stored close to the excavation and excess material will be used as berms along the site access roads.
- To aid construction, a concrete pipe is placed into each excavation to allow operatives level the mast at the bottom of the excavation. The frame of the reinforcing bars will be prepared and strapped to a concrete pipe with spacers as required. The reinforcing bars will be lifted into each excavated foundation using the excavator and chains/slings. The base and body section of each tower will then be assembled next to excavation.
- Concrete trucks will pour concrete directly into each excavation in distinct stages.
- A third pour for the leg of the tower 1m x 1m and will be 300mm over ground level.
- Once the main concrete foundation pour is cured after circa five days, metal shuttering is installed to accommodate the placement of concrete around the tower legs. During each pour, the concrete will be vibrated thoroughly using a vibrating poker.
- Once the concrete is set after the five days the shuttering is removed.
- The tower foundations will be backfilled one leg at a time with the material already excavated at the location. The backfill will be placed and compacted in layers. All dimensions will be checked following the backfilling process. All surplus excavated material and removed from the tower locations and stored in berms adjacent to the Substation Compound or distributed on site in accordance with approved environmental procedures.
- The existing overhead line will be de-energised by ESB so work can commence on the construction of the towers.
- An earth mat consisting of copper or aluminium wire will be laid circa 400mm below ground around the tower. This earth mat is a requirement for the electrical connection of the equipment on the tower structure.
- Once the base section of each tower is completed and the concrete sufficiently cured, it is ready to receive the tower body. Temporary hardstands may be removed and disposed of off site where necessary.
- A hardstand area for the crane will be created by laying geogrid material on the ground surface and overlaying this geogrid with a suitable grade of aggregate.

- A physical barrier (Heras Fence Site Boundary) will be put in place to restrict plant from coming too close to the OHL.
- The towers will be constructed lying flat on the ground beside the recently installed tower base.
- The conductor will be moved off centre using a stay wire and weights to anchor the stay wire to ground.
- The tower section will be lifted into place using the crane and guide ropes.
- The body sections will be bolted into position.
- The conductor will be centred over the towers and held in place. Once the conductor is secured at both ends it is then cut and attached onto each tower. The section of conductor in between the two towers will be removed and utilised as connector wire for the new towers.

Stringing of Conductors

Stringing of overhead lines on the supporting lattice structures will be kept clear of all obstacles along the straight by applying sufficient tension. This method requires the pulling of a light pilot line (nylon rope) which is normally carried by hand into the stringing wheels. This in turn is used to pull a heavier pilot line (Steel rope) which is subsequently used to pull the conductors from the drum stands using specifically designed “puller – tensioner” machines. The main advantages with this method are:

- The line is protected from surface damage
- Major obstacles can be completed without any significant disruption.

Once the conductors have been pulled into position, one end of the straight is terminated on the appropriate tension fittings and insulator assemblies. The free end of the straight is then placed in temporary clamps which take the conductor tension. The conductor is then cut from the puller-tensioner and the conductor is sagged using a chain hoist. Bird flight diverters or warning spheres can be added following the sagging procedure if required.

2.4.3 Decommissioning

The wind turbines proposed as part of the proposed development are expected to have a lifespan of approximately 30 years. Following the end of their useful life, the wind turbines may be replaced with a new set of turbines, subject to planning permission being obtained, or the proposed development may be decommissioned fully. The onsite substation will remain in place as it will be under the ownership of the EirGrid.

Upon decommissioning of the proposed development, the wind turbines would be disassembled in reverse order to how they were erected. All above ground turbine components would be separated and removed off-site for recycling. Turbine foundations would remain in place underground and would be covered with earth and reseeded as appropriate. Leaving the turbine foundations in-situ is considered a more environmentally prudent option, as to remove that volume of reinforced concrete from the ground could result in significant environment nuisances such as noise, dust and/or vibration. Site roadways will be in use as amenity and recreational pathways, and therefore will not be removed during decommissioning. If it were to be confirmed that the roads were not required in the future for any other useful purpose, they could be removed where required. Underground cables, including grid connection, will be removed and the ducting left in place. A decommissioning plan will be agreed with Offaly County Council three months prior to decommissioning the proposed development.

3. ENVIRONMENTAL MANAGEMENT

3.1 Introduction

This CEMP has been prepared and presented as a standalone document and includes all best practice measures required to construct the wind farm. The following sections give an overview of the drainage design, dust and noise control measures and a waste management plan for the site.

3.2 Protecting Water Quality

3.2.1 Good Environmental Management During Construction

Timing of works can strongly influence the potential for damaging the freshwater environment. Operations during wetter periods of the year pose a significantly greater risk of causing erosion and siltation, which can be particularly severe following major rainfall or snowmelt events. Traditionally, wind farm construction undertaken during the drier summer months would result in significantly less erosion and siltation. Construction activities in the hydrological buffer zones shall be avoided during or after prolonged rainfall or an intense rainfall event and work will cease entirely near watercourses when it is evident that water quality is being impacted. Given that this site has an established drainage network and existing watercourse crossing points, there will be minimal impacts on watercourses.

3.2.2 Site Drainage Principles

The site drainage features have been outlined in Chapter 4, Section 4.7 of the EIAR in addition to the drainage design and management for the proposed development. . The protection of the watercourses within and surrounding the site, and downstream catchments that they feed is of utmost importance in considering the most appropriate drainage proposals for the site of the proposed development. There is an existing drainage system and surface water discharges from the site which is regulated by the Environmental Protection Agency (Licence Ref. P0500-01). The proposed development's drainage design has therefore been proposed specifically with the intention of having no negative impact on the water quality of the site and its associated rivers and lakes, and consequently no impact on downstream catchments and ecological ecosystems.

No routes of any natural drainage features will be altered as part of the proposed development and turbine locations and associated new roadways were originally selected to avoid natural watercourses, and existing roads are to be used wherever possible. There will be no direct discharges to any natural watercourses, with all drainage waters being dispersed as overland flows. All discharges from the proposed works areas will be made over vegetation filters at an appropriate distance from natural watercourses. Buffer zones around the existing natural drainage features have been used to inform the layout of the Proposed Development.

3.2.3 Best Practice Guidance

The drainage design has been prepared based on experience of the project team of other renewable energy sites in peat-dominated environments, and the number of best practice guidance documents.

There is no one guidance document that deals with drainage management and water quality controls for wind farm and other renewable energy developments. However, a selection of good practice approaches have been adopted in preparation of this CEMP, and these are taken from the various best practice guidance documents listed below.

- National Roads Authority (2005): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Department of the Environment, Heritage and Local Government (2006): Wind Farm Development Guidelines for Planning Authorities;
- Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites. Eastern Regional Fisheries Board;
- Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries During Construction Works Adjacent to Waters;
- Scottish Natural Heritage (2010): Good Practice During Wind Farm Construction;
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note);
- PPG5 – Works or Maintenance in or Near Water Courses (UK Guidance Note);
- CIRIA (Construction Industry Research and Information Association) guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006);
- Control of water pollution from construction sites - Guidance for consultants and contractors. CIRIA C532. London, 2001; and,
- Control of water pollution from linear construction projects -Technical guidance. CIRIA C648 London, 2006.

3.2.4 Site Drainage Design and Management

The proposed site drainage features for this site are outlined in Chapter 4, Section 4.7 of the EIAR. As this CEMP is a working document and is presented as an Appendix to the EIAR, the detailed drainage measures are not included in this document. When the final CEMP report is prepared, and presented as a standalone document, all drainage measures will be included in that document. The drainage proposals will be developed further prior to the commencement of construction. The following sections give an outline of drainage management arrangements in terms of pre-construction, construction and operational phases of the Proposed Development.

3.2.4.1 Pre-Construction Drainage

The surface of the cutover bog is drained by a network of parallel field drains that are typically spaced every 15 - 20m. The field drains are approximately 0.5 - 1.5m deep and in most areas, they intercept the mineral subsoil underlying the peat. These field drains mostly feed into larger surface water drains which drain the main catchments across the two bogs. This existing drainage system will continue to function as it is during the pre-construction phase.

However, prior to commencement of works in sub-catchments across the site, main drain inspections will be competed to ensure ditches and streams are free from debris and blockages that may impede drainage. It is proposed to complete these inspections on a catchment by catchment basis as the construction works develop across the site, as works in all areas will not commence simultaneously.

3.2.4.2 Construction Phase Drainage

The Project Hydrologist/Design Engineer will complete a site drainage and maintenance plan before construction commences and will attend the site to set out and assist with micro-siting of proposed drainage controls as outlined in Chapter 4, Section 4.7 of the EIAR. The drainage system will be excavated and constructed in conjunction with the road and hard standing construction. Drains will be excavated and stilling ponds constructed to eliminate any suspended solids within surface water running off the site.

Best practice and practical experience on other similar projects suggests that in addition to the drainage plans that are included in the EIAR, there are additional site based decisions and plans that can only be made in the field through interaction between the Site Construction Manager, the Project Hydrologist and the Project Geotechnical Engineers. The mechanisms for interaction between these are outlined within Section 4 of this CEMP.

In relation to decisions that are made on site it is important to stress that these will be implemented in line with the associated drainage controls and mitigation measures outlined in Section 6 below, and to ensure protection of all watercourses.

3.2.4.3 Operational Phase Drainage

The project hydrologist will inspect and review the drainage system after construction has been completed to provide guidance on the requirements of an operational phase drainage system. This operational phase drainage system will have been installed during the construction phase in conjunction with the road and hardstanding construction work as described below:

- Interceptor drains will be maintained up-gradient of all proposed infrastructure to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where suspended sediment could become entrained. It will then be directed to areas where it can be re-distributed over the ground by means of a level spreader.
- Swales/road side drains will be maintained to intercept and collect runoff from access roads and hardstanding areas of the site, likely to have entrained suspended sediment, and channel it to stilling ponds for sediment settling;
- Check dams will be maintained at regular intervals along interceptor drains and swales/roadside drains in order to reduce flow velocities and therefore minimise erosion within the system during storm rainfall events; and,
- Stilling ponds/settlement ponds, emplaced downstream of swales and roadside drains, will buffer volumes of runoff discharging from the drainage system during periods of high rainfall, by retaining water until the storm hydrograph has receded, thus reducing the hydraulic loading to watercourses. The stilling ponds will be sized according to the size of the area they will be receiving water from, but will be sufficiently large to accommodate peak flows storm events. Inspection and maintenance of all settlement ponds will be ongoing through the construction period.

3.2.4.4 Preparative Site Drainage Management

All materials and equipment necessary to implement the drainage measures outlined above will be brought on-site in advance of any works commencing.

An adequate quantity of straw bales, clean stone, terram, stakes, etc. will be kept on site at all times to implement the drainage design measures as necessary. The drainage measures outlined in the above will be installed prior to, or at the same time as the works they are intended to drain.

3.2.4.5 Pre-emptive Site Drainage Management

The works programme for the groundworks part of the construction phase of the project will also take account of weather forecasts, and predicted rainfall. Large excavations and movements of overburden or large-scale overburden or soil stripping will be suspended or scaled back if heavy rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

3.2.4.6 Reactive Site Drainage Management

The final drainage design prepared for the site has provided for reactive management of drainage measures. The effectiveness of drainage measures designed to minimise runoff entering works areas and capture and treat silt-laden water from the works areas, will be monitored continuously by the Environmental Clerk of Works (ECoW) on-site. The ECoW or supervising hydrologist will respond to changing weather, ground or drainage conditions on the ground as the project proceeds, to ensure the effectiveness of the drainage design is maintained in so far as is possible. This may require the installation of additional check dams, interceptor drains or swales as deemed necessary on-site. The drainage design may have to be modified on the ground as necessary, and the modifications will draw on the various features outlined above in whatever combinations are deemed to be most appropriate to situation on the ground at a particular time.

In the event that works are giving rise to siltation of watercourses, the ECoW or supervising hydrologist will stop all works in the immediate area around where the siltation is evident. The source of the siltation will be identified and additional drainage measures such as those outlined above will be installed in advance of works recommencing.

3.2.5 Cable Trench Drainage

Cable trenches are typically developed in short sections, thereby minimising the amount of ground disturbed at any one time, and minimising the potential for drainage runoff to pick up silt or suspended solids. Each short section of trench is excavated, ducting installed and bedded, and backfilled with the appropriate materials, before work on the next section commences.

To efficiently control drainage runoff from cable trench works areas, excavated material is stored on the upgradient side of the trench. Should any rainfall cause runoff from the excavated material, the material is contained in the downgradient cable trench. Excess subsoil is removed from the cable trench works area immediately upon excavation, and in the case of the proposed development, would be used for landscaping and reinstatements of other areas elsewhere on site.

3.2.6 Refuelling, Fuel and Hazardous Materials Storage

The following mitigation measures are proposed to avoid release of hydrocarbons at the site:

- Minimal refuelling or maintenance of construction vehicles or plant will take place on site. Off-site refuelling should occur at a controlled fuelling station;
- On-site refuelling will take place using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled off site, and will be towed around the site by a 4x4 jeep to where machinery is located. It is not practical for all vehicles to travel back to a single refuelling point, given the size of the cranes, excavators, etc. that will be used during the construction of the wind farm. The 4x4 jeep will also carry fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use. Only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations.
- Fuels volumes stored on site should be minimised. Any fuel storage areas will be bunded appropriately for the fuel storage volume for the time period of the construction and fitted with a storm drainage system and an appropriate oil interceptor;
- The electrical substation compound will be bunded appropriately to the volume of oils likely to be stored, and to prevent leakage to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used will be regularly inspected for leaks and fitness for purpose; and,
- An emergency plan for the construction phase to deal with accidental spillages will be developed (refer to Section 5) Spill kits will be available to deal with and accidental spillage in and outside the refuelling area.

3.2.7 Cement Based Products Control Measures

The following mitigation measures are proposed to avoid release of cement leachate from the site:

- No batching of wet-cement products will occur on site;
- Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will take place. Where possible pre-cast elements for culverts and concrete works will be used;
- No washing out of any plant used in concrete transport or concreting operations will be allowed on-site;
- Where concrete is delivered on site, only chute cleaning will be permitted, using the smallest volume of water possible. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed.
- Use weather forecasting to plan dry days for pouring concrete;
- Ensure pour site is free of standing water and plastic covers will be ready in case of sudden rainfall event;
- The small volume of water that will be generated from washing of the concrete lorry's chute will be directed into a concrete washout area, typically built using straw bales and lined with an impermeable membrane. below. The areas are generally covered when not in use to prevent rainwater collecting. In periods of dry weather, the areas can be uncovered to allow much of the water to be lost to evaporation. At the end of the concrete pours, any of the remaining liquid contents is tankered off-site. Any solid contents that will have been cleaned down from the chute will have solidified and can be broken up and disposed of along with other construction waste.

3.2.8 Peat Stability Management

Peat instability or failure refers to a significant mass movement of a body of peat that would have an adverse impact on wind farm development and the surrounding environment. Peat failure excludes localised movement of peat that could occur below an access road, creep movement or erosion type events. In the absence of appropriate mitigation, the consequence of peat failure at the study area may result in:

- Death or injury to site personnel;
- Damage to machinery;
- Damage or loss of access tracks;
- Drainage disrupted;
- Site works damaged or unstable;
- Contamination of watercourses, water supplies by sediment particulates; and,
- Degradation of the environment.

3.2.9 General Recommendations for Good Construction Practice

The peat stability assessment indicates that the site has an acceptable margin of safety and is suitable for the proposed wind farm development. The following mitigation measures are recommended and should be taken into account when preparing Construction Method Statements for the development:

- Appointment of experienced and competent contractors;
- The site should be supervised by experienced and qualified personnel;
- Allocate sufficient time for the project (be aware that decreasing the construction time has the potential to increase the risk of initiating a peat movement);
- Prevent undercutting of slopes and unsupported excavations;

- Maintain a managed robust drainage system;
- Prevent placement of loads/overburden on marginal ground;
- Set up, maintain and report readings from peat stability monitoring systems;
- Ensure construction method statements are followed; and,
- Revise and amend the Construction Risk Register as construction progresses to ensure that risks are managed and controlled for the duration of construction.

3.2.10 Dust Control

Construction dust can be generated from many on-site activities such as excavation and backfilling. The extent of dust generation will depend on the type of activity undertaken, the location, the nature of the dust, i.e. soil, sand, peat, etc. and the weather. In addition, dust dispersion is influenced by external factors such as wind speed and direction and/or, periods of dry weather. Construction traffic movements also have the potential to generate dust as they travel along the haul route.

Proposed measures to control dust include:

- Any site roads with the potential to give rise to dust will be regularly watered, as appropriate, during dry and/or windy conditions;
- The designated public roads outside the site and along the main transport routes to the site will be regularly inspected by the ECoW for cleanliness, and cleaned as necessary;
- Material handling systems and material storage areas will be designed and laid out to minimise exposure to wind;
- Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods;
- Water misting or bowsers will operate on-site as required to mitigate dust in dry weather conditions;
- The transport of soils or other material, which has significant potential to generate dust, will be undertaken in tarpaulin-covered vehicles where necessary;
- All construction related traffic will have speed restrictions on un-surfaced roads to 20 kph;
- Daily inspection of construction sites to examine dust measures and their effectiveness.
- When necessary, sections of the haul route will be swept using a truck mounted vacuum sweeper; and,
- All vehicles leaving the construction areas of the site will pass through a wheel washing area prior to entering the local road network.

3.2.11 Noise Control

The operation of plant and machinery, including construction vehicles, is a source of potential impact that will require mitigation at all locations within the site. Proposed measures to control noise include:

- Diesel generators will be enclosed in sound proofed containers to minimise the potential for noise impacts;
- Plant and machinery with low inherent potential for generation of noise and/or vibration will be selected. All construction plant and equipment to be used on-site will be modern equipment and will comply with the European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations;
- Regular maintenance of plant will be carried out in order to minimise noise emissions. Particular attention will be paid to the lubrication of bearings and the integrity of silencers;
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the works;
- Compressors will be of the “sound reduced” models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers;

- Machines, which are used intermittently, will be shut down during those periods when they are not in use;
- Training will be provided by the ECoW to drivers to ensure smooth machinery operation/driving, and to minimise unnecessary noise generation; and,
- Local areas of the haul route will be condition monitored and maintained, if necessary.

3.3 Invasive Species Management

A baseline invasive species survey will be carried out at the site to identify the presence and location of any invasive species (listed under the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011) by a suitably qualified ecologist. If the presence of such species is found at or adjacent to the site, particularly in areas where its excavation may be required, an invasive species management plan will be prepared for the site to prevent the introduction or spread of any invasive species within the footprint of the works. An invasive species management plan, if required, will set out best practice control methods as summarised in the following sections.

3.3.1 Site Management

Careful preparation of the site and planning of the works is crucial to successful treatment of invasive species. The following list of guidelines, which is not exhaustive, shall be followed by all on-site personnel. Only those who have been inducted into biosecurity measures on-site may enter the contaminated zones within the works areas. Should any risk of contaminated material escaping be observed by the site supervisor, the management plan for the site must be amended by an appropriately qualified person to mitigate against the risk.

3.3.2 Establishing Good Site Hygiene

- A risk assessment and method statement must be provided by the Contractor prior to commencing works.
- Fences will be erected around areas of infestation, as confirmed by test pits, and warning signs shall be erected.
- A designated wash-down area will be created, where power-washed material from machinery can be contained, collected and disposed of with other contaminated material. This area will contain a washable membrane or hard surface.
- Stockpile areas will be chosen to minimise movement of contaminated soil.
- Stockpiles will be marked and isolated.
- Contaminated areas which will not be excavated will be protected by a root barrier membrane if they are likely to be disturbed by machinery. Root barrier membranes will be protected by a layer of sand above and below and topped with a layer of hardcore.
- The use of vehicles with caterpillar tracks within contaminated areas will be avoided to minimise the risk of spreading contaminated material.
- An ECoW/suitably qualified ecologist will be on site to monitor and oversee the implementation of invasive species management plans.

Plant and equipment which is operated within an area for the management of materials in contaminated areas should be decontaminated prior to relocating to a different works area. The decontamination procedures should take account of the following:

- Personnel may only clean down if they are familiar with the plant and rhizome material and can readily identify it.
- Decontamination will only occur within designated wash-down areas.
- Vehicles will be cleaned using stiff-haired brush and pressure washers, paying special attention to any areas that might retain rhizomes e.g. wheel treads and arches.

- All run-off will be isolated and treated as contaminated material. This will be disposed of in already contaminated areas.

3.4 Waste Management

This section of the CEMP provides a waste management plan (WMP) which outlines the best practice procedures during the excavation and construction phases of the project. The WMP will outline the methods of waste prevention and minimisation by recycling, recovery and reuse at each stage of construction of the proposed development. Disposal of waste will be seen as a last resort.

3.4.1 Legislation

The Waste Management Act 1996 and its subsequent amendments provide for measures to improve performance in relation to waste management, recycling and recovery. The Act also provides a regulatory framework for meeting higher environmental standards set out by other national and EU legislation.

The Act requires that any waste related activity has to have all necessary licenses and authorisations. It will be the duty of the Waste Manager on the site of the development to ensure that all contractors hired to remove waste from the site have valid Waste Collection Permits. It will then be necessary to ensure that the waste is delivered to a licensed or permitted waste facility. The hired waste contractors and subsequent receiving facilities must adhere to the conditions set out in their respective permits and authorisations.

The Department of the Environment provides a document entitled, 'Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects' (2006). It is important to emphasise that no demolition will take place at this site, however, this document was referred to throughout the process of completing this WMP.

3.4.2 Waste Management Hierarchy

The waste management hierarchy sets out the most efficient way of managing in the following order:

Prevention and Minimisation:

The primary aim of the WMP will be to prevent and thereby reduce the amount of waste generated at each stage of the project.

Reuse of Waste:

Reusing as much of the waste generated on site as possible will reduce the quantities of waste that will have to be transported off site to recovery facilities or landfill.

Recycling of Waste:

There are a number of established markets available for the beneficial use of Construction and Demolition waste such as using waste concrete as fill for new roads.

At all times during the implementation of the WMP, disposal of waste to landfill will be considered only as a last resort.

3.4.3 Construction Phase Waste Management

3.4.3.1 Description of the Works

The construction of the development will involve the construction of 21 no. turbines, new and upgradedsite access roads, internal cabling and grid connection, substation and control buildings and all associated infrastructure.

The turbines will be manufactured off site and delivered to site where on site erection will occur.

The turbine foundations will consist of stone from the local quarries and a concrete base which will contain reinforcing steel. These concrete foundations will be shuttered with steel formwork specifically designed for the works and re-usable off site on similar projects.

The construction of the substation will comprise of a concrete foundation with concrete masonry blocks and a timber roof structure with roof tile or slate covering. The roof structure will be made up of prefabricated roof trusses manufactured off site to minimise timber cutting on site.

The site roads will be constructed with rock won from local quarries

The waste types arising from the construction phase of the development are outlined in Table 3.1 below.

Table 3.1 Expected waste types arising during the Construction Phase

Material Type	**Example**	**EWC Code**
Cables	Electrical wiring	17 04 11
Cardboard	Boxes, cartons	15 01 01
Composite packaging	Containers	15 01 05
Metals	Copper, aluminium, lead, iron and steel	17 04 07
Inert materials	Sand, stones, plaster, rock, blocks	17 01 07
Mixed municipal waste	Daily canteen waste from construction workers, miscellaneous	20 03 01
Plastic	PVC frames, electrical fittings	17 02 03
Plastic packaging	Packaging with new materials	15 01 02
Tiles and ceramics	Slates and tiles	17 01 03
Wooden packaging	Boxes, pallets	15 01 03

Hazardous wastes that may occur on site during the construction phase of the development may include oil, diesel fuel, chemicals, paints, preservatives etc. All hazardous wastes will be stored in bunded containers/areas before being collected by an authorised waste contractor and brought to an EPA licensed waste facility. As mentioned above, hazardous wastes will be kept separate from non-hazardous wastes that contamination does not occur.

3.4.3.2 Waste Arisings and Proposals for Minimisation, Reuse and Recycling of Construction Waste

Construction waste will arise on the project mainly from excavation and unavoidable construction waste including material surpluses and damaged materials and packaging waste.

Appropriate measures should be taken to ensure excess waste is not generated during construction, including;

- Ordering of materials should be on an 'as needed' basis to prevent over supply to site. Co-ordination is required with suppliers enabling them to take/buy back surplus stock.
- Purchase of materials pre-cut to length to avoid excess scrap waste generated on site.
- Request that suppliers use least amount of packaging possible on materials delivered to the site.
- Ensuring correct storage and handling of goods to avoid unnecessary damage that would result in their disposal
- Ensuring correct sequencing of operations.
- Use reclaimed materials in the construction works.

Hazardous waste will be kept separate from all other construction waste to prevent contamination and removed appropriately.

3.4.3.3 Waste Arising from Construction Activities

All waste generated on site t will be contained in waste skips at a waste storage area on site. This waste storage area will be kept tidy with skips clearly labelled to indicate the allowable material to be disposed of therein.

The expected waste volumes generated on site are unlikely to be large enough to warrant source segregation at the wind farm site. Therefore, all wastes streams generated on site will be deposited into a single waste skip. This waste material will be transferred to a Materials Recovery Facility (MRF) by a fully licensed waste contractor where the waste will be sorted into individual waste streams for recycling, recovery or disposal.

The waste generated from the turbine erection will be limited to the associated protective covers which are generally reusable. Considering the specialist nature of this packaging material the majority will be taken back by suppliers for their own reuse. Any other packaging waste generated from the turbine supply will be deposited into the on-site skips and subsequently transferred to the MRF.

It is not envisaged that there will be any waste material arising from the materials used to construct the site roads as only the quantity of stone necessary will be sourced from local quarries and brought on site on an 'as needed' basis.

Site personnel will be instructed at induction that no under no circumstances can waste be brought to site for disposal in the on-site waste skip. It will also be made clear that the burning of waste material on site is forbidden.

3.4.4 Waste Arising from Decommissioning

The design life of the wind farm is 30 years after which time a decision will be made to determine whether or not the turbines will be replaced by new turbines or if decommissioning will occur. The lengthy time frame between the completion of the construction phase and decommissioning will result in the only materials remaining on site at that time will be infrastructural material such as the turbine foundations, turbines and the granular material used to construct roads. If the site is decommissioned, cranes will disassemble each turbine tower and all equipment. The associated components will be removed from site for re-use, recycling or waste disposal. Any structural elements that are not suitable for recycling will be disposed of in an appropriate manner. All lubrication fluids will be drained down and put aside for appropriate collection, storage, transport and disposal. Any materials which cannot be re-used or recycled will be disposed of by an appropriately licenced contractor.

The waste types arising from the decommissioning of the development are outlined in Table 3.2 below.

Table 3.2 Expected waste types arising during the Decommissioning Phase

Material Type	Example	EWC Code
Cables	Electrical wiring	17 04 11
Metals	Copper, aluminium, lead, iron and rebar	17 04 07
Inert materials	Crushed stone, concrete	17 01 07

3.4.4.1 Reuse

Many construction materials can be reused a number of times before they have to be disposed of:

- Concrete can be reused as aggregate for roads cable trench backfilling material.
- Plastic packaging etc. can be used to cover materials on site or reused for the delivery of other materials.
- Excavated peat can be reused for reinstatement of the areas around turbine foundations and adjacent to site roads.

3.4.4.2 Recycling

If a certain type of construction material cannot be reused onsite, then recycling is the most suitable option. The opportunity for recycling on site will be restricted to the associated packaging from the wind turbines.

All waste that is produced during the construction phase including dry recyclables will be deposited in the on-site skip initially and sent for subsequent segregation at a remote facility. The anticipated volume of all waste material to be generated at the development is low which provides the justification for adopting this method of waste management.

3.4.4.3 Implementation

3.4.4.3.1 *Roles and Responsibilities for Waste Management*

Prior to the commencement of the development a Construction Waste Manager will be appointed by the Contractor. The Construction Waste Manager will be in charge of the implementation of the objectives of the plan, ensuring that all hired waste contractors have the necessary authorisations and that the waste management hierarchy is adhered to. The person nominated must have sufficient authority so that they can ensure everyone working on the development adheres to the management plan.

3.4.4.3.2 *Training*

It is important for the Construction Waste Manager to communicate effectively with colleagues in relation to the aims and objectives of the waste management plan. All employees working on site during the construction phase of the project will be trained in materials management and thereby, should be able to:

- Distinguish reusable materials from those suitable for recycling;
- Ensure maximum segregation at source;
- Co-operate with site manager on the best locations for stockpiling reusable materials;
- Separate materials for recovery; and
- Identify and liaise with waste contractors and waste facility operators.

3.4.4.3.3 *Record Keeping*

The WMP will provide systems that will enable all arisings, movements and treatments of construction waste to be recorded. This system will enable the contractor to measure and record the quantity of waste being generated. It will highlight the areas from which most waste occurs and allows the measurement of arisings against performance targets. The WMP can then be adapted with changes that are seen through record keeping.

The fully licensed waste contractor employed to remove waste from the site will be required to provide documented records for all waste dispatches leaving the site. Each record will contain the following:

- Consignment Reference Number
- Material Type(s) and EWC Code(s)
- Company Name and Address of Site of Origin
- Trade Name and Collection Permit Ref. of Waste Carrier
- Trade Name and Licence Ref. of Destination Facility
- Date and Time of Waste Dispatch
- Registration no. of Waste Carrier vehicle
- Weight of Material
- Signature of Confirmation of Dispatch detail
- Date and Time of Waste Arrival at Destination
- Site Address of Destination Facility

3.4.4.4 Waste Management Plan Conclusion

The WMP will be properly adhered to by all staff involved in the project which will be outlined within the induction process for all site personnel. The waste hierarchy should always be employed when designing the plan to ensure that the least possible amount of waste is produced during the construction phase. Reuse of certain types of construction wastes will cut down on the cost and requirement of raw materials therefore further minimising waste levels.

This preliminary WMP has been prepared to outline the main objectives that are to be adhered to for the preparation of a more detailed WMP to be completed after the planning phase of the proposed development.

4. ENVIRONMENTAL MANAGEMENT IMPLEMENTATION

4.1 Roles and Responsibilities

The Site Supervisor/Construction Manager and/or Environmental Clerk of Works are the project focal point relating to construction-related environmental issues.

In general, the Environmental Clerk of Works will maintain responsibility for monitoring the works and Contractors/Sub-contractors from an environmental perspective. The Environmental Clerk of Works will act as the regulatory interface on environmental matters by reporting to and liaising with Offaly County Council and other statutory bodies as required.

The Environmental Clerk of Works will report directly to the Site Supervisor/Construction Manager. An Environmental Clerk of Works or Project Ecologist, Project Hydrologist, Project Archaeologist and Project Geotechnical engineer will visit the site regularly and report to the Site Environmental Office. This structure provides a "triple lock" review/interaction by external specialists. An organogram structure for the construction stage is as follows:

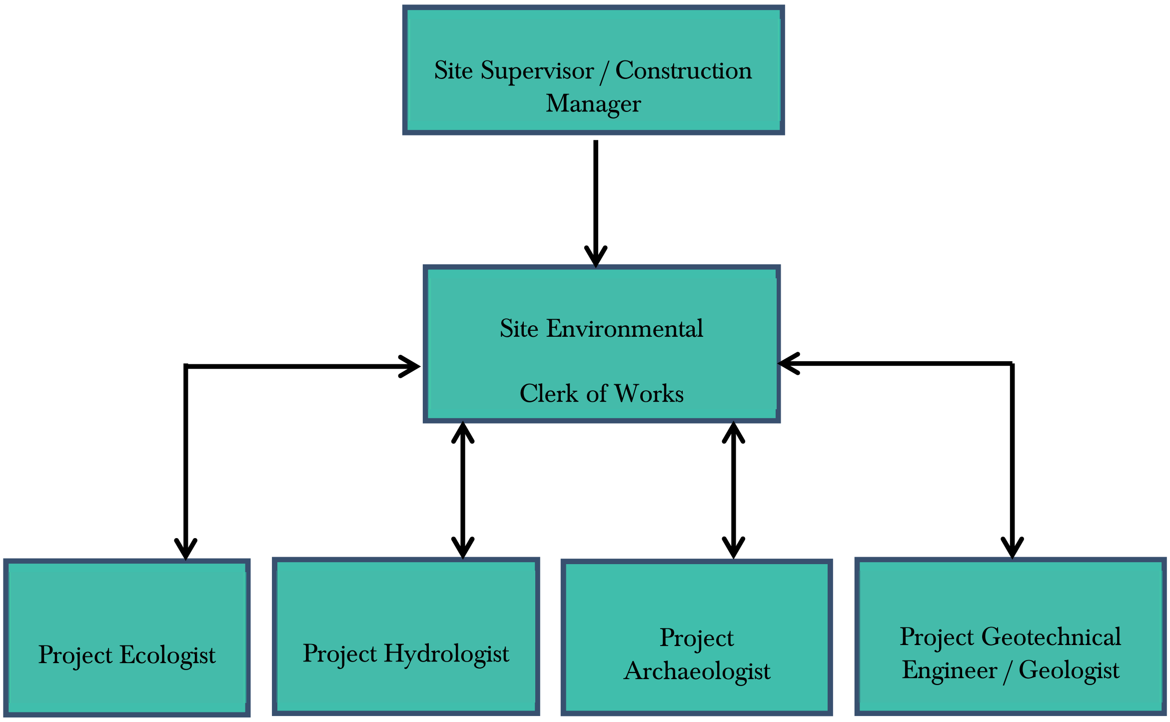


Figure 4.1 Site Management Chain of Command

Any requirement of the granted permission, for the works to be supervised by an engineer with professional indemnity insurance, who upon completion of the works, including site stability, shall certify the said works, will be adhered to. Such an engineer will be appointed to oversee and supervise the construction phase of the project.

4.1.1 Wind Farm Construction Manager/Site Supervisor

The Site Supervisor/Construction Manager will have overall responsibility for the organisation and execution of all related environmental activities as appropriate, in accordance with regulatory and project environmental requirements. The duties and responsibilities of the Site Supervisor/Construction Manager will include:

- Ensure that all works are completed safely and with minimal environmental risk;
- Approve and implement the Project CEMP and supporting environmental documentation, and ensure that all environmental standards are achieved during the construction phase of the project;
- Take advice from the Environmental Clerk of Works on legislation, codes of practice, guidance notes and good environmental working practice relevant to their work;
- Ensure compliance through audits and management site visits;
- Ensure timely notification of environmental incidents; and,
- Ensure that all construction activities are planned and performed such that minimal risk to the environment is introduced.

4.1.2 Environmental Clerk of Works

The main contractor will be required to engage a qualified Environmental Engineer, Environmental Scientist, or equivalent, with experience in wind farm construction to fulfil the role of Environmental Clerk of Works, and to monitor all site works and to ensure that methodologies and mitigation are followed throughout construction to avoid negatively impacting on the receiving environment.

The Environmental Clerk of Works will report to the Site Supervisor/Construction Manager. The responsibilities and duties of the Environmental Clerk of Works will include the following:

- Preparation and update of the CEMP as required, and supporting environmental documentation and review/approval of contractor method statements;
- Undertake inspections and reviews to ensure the works are carried out in compliance with the CEMP;
- Monitor the implementation of the CEMP, particularly all proposed/required Environmental Monitoring;
- Generate environmental reports as required to show environmental data trends and incidents and ensure environmental records are maintained throughout the construction period;
- Advise site management/contractor/sub-contractors on:
    - Prevention of environmental pollution and improvement to existing working methods;
    - Changes in legislation and legal requirements affecting the environment;
    - Suitability and use of plant, equipment and materials to prevent pollution;
    - Environmentally sound methods of working and systems to identify environmental hazards;
- Ensure the specified mitigation measures are initiated and adhered to during the construction phase;
- Liaise with Project Ecologist, Project Hydrologist and Project Geotechnical Engineer to ensure regular site visits and audits/inspections are completed;
- Ensure adequate arrangements are in place for site personnel to identify potential environmental incidents;
- Ensure that details of environmental incidents are communicated in a timely manner to the relevant regulatory authorities, initially by phone and followed up as soon as is practicable by e-mail;
- Support the investigation of incidents of significant, potential or actual environmental damage, and ensure corrective actions are carried out, recommend means to prevent recurrence and communicate incident findings to relevant parties; and,
- Identify environmental training requirements and arrange relevant training for all levels of site based staff/workers.

The level, detail and frequency of reporting expected from the Environmental Clerk of Works for the Construction Manager, developer's project manager, and any Authorities or other Agencies, will be agreed by all parties prior to commencement of construction, and may be further adjusted as required during the course of the project.

4.1.3 Project Ecologist

The Project Ecologist will report to the Environmental Clerk of Works and is responsible for the protection of sensitive habitats and species encountered during the construction phase of the wind farm. The Project Ecologist will not be full time on site but will visit the site at least once a month during construction.

The responsibilities and duties of the Project Ecologist will include the following:

- Review and input to the final construction phase CEMP in respect of ecological matters;
- In liaison with Environmental Clerk of Works, oversee and provide advice on all relevant ecology mitigation measures set out in the EIAR and planning permission conditions;
- Regular inspection and monitoring of the development, through all phases of construction/operation and provide ecological advice as required;
- Carry out ecological monitoring and survey work as may be required by the planning authority.

4.1.4 Project Hydrologist

The Project Hydrologist will report to the Environmental Clerk of Works and is responsible for inspection and review of drainage and water quality aspects associated with construction of the wind farm. The Project Hydrologist will not be full time on site but will visit the site at least once a month during construction and on a weekly basis during site preparation/groundworks.

The responsibilities and duties of the Project Hydrologist will include the following:

- Assist in compiling a detailed drainage design before construction commences and attend the site to set out and assist with micro siting of drainage controls. This will be completed over several site visits at the start of the construction phase;
- Review and input to the final construction phase CEMP in respect of drainage and water quality management;
- Following the initial stage of drainage construction regular site visits will be required, at least once a month, to complete hydrological and water quality audits and reviews and report any issues noted to the Site Supervisor/Construction Manager; and,
- Complete ongoing inspection and monitoring of the development, particularly in areas of drainage control, through all phases of construction (including pre, during and post construction) and ensure construction is carried out as specified in the EIAR, and in relevant planning conditions.

4.1.5 Project Geotechnical Engineer / Geologist

The Geotechnical Engineer or Project Geologist will report to the Environmental Clerk of Works and is responsible for inspection and review of geotechnical aspects associated with construction of the wind farm. The Geotechnical Engineer will not be full time on site but will visit site at least once a month during the construction phase and on a weekly basis during site preparation/groundworks.

The responsibilities and duties of the Geotechnical Engineer or Geologist will include the following:

- Visit site regularly, or at least once a month during the construction phase, to complete geotechnical audits and reviews and report any issues to the Site Supervisor/Construction Manager;
- Ensuring that identified hazards are listed in the Construction Risk Register and that these are subject to ongoing monitoring; and,
- Ongoing inspection and monitoring of the development, particularly in areas of peatland and the peat repository areas, through all phases of construction (including pre, during and post construction) and ensure construction is carried out as specified in the EIAR, and in relevant planning conditions.

4.2 Environmental Awareness and Training

4.2.1 Environmental Induction

The Environmental Induction will be integrated into the general site induction on a case by case basis for each member of staff employed on-site depending on their assigned roles and responsibilities on site. Where necessary, the Environmental Induction will as a minimum include:

- A copy of the Environmental Management Site Plans and discussion of the key environmental risks and constraints;
- An outline of the CEMP structure;
- A discussion of the applicable Works Method Statement;
- The roles and responsibilities of staff, including contractors, in relation to environmental management; and,
- An outline of the Environmental Incident Management Procedure.

4.2.2 Toolbox Talks

Tool box talks would be held by the ECoW or Site Supervisor/Construction Manager at the commencement of each day, or at the commencement of new activities. The aims of the tool box talks are to identify the specific work activities that are scheduled for that day or phase of work. In addition, the necessary work method statements and sub plans would be identified and discussed prior to the commencement of the day's activities.

Site meetings would be held on a regular basis involving all site personnel. The objectives of site meetings is to discuss the coming weeks activities and identify the relevant work method statements and sub plans that will be relevant to that week's activities. Additionally, any non-compliance identified during the previous week would also be discussed with the aim to reduce the potential of the same non-compliance reoccurring.

5. EMERGENCY RESPONSE PLAN

5.1 Overview

The Emergency Response Plan (ERP) is presented in this section of the CEMP. It provides details of procedures to be adopted in the event of an emergency. The site ERP includes details on the response required and the responsibilities of all personnel in the event of an emergency. The ERP will require updating and submissions from the contractor/PSCS and suppliers as the project progresses. Where sub-contractors that are contracted on site are governed by their own emergency response procedure a bridging arrangement will be adopted to allow for inclusion of the sub-contractor's ERP within this within this document.

This is a working document that requires updating throughout the various stages of the project.

5.1.1 Roles and Responsibilities

The chain of command during an emergency response sets out who is responsible for coordinating the response. The Site Supervisor/Construction Manager will lead the emergency response which makes him responsible for activating and coordinating the emergency response procedure. The other site personnel who can be identified at this time who will be delegated responsibilities during the emergency response are presented in Figure 5-1. In a situation where the Site Supervisor/ Construction Manager is unavailable or incapable of coordinating the emergency response, the responsibility will be transferred to the next person in the chain of command outlined in Figure 5-1. This will be updated throughout the various stages of the project.

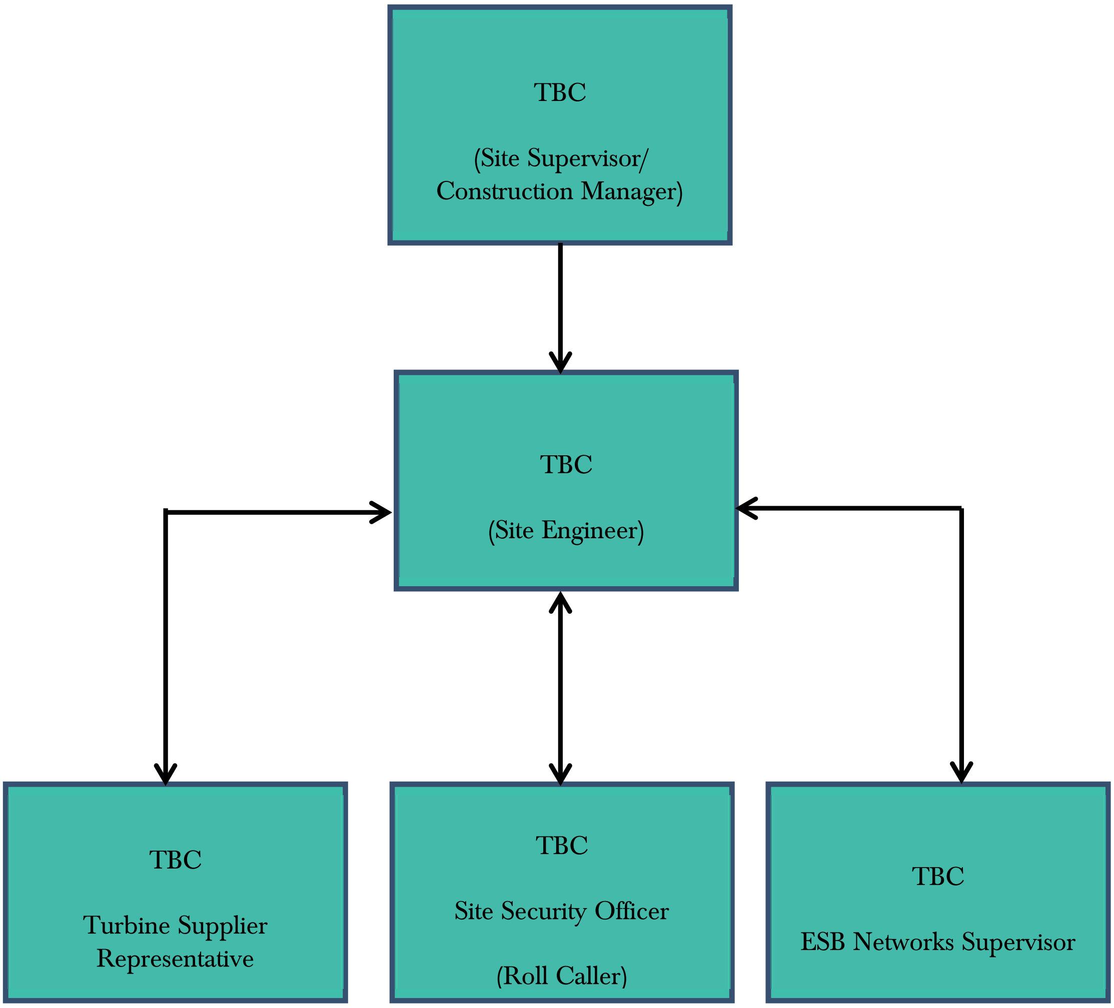


Figure 5-1 Emergency Response Procedure Chain of Command

5.1.2 Hazard Identification

In order to establish the type and scale of potential emergencies that may occur, the following hazards have been identified as being potential situations that may require an emergency response in the event of an occurrence.

Table 5.1 Hazards associated with potential emergency situations

Hazard	Emergency Situation
Construction Vehicles: Dump trucks, tractors, excavators, cranes etc.	Collision or overturn which has resulted in operator or third-party injury.
Abrasive wheels/Portable Tools	Entanglement, amputation or electrical shock associated with portable tools
Contact with services	Electrical shock or gas leak associated with an accidental breach of underground services
Fire	Injury to operative through exposure to fire

Hazard	Emergency Situation
Falls from heights including falls from scaffold towers, scissor lifts, ladders, roofs and turbines	Injury to operative after a fall from a height
Sickness	Illness unrelated to site activities of an operative e.g. heart attack, loss of consciousness, seizure
Turbine Specific Incident	This will be included when the upon agreement and section of the final turbine type

In the event of an emergency situation associated with, but not restricted to, the hazards outlined in Table 5-1 the Site Supervisor/Construction Manager will carry out the following:

- Establish the scale of the emergency situation and identify the number of personnel, if any, have been injured or are at risk of injury.
- Where necessary, sound the emergency siren/fog horn that activates an emergency evacuation on the site. The Site Supervisor/Construction Manager must proceed to the assembly point if the emergency poses any significant threat to their welfare and if there are no injured personnel at the scene that require assistance. The Site Supervisor/Construction Manager will be required to use their own discretion at that point. In the case of fire, the emergency evacuation of the site should proceed, without exception. The site evacuation procedure is outlined in Section 5.1.3.
- Make safe the area if possible and ensure that there is no identifiable risk exists with regard to dealing with the situation e.g. if a machine has turned over, ensure that it is in a safe position so as not to endanger others before assisting the injured.
- Contact the required emergency services or delegate the task to someone. If delegating the task, ensure that the procedures for contacting the emergency services as set out in Section 5.3 is followed.
- Take any further steps that are deemed necessary to make safe or contain the emergency incident e.g. cordon off an area where an incident associated with electrical issues has occurred.
- Contact any regulatory body or service provider as required e.g. ESB Networks the numbers for which as provided in Section 5.4.
- Contact the next of kin of any injured personnel where appropriate.

5.1.3 Site Evacuation/Fire Drill

A site evacuation/fire drill procedure will provide basis for carrying out the immediate evacuation of all site personnel in the event of an emergency. The following steps will be taken:

- Notification of the emergency situation. Provision of a siren or fog horn to notify all personnel of an emergency situation.
- An assembly point will be designated in the construction compound area and will be marked with a sign. All site personnel will assemble at this point.
- A roll call will be carried out by the Site Security Officer to account for all personnel on site.
- The Site Security Officer will inform the Site Supervisor/Construction Manager when all personnel have been accounted for. The Site Supervisor/Construction Manager will decide the next course of action, which be determined by the situation that exists at that time, and will advise all personnel accordingly.

All personnel will be made aware of the evacuation procedure during site induction. The Fire Services Acts of 1981 and 2003 require the holding of fire safety evacuation drills at specified intervals and the keeping of records of such drills.

5.2 Environmental Emergency Response Procedure

5.2.1 Excessive Peat Movement

Where there is excessive peat movement or continuing peat movement recorded at a monitoring location, or identified at any location within the site, but no apparent signs of distress to the peat (e.g. cracking, surface rippling) then the following shall be carried out.

1. *All construction activities shall cease within the affected area.*
2. *Increased monitoring at the location shall be carried out. The area will be monitored, as appropriate, until such time as movements have ceased.*
3. *Re-commencement of limited construction activity shall only start following a cessation of movement and the completion of a geotechnical risk assessment by a geotechnical engineer.*

5.2.2 Onset of Peat Slide

Where there is the onset or actual detachment of peat (e.g. cracking, surface rippling) then the following shall be carried out.

1. *On alert of a peat slide incident, all construction activities will cease and all available resources will be diverted to assist in the required mitigation procedures.*
2. *Where considered possible action will be taken to prevent a peat slide reaching any watercourse. This will take the form of the construction of check barrages on land. Due to the terrain, the possible short run-out length to watercourses, speed of movement and the inability to predict locations it may not be possible to implement any on-land prevention measures, in this case a watercourse check barrage will be implemented.*
3. *For localised peat slides that do not represent a risk to a watercourse and have essentially come to rest the area will be stabilised initially by rock infill, if required. The failed area and surrounding area will then be assessed by the engineering staff and stabilisation procedures implemented. The area will be monitored, as appropriate, until such time as movements have ceased.*

5.2.3 Spill Control Measures

Every effort will be made to prevent an environmental incident during the construction and operational phase of the project. However, in the event of an oil / fuel spill occurring the following steps will be followed:

- Stop the source of the spill and raise the alarm to alert people working in the vicinity of any potential dangers.
- If applicable, eliminate any sources of ignition in the immediate vicinity of the incident.
- Contain the spill using the spill control materials, track mats or other material as required. Do not spread or flush away the spill.
- If possible, cover or bund off any vulnerable areas where appropriate such as drains, watercourses or sensitive habitats.
- If possible, clean up as much as possible using the spill control materials.
- Contain any used spill control material and dispose of used materials appropriately using a fully licensed waste contractor with the appropriate permits so that further contamination is limited.

- Notify the Environmental Clerk of Works immediately giving information on the location, type and extent of the spill so that they can take appropriate action.
- The Environmental Clerk of Works will inspect the site and ensure the necessary measures are in place to contain and clean up the spill and prevent further spillage from occurring.
- The Environmental Clerk of Works will notify the appropriate regulatory body such as Offaly County Council, and the Environmental Protection Agency (EPA), if deemed necessary.

The importance of a swift and effective response in the event of such an incident occurring cannot be over emphasised. Environmental incidents are not limited to just fuel spillages. Therefore, any environmental incident must be investigated in accordance with the following steps.

- The Environmental Clerk of Works must be immediately notified.
- If necessary, the Environmental Clerk of Works will inform the appropriate regulatory authority. The appropriate regulatory authority will depend on the nature of the incident.
- The details of the incident will be recorded on an Environmental Incident Form which will provide information such as the cause, extent, actions and remedial measures used following the incident. The form will also include any recommendations made to avoid reoccurrence of the incident.
- If the incident has impacted on an ecologically sensitive receptor, such as a sensitive habitat, protected species or designated conservation site (pSPA or cSAC), the Environmental Clerk of Works will liaise with the Project Ecologist.
- If the incident has impacted on a sensitive receptor such as an archaeological feature the Environmental Clerk of Works will liaise with the Project Archaeologist.
- A record of all environmental incidents will be kept on file by the Environmental Clerk of Works and the Main Contractor. These records will be made available to the relevant authorities such as Offaly County Council, EPA if required.

The Environmental Clerk of Works will be responsible for any corrective actions required as a result of the incident e.g. an investigative report, formulation of alternative construction methods or environmental sampling, and will advise the Main Contractor as appropriate.

5.3 Contact the Emergency Services

5.3.1 Emergency Communications Procedure

In the event of requiring the assistance of the emergency services the following steps should be taken:

Stay calm. It's important to take a deep breath and not get excited. Any situation that requires 999/112 is, by definition, an emergency. The dispatcher or call-taker knows that and will try to move things along quickly, but under control.

Know the location of the emergency and the number you are calling from. This may be asked and answered a couple of times but don't get frustrated. Even though many emergency call centres have enhanced capabilities meaning they are able to see your location on the computer screen they are still required to confirm the information. If for some reason you are disconnected, at least emergency crews will know where to go and how to call you back.

Wait for the call-taker to ask questions, then answer clearly and calmly. If you are in danger of assault, the dispatcher or call-taker will still need you to answer quietly, mostly "yes" and "no" questions.

If you reach a recording, listen to what it says. If the recording says your call cannot be completed, hang up and try again. If the recording says all call takers are busy, WAIT. When the next call-taker or dispatcher is available to take the call, it will transfer you.

Let the call-taker guide the conversation. He or she is typing the information into a computer and may seem to be taking forever. There's a good chance, however, that emergency services are already being sent while you are still on the line.

Follow all directions. In some cases, the call-taker will give you directions. Listen carefully, follow each step exactly, and ask for clarification if you don't understand.

Keep your eyes open. You may be asked to describe victims, suspects, vehicles, or other parts of the scene.

Do not hang up the call until directed to do so by the call taker.

Due to the remoteness of the site it may be necessary to liaise with the emergency services on the ground in terms of locating the site. This may involve providing an escort from a designated meeting point that may be located more easily by the emergency services. This should form part of the site induction to make new personnel and sub-contractors aware of any such arrangement or requirement if applicable.

5.4 Contact Details

A list of emergency contacts is presented in Table 5-2. A copy of these contacts will be included in the Site Safety Manual and in the site offices and the various site welfare facilities.

Table 5.2 Emergency Contacts

Contact	Telephone no.
Emergency Services – Ambulance, Fire, Gardaí	999/112
Doctor – Banagher Family Practice	057 915 1247
Hospital – Midlands Regional Hospital Tullamore	057 932 1501
ESB Emergency Services	1850 372 999
Gas Networks Ireland Emergency	1850 20 50 50
Gardaí –Banagher Garda Station	057 915 1310
Health and Safety Co-ordinator - Health & Safety Services	TBC
Health and Safety Authority	1890 289 389
Inland Fisheries Ireland (IFI)	1890 347 424
Project Supervisor Construction Stage (PSCS): TBC	TBC
Project Supervisor Design Stage (PSDS): MKO	091 735611
Client: Bord na Móna Powergen Ltd.	045 439000

5.4.1 Procedure for Personnel Tracking

All operatives on site without any exception will have to undergo a site induction where they will be required to provide personal contact details which will include contact information for the next of kin.

In the event of a site operative becoming in an emergency situation where serious injury has occurred and hospitalisation has taken place, it will be the responsibility of the Site Manager or next in command if unavailable to contact the next of kin to inform them of the situation that exists.

5.5 Induction Checklist

Table 5-3 provides a list of items highlighted in this ERP which must be included or obtained during the mandatory site induction of all personnel that will work on the site. This will be updated throughout the various stages of the project.

Table 5-3 Emergency Response Plan Items Applicable to the Site Induction Process

ERP Items to be included in Site Induction	Status
All personnel will be made aware of the evacuation procedure during site induction	
Due to the remoteness of the site it may be necessary to liaise with and assist the emergency services on the ground in terms of locating the site. This may involve providing an escort from a designated meeting point that may be located more easily by the emergency services. This should form part of the site induction to make new personnel and sub-contractors aware of any such arrangement or requirement if applicable.	
All operatives on site without any exception will have undergo a site induction where they will be required to provide personal contact details which will include contact information for the next of kin.	

6. MITIGATION PROPOSALS

All mitigation measures relating to the pre-commencement, construction and operational phases of the proposed development were set out in the various sections of the Environmental Impact Assessment Report (EIAR) prepared as part of the planning permission application to An Bord Pleanála.

This section of the CEMP groups together all of the mitigation measures presented in the EIAR. The Mitigation Measures are presented in the following pages.

By presenting the mitigation proposals in the below format, it is intended to provide an easy to audit list that can be reviewed and reported on during the future phases of the project. The tabular format in which the below information is presented, can be further expanded upon during the course of future project phases to provide a reporting template for site compliance audits.

Ref. No.	Reference Heading	Location	Mitigation Measure
Pre-Commencement Phase			
MM1	Environmental Management	EIAR Chapter 4	The Contractor will be responsible for implementing the mitigation measures specified throughout the EIAR and compiled in the Audit Report which is included in the CEMP. The Contractor will also be responsible for ensuring that all construction staff understand the importance of implementing the mitigation measures. The implementation of the mitigation measures will be overseen by the environmental clerk of works or supervising hydrogeologists, environmental scientists, ecologists or geotechnical engineers, depending on who is best placed to advise on the implementation. The system of auditing referred to above ensures that the mitigation measures are maintained for the duration of the construction phase, and into the operational phase where necessary.
MM2	Environmental Management	EIAR Chapter 4	The Environmental Clerk of Works will maintain responsibility for monitoring the works and Contractors/Sub-contractors from an environmental perspective. In addition, an Environmental Clerk of Works or Project Ecologist, Project Hydrologist, Project Geotechnical engineer will visit the site regularly and report to the Site Environmental Office.
MM3	Environmental Management	EIAR Chapter 4	A Site Environmental Clerk of Works will oversee the site works and implementation of the Construction Environmental Management Plan (CEMP), and provide on-site advice on the mitigation measures necessary as necessary to ensure the project proceeds as intended. The level, detail and frequency of reporting expected from the Site Environmental Clerk of Works for the Construction Manager, developer's project manager, and any Authorities or other Agencies, will be agreed by parties where required prior to commencement of construction, and may be further adjusted as required during the course of the project.
MM4	Environmental Management- Invasive Species	CEMP Section 3	A baseline invasive species survey will be carried out at the site to identify the presence and location of any invasive species (listed under the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011) by a suitably qualified ecologist. If the presence of such species is found at or adjacent to the site, particularly in areas where excavation may be required, an invasive species management plan will be prepared for the site to prevent the introduction or spread of any invasive species within the footprint of the works. An invasive species management plan, if required, will set out best practice control methods.

MM5	Roads	CEMP Section 2	Prior to commencing road construction movement monitoring posts should be installed in areas where the peat depth is greater than 1m.
MM6	Drainage	CEMP Section 2	Interceptor drains should be installed upslope of the access road alignment to divert any surface water away from the construction area.
MM7	Drainage	CEMP Section 3	Prior to commencement of works in sub-catchments across the site, main drain inspections will be competed to ensure ditches and streams are free from debris and blockages that may impede drainage
MM9	Biodiversity	EIAR Chapter 6	On a precautionary basis, prior to the commencement of any site works, a badger sett disturbance licence will be sought from the National Parks and Wildlife Service.
MM10	Biodiversity	EIAR Chapter 6 and Chapter 4	A detailed drainage maintenance plan for the proposed development is provided in Section 4.7 of this EIAR. This plan provides details of how water quality will be protected during the construction of the proposed development
MM11	Biodiversity	EIAR Chapter 6 and Appendix 6.7	A Biodiversity Management Plan has been provided to avoid loss of uncut raised bog and natural woodlands and the ecological enhancement of areas of cutover bog through rewetting to promote the development of wetland vegetation.
MM12	Biodiversity	EIAR Chapter 6 and Appendix 6.6	A Lepidoptera Management Plan has been produced which outlines the areas of suitable marsh fritillary habitat that will be fenced off or clearly marked prior to the commencement of any site works under the guidance and supervision of a suitably qualified Ecological Clerk of Works (ECoW). › Pre-commencement surveys will be undertaken for marsh fritillary to determine long term trends of the population within the site. › Vegetation structure and suitability will be monitored following the NBDC survey methodology (NBDC, 2019). › Pollinator enhancement measures through habitat creation.
MM13	Traffic Management Plan, Delivery Programme,	EIAR Chapter 14	› **A Pre-Construction Condition Survey** – Where required by the local authority, a pre-condition survey of roads associated with the proposed development can be carried out immediately prior

	pre-commencement road works		to construction commencement to record an accurate condition of the road at the time. Where required the timing of these surveys will be agreed with the local authority.
			- A detailed **Traffic Management Plan (TMP)**, will be provided specifying details relating to traffic management and included in the CEMP prior to the commencement of the construction phase of the proposed development. The TMP will be agreed with the local authority and An Garda Síochána prior to construction works commencing on site. The detailed TMP will include the following:
			  o **Traffic Management Coordinator** – a competent Traffic Management Co-ordinator will be appointed for the duration of the project and this person will be the main point of contact for all matters relating to traffic management.
			  o **Delivery Programme** – a programme of deliveries will be submitted to the County Council in advance of deliveries of turbine components to site. Liaison with the relevant local authorities and Transport Infrastructure Ireland (TII) will be carried out where required regarding requirements such as delivery timetabling. The programme will ensure that deliveries are scheduled in order to minimise the demand on the local network and minimise the pressure on the access to the site.
			- Selection of the most appropriate delivery route to transport the wind turbine components, requiring the minimum remedial works to accommodate the vehicles
			- Construction of temporary improvements to the local highway network at locations

MM14	Information to Local Residents	EIAR Chapter 14	Locals in the area will be informed of any upcoming traffic related matters e.g. temporary lane/road closures (where required) or delivery of turbine components at night, via letter drops and posters in public places. Information will include the contact details of the Project Co-Ordinator, who will be the main point of contact for all queries from the public or local authority during normal working hours. An "out of hours" emergency number will also be provided

Construction Phase			
Construction Management			
MM15	Health and Safety	EIAR Chapter 5	During construction of the Proposed Development, all staff will be made aware of and adhere to the Health & Safety Authority's *'Guidelines on the Procurement, Design and Management Requirements of the Safety, Health and Welfare at Work (Construction) Regulations 2013'*. This will encompass the use of all necessary Personal Protective Equipment and adherence to the site Health and Safety Plan which will include measures to exclude members of the public from certain areas of the site during construction.
MM16	Health and Safety	EIAR Chapter 5	The scale and scope of the project requires that a Project Supervisor Design Process (PSDP) and Project Supervisor Construction Stage (PSCS) are required to be appointed in accordance with the provisions of the Health & Safety Authority's 'Guidelines on the Procurement, Design and Management Requirements of the Safety, Health and Welfare at Work (Construction) Regulations 2006'. The PSDP appointed for the construction stage shall be required to perform his/her duties as prescribed in the Safety, Health and Welfare at Work (Construction) Regulations. These duties include (but are not limited to): › Identify hazards arising from the design or from the technical, organisational, planning or time related aspects of the project; › Where possible, eliminate the hazards or reduce the risks; › Communicate necessary control measures, design assumptions or remaining risks to the PSCS so they can be dealt with in the Safety and Health Plan; › Ensure that the work of designers is coordinated to ensure safety; › Organise co-operation between designers; › Prepare a written Safety and Health Plan; › Prepare a safety file for the completed structure and give it to the client; and

			Notify the Authority and the client of non-compliance with any written directions issued
MM17	Health and Safety	EIAR Chapter 5	The PSCS appointed for the construction stage shall be required to perform his/her duties as prescribed in the Safety, Health and Welfare at Work (Construction) Regulations. These duties include (but are not limited to): - Development of the Safety and Health Plan for the construction stage with updating where required as work progresses; - Compile and develop safety file information - Reporting of accidents / incidents; - Weekly site meeting with PSCS; - Coordinate arrangements for checking the implementation of safe working procedures. Ensure that the following are being carried out: - Induction of all site staff including any new staff enlisted for the project from time to time; - Toolbox talks as necessary; - Maintenance of a file which lists personnel on site, their name, nationality, current Safe Pass number, current Construction Skills Certification Scheme (CSCS) card (where relevant) and induction date; - Report on site activities to include but not limited to information on accidents and incidents, disciplinary action taken and PPE compliance; - Monitor the compliance of contractors and others and take corrective action where necessary; and Notify the Authority and the client of non-compliance with any written directions issued.
MM18	Reinstatement	EIAR Chapter 4	Some overburden material will be stored temporarily adjacent to the works areas for reinstatement when the main construction activities are completed. Soil will be backfilled outside the drainage channels along track-sides and vegetated sods replaced over the surface, bedded-in, regraded, etc., to re-constitute a stable and settled ground surface on which the natural vegetation can recover and will be resistant to erosion.
MM19	Waste Materials	CEMP Section 3	A fully licensed waste contractor will be employed to remove waste from the site and will be required to provide documented records for all waste dispatches leaving the site of the proposed development.

Drainage Design and Management			
MM20	Earthworks	EIAR Chapter 9	Avoid working during heavy rainfall and for up to 24 hours after heavy events to ensure drainage systems are not overloaded.
MM21	Excavation Dewatering and Surface Water Quality	EIAR Chapter 9	› If required, pumping of excavation inflows will prevent build-up of groundwater in the excavation; › The interceptor drainage will be discharged to the existing drainage system or onto the bog surface; › The pumped water volumes will be discharged via volume and sediment attenuation ponds adjacent to excavation areas, or via specialist treatment systems such as a “Siltbuster” unit; › There will be no direct discharge to the existing drainage network and therefore no risk of hydraulic loading or contamination will occur; and, › Daily monitoring of excavations by a suitably qualified person will occur during the construction phase. If high levels of seepage inflow occur, excavation work should immediately be stopped, and a geotechnical assessment undertaken.
MM22	Watercourse Buffers	EIAR Chapter 9	A self-imposed buffer zone for peat storage will be established around the existing field drains on site. Also, a buffer zone around field ditches and watercourses where no peat can be stored is being implemented. A 25 m buffer around field ditches and a 50m construction buffer from all watercourses is recommended as per industry best practice. With the exception of upgrading watercourse crossings.
MM23	Drainage Swales	EIAR Chapter 9, Appendix 4-5	Swales will be used to intercept and collect run off from construction areas of the site during the construction phase, and channel it to settlement ponds for sediment attenuation as per the drainage design.
MM24	Interceptor Drains	EIAR Chapter 9, Appendix 4-5	Interceptor drains will be installed up-gradient of any works areas to collect surface flow runoff and prevent it reaching excavations and construction areas of the site. It will then be directed to areas where it can be re-distributed over the ground as sheet flow as per the drainage design.
MM25	Transverse drains	EIAR Chapter 9, Appendix 4-5	On steep sections of access road transverse drains (‘grips’) will be constructed where appropriate in the surface layer of the road to divert any runoff off the road into swales/road side drains;

MM26	Check dams	EIAR Chapter 9, Appendix 4-5	Check dams will not be used in any natural watercourses, only artificial drainage channels and interceptor drains. The check dams will be installed at regular intervals along interceptor drains to restrict flow velocity, minimise channel erosion and promote sedimentation behind the dam as per the drainage design.
MM27	Level Spreaders	EIAR Chapter 9, Appendix 4-5	A level spreader will be constructed at the end of each interceptor drain to convert concentrated flows in the drain into diffuse sheet flow on areas of vegetated ground. The levels spreaders will be located downgradient of any proposed works areas in locations where they are not likely to contribute further to water ingress to construction areas of the site.
MM28	Vegetation filters	EIAR Chapter 9, Appendix 4-5	Vegetation filters, that is areas of existing vegetation, accepting drainage water issuing from level spreaders as sheet flow, will remove any suspended sediment from water channelled via interceptor drains or any remaining sediment in waters channelled via swales and settlement ponds.
MM29	Settlement ponds	EIAR Chapter 9, Appendix 4-5	Settlement ponds, placed either singly or a pair in series, will buffer volumes of run-off discharging from the drainage system during periods of high rainfall, by retaining water until the storm hydrograph has receded, thus reducing the hydraulic loading to water courses as per the drainage design.
MM30	Siltbuster	EIAR Chapter 9, Appendix 4-5	If the discharge water from construction areas fails to be of a high quality, then a filtration treatment system (such as a 'siltbuster' or similar equivalent treatment train (sequence of water treatment processes)) will be used to filter and treat all surface discharge water collected in the dirty water drainage system. This will apply for all of the construction phase.
MM31	Silt Fences	EIAR Chapter 9, Appendix 4-5	Silt fences will be emplaced within drains down-gradient of all construction areas. Silt fences are effective at removing heavy settleable solids. This will act to prevent entry to the existing drainage network of sand and gravel-sized sediment, released from excavation of mineral sub-soils of glacial and glacio-fluvial origin and entrained in surface water runoff. Inspection and maintenance of these structures during construction phase is critical to their functioning to stated purpose. They will remain in place throughout the entire construction phase.
MM32	Silt Bags	EIAR Chapter 9, Appendix 4-5	Silt bags will be used where small to medium volumes of water need to be pumped from excavations (e.g. the proposed underpass locations). As water is pumped through the bag, most of the sediment is retained by the geotextile fabric allowing filtered water to pass through.

MM33	Potential Release of Hydrocarbons	EIAR Chapter 9 CEMP Section 3	- All plant will be inspected and certified to ensure they are leak free and in good working order prior to use on site; - On-site re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer or truck will be re-filled off site and will be towed/driven around the site to where machinery are located. The 4x4 jeep/fuel truck will also carry fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations; - Fuels stored on site will be minimised. Any storage areas will be bunded appropriately for the fuel storage volume for the time period of the construction; - The electrical control building will be bunded appropriately to the volume of oils likely to be stored and to prevent leakage of any associated chemicals and to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor; - An emergency plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan. Spill kits will be available to deal with accidental spillages.
MM34	Release of Cement-Based Products	EIAR Chapter 9 CEMP Section 3	- No batching of wet-cement products will occur on site. Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will take place; - Where possible pre-cast elements for culverts and concrete works will be used; - No washing out of any plant used in concrete transport or concreting operations will be allowed on-site; - Where concrete is delivered on site, only the chute will be cleaned, using the smallest volume of water possible. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Chute cleaning water is to be isolated in temporary lined wash-out pits located near proposed site compounds. These temporary lined wash-out pits will be removed from the site at the end of the construction phase;

			› Will use weather forecasting to plan dry days for pouring concrete; and, › Will ensure pour site is free of standing water and plastic covers will be ready in case of sudden rainfall event
MM35	Plant and equipment inspections	EIAR Chapter 8	Site plant will be regularly inspected for leaks and fitness for purpose; and, an emergency plan for the construction phase to deal with accidental spillages will be contained within Environmental Management Plan. Spill kits will be available to deal with accidental spillages.
MM36	Wastewater Disposal	EIAR Chapter 8	Temporary port-a-loo toilets located within a staff portacabin will be used during the construction phase. Wastewater from staff toilets will be directed to a sealed storage tank, with all wastewater being tankered off site by an appropriately consented waste collector to wastewater treatment plants.
MM37	Concrete Deliveries and Management	CEMP Section 3	No batching of wet-cement products will occur on site. Ready-mixed supply of wet concrete products will be used and where possible, pre-cast elements for culverts and concrete works will be used.
MM37	Concrete Deliveries and Management	CEMP Section 3	No washing out of any plant used in concrete transport or concreting operations will be allowed on-site.
MM38	Concrete Deliveries and Management	CEMP Section 3	Where concrete is delivered on site, only the chute need be cleaned, using the smallest volume of water possible. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Chute cleaning water is to be directed into a dedicated lined washout area. This lined area will be removed from site once the construction phase is complete.
MM39	Concrete Deliveries and Management	CEMP Section 3	Weather forecasting will be used to plan dry days for pouring concrete. Ensure pour site is free of standing water and plastic covers will be ready in case of sudden rainfall event
MM40	Concrete Deliveries and Management	CEMP Section 3	Where possible pre-cast elements for culverts and concrete works will be used
Peat, Subsoils and Bedrock			
MM40	Topsoil/Peat and Subsoil Excavation	EIAR Chapter 8	› The peat and subsoil which will be removed during the construction phase will be localised to the wind farm infrastructure turbine location, substation and temporary compounds and access roads;

			- The proposed development has been designed to avoid sensitive habitats within the application area; - A minimal volume of peat and subsoil will be removed to allow for infrastructural work to take place in comparison to the total volume present on the site due to optimisation of the layout by mitigation by design; - Excavated peat will only be moved short distances from the point of excavation and will be used locally for landscaping; and, - Construction of settlement ponds will be volume neutral, and all excess material will be used locally to form pond bunds and surrounding landscaping.
MM41	Peat Instability and Failure	EIAR Chapter 8	- Appointment of experienced and competent contractors; - The site should be supervised by experienced and qualified personnel; - Allocate sufficient time for the project (be aware that decreasing the construction time has the potential to increase the risk of initiating a localised peat movement); - Prevent undercutting of slopes and unsupported excavations; - Maintain a managed robust drainage system; - Prevent placement of loads/overburden on marginal ground; - Set up, maintain and report findings from monitoring systems (as outlined in the Geotechnical and Peat Stability Assessment (Appendix 8.1)); - Ensure construction method statements are developed and agreed before commencement of construction and are followed by the contractor; and, - Revise and amend the Construction Risk Register as construction progresses to ensure that risks are managed and controlled for the duration of construction.
MM42	Erosion of Exposed Subsoils and Peat During Construction of Infrastructure	EIAR Chapter 8 and Appendix 4-2	- Peat removed from turbine locations and access roads will be used for landscaping close to the extraction area; - Where possible, the upper vegetative layer (where still present) will be stored with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation at the surface of the stored peat within the peat storage areas; - Re-seeding and spreading/planting will also be carried out in these areas; - A full Peat and Spoil Management Plan for the development is shown as Appendix 4.2.

Biodiversity			
MM43	Badger setts	EIAR Chapter 4 and Chapter 6	- An exclusion zone around the sett will be maintained for the duration of the construction works. No works will be undertaken within 30m of the sett. - Following best practice, the proposed works within 50 metres of the sett will be undertaken outside of the badger breeding season (December to June) (NRA, 2005). - The proposed access track construction in close proximity to a badger sett will be constructed as a 'floating road' construction. This will avoid the requirements for the excavation of materials and therefore reduce both the construction time and intensity of the proposed construction works in this area. - To protect individual badgers during the construction phase of the proposed development, all open excavations on site will be covered when not in use and backfilled as soon as possible. Excavations will also be covered at night and any deep excavations left open will have appropriate egress ramps in place to allow mammals to safely exit excavations should they fall in.
MM44	Bats	EIAR Chapter 6	- Any loss of woodland habitat will be mitigated through replacement planting - Construction best practice will be employed to minimise general noise and disturbance potential. Plant machinery will be turned off when not in use and all plant and equipment for use will comply with the Construction Plant and Equipment Permissible Noise Levels Regulations (SI 359/1996).
MM45	Invasive Species	Appendix 4-5	- A designated wash-down area will be created, where power-washed material from machinery can be contained, collected and disposed of with other contaminated material. This area will contain a washable membrane or hard surface. - Stockpile areas will be chosen to minimise movement of contaminated soil. - Stockpiles will be marked and isolated. - Contaminated areas which will not be excavated will be protected by a root barrier membrane if they are likely to be disturbed by machinery. Root barrier membranes will be protected by a layer of sand above and below and topped with a layer of hardcore. - The use of vehicles with caterpillar tracks within contaminated areas will be avoided to minimise the risk of spreading contaminated material. - An ECoW/suitably qualified ecologist will be on site to monitor and oversee the implementation of invasive species management plans. - Personnel may only clean down if they are familiar with the plant and rhizome material and can readily identify it. - Decontamination will only occur within designated wash-down areas.

			Vehicles will be cleaned using stiff-haired brush and pressure washers, paying special attention to any areas that might retain rhizomes e.g. wheel treads and arches.
Ornithology			
MM46	Lapwing, Waterfowl and Wader Habitat	EIAR Chapter 7 and Appendix 7.8	› Lapwing, Waterfowl and Wader Habitat Enhancement Plan will be implemented to enhance potential habitats and minimise potential habitat loss. The plan focuses on the enhancement of supporting habitat for lapwing but its implementation will also benefit, redshank, black-headed gull, woodcock, ringed plover, whooper swan and snipe.
MM47	Ornithology	EIAR Chapter 7	› The removal of woody vegetation will be undertaken outside the bird breeding season which begins on the1st day of March and ends on the 31st day of August in any year. › All woodland/scrub (c. 7.24ha) that is removed to facilitate the construction of the proposed development will be replaced with native tree species (c. 13ha). This will ensure there will be a net gain of woodland within the proposed development area. › During the construction phase, noise limits, noise control measures, hours of operation (i.e. dusk and dawn is high faunal activity time) and selection of plant items will be considered in relation to disturbance of birds. › Plant and machinery will be turned off when not in use. › All plant and equipment for use will comply with the Construction Plant and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations 2001 (S.I. No. 632 of 2001) other relevant legislation. › An Ecological Clerk of Works (ECoW) will be appointed and will operate for the duration of construction works. Duties will include: o Undertake a pre-construction transect/walkover bird survey to ensure that significant effects on breeding birds will be avoided. o Inform and educate on-site personnel of the ornithological and ecological sensitivities within the Proposed Development site. o Oversee management of ornithological and ecological issues during the construction period and advise on ornithological issues as they arise. o Provide guidance to contractors to ensure legal compliance with respect to protected species onsite.

			o Liaise with officers of consenting authorities and other relevant bodies with regular updates in relation to construction progress.
Noise			
MM48	Best Practise Measures BS5528-1	EIAR Chapter 11	Best Practice Mitigation Measures from BS5528-1 standard will be implemented for the duration of the construction phase: - limiting the hours during which site activities likely to create high levels of noise or vibration are permitted; - establishing channels of communication between the contractor/developer, Local Authority and residents; - appointing a site representative responsible for matters relating to noise and vibration; - monitoring typical levels of noise and vibration during critical periods and at sensitive locations; - keeping site access roads even to mitigate the potential for vibration from lorries. A variety of practicable noise control measures will also be employed. These include: - selection of plant with low inherent potential for generation of noise and/ or vibration; - placing of noisy / vibratory plant as far away from sensitive properties as permitted by site constraints, and; - regular maintenance and servicing of plant items.
Air Quality/Dust			
MM49	Dust Emissions	EIAR Chapter 5,10 CEMP Section 3	- Sporadic wetting of loose stone surface will be carried out during the construction phase to minimise movement of dust particles to the air. In periods of extended dry weather, dust suppression may be necessary along haul roads to ensure dust does not cause a nuisance. If necessary, water will be taken from stilling ponds in the site's drainage system and will be pumped into a bowser or water spreader to dampen down haul roads and site compound to prevent the generation of dust where required. Water bowser movements will be carefully monitored to avoid, insofar as reasonably possible, increased runoff. - All plant and materials vehicles shall be stored in dedicated areas (on site).

			- Areas of excavation will be kept to a minimum, and stockpiling will be minimised by coordinating excavation, spreading and compaction. - Turbines and construction materials will be transported to the site on specified haul routes only. - The agreed haul route roads adjacent to the site will be regularly inspected for cleanliness and cleaned as necessary. - The transport of construction materials to the site that have significant potential to cause dust, will be undertaken in tarpaulin or similar covered vehicles where necessary. - A Construction and Environmental Management Plan (CEMP) will be in place throughout the construction phase (see Appendix 4.3). The CEMP includes dust suppression measures.
MM50	Exhaust Emissions	EIAR Chapter 5, Chapter 10	- All construction vehicles and plant will be maintained in good operational order while onsite, thereby minimising any emissions that arise. - Turbines and construction materials will be transported to the site on specified routes only unless otherwise agreed with the Planning Authority. - Aggregate materials for the construction of site access tracks and all associated infrastructure will all be locally sourced, where possible, which will further reduce potential emissions.
MM51	Greenhouse Gas Emissions	EIAR Chapter 10	- All construction vehicles and plant will be maintained in good operational order while onsite, thereby minimising any emissions that arise. - Turbines and construction materials will be transported to the site on specified routes only unless otherwise agreed with the Planning Authority. - Aggregate materials for the construction of site access tracks and all associated infrastructure will all be locally sourced, where possible, which will further reduce potential emissions.
Traffic			
MM52	Traffic Management Co-Ordinator	EIAR Chapter 14	A competent Traffic Management Coordinator will be appointed for the duration of the project and this person will be the main point of contact for all matters relating to traffic management.
MM53	Liaison with the relevant local authority	EIAR Chapter 14	Liaison with the relevant local authority including the roads section of local authorities that the delivery routes traverse and An Garda Siochána, during the delivery phase.

MM54	Travel Plans for Construction Workers	EIAR Chapter 14	The construction company will be required to provide a travel plan for construction staff, which will include the identification of a routes to / from the site and identification of an area for parking.
MM55	Temporary traffic signs	EIAR Chapter 14	As part of the traffic management measures temporary traffic signs will be put in place at all key junctions, including the access junction on the N15. All measures will be in accordance with the *"Traffic Signs Manual, Chapter 8 – Temporary Traffic Measures and Signs for Road Works"* (DoT now DoTT&S) and "Guidance for the Control and Management of Traffic at Roadworks" (DoTT&S). A member of construction staff (flagman) will be present at key junctions during peak delivery times.
Cultural Heritage			
MM56	Impact of excavation works on unrecorded potential sub-surface sites	EIAR Chapter 13	› During the excavation of new proposed access routes, a known memorial plaque located along the proposed route from T21 to the proposed substation will be fenced off prior to construction works in this location. Fencing will be maintained for the duration of the construction works.
Operational Phase			
Health and Safety			
MM57	Health & Safety	EIAR Chapter 5	Access to the turbines is through a door at the base of the structure, which will be locked at all times outside maintenance visits.
Biodiversity			
MM58	Bats	EIAR Chapter 6 and Appendix 6.2.	Ongoing monitoring of bat activity will be undertaken for at least three years' post construction of the wind farm. Full details of the proposed monitoring programme are provided in Appendix 6.2 and include measurement of bat activity, weather conditions and any correlation between the two. The monitoring will also include corpse searching in the areas surrounding the turbines to gather data on any actual collisions. If, following monitoring, there are significant effects recorded, a range of measures are proposed to ensure that any such effects are fully mitigated. These measures include blade feathering, curtailment of turbines during certain conditions and increase of buffers surrounding the turbines. Any or all of

			the above measures may be employed following actual monitoring of the impact of the operating turbines on bats.
Traffic Management			
MM59	Roads	EIAR Chapter 14	**A Post Construction Condition Survey** – Where required by the local authority, a post construction survey will be carried out after works are completed to ensure that any remediation works are carried out to a satisfactory standard. Where required the timing of these surveys will be agreed with the local authority. All road surfaces and boundaries will be re-instated to pre-development condition, as agreed with the local authority engineers
Drainage Management Plan			
MM60	Drainage Inspection	EIAR Chapter 9, CEMP Section 3	› Monitoring the effectiveness of drainage measures installed during the construction phase will continue to be monitored into the operational phase. Any excess build-up of silt levels at dams, the settlement pond, or any other drainage features that may decrease the effectiveness of the drainage feature, will be removed.

7. MONITORING PROPOSALS

All monitoring proposals relating to the pre-commencement, construction and operational phases of the proposed development were set out in various sections of the EIAR prepared as part of the planning permission application to An Bord Pleanála.

This section of the Construction and Environment Management Plan groups together all of the monitoring proposals presented in the EIAR. The monitoring proposals are presented in the following pages.

By presenting the monitoring proposals in the below format, it is intended to provide an easy to audit list that can be reviewed and reported on during the future phases of the project. The tabular format in which the below information is presented, can be further expanded upon during the course of future project phases to provide a reporting template for site compliance audits.

Ref. No.	Reference Heading	Reference Location	Monitoring Measure
Pre-Commencement Phase			
MX1	Water Quality and Monitoring	EIAR Section 9	An inspection and maintenance plan for the on-site drainage system will be prepared in advance of commencement of any works.
MX2	Invasive Species	CEMP Section 4	A pre-commencement invasive species survey shall be completed for the site
MX3	Mammal Survey	EIAR Section 6	A pre-construction mammal survey will be undertaken to identify any Otter holts or Badger setts within the works areas associated with the development. The survey will be undertaken to ensure that Otter or Badger have not taken up residence within or close to the development footprint
MX4	Marsh Fritillary	EIAR Section 6	Pre-commencement surveys will be undertaken for marsh fritillary to determine long term trends of the population within the site.
Construction Phase			
MX5	Water Quality and Monitoring	EIAR Section 8	An inspection and maintenance plan for the on-site drainage system will be prepared in advance of commencement of any works. Regular inspections of all installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended.
MX6	Daily Monitoring	EIAR Section 8	Daily monitoring of excavations by a suitably qualified person will occur during the construction phase. If high levels of seepage inflow occur, excavation work should immediately be stopped and a geotechnical assessment undertaken
MX7	Check Dams	EIAR Section 4	Check dams will be inspected and maintained regularly to insure adequate performance. Maintenance checks will also ensure the centre elevation of the dam remains lower than the sides of the dam.

MX8	Settlement Ponds	EIAR Section 3 CEMP Section 5	Settlement ponds will be inspected weekly and following rainfall events. Inlet and outlets will be checked for sediment accumulation and anything else that might interfere with flows. Inspection and maintenance of these of these structures during construction phase is critical to their functioning to stated purpose.
MX9	Culverts	EIAR Section 3	All culverts will be inspected regularly to ensure they are not blocked by debris, vegetation or any other material that may impede conveyance.
MX10	Drainage Management	EIAR Section 3 CEMP Section 5	The effectiveness of drainage measures designed to minimise runoff entering works areas and capture and treat silt-laden water from the works areas, will be monitored continuously by the Environmental Clerk of Works or supervising hydrologist on-site. The Environmental Clerk of Works or supervising hydrologist will respond to changing weather, ground or drainage conditions on the ground as the project proceeds, to ensure the effectiveness of the drainage design is maintained in so far as is possible. This may require the installation of additional check dams, interceptor drains or swales as deemed necessary on-site.
MX11	Plant and Equipment Inspections	EIAR Section 7 CEMP Section 5	The plant used should be regularly inspected for fuel leaks, unnecessary noise generation and general fitness for purpose.
MX12	Drainage Inspection	EIAR Section 8 CEMP Section 5	Regular inspections of all installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended. Inspections will also be undertaken after tree felling.
MX13	Marsh Fritillary	EIAR Chapter 6	Habitat condition monitoring will be undertaken to ensure that there are no negative effects on marsh fritillary habitat.
MX14	Archaeological Monitoring	EIAR Section 13	Archaeological monitoring (under licence from the National Monuments Service) of any further geotechnical / engineering trial pits or investigations and a report detailing the results of same. Pre-development Licensed testing in areas where peat depths allow a meaningful investigation. Testing should only be undertaken in areas where ground disturbance will take place as part of the development. Where peat depths become a limitation to testing, monitoring at the construction stage should be undertaken. The areas to be tested will be chosen by the appointed archaeologist and the number of test trenches agreed between the archaeologist and the National Monuments Service (NMS) through the licensing system. Peat depth data and local ground conditions may dictate the number and location of test trenches to be undertaken.

			Archaeological monitoring of ground works during construction works. The National Monuments Service will be informed of such findings to discuss how best to proceed. If archaeological finds, features or deposits are uncovered during archaeological monitoring, the developer will be prepared to provide resources for the resolution of such features whether by preservation by record (excavation) or preservation in situ (avoidance).Once the project is completed, a report on the results of the monitoring will be compiled and submitted to the relevant authorities. › During the excavation of new proposed access routes, a known memorial plaque located along the proposed route from T21 to the proposed substation will be fenced off prior to construction works in this location. Fencing will be maintained for the duration of the construction works.
Operational Phase			
MX15	Vantage Point Surveys	EIAR Section 6 – Appendix 6-5	Vantage Point bird surveys will be carried in years 1, 2, 3, 5, 10 and 15.
MX16	Breeding Bird Surveys	EIAR Section 7 – Appendix 7.9	Breeding bird surveys will be carried in years 1, 2, 3, 5, 10 and 15 between the months of March to July.
MX17	Bat Monitoring	EIAR Section 6	Ongoing monitoring of bat activity will be undertaken for at least three years' post construction of the wind farm. Full details of the proposed monitoring programme are provided in Appendix 6.2 and include measurement of bat activity, weather conditions and any correlation between the two. The monitoring will also include corpse searching in the areas surrounding the turbines to gather data on any actual collisions.
MX18	Corpse Searching	EIAR Section 7 – Appendix 6-5	Corpse searching will be carried in years 1, 2, 3, 5, 10 and 15. The survey will be carried out on 12 monitoring visits per year (1 visit/month) and will be targeted corpse searches at turbine bases.
MX19	Drainage Inspection	EIAR Section 9	Monitoring the effectiveness of drainage measures installed during the construction phase will continue to be monitored into the operational phase. Any excess build-up of silt levels at dams, the settlement pond, or any other drainage features that may decrease the effectiveness of the drainage feature, will be removed.
MX20	Shadow Flicker	EIAR Chapter 5	Where daily or annual shadow flicker exceedances are experienced at buildings, a site visit will be undertaken to determine the level of occurrence, existing screening and window orientation.

MX21	Operational Phase Noise	EIAR Section 11	The following programme of measures would be implemented in the event of an issue of aerodynamic modulation being identified and associated with the site: › A detailed noise survey conducted by an appropriately qualified acoustic consultant will be commissioned in order to confirm the presence or not of the issue, the extent of the issue (i.e. number of locations, wind speeds and environmental conditions in which it is occurring); › Based on the findings of this work and where aerodynamic modulation is identified a schedule of measures will be formulated and agreed with the planning authority, which would typically be envisaged to focus on control and regulation of the operation of turbine unit(s) in certain atmospheric and meteorological conditions.

8. PROGRAMME OF WORKS

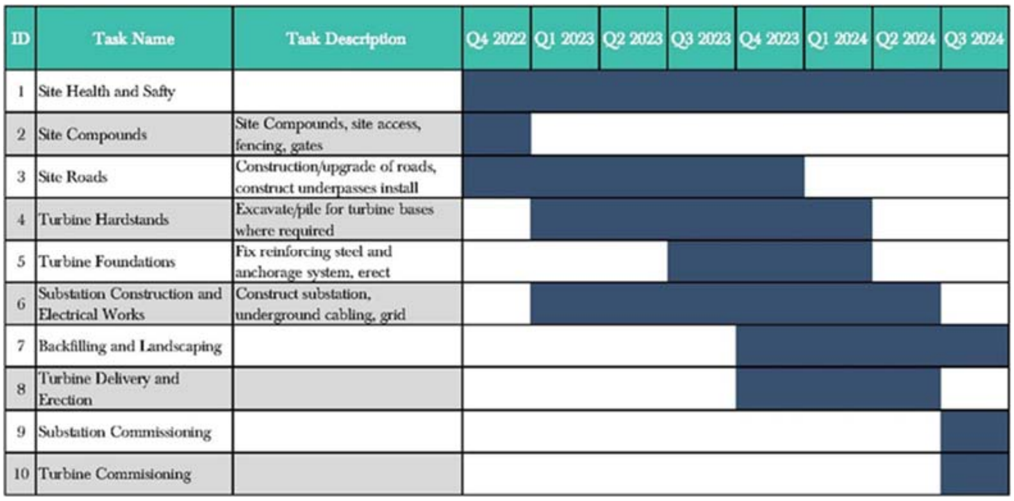
8.1 Construction Schedule

The construction phase will take approximately 24-30 months to complete from starting on site to the commissioning of the electrical system and export of electricity from site.

The EIAR stipulated that in the interest of breeding birds, construction would not commence during the breeding bird season, which runs from April to July. The EIAR stipulated that construction may commence between August to the end of March, so that construction activities are ongoing by the time the next breeding bird season comes around, and can continue throughout the next breeding season.

Works during the construction phase of the development, including delivery of construction materials will generally take place between 7 a.m. and 7 p.m. daily Monday to Saturday with large concrete pours requiring an earlier start when deemed necessary. Delivery of abnormal loads such as turbine tower sections and blades will take place at night outside of peak traffic hours.

The phasing and scheduling main construction task items are outlined in Figure 8.1 below, where 1st October 2022 has been selected as an arbitrary start date for construction activities.



ID	Task Name	Task Description	Q4 2022	Q1 2023	Q2 2023	Q3 2023	Q4 2023	Q1 2024	Q2 2024	Q3 2024
1	Site Health and Safty									
2	Site Compounds	Site Compounds, site access, fencing, gates								
3	Site Roads	Construction/upgrade of roads, construct underpasses install								
4	Turbine Hardstands	Excavate/pile for turbine bases where required								
5	Turbine Foundations	Fix reinforcing steel and anchorage system, erect								
6	Substation Construction and Electrical Works	Construct substation, underground cabling, grid								
7	Backfilling and Landscaping									
8	Turbine Delivery and Erection									
9	Substation Commissioning									
10	Turbine Commisioning									

Figure 8.1 Indicative Construction Schedule

9. COMPLIANCE AND REVIEW

9.1 Site Inspections and Environmental Audits

Routine inspections of construction activities will be carried out on a daily and weekly basis by the ECoW and the Site Supervisor/Construction Manager to ensure all controls to prevent environmental impact, relevant to the construction activities taking place at the time, are in place.

Environmental inspections will ensure that the works are undertaken in compliance with this CEMP and all other planning application documents. Only suitably trained staff will undertake environmental site inspections.

9.2 Auditing

The Contractor will be responsible for implementing the mitigation and monitoring measures specified throughout the EIAR and compiled in Sections 6 and 7 of this CEMP. The Contractor will also be responsible for ensuring that all construction staff understand the importance of implementing the mitigation measures. The implementation of the mitigation measures will be overseen by the environmental clerk of works or supervising hydrogeologists, environmental scientists, ecologists or geotechnical engineers, depending on who is best placed to advise on the implementation.

Environmental audits will be carried out during the construction phase of the project. In contrast to monitoring and inspection activities, audits are designed to shed light on the underlying causes of non-compliance, and not merely detect the non-compliance itself. In addition, audits are the main means by which system and performance improvement opportunities may be identified. Environmental audits will be carried out by contractor staff or alternatively by external personnel acting on their behalf. It is important that an impartial and objective approach is adopted. Environmental audits will be conducted at planned intervals to determine whether the CEMP is being properly implemented and maintained. The results of environmental audits will be provided to project management personnel.

9.3 Environmental Compliance

The following definitions shall apply in relation to the classification of Environmental Occurrences during construction of the wind farm:

Environmental Near Miss: An occurrence which if not controlled or due to its nature could lead to an Environmental Incident.

Environmental Incident: Any occurrence which has potential, due to its scale and nature, to migrate from source and have an environmental impact beyond the site boundary.

Environmental Exceedance Event: An environmental exceedance event occurs when monitoring results indicate that limits for a particular environmental parameter (as indicated in the Environmental Monitoring Programme) has been exceeded.

An exceedance will immediately trigger an investigation into the reason for the exceedance occurring and the application of suitable mitigation where necessary.

Exceedance events can be closed out on achieving a monitoring result below the assigned limit for a particular environmental parameter.

Environmental Non-Compliance: Non-fulfilment of a requirement and includes any deviations from established procedures, programs and other arrangements related to the EMP.

9.4 Corrective Action Procedure

A corrective action is implemented to rectify an environmental problem on-site. Corrective actions will be implemented by the Site Supervisor/Construction Manager, as advised by the Site Environmental Clerk of Works. Corrective actions may be required as a result of the following;

- Environmental Audits;
- Environmental Inspections and Reviews;
- Environmental Monitoring;
- Environmental Incidents; and,
- Environmental Complaints.

A Corrective Action Notice will be used to communicate the details of the action required to the main contractor. A Corrective Action Notice is a form that describes the cause and effect of an environmental problem on site and the recommended corrective action that is required. The Corrective Action Notice, when completed, will include details of close out and follow up actions.

If an environmental problem occurs on site that requires immediate attention direct communications between the Site supervisor/Construction Manager and the Site Environmental Clerk of Works will be conducted. This in turn will be passed down to the site staff involved. A Corrective Action Notice will be completed at a later date.

9.5 Construction Phase Plan Review

This CEMP will be updated and reviewed prior to commencement of construction, and also every six months thereafter during the construction phase of the project.

APPENDIX 4

AQUATIC SURVEY REPORT

Aquatic and Fisheries Report for proposed Derrinlough wind farm, Co. Offaly

Prepared by Triturus Environmental Ltd. for McCarthy Keville O'Sullivan

December 2019

Please cite as:

Triturus (2019). Aquatic and Fisheries report for proposed Derrinlough wind farm, Co. Offaly. Report prepared by Triturus Environmental Ltd. on behalf of McCarthy Keville O'Sullivan for Bord na Móna Powergen Ltd., December 2019.

Contents

1. Introduction

1.1 Project background

Triturus Environmental Ltd. were appointed by McCarthy Keville O'Sullivan Ltd. (MKO) on behalf of Bord na Móna to undertake a baseline aquatic survey of watercourses in the vicinity of the proposed Derrinlough wind farm located near Cloghan, Co. Offaly.

The proposed wind farm site has indirect downstream connectivity, via several riverine watercourses, with the River Shannon Callows SAC (site code: 000216) and the Middle Shannon Callows SPA (site code: 004096). Located approx. 2.8km downstream (shortest distance, via the Grant's Island Stream), the River Shannon Callows SAC is designated for otter (*Lutra lutra*) in addition to non-aquatic habitats (NPWS, 2018a). The Middle Shannon Callows SPA (shortest distance 2.8km downstream) is designated for wetland habitat plus a range of birds including whooper swans (*Cygnus cygnus*) and the corncrake (*Crex crex*) (NPWS, 2018b), a species Red-listed under the Birds of Conservation Concern in Ireland (BoCCI; Colhoun & Cummins, 2014).

The aquatic habitats within the catchment of the proposed wind farm may provide downstream contributions to the downstream River Shannon Callows SAC, Middle Shannon Callows SPA sites and All Saints Bog SPA sites. The main purpose of the site surveys, including both desktop and walkover surveys, was to describe the existing environment in terms of its fisheries value but also for important aquatic species and habitats within the vicinity of the development. The baseline data collated would thus inform the preparation of the final Environmental Impact Assessment Report (EIAR) for the proposed development.

1.2 Project description

The aquatic baseline survey was undertaken in the context of the proposed 21 turbine, Derrinlough wind farm, located in west Co. Offaly, approximately 4.5km south of Cloghan and 10km west of Kilcormac (Figure 1.1). The wind farm site encompasses both Clongawny and Drinagh Bogs, both part of the Boora Bog group. The Boora Bog group is regulated by the Environmental Protection Agency (EPA) under IPC Licence Register No. P0500-01. Two smaller-scale wind farm developments adjoin the proposed site namely the constructed Meenwaun (4 turbine) site and the proposed Cloghan (9 turbine) site. The proposed site location for the wind farm development is provided in Figure 1.1

The proposed wind farm will have approximately 28km of internal road network. It is intended that approximately 18km of this road network will be open for public use when the wind farm becomes operational. An additional 6.5km of amenity links are proposed to provide connectivity from the internal road network to local/regional roads.

The two bogs have a total area of approximately 2,360 hectares. Combined they are approximately 6km long in a north/south direction and 9km wide in an east/west direction at their widest point. The closest settlements to the site are Cloghan which is located approximately 2km to the north and Fivealley which is located approximately 2.5km to the south. Other settlements and towns in the area include Banagher (circa. 3km west), Ferbane (circa. 6km north) Birr (circa 7km south-west) and Shannonbridge (circa. 15km north-west).

The land use activities within the proposed development site is a mixture of ceased peat extraction, bare cutaway peat, re-vegetation of bare peat, telecommunications and wind measurement (a single anemometry mast on Clongawny Bog). There are also a number of Bord na Móna rail lines that pass through the bogs facilitating the transportation of milled peat to Derrinlough Briquette Factory which is located in the most western part of Drinagh bog. The surrounding landscape is a mixture of forestry, agricultural land and cutaway peatland. The landscape is predominately flat.

For a detailed description of the proposed wind farm development and associated infrastructure please refer to Chapters 1 & 4 of the accompanying EIAR.

1.3 Derrinlough fisheries asset

The Derrinlough study area is part of both the wider River Brosna and River Shannon catchments and features a number of major and minor riverine watercourses (see Figure 1.1 for locations). A number of lacustrine (wetland) waterbodies are also associated with areas of historical cutover bog.

The Silver River is the major watercourse in the vicinity of Derrinlough wind farm and represents an important recreational fishery, especially for the "Croneen" trout, a genetically-distinct population of brown trout indigenous to Lough Derg and its tributaries, including the River Brosna catchment. There is a run of "Croneen" trout from Lough Derg to the Silver River, particularly from mid-July to September, depending on water levels. The river also supports the protected white-clawed crayfish (*Austropotamobious pallipes*) and brook lamprey (*Lampetra planeri*) and still receives a small, irregular run of Atlantic salmon (*Salmo salar*) (Triturus, 2019). Although regularly utilised by anglers, historical drainage has made the banks throughout the Silver River catchment difficult to access (O'Reilly, 2003). In addition to trout, the Silver River (at Lumcloon Bridge near Kilcormac) is known to support European eel (*Anguilla anguilla*), gudgeon (*Gobio gobio*), minnow (*Phoxinus phoxinus*), perch (*Perca fluviatilis*), three-spined stickleback (*Gasterosteus aculeatus*), stone loach (*Barbatula barbatula*) and occasional Atlantic salmon (Kelly et al., 2015; Kelly et al., 2009).

The Little (Cloghan) River, a tributary of the Brosna River, bisects the Derrinlough wind farm site and is known to support stocks of brown trout, minnow, Lampetra sp., gudgeon, roach (*Rutilus rutilus*), stone loach and three-spined stickleback in its lower reaches (Kelly et al., 2015; Kelly et al., 2009).

1.4 Water quality in the study area

The following outlines the available water quality data for the watercourses in context of the proposed Derrinlough wind farm development. Only recent water quality (i.e. since 2002) is summarised below. No existing EPA biological monitoring data was available for the Mullaghkaraun Stream, Feeghroe River, Whigsborough Stream, Derrinlough Stream, Stonestown Stream, Madden's Derry Stream or Grants Island Stream. Please note that contemporary physio-chemical and biological water quality analysis was undertaken as part of this study, with the data presented in the results section of this report.

Little Cloghan River

The Little Cloghan River (EPA code: 25L01) is a lowland tributary of the River Brosna which rises south of Drinagh Bog at Whigsborough. Approximately half of the watercourse flows through cutover bog (PB4; Fossitt, 2000) in the vicinity of Derrinlough wind farm. There is a single recent EPA monitoring station (station code: RS25L010200) on the river, located at the R356 road crossing, approx. 4.5km downstream of survey site 6 (see Figure 1.1 below for sampling site locations). This site was assessed in 2017 as having Q4-5 (high status) water quality. Historically, another monitoring station on the Little Cloghan River (RS25L010100) at Crancreagh Bridge (N62 road crossing), approx. 1.4km downstream of site 6, achieved Q2-3 (poor status) water quality in 1999 (pre-Water Framework Directive monitoring).

Silver River

The Silver River (EPA code: 25S02) is a major lowland tributary of the River Brosna which rises in the Slieve Bloom Mountains east of Kilcormac and flows through an agricultural grassland-dominated landscape. There are a number of current EPA monitoring stations on the Silver River (EPA code: 25S02) downstream of Kilcormac. The nearest upstream monitoring point (station code: RS25S020500) is located at Wooden Bridge, approx. 5km upstream of survey site 9. This site was assessed as having Q4 (good status) water quality in 2017. Further upstream, near Kilcormac, two stations (RS25S020400 and RS25S020320) were assessed as having Q3-4 (moderate status) water quality in 2017. The nearest downstream monitoring point to survey site 9 is located at Lumcloon Bridge (station code: RS25S020700) (approx. 1.3km downstream). This site achieved Q4 (good status) in 2017.

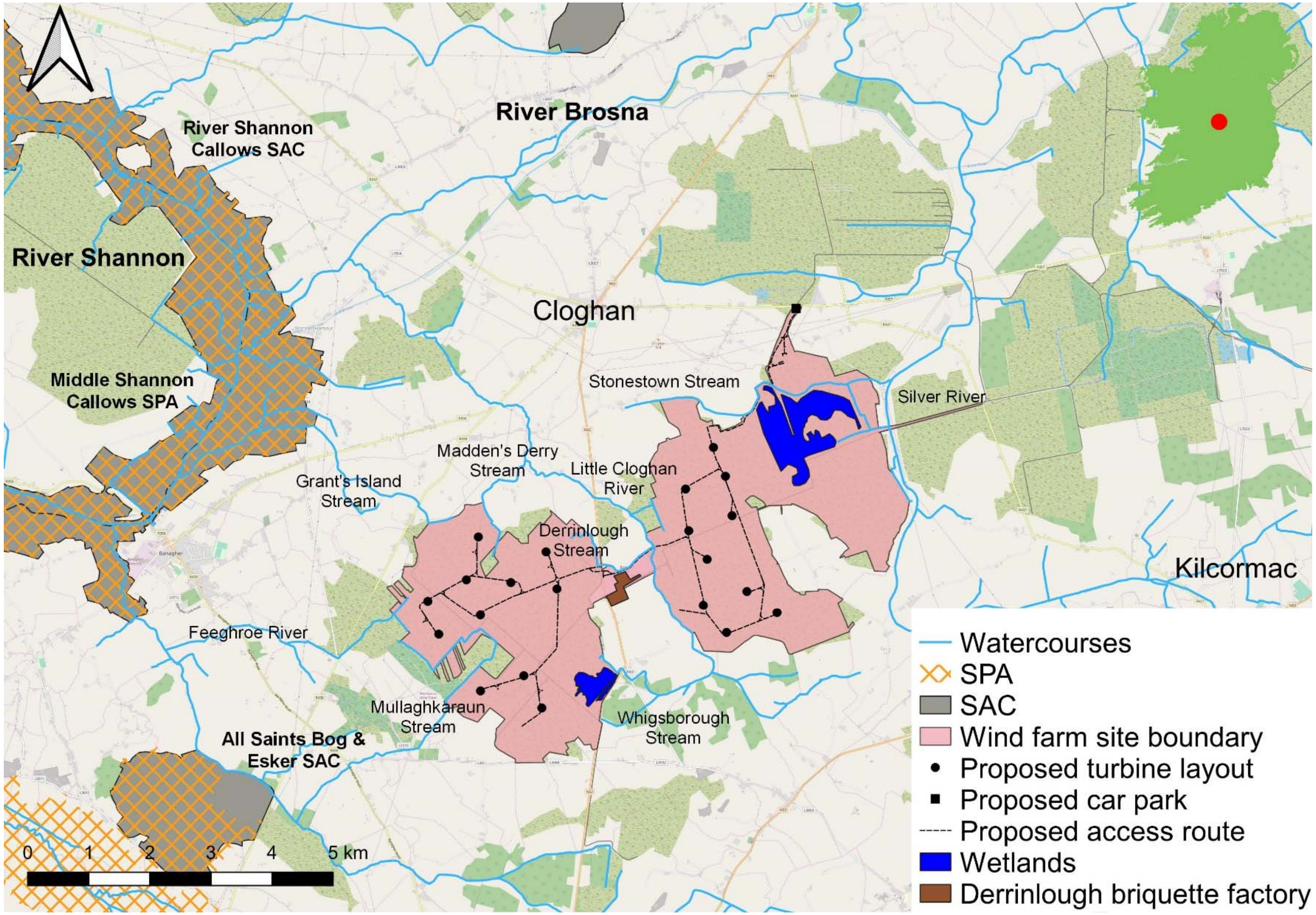


Figure 1.1 Location of the proposed Derrinlough wind farm near Cloghan, Co. Offaly.

2. Methodology

2.1 Desktop review

A desktop survey of published and unpublished material for the watercourses in the vicinity of the proposed wind farm development was undertaken in respect of fisheries and general aquatic flora and fauna. The review included data held by the National Parks and Wildlife Service (NPWS), National Biodiversity Data Centre (NBDC), Inland Fisheries Ireland (IFI) and Botanical Society of Britain & Ireland (BSBI).

2.2 Walkover surveys

Walkover surveys of the Derrinlough wind farm site were conducted on Tuesday 22nd and Wednesday 23rd October 2019. Watercourses within and adjoining the site boundary were assessed in light of proposed works, with survey effort focused on both instream and riparian habitats at each site. Surveys were focused at sites on the Feeghroe River (EPA code: 25F41), Mullaghkaraun Stream (25M48), Whigsborough Stream (25W43), Derrinlough Stream (25I29), Little Cloghan River (25L01), Silver River (25S02), Madden’s Derry Stream (25M776), Stonestown Stream (25S55) and Grants Island Stream (25Y47), as well as three unnamed wetland/bog pool habitats (Table 2.1, Figure 2.1).

Aquatic habitat assessment was conducted according to the methodology given in the Environment Agency's '*River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003*' (EA, 2003) and the Irish Heritage Council's '*A Guide to Habitats in Ireland*' (Fossitt, 2000). All sites were assessed in terms of:

- Stream width and depth and other physical characteristics.
- Substrate type, listing substrate fractions in order of dominance, i.e. large rocks, cobble, gravel, sand, mud etc.
- Flow type, listing percentage of riffle, glide and pool in the sampling area.
- In-stream vegetation, listing plant species occurring and their percentage coverage of the stream bottom at the sampling site (as applicable) and on the bankside.
- Bankside vegetation composition.

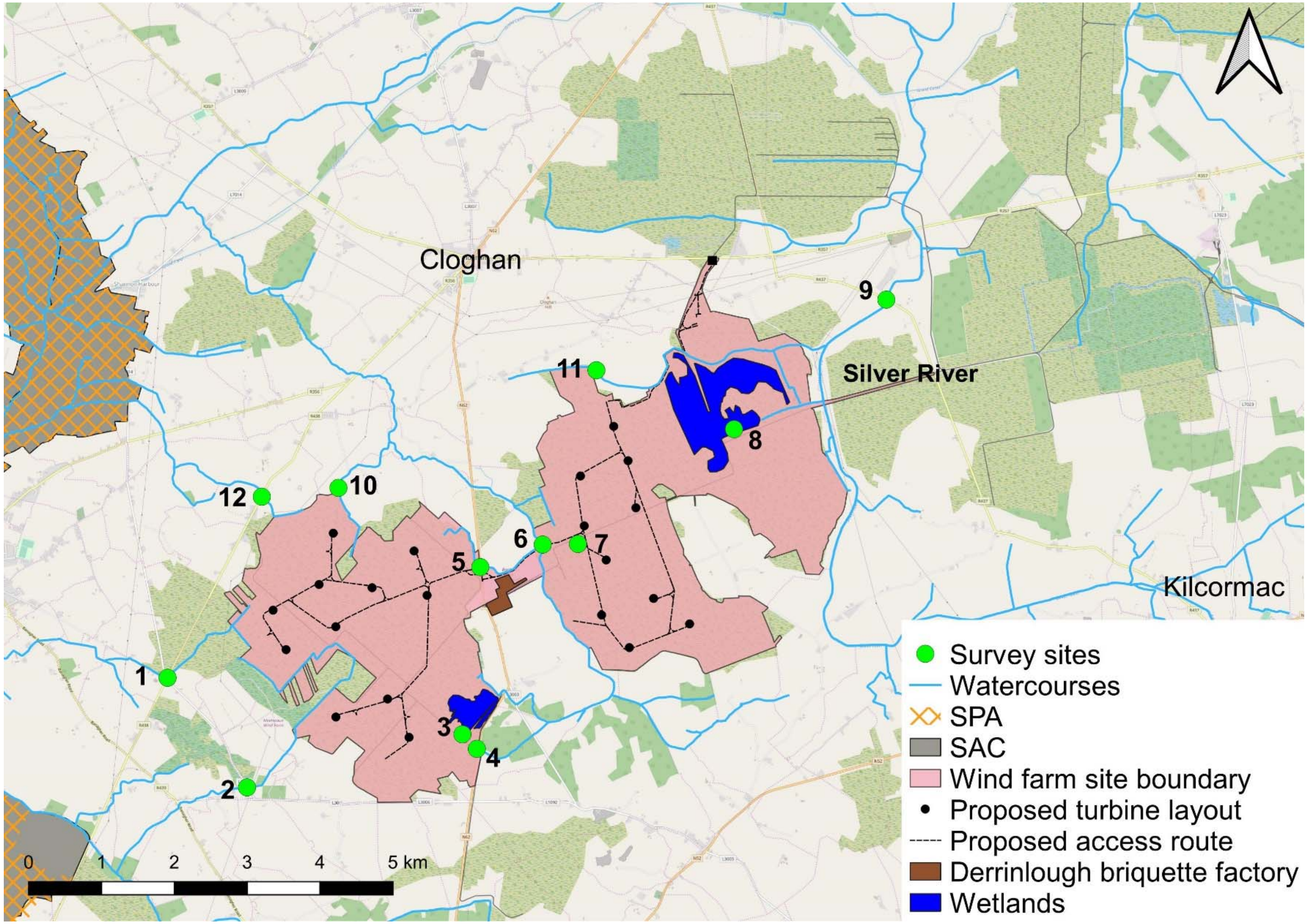


Figure 2.1 Location of aquatic survey sites visited in the vicinity of Derrinlough wind farm, October 2019.

Table 2.1 Location of aquatic survey sites. *denotes Q-sample site

Site no.	Site name	Location / townland	ITM (x)	ITM (y)
1*	Mullaghkaraun Stream	Boggaunreagh	604740	712138
2*	Feeghroe River	Five Roads Cross	603631	713628
3	Unnamed wetland	Clooneen	607678	713012
4*	Whigsborough Stream	Clooneen	607855	712651
5*	Derrinlough Stream	N62 road crossing	607930	715156
6*	Little Cloghan River	Derrinlough	608791	715461
7	Settlement pond	Derrinlough	609267	715481
8	Unnamed wetland	Stonestown	611309	716948
9*	Silver River	Millbrook Bridge	613487	718835
10	Madden's Derry Stream	R438 road crossing	604935	716121
11*	Stonestown Stream	Stonestown	609514	717862
12	Grants Island Stream	R438 road crossing	604938	716124

2.3 Fisheries habitat

An assessment of fisheries habitat at the survey sites within the vicinity of the Derrinlough wind farm site was undertaken to establish the importance of these areas as salmonid, lamprey, European eel and general fisheries habitat. The baseline appraisal considered the quality of spawning, habitat and nursery habitat at the sites. No targeted electro-fishing or netting methodologies were employed to further elucidate fish stocks of the study site during this survey.

Salmonids

Fisheries habitat for salmonids was assessed using the Life Cycle Unit method (Kennedy, 1984; O'Connor & Kennedy, 2002) to map riverine sites as nursery, spawning and holding water, by assigning quality scores to each type of habitat. Overall scores are calculated as the sum of individual habitat scores. Those habitats with poor quality substrata, shallow depth and a poorly defined river profile receive a higher score. Higher scores in the Life Cycle Unit method of fisheries quantification are representative of poorer value, with lower scores being more optimal despite this appearing counter-intuitive. Life Cycle Unit scores are not calculated for lacustrine habitats.

Table 2.1 Life Cycle Unit scoring system for salmonid nursery, spawning and holding habitat value

Habitat quality	Habitat score	Overall score
Poor	4	12
Moderate	3	9-11
Good	2	6-8
Excellent	1	3-5

Lamprey species

Lamprey habitat evaluation for each riverine site was undertaken using the Lamprey Habitat Quality Index (LHQI) scoring system as devised by Macklin et al. (2018).

The LHQI broadly follows a similar rationale as the Life Cycle Unit score for salmonids. Those habitats with a lack of soft, largely organic sediment areas for ammocoete burrowing, shallow sediment depth (<10cm) or compacted sediment nature receive a higher score. Higher scores in this index are thus of poorer value (in a similar fashion to the salmonid Life Cycle Unit Index), with lower scores being more optimal. Overall scores are calculated as a simple function of the sum of individual habitat scores.

Larval lamprey habitat quality as well as the suitability of adult spawning habitat is assessed based on the information provided in Maitland (2003) and other relevant literature (e.g. Gardiner, 2003). Unlike the salmonid Life Cycle Unit index, holding habitat for adult lamprey is not assessed owing to their different migratory and life history strategies, and that surveys such as this one routinely only sample larval lamprey.

The LHQI scoring system provides additional information compared to the habitat classification based on the observations of Applegate (1950) and Slade et al. (2003), which deals specifically with larval (sea) lamprey settlement habitat. Under this scheme, habitat is classified into three different types: preferred (Type 1), acceptable (Type 2), and not acceptable for larvae (Type 3) (Slade et al. 2003). Type 1 habitat is characterized by soft substrate materials usually consisting of a mixture of sand and fine organic matter, often with some cover over the top such as detritus or twigs in areas of deposition. Type 2 habitat is characterized by substrates consisting of shifting sand with little if any organic matter and may also contain some gravel and cobble (lamprey may be present but at much lower densities than Type 1). Type 3 habitat consists of materials too hard for larvae to burrow including bedrock and highly compacted sediment. This classification can also be broadly applied to other lamprey species ammocoetes.

Table 2.2 Lamprey Habitat Quality Index (LHQI) scoring system for lamprey spawning and settlement habitat value (Macklin et al., 2018)

Habitat quality	Habitat score	Overall score
Poor	4	8
Moderate	3	6 - 7
Good	2	3 - 5
Excellent	1	2

2.4 White-clawed crayfish

A survey for white-clawed crayfish (*Austropotamobius pallipes*) at each aquatic survey site was undertaken using a combination of sweep netting, hand-searching and mustelid spraint walkover surveys. Furthermore, a desktop review of known distributions of crayfish within the wider proposed development catchment was undertaken.

Crayfish survey (sweep netting)

Sweep netting (following Reynolds et al., 2010) was utilised at each site to detect both adult and juvenile crayfish and assess habitat quality. Sweep netting involves sampling of both in-channel macrophytes, in addition to checking typical refugia via lifting of littoral boulders (single boulder considered a single refuge) while the net is swept underneath to trap any crayfish.

Crayfish survey (riparian walkover survey)

Riparian walkover surveys were undertaken at each site to examine any spraint from mustelids (i.e. otters and mink) feeding along riparian corridors. Given that mustelids hunt large areas of river, they can detect cryptic prey present at low densities, which are not easily attainable via conventional survey methodologies (e.g. sweep netting). Riparian walkover/spraint surveys are useful for clarifying the presence or absence of crayfish at a particular site.

2.5 Biological water quality (Q-sampling)

Biological water quality was assessed through Q-sampling at each riverine site (*n*=8 samples) (Table 2.1). Macro-invertebrate samples were converted to Q-ratings as per Toner et al. (2005). The applied Q ratings followed the EPA water quality classes and Water Framework Directive status categories (Table 2.3 below). All riverine samples were taken with a standard kick sampling hand net (250mm width, 500µm mesh size) from areas of riffle/glide utilising a two-minute sample, as per ISO standards for water quality sampling (ISO 10870:2012). Large cobble was also washed at each site where present and samples were elutriated and fixed in 70% ethanol for subsequent laboratory identification. Any rare invertebrate species were identified from the NPWS Red List publications for beetles (Foster et al., 2009), mayflies (Kelly-Quinn & Regan, 2012) and other relevant taxa (i.e. Byrne et al., 2009; Nelson et al., 2011).

Table 2.3 Reference categories for EPA Q Ratings (Q1 to Q5)

Q Value	WFD Status	Pollution Status	Condition
Q5 or Q4-5	High Status	Unpolluted	Satisfactory
Q4	Good Status	Unpolluted	Satisfactory
Q3-4	Moderate Status	Slightly polluted	Unsatisfactory
Q3 or Q2-3	Poor	Moderately polluted	Unsatisfactory
Q2, Q1-2 or Q1	Bad	Seriously polluted	Unsatisfactory

2.6 Physio-chemical water quality

Physio-chemical water quality samples were collected from each aquatic survey site (*n*=11 samples) on the 22nd-23rd October 2019. Samples were cooled and delivered to the laboratory on the same day for analysis. In order to collate a broad water quality baseline for the study area in question, a range of physio-chemical parameters for each site were laboratory-tested, namely;

- pH
- Alkalinity (mg $CaCO_3$/l)
- Conductivity @25°C (µS/cm)
- Suspended solids (mg/L)
- Molybdate Reactive Phosphorus (MRP) (mg P/l)
- Total Ammonia (mg N/l)
- Total Nitrate (mg N/l)
- Total Oxidised Nitrogen (TON) (mg N/l)
- Biochemical Oxygen Demand (BOD) (mg O_2/l)
- Chemical Oxygen Demand (COD) (mg O_2/l)
- Dissolved Organic Carbon (DOC) (mg C/l)

2.7 Biosecurity protocol

A strict biosecurity protocol including the Check-Clean-Dry approach was adhered to during all surveys for all equipment and PPE used. Disinfection of all equipment and PPE was carried out before and after use with Virkon™ was conducted to prevent the transfer of pathogens or invasive propagules between survey sites. Particular cognisance was given to the potential spread of crayfish plague (*Aphanomyces astaci*) given recent outbreaks across Ireland. Surveys were undertaken at sites in a downstream order to minimise the risk of upstream propagule mobilisation.

3. Results

3.1 Site descriptions and habitats

Site 1 – Feeghroe River

The Feeghroe River (EPA code: 25F41) at site 1 was a small 1.5-2m wide shallow stream (FW2) running alongside and underneath the R438 road at Five Roads Cross. Located approx. 1.1km downstream of the Derrinlough wind farm site, the channel had been straightened along the road historically and deepened locally downstream of the cross roads (but not upstream). The river was bordered by birch and willow-dominated scrub/woodland to the north with improved agricultural grassland (GA1) to the south. The river featured largely homogenous habitat with slow, heavily silted slow glide dominating throughout although a small area of harder substrata and accelerated flow was present in association with the main road culvert. The channel was glide dominated (90%) with smaller proportions of riffle and pool (5% by surface area of each). The average depth upstream of road crossing was 0.1-0.2m with 100% silt base and much instream detritus. Downstream of the road culvert the channel had been deepened historically and was more representative of a drainage channel, with a 100% silt (peat) base, deeper U-shaped profile and imperceptible flow rates. A small area immediately downstream of the culvert (between road culverts) featured deeper pool habitat up to 0.4m deep and medium to coarse gravels plus small cobble (partially bedded). Riparian shading was high from mature treelines of ash, sycamore and willow. There were no instream macrophytes due to shading and peat-staining, which was relatively high at time of survey. The road bridge structure had partially collapsed at time of survey and was limiting fish passage upstream (i.e. through the culvert).

Site 1 offered poor salmonid value overall with very limited spawning habitat (single location only, downstream of the main road culvert). Nursery and holding habitat was also considered as poor. Fish passage was impacted due to poorly accessible road culverts. Lamprey habitat was poor with any silt accumulations peat-derived and thus not suitable for larval settlement (too fine, humic sediment). The site offered some moderate value for European eel. White-clawed crayfish habitat was considered poor overall but some localised moderate value habitat was present immediately downstream of the road culvert and was found to support the species at low densities (via kick sampling).

Plate 3.1 The Feeghroe River at site 1

Site 2 – Mullaghkaraun Stream

Site 2 on the Mullaghkaraun Stream (EPA code: 25M48) was a small 2-2.5m wide stream (FW2) located at a road crossing approx. 1km downstream of the existing Meenwaun wind farm. The channel demonstrated some local straightening but had not been deepened historically in the vicinity of a 1.5m pipe culvert. The site was relatively fast flowing with an average depth 0.2m (uniform) and up to 0.3m near the culvert (small pool). Shallow, fast glide habitat dominated (90%) with 5% pool and 5% riffle. The substrata were dominated by fine-coarse gravels which were partially bedded with 20% small cobble and occasional small boulder. The site featured moderate siltation, which was largely peat derived. The site was bordered by coniferous plantations (WD4; sitka & lodgepole pine with alder/willow border) and agricultural grassland (GA1) to south (both sides of road). Heavy tunnelling was present upstream of culvert due to mature treelines of ash and hawthorn with a dense bramble and bracken-dominated scrub understorey. A greater degree of shading was present downstream of the culvert with heavy tunnelling from willow scrub. There were no instream macrophytes or bryophytes due to high riparian shading with no bryophytes.

The Mullaghkaraun Bog Stream at site 2 offered moderate value salmonid habitat. There was limited spawning due to siltation and bedding of substrata and a lack of deeper holding habitat for adult fish. Nursery habitat was of moderate value. The lamprey habitat was poor with limited spawning and little to no suitable nursery habitat due to fast flows and harder substrata dominating (few silt accumulations). Some moderate eel value was present although the lack of deeper areas and larger boulder refugia reduced the value overall. White-clawed crayfish habitat was poor overall and none were recorded via sweep netting.

Plate 3.2 The Mullaghkaraun Stream at site 2

Site 3 – Unnamed wetland, Clooneen

Site 3 comprised an extensive area of artificial wetland (dystrophic lake habitat, FL1) located in cutaway bog (PB4) to the south-west of the Derrinlough Bord na Mona briquette factory. The c. 20ha wetland was shallow (mostly <1m) with a 100% silt (peat) base and fringed by extensive beds of bottle sedge (*Carex rostrata*) with occasional bog pondweed (*Potamogeton polygonifolius*). Small islands of bulrush (*Typha latifolia*) were present occasionally in open water. Peat-staining was high at the time of survey. The banks were dominated by exposed peat with scattered growth of ling (*Calluna vulgaris*), downy birch (*Betula pubescens*), lodgepole pine (*Pinus contorta*), gorse (*Ulex europaeus*), cotton grass (*Eriophorum angustifolium*), deergrass (*Trichophorum cespitosum*) and purple moor grass (*Molinia caerulea*).

The site provided low to moderate value habitat for both salmonids (brown trout only) and European eel and both were known locally. Three-spined stickleback were recorded via sweep netting. Intermittent drainage channels provided only intermittent surface water connectivity to downstream watercourses. There was no lamprey potential given the lacustrine habitat. No white-clawed crayfish were recorded and suitability was very low for the species.

Plate 3.3 Site 3 was an unnamed wetland at Clooneen

Site 4 – Whigsborough Stream

Site 4 on the upper Whigsborough Stream (EPA code: 25W43) was a narrow, shallow drainage channel (FW4) located in cutaway bog (PB4) to the west of the wetland at site 3. The channel provided only intermittent surface water connectivity with the wetland given to infilling and was frequently impounded. The drainage channel ran alongside a Bord na Móna railway and was stagnant throughout, being more representative of pond habitat upstream of the N62 road. The 1-2m wide channel had a 100% deep silt base composed of peat, with frequently exposed banks of peat. Some sparse vegetation of ling, gorse, downy birch, wild carrot (*Daucus carota*), common knapweed (*Centaurea nigra*) and purple moor grass was present on degraded cutover bog. Instream, bottle sedge and broad-leaved pondweed dominated the macrophyte community although cover was limited overall (20%). The depth was typically <0.1m, often less although some sections of channel featured depths to 0.5m. Sediment was often >0.5m in depth.

Site 4 provided little fisheries value although three-spined stickleback were present in moderate densities (confirmed by sweep netting). Surface water connectivity with the wetland (site 3) and downstream watercourses (i.e. Derrymullin Stream, Loughderry Stream, Little Cloghan River) was very poor. The site offered low value for migratory European eel. Salmonid and lamprey habitat was absent. No white-clawed crayfish were recorded and the site was considered unsuitable for the species.

Plate 3.4 The upper reaches of the Whigsborough Stream at site 4

Site 5 – Derrinlough Stream

Site 5 on the Derrinlough Stream (EPA code: 25I29) was located approx. 100m upstream of Derrinlough Briquette Factory at the N62 road crossing. The lowland depositing stream (FW2) stream was 1.5-2m wide and situated in a very steep V-shaped peat-based channel, which had been straightened and extensively deepened historically. Bank height exceeded 6-7m upstream of the road crossing (pipe culvert). The depth averaged 0.2-0.5m with a bed composed of heavily compacted gravels and cobbles with very heavy peat siltation. The instream profile comprised 90% glide, 5% riffle and 5% pool. Flow was slow and dominated by glide at the time of survey. The channel supported occasional branched bur-reed and very localised fool's watercress. The steep channel embankments supported riparian scrub dominated by willow, gorse, bramble and bracken. The channel bordered cutover bog with fringes of scrub.

The site offered some low-quality salmonid (brown trout only) habitat, but this was diminished due to low flow rates and heavily compacted gravels with very heavy peat siltation. The site was not considered suitable for lamprey. Three-spined stickleback were present (sweep netting). The stream offered low potential for European eel. No white-clawed crayfish were recorded although there was some low suitability given their known presence downstream (i.e. Little Cloghan River confluence).

Plate 3.5 The Derrinlough Stream at site 5, upstream of the N62 road crossing

Site 6 – Little Cloghan River

Site 6 on the Little Cloghan River (EPA code: 25L01) was located at the confluence with the Derrinlough Stream, approx. 0.4km downstream of the Derrinlough Peat Briquette Factory. The river had been straightened and deepened historically to facilitate bog drainage and sat in a 3m-wide, deep U-shaped channel. Bank heights were up to 3m in places. Downstream of the pipe culvert, the depth varied between 0.5 and 1m with a peat dominated base with some low clay fractions. Glide dominated the site (100%). Macrophyte growth was sparse although occasional common reed (*Phragmites australis*), fool's watercress and common water starwort (*Callitriche stagnalis*) grew occasionally in the margins. Water plantain (*Alisma plantago-aquatica*) was rare. Upstream of the pipe culvert was shallower (0.5m) and more heavily vegetated with dense stands of common reed instream. The river was bordered by cutover bog (PB4), improved agricultural grassland (GA1), scrub (WS1) and hawthorn hedgerows (WL1). Riparian areas comprised bramble, bracken, gorse and hawthorn hedgerows with scattered willow. The adjoining Derrinlough Stream featured shallow, fast glide and riffle over a partially bedded bed of boulder, cobble, coarse gravels and occasional clay.

Site 6 was considered of some moderate value to salmonids (brown trout only) given the presence of deeper holding habitat. Nursery and spawning conditions were poor due to siltation and slow flow rates but were superior in the adjoining Derrinlough Stream (moderate value). The site was not of value to lamprey due to high clay/ humic fractions in sediment. Both channels could be considered of moderate value for European eel, however the limited boulder and cobble would reduce the habitat potential for the species. Although no white-clawed crayfish were recorded during the survey, the species is alleged to occur at the site (Bord na Móna pers. comm.). There was some moderate crayfish potential given instream macrophyte refugia.

Plate 3.6 The Little Cloghan River at site 6, approx. 0.4km downstream of the Derrinlough Peat Briquette Factory.

Site 7 – Settlement pond, Derrinlough

Site 7 was an artificial peat settlement channel situated in cutover bog (PB4). The site was approx. 200m long, 6-8m wide and averaged 1-1.5m deep. Bank height was 3-4m. There was some indirect connectivity with the Little Cloghan River via several other settlement ponds and drains to the north of the site. There was a slow flow of water through the channel. The channel featured a peat base with high fractions of clay underneath and on marginal slopes. Boulders were frequent but were bedded in peat. Fossilised sedimentary rocks (Carboniferous limestone) were frequent to the north of the site in cutover bog and were noted as possibly being of geological heritage value. They contained fossilised bryozoans, ammonites and crinoids. The site featured exposed peat and clay banks with little riparian vegetation. Macrophyte cover was sparse although localised common reed and broad-leaved pondweed was present marginally.

The settlement pond at site 7 was considered of moderate vale for brown trout and European eel, given the connectivity with riverine watercourses downstream. The general lack of flowing water would preclude lamprey species. Three-spined stickleback were confirmed present during sweep netting. Although no white-clawed crayfish were recorded, similar settlement ponds to the north of the site (downstream) are known to support crayfish and there was some moderate suitability for the species at this site.

Plate 3.7 Unnamed settlement pond at site 7

Site 8 – Unnamed wetland complex, Stonestown

Site 8 was an artificial wetland complex (dystrophic lake FL1 habitat) situated in cutover bog (PB4) to the eastern extent of the Derrinlough bog site. The wetlands covered approx. 150ha in area and were shallow, invariably <1m deep. The base was composed of 100% peat-derived sediment and peat-staining was high throughout. Connectivity with the Silver River to the east was poor and largely via seepage or intermittent peat drainage channels. The wetland supported extensive marginal beds of bottle sedge with occasional stands of bulrush and common clubrush (*Schoenoplectus lacustris*) in open water, indicating occasional calcareous influences. Bog bean (*Menyanthes trifoliata*) was also present in marginal areas. Riparian areas supported typically low-lying wetland community composed primarily of purple moor grass, deer grass, downy birch and willow shrubs.

Despite limited connectivity with flowing watercourses, the wetland offered moderate value for brown trout (observed during site visit). Three-spined stickleback were present in good numbers. European eel value was moderate to good. The lack of flowing water precluded lamprey species. No white-clawed crayfish were recorded and the wetland was considered to offer low suitability given high siltation levels.

Plate 3.8 The unnamed wetland complex at site 8

Site 9 – Silver River, Millbrook Bridge

The Silver River (EPA code: 25S02) at site 9 was a lowland depositing watercourse (FW2) with a semi-natural profile (i.e. broken glide habitat) despite evident historical deepening and straightening. The channel had bank heights of 3-5m and was 7-8m wide. The water depth was 1.0-1.2m deep on average although deeper pools were present locally upstream of the bridge. The channel instream profile comprised 100% fast flowing deep glide. The river bed comprised bedded boulder and cobble (heavily compacted) with evident clay deposits. Some localised medium and finer gravels existed between cobble habitat. Sediment accumulations were restricted to marginal extremities – these were shallow and compacted where present. Instream macrophytes comprised bog pondweed with ivy leaved duckweed (*Lemna trisulca*) present locally in the river margins. Common clubrush was present in very localised patches (i.e. rare). The embankments (riparian areas) supported frequent grey willow, alder, sycamore and hawthorn. The bordering land use was heavily improved pasture.

The site offered good quality nursery habitat for salmonids in swift flowing glide, but the spawning value was diminished due to compacted substrata (dominated by boulder and cobble). The holding value was good due to deep glides. European eel habitat was good due to widespread boulder habitat although this too was somewhat reduced because of bedding. Lamprey spawning habitat was present given small lenses of finer gravels between cobble but soft substrata was very localised and evidently compacted given high clay fractions. No white-clawed crayfish were recorded during the site visit but are known from the river. Suitability was moderate given the typically fast flows.

Plate 3.9 Site 9 on the Silver River at Millbrook Bridge

Site 10 – Madden's Derry Stream

Site 10 on the Madden's Derry Stream (EPA code: 25M76) was located approx. 50m downstream of the wind farm boundary in an area of agricultural grassland (GA1). The 2-2.5m wide channel represented a drainage ditch (FW4) and had been historically straightened and deepened in the vicinity of the survey site, with near-vertical V-shaped banks (2-3m bank height). The stream was heavily silted throughout with an imperceptible flow at the time of survey – the channel was stagnant and featured pool habitat only. The average depth was <0.2m with a 100% silt base. Some harder substrata were present underfoot but bedded in >0.2m of soft sediment. There was excessive instream vegetation from both terrestrial (rank grasses, bramble etc.) with macrophyte species such as watercress (*Rorippa nasturtium-aquaticum*) and fool's watercress present in more open areas of channel. Blockages to flow (and fish passage) were frequent throughout. Cover of common duckweed (*Lemna minor*) was extremely high in more open areas (>90%). Riparian shading was very high (>80%) throughout much of the site with the channel flanked by dense hawthorn hedgerow (WL1) (north bank) and dense bramble-dominated scrub elsewhere. Livestock poaching (cattle) was evident at several more accessible points downstream of the survey site.

There was no salmonid potential at this site although habitat did improve considerably further down the watercourse (near the Little Cloghan River confluence >1km downstream). Lamprey habitat was not present given the absence of spawning substrata and the lack of flow which removed potential for nursery habitat. Some low potential existed for migratory European eel but the channel was considered unlikely to support resident eel. Three-spined stickleback were present in high densities at the time of survey. No white-clawed crayfish were recorded.

Plate 3.10 The Madden's Derry Stream at site 10

Site 11 – Stonestown Stream

Site 11 on the Stonestown Stream (EPA code: 25S55) was located at the northern extent of Derrinlough Bog, approx. 3.8km upstream of the Little Cloghan River confluence. The lowland depositing river (FW2) had been heavily modified historically (straightened and deepened throughout) and sat in a deep U-shaped channel. The river featured bank heights of 2-3m and was 4-6m wide. Depths typically exceeded 1m and were uniform (typical of dredged channels). The site was composed of 100% deep glide with an imperceptible flow. The river bed comprised 100% silt and clay substrata. Macrophyte cover was heavy (70% cover) with common reed (dominant) and abundant unbranched bur-reed (*Sparganium emersum*). Common duckweed was occasional. The embankments were heavily scrubbed with grey willow, bramble, bracken, gorse and occasional dog rose. The water clarity was good at the time of survey with low levels of suspended sediment.

Site 11 offered some low-quality brown trout and European eel holding habitat, but was diminished due to low flow rates and silt base. The site was not considered of any value as a nursery or for spawning. Lamprey habitat was poor given the imperceptible flow. White-clawed crayfish were not recorded during sweep netting and overall the site offered low potential for the species.

Plate 3.11 The Stonestown Stream at site 11

Site 12 – Grants Island Stream

Site 12 on the Grants Island Stream (EPA code: 25Y47) was located along the wind farm boundary in a small area of beech-dominated mixed broadleaved woodland with sycamore, holly, hazel and sitka spruce (WD1). The site was adjoined by agricultural grassland on all sides (GA1). The stream was representative of a drainage channel (FW4) and was dry at the time of sampling with only small rainwater pools present and no flow. The channel had been straightened and deepened historically in the vicinity of the road crossing, with bankful heights of 2-3m in a steep V-shaped channel. The stream had a 100% mud base and appeared to only carry water during high rainfall or flood events (i.e. largely seasonal channel). There were no instream macrophytes or bryophytes present.

The site had no fisheries potential or habitat present at the time of survey. Given surface water connectivity with Derrinlough Bog there may be some limited (seasonal) potential for migrating European eel during higher water periods.

Plate 3.12 The Grants Island Stream at site 12 (dry at the time of survey)

3.2 Fisheries habitat

Salmonids

Salmonid habitat ranged from poor to moderate value across the majority of survey sites (Table 3.2). Only site 9 (Silver River) offered good salmonid habitat according to life Cycle Unit scores, owing to the presence of some good quality spawning substrata and deeper holding habitat for adults in the vicinity of Millbrook Bridge. Sites 4, 5 and 10 offered poor quality habitat overall. Sites 3 and 8 were lacustrine habitats but nevertheless provided some moderate nursery value for brown trout, as did site 7 (settlement pond with outflow). Site 12 was dry at the time of survey and did not support fish.

Table 3.2 Life Cycle Unit scores for sites surveyed in the vicinity of the proposed Derrinlough wind farm

Site	Salmonid habitat value	Spawning	Nursery	Pool (holding)	Total Score
1	Moderate	3	3	3	**9**
2	Moderate	3	3	3	**9**
3	Moderate	4	3	4	**11**
4	Poor	4	4	4	**12**
5	Poor	4	4	4	**12**
6	Moderate	4	3	2	**9**
7	Moderate	3	3	3	**9**
8	Moderate	3	4	3	**10**
9	Good	2	3	2	**7**
10	Poor	4	4	4	**12**
11	Moderate	4	4	3	**11**
12	n/a – site dry at time of survey				

Lamprey

Lamprey habitat was poor across the majority of survey sites, with poor spawning and poor nursery habitat present throughout all but one site. Site 9 on the Silver River at Millbrook Bridge offered moderate quality spawning and nursery habitat. Sites 3 and 8, being lacustrine habitats with no flow, were not considered suitable for lamprey. Site 7, although more representative of a lacustrine habitat (i.e. settlement pond), featured some flowing water at the outflow but this offered poor quality lamprey habitat. Site 12 was dry at the time of survey and was not capable of supporting fish.

Table 3.3 Lamprey Habitat Quality Index (LHQI) scores for riverine sites surveyed in the vicinity of the proposed Derrinlough wind farm

Site	Lamprey habitat value	Spawning	Nursery	Total Score	Habitat type present
1	Poor	4	4	**8**	Type 2
2	Poor	4	4	**8**	Type 2
3	n/a – lacustrine habitat				
4	Poor	4	4	**8**	Type 2
5	Poor	4	4	**8**	Type 2
6	Poor	4	4	**8**	Type 2
7	Poor	4	4	**8**	Type 2
8	n/a – lacustrine habitat				
9	Moderate	3	3	**6**	Type 2
10	Poor	4	4	**8**	Type 2
11	Poor	4	4	**8**	Type 2
12	n/a – site dry at time of survey				

European eel

European eel habitat was moderate across most survey sites. The larger riverine sites such as site 6 and 9 offered the best eel habitat overall in terms of foraging, refugia and downstream connectivity with larger watercourses, i.e. River Shannon catchment. Wetland habitats at sites 3 and 8, as well as the settlement pond at site 7, also offered good overall eel habitat although downstream connectivity issues were evident. Whilst site 12 was dry at the time of survey and was not capable of supporting fish, the channel offered some low potential for migrating eel during higher flow periods given downstream connectivity with the River Shannon catchment.

3.3 White-clawed crayfish

White-clawed crayfish were recorded from a single site during the survey; sweep netting resulted in the capture of a single crayfish at site 1 on the Feeghroe Stream (immediately below the R468 road culvert). Despite some moderate to good suitability for the species at certain sites (e.g. sites 6, 7, 9), no live crayfish were recorded from any other site via sweep netting or hand searching. However, crayfish are known locally (Bord na Móna pers. comm.) from site 6 (Little Cloghan River) and the connected settlement pond at site 7, both in the vicinity of the Derrinlough briquette factory. Walkover surveys failed to identify remains of crayfish in mustelid spraint.

3.4 Biological water quality (Q-sampling)

Q-samples were collected and analysed from *n*=8 riverine sites in the vicinity of the proposed Derrinlough wind farm. A total of *n*=42 species across *n*=32 families were recorded in the kick samples (sample compositions summarised in Table 3.5A and 3.5B below).

Following the methodology of Toner et al. (2005), the Environmental Protection Agency (EPA) group invertebrates into classes whereby pollution intolerant species are denoted class A, and species with greater pollution tolerance fall into successive classes (B through E, respectively). As such, the presence or absence of these groups and their relative abundance facilitates an assessment of biological river health. Good status (Q4) unpolluted water quality is achieved according to the EPA if at least one Group A taxon is present in, at least, fair numbers (5-10% total sample composition). Group B taxa may be common or absent and *Baetis rhodani* (large dark olive mayfly) is often dominant. Other Group C taxa are never excessive and group D / E taxa are present in small numbers or absent (Toner et. al., 2005). Our results are discussed in this context in order to interpret potential changes in the macroinvertebrate community composition.

Of the eight sampling sites, only site 9 on the Silver River attained target good status **Q4** water quality as required under the Water Framework Directive (2000/60/EC). The presence of clean water indicative EPA Class A Ephemeridae mayflies and class B caddisflies (Seracostomatidae and Limnephilidae) was indicative of better water quality.

The majority of the remaining sites had either **Q2-3** or **Q3** water (i.e. Poor Status). These includes sites 1, 2, 4, 5, 6 and 11. These sites were for the most part highly modified streams with fine peat-derived sediment deposits. The taxonomic compositions of these samples typically were dominated by more pollution tolerant EPA Class C and D invertebrates. The samples comprised a mixture of caseless caddis, coleopterans and dipterans with pollution indicator species such as freshwater hoglouse *Asellus aquaticus* often being numerically abundant.

The lowest biological Q rating of **Q2** (Bad Status) was recorded at site 10 (Madden's Dairy Stream), albeit a tentative Q was applied given the very limited flow recorded within the stream. The samples only had three taxa present, two of which are pollution indicators, namely the gastropod snail species *Radix balthica* and *Asellus aquaticus* (EPA class D).

No rare macroinvertebrate species were recorded from the *n*=8 samples collected in the vicinity of Derrinlough wind farm (summarised below & cross referenced against national red lists; Tables 3.5A and 3.5B). In summary, of the *n*=8 survey sites, only site 9 (Silver River) achieved good status **Q4** water quality as required under the Water Framework Directive (2000/60/EC). This is implemented by the recently amended European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (S.I. No. 77 of 2019) that specify a minimum target EQR of 0.75 or equivalent **Q4** for all rivers. The Q-Ratings for each watercourse can be summarised in Table 3.4 and Figure 3.1 below.

Table 3.4 Q-ratings for aquatic survey sites in the vicinity of Derrinlough wind farm, October 2019

Site	Watercourse	Q-rating	WFD status
1	Mullaghkaraun Stream	**Q2-3**	Poor Status
2	Feeghroe Stream	**Q3**	Poor Status
4	Whigsborough Stream	**Q3**	Poor Status
5	Derrinlough Stream	**Q3**	Poor Status
6	Little Cloghan River	**Q2-3**	Poor Status
9	Silver River	**Q4**	Good Status
10	Madden's Derry Stream	**Q2**	Bad Status
11	Stonestown Stream	**Q3**	Poor Status

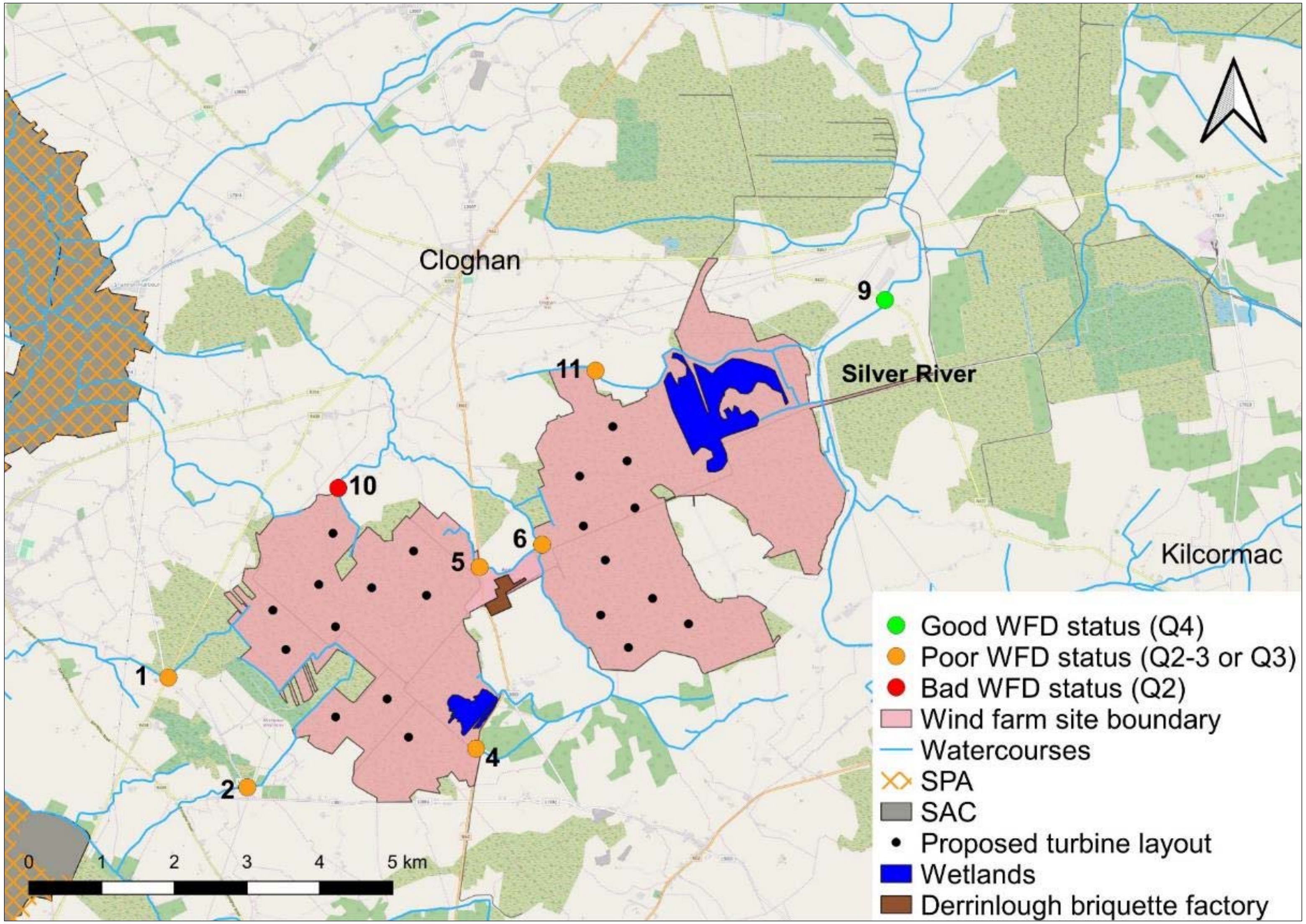


Figure 3.1 Water quality of Q-sampling sites visited in the vicinity of Derrinlough wind farm, October 2019.

Table 3.5A Macro-invertebrate Q-sample compositions for sites 1, 2, 4 and 5 sampled in the vicinity of Derrinlough wind farm, October 2019

Group	Family	Species	Site 1	Site 2	Site 4	Site 5	EPA Class
Emphemeroptera	Baetidae	*Baetis rhodani*	None	4	None	None	C
Trichoptera (cased)	Limnephilidae	*Limnephilus* sp.	None	None	None	2	B
	Seracostomatidae	*Seracostoma personatum*	None	3	None	None	B
	Glossosomatidae	*Agapetus fuscipes*	None	None	None	7	B
Trichoptera (uncased)	Hydropyshcidae	*Hydropsyche angustipennis*	None	2	None	None	C
Odonata	Coenagrionidae	*Ischnura elegans*	None	None	2	None	C
Hemiptera	Notonectidae	*Notonecta glauca*	None	None	1	None	C
Hemiptera	Corixinae	n/d	None	None	2	None	C
Coleoptera	Dyistcidae	*Dytiscus marginalis*	None	None	1	None	C
Coleoptera	Haliplidae	*Haliplus confinus*	None	None	2	None	C
Coleoptera	Elmidae	*Limnius volckmari*	None	3	None	5	C
Coleoptera	Elmidae	*Elmis aenea*	2	2	None	None	C
Mollusca	Lymnaeidae	*Radix balthica*	None	None	9	None	D
	Hydrobiidae	*Potamopyrgus antipodarum*	None	None	None	5	C
Crustacea	Asellidae	*Asellus aquaticus*	15	12	None	1	D
Crustacea	Gammaridae	*Gammarus duebenii*	11	17	None	6	C
Crustacea	Astacidae	*Austropotamobius pallipes*	1	None	None	None	C
Diptera	Tipulidae	*Dicranota* sp.	None	None	None	2	C
Diptera	Chironomidae	*Chironomini tribe*	1	None	None	None	C
Diptera	Chironomidae	*Chironomus* sp.	9	None	None	None	D
Diptera	Simuliidae	*Simulium* sp.	6	None	None	None	C
Hirudinea	Glossiphonidae	*Glossiphonia complanata*	None	1	None	None	D
Notes			**Small stream**	**Small stream**	**Tentative Q (canalised bog drain)**	**Small stream**	
Q Rating			**Q2-3 (moderately polluted)**	**Q3 (Moderately Polluted)**	**Q3 (Moderately Polluted)**	**Q3 (Moderately Polluted)**	
Equivalent WFD Status			**Poor Status**	**Poor Status**	**Poor Status**	**Poor Status**	

Table 3.5B Macro-invertebrate Q-sample compositions for sites 6, 9, 19 and 11 sampled in the vicinity of Derrinlough wind farm, October 2019

Group	Family	Species	Site 6	Site 9	Site 10	Site 11	EPA Class
Emphemeroptera	Ephemeridae	*Ephemera danica*	None	5	None	None	A
Trichoptera (cased)	Limnephilidae	*Limnephilus flavicornis*	None	2	None	None	B
	Leptoceridae	*Anthripsodes* sp.	None	None	None	5	B
	Seracostomatidae	*Seracostoma personatum*	None	8	None	None	B
Trichoptera (uncased)	Hydropyshcidae	*Hydropsyche angustipennis*	2	3	None	None	C
Trichoptera (uncased)	Polycentropodidae	*Polycentropus flavomaculatus*	None	1	None	None	C
Odonata	Coenagrionidae	*Ischnura elegans*	None	None	None	6	C
Coleoptera	Dyistcidae	*Dytiscus marginalis*	None	None	None	1	C
Coleoptera	Haliplidae	*Haliplus* sp.	1	None	None	None	C
Coleoptera	Elmidae	*Elmis aenea*	None	3	None	None	C
Mollusca	Lymnaeidae	*Radix balthica*	None	None	None	3	D
	Lymnaeidae	*Lymnaea stagnalis*	None	None	6	5	C
	Valvatidae	*Valvata piscinalis*	None	1	None	None	C
	Valvatidae	*Valvata cristata*	None	None	None	2	C
	Valvatidae	*Anisus leucostoma*	None	None	3	None	C
	Sphaeriidae	*Pisdium subtruncatum*	None	None	None	2	C
	Sphaeriidae	*Pisidium personatum*	1	None	None	None	C
	Hydrobiidae	*Potamopyrgus antipodarum*	None	1	None	None	C
Crustacea	Asellidae	*Asellus aquaticus*	93	2	26	24	D
Diptera	Chironomidae	*Chironomus* sp.	None	4	None	12	D
Diptera	Simuliidae	*Simulium* sp.	None	6	None	None	C
Chelicerata	Hydrachnidae	*Not identifiable*	None	None	None	5	C
Oligochaeta	Lumbricidae	*Eiseniella tetraeda*	None	1	None	None	N/A
Oligochaeta	Tubificidae	*Tubifex* sp.	93	None	None	None	D
Notes			**Small stream**	**Silver River**	**Tentative Q (stream with limited flow)**	**Tentative Q (canalised peat drain)**	
Q Rating			**Q2-3 (moderately polluted)**	**Q4 (unpolluted)**	**Q2 (Seriously polluted)**	**Q3 (Moderately Polluted)**	
Equivalent WFD Status			**Poor Status**	**Good Status**	**Bad Status**	**Poor Status**	

3.5 Physio-chemical water quality

Table 3.6 below provides a summary of physio-chemical results collected at the same locations as the biological water quality monitoring (*n*=8 sites). The results are discussed below relative to target thresholds in the legislation.

The pH and alkalinity were relatively consistent across all samples, with high alkalinity of ≥169 mg $CaCO_3$/l in all samples (Table 3.6) reflecting local calcareous geological influences (GSI, 2019). Levels of Molybdate Reactive Phosphorus (MRP) (the amount of phosphorus bioavailable for plant uptake) were low across all sample sites, i.e. all ≤0.012mg P/l) (Table 3.6). The Surface Water Regulations (S.I. 77 of 2019) sets a target of ≤0.025 mg P/l for high status rivers. Thus, all samples conformed to high status based on MRP levels.

The recorded suspended solids levels were low across the survey sites with levels recorded at <25mg/l with the exception of site 4 where levels were recorded at 39.3mg/l (see Table 3.6 below).

Levels of Total Oxidised Nitrogen (TON) (nitrate + nitrite in combination) were varied across the samples, ranging from 0.069 to 3.205mg N/l (Table 3.6). The European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (S.I. 77 of 2019) sets no specific boundary conditions for nitrate. However, EPA assessment of high-quality water sources has set boundary conditions of 0.8 mg/l NO_3-N (nitrate as nitrogen) for high quality waters and 1.8 mg/l NO_3-N for good quality waters. Thus, only site 4 (Whigsborough Stream) met the high-quality threshold. Sites 1 and 5 met good quality standards (0.806, 0.850mg N/l). Sites 2, 6, 9, 10 and 11 failed to meet good quality standards, with all TON levels exceeding 2.246mg N/l. Such levels indicate enrichment (eutrophication).

Nitrite is an intermediate in the oxidation of ammonia to nitrate and concentrations of nitrite in unpolluted waters should be low (<0.05mg N/l) according to the EPA but also in salmonid bearing watercourses. Levels of nitrite were low across all of the *n*=8 physiochemical sampling sites. Levels of total ammonia however, exceeded limits set for healthy waters (good status ≤0.065 mg N/l) under the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (S.I. 77 of 2019) at the majority of sites (i.e. sites 1, 2, 4, 5, 6, and 11, all ≥ 0.069mg N/l). Total ammonia levels at sites 1, 2 and 5 were particularly high (all ≥0.352mg N/l) (Table 3.6). Of the *n*=8 physiochemical sampling sites only two sites (i.e. sites 9 and 10) corresponded to 'high status' given significantly lower levels of total ammonia levels at ≤0.034mg N/l. The un-ionised fraction of ammonia (NH_3) is known to be toxic to freshwater fish and elevations e.g. >0.1mg/l indicate contamination from effluent and or agricultural sources. The European Communities (Quality of Salmonid Waters) Regulations 1988 (S.I. 293 of 1988) specifies a limit for unionised ammonia of 0.02 mg/l NH_3. Thus, all sites met un-ionised ammonia targets (all sites ≤0.016mg mg/l NH_3).

Biochemical Oxygen Demand (BOD), the amount of oxygen consumed by microorganisms in breaking down the organic matter, for all sites was ≤2.4 mg/l O_2 (Table 3.6). Therefore, all sampling sites fell within acceptable limits for clean river water (i.e. ≤2.6 mg/l O_2 95th percentile) as set out under the under the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (S.I. 77 of 2019).

Levels of dissolved organic carbon (DOC) were varied across sampling sites (8.2 – 34.7mg C/l). Sites 1, 4, 5, and 10 showed higher DOC levels (≥58.9 mg C/l) and this likely reflects the greater levels of humic substances present, originating from cutover bog habitats.

Table 3.6 Physio-chemical water quality results, October 2019. No samples were taken for lacustrine sites 3, 7 or 8. Site 12 was dry at the time of survey[1].

Parameter	Site 1	Site 2	Site 4	Site 5	Site 6	Site 9	Site 10	Site 11
pH	7.48	7.40	7.63	7.37	7.72	7.90	7.49	7.72
Alkalinity (mg $CaCO_3$/l)	183	252	169	182	293	280	273	326
Suspended solids (mg/l)	0.8	2.0	**39.3**	0.6	1.8	2.6	6.2	0.2
MRP (mg P/l)	0.005	0.002	0.011	0.007	0.004	0.012	0.007	0.004
Total Oxidised Nitrogen (mg N/l)	0.806	**2.402**	0.069	0.850	**2.722**	**3.008**	**2.246**	**3.205**
Nitrite (mg N/l)	0.010	0.032	<0.001	0.033	0.025	0.010	0.019	0.033
Total Ammonia (mg N/l)	**0.356**	**0.374**	**0.102**	**0.352**	**0.082**	0.032	0.032	0.069
BOD (mg O_2/l)	0.004	0.004	0.002	0.004	0.002	0.001	<0.001	0.016
COD (mg O_2/l)	2.1	2.2	1.8	2.4	1.4	1.0	2.0	0.6
DOC (mg C/l)	**71.3**	45.4	**118.9**	**58.9**	37.7	24.9	**72.9**	12.9

[1] Results highlighted in bold indicate elevations

4. Discussion

4.1 Most and least valuable sites

Salmonids

Salmonid habitat was poor to moderate across the majority of survey sites based on combinations of nursery, spawning and adult holding habitat (i.e. Life Cycle Unit scores; Table 3.2 results). This largely reflected the peat-based nature and heavily silted substrata of many sites (e.g. sites 1, 2, 5, 10, 11), which significantly reduced or removed the availability of clean, unbedded gravel/cobble spawning habitat required for healthy salmonid populations. Peat-based catchments such as Derrinlough are less productive than other those flowing over other geologies (O'Grady, 2006), with reduced primary productivity, reduced macro-invertebrate communities, and, generally speaking, lower fish biomass (Richardson, 1993).

Channels with higher proportions of fine sediment (such as peat) can also impact spawning and intragravel development of salmonid eggs (Louhi et al., 2011; Greig et al., 2007), further limiting local populations. Such conditions were prevalent at sites 1, 2, 5, 10 and 11 which were however, highly degraded from historical drainage works. Silted and compacted gravels can no longer function as salmonid spawning areas and it has been shown that eggs laid in clean gravels which have subsequently been silted over by peat have failed to hatch (Crisp 1993, 2000). Siltation of watercourses from peat-derived sediment in the vicinity of the proposed wind farm site primarily relates to historical drainage works.

Site 9 on the Silver River at Millbrook Bridge, the largest watercourse within the study area, offered the best salmonid habitat overall, with both good quality spawning and (adult) holding habitat present but localised in the vicinity of the bridge. The (Kilcormac) Silver River is locally recognised as a recreational brown trout fishery and receives small runs of Croneen trout (genetically-distinct migratory form from Lough Derg) and Atlantic salmon via the Brosna River.

Although offering limited (poor) spawning opportunities, the wetlands located at sites 3 and 8, as well as the settlement pond at site 7, provided some moderate brown trout habitat in terms of nursery and feeding. Trout are known locally from all three sites (Bord na Móna, pers. comm.).

Lamprey species

Overall, lamprey potential (primarily for brook lamprey *Lampetra planerii* given the location of the Derrinlough sites) was low across the riverine sites surveyed (Table 3.3). No sites were considered to offer moderate or good lamprey spawning or nursery habitat (i.e. all poor, according to LHQI scores). Primarily this was due to limited (or absent) clean, unbedded gravel substrata and the predominance of humic, flocculent sediment. *Lampetra* species such as brook lamprey not only require good fractions of clean, fine gravels for spawning but also soft, organic-rich sediment for larval settlement, be it mud, sand, silt, clay or a matrix of all types, ≥5cm in depth (Maitland, 2003). Invariably such areas are composed of organic-rich fines with a high level of non-humic detritus. Such conditions were not present across the Derrinlough survey sites. Site 9, on the Silver River at Millbrook Bridge, featured more in the way of cleaner hard substrata (including some coarse gravels) required for lamprey spawning but these were bedded given high flow rates and were considered sub-optimal. However, *Lampetra* sp. (likely brook lamprey, given access difficulties for river lamprey) are known from the Silver River both upstream and downstream of this site (Kelly et al., 2009, 2015).

The survey sites were dominated by peat-derived sediments. Typically, heavily silted peat-dominated channels, such as those found in the vicinity of Derrinlough wind farm, do not provide optimal conditions for lamprey spawning or settlement, with the species generally favouring sites with well-sorted soft substrata and clean, uncompacted gravels (Goodwin et al., 2008; Aronsuu & Virkkala, 2014).

European eel

European eel habitat was moderate across most survey sites, with the quality typically reduced given limited deeper holding water and limited refugia such as macrophyte beds and boulders. Diurnal refugia are vital to European eel such as deep pools, large macrophyte beds, boulders, large cobble and in-stream structure like submerged tree roots and stumps (Degerman et al., 2019; Laffaille et al., 2003). The larger riverine sites such as site 6 (Little Cloghan River) and 9 (Silver River) offered the best eel habitat overall in terms of foraging, boulder/macrophyte refugia and downstream connectivity with larger watercourses, i.e. River Shannon catchment.

The wetland habitats located at sites 3 and 8, as well as the settlement pond at site 7, also offered good overall eel habitat although downstream connectivity issues were evident (e.g. impounded peat drainage channels, partially-blocked culverts etc.). These sites provided ample refugia and prey resources for eel (e.g. three-spined stickleback, amphibians, macro-invertebrates).

Whilst site 12 was dry at the time of survey and was not capable of supporting fish, the channel offered some low potential for migrating eel during higher flow periods given downstream connectivity with the River Shannon catchment. More so than other fish species, even perceptibly sub-optimal foraging and nursery sites may act as valuable migratory pathways for European eel to and from the wider Brosna and Shannon catchments, particularly in the higher-flow periods typically persistent during the adult eel migration season (i.e. October onwards). Thus, anywhere that is capable of facilitating passage for this Annex II, critically endangered species (Jacoby & Gollock, 2014), should be considered of value.

White-clawed crayfish

A single white-clawed crayfish was recorded from site 1 on the Feeghroe Stream during the survey. This watercourse has indirect downstream connectivity (approx. 5.7km, via the Rapemills River) with the River Shannon. Despite some moderate to good suitability for the species at certain sites (e.g. sites 6, 7, 9), no live crayfish were recorded from any other site via sweep netting or hand searching. However, crayfish are known locally from site 6 (Little Cloghan River) and the connected settlement pond at site 7 (Bord na Móna pers. comm.), both in the vicinity of the Derrinlough briquette factory. Walkover surveys failed to identify remains of crayfish in mustelid spraint in the vicinity of any survey sites.

White-clawed crayfish typically require hard, mineral rich waters flowing over (high calcium) calcareous substrates, preferably with alkalinity levels of >100mg $CaCO_3$ (Lucey & MacGarrigle, 1987; Holdich, 2003; Gallagher et al., 2006). Consequentially, crayfish distribution follows many of Ireland's carboniferous limestone belts and occurs mostly throughout the limestone-rich midlands. Whilst the Derrinlough wind farm site drains Clongawny and Drinagh Bogs, these areas are underlain by carboniferous limestone and mudstones (Waulsortian limestones, GSI, 2019). Alkalinity levels are appreciably high across the riverine sampling sites (≥169 mg $CaCO_3$/l, Table 3.7) and are therefore, physiochemically capable of supporting white-clawed crayfish. Aside from site 1 on the Feeghroe Stream, sites 6 (Little Cloghan River) and 7 (settlement pond) are known locally to support crayfish despite a lack of records during the current survey.

Siltation is known to negatively impact respiratory function of crayfish (Rosewarne et al., 2014) and the high levels of peat-derived, flocculent sediments in the majority of survey sites (e.g. site 2, 5, 10, 11) have resulted in sub-optimal crayfish habitat, despite some suitable physiochemical and physical habitat parameters.

Water quality

Water quality was measured both physiochemically (i.e. surface water samples tested by a laboratory) and biologically (i.e. Q samples).

The biological water quality was recorded as good status **Q4** as required under the Water Framework Directive (2000/60/EC) at site 9 but at none of the other sites Q-sampling sites (i.e. sites 1, 2, 4, 5, 6, 10 & 11). These sites had biological water quality recorded between **Q2** and **Q3** (i.e. either bad or poor status). The channelised nature of many of the watercourses and high quantities of peat is considered to be the main reason for the poorer recorded biological water quality.

The physiochemical samples recorded at the same *n*=8 sites recorded elevations in Total Oxidised Nitrogen (TON), Total Ammonia and Dissolved Organic Carbon (DOC). Sites 2, 6, 9, 10 and 11 failed to meet good quality standards, with all TON levels exceeding 2.246mg N/l, thus not meeting the 1.8mg/l threshold for good status water. Total ammonia (sum of ammonia and ammonium) levels at sites 1, 2 and 5 were considered high with all sites recording levels of ammonia at ≥0.352mg N/l) (Table 3.7 results). Sites 1, 4, 5, and 10 had elevated DOC levels (≥58.9 mg C/l). These elevations likely reflect the greater levels of humic substances present, originating from adjacent cutover bog habitats. Overall, the observed localised elevations in ammoniacal substances and DOC would not be considered unusual for watercourses emanating from extensive peat cutover.

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