MKO

Planning and Environmental Consultants

PLANNING SECTION
LEITRIM COUNTY COUNCIL
29 JUL 2020
P. 20/120

Environmental Impact Assessment Report

Proposed Croagh Wind Farm, Co. Leitrim and Co. Sligo
Volume 3a
EIAR Appendices 2-1 – 6-5

Volume 3a: Appendices 2-1 to 6-5

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APPENDIX 2-1

SCOPING RESPONSES

Lorraine Meehan

From: Ian Lumley <heritage@antaisce.org>
Sent: 04 April 2019 18:30
To: Lorraine Meehan <lmeehan@mkoireland.ie>
Subject: Croagh Wind Farm EIA - Scoping follow-up

Lorraine,

Thanks for your reminder email.

OUR PARTICULAR CONCERNS WOULD RELATE TO

1 CUMULATIVE IMPACT WITH EXISTING AND PROPOSED WIND FARMS KIN AREA.

2 EVALUATION OF BIRD IMPACT IN OTHER EXISTING WIND FARMS IN THE AREA SINCE CONSTRUCTION

Regards

Ian Lumley

--
An Taisce - The National Trust for Ireland | www.antaisce.org
The Tailors' Hall, Back Lane, Dublin 8, Ireland
Company Reg. No. 12469 | Charity Ref. No. CHY4741 | Charity Regulator No. 20006358
An Taisce is a membership-based charity
Join at www.antaisce.org/membership

Lorraine Meehan

From: padraig.condon@bt.com [mailto:padraig.condon@bt.com]
Sent: 15 August 2018 17:30
To: Lorraine Meehan <lmeehan@mccarthykos.ie>
Subject: RE: 180511 Carrane Hill WF, Co Leitrim

Hi Lorraine,
I can confirm the planned development will have no impact on the BT Ireland microwave radio network.

Regards

Padraig Condon
BT Radio Ops

Lorraine Meehan

From: Environmental Co-ordination (Inbox) [mailto:Environmental_Co-ordination@agriculture.gov.ie]
Sent: 22 January 2019 09:42
To: Lorraine Meehan <lmeehan@mccarthykos.ie>
Subject: RE: 180511 Croagh Wind Farm EIAR - Scoping

Dear Ms. Meehan,

The following are the comments from this Division in relation to the proposed development:

If the proposed development will involve the felling or removal of any trees, the developer must obtain a Felling License from this Department before trees are felled or removed. A Felling Licence application form can be obtained from **Felling Section, Department of Agriculture, Food and the Marine, Johnstown Castle Estate, Co. Wexford**. Tel: 076-1064459, Web https://www.agriculture.gov.ie/forestservice/treefelling/treefelling/

A Felling Licence granted by the Minister for Agriculture, Food and the Marine provides authority under the Forestry Act 2014 to fell or otherwise remove a tree or trees and/or to thin a forest for silvicultural reasons. The Act prescribes the functions of the Minister and details the requirements, rights and obligations in relation to felling licences. The principal set of regulations giving further effect to the Forestry Act 2014 are the Forestry Regulations 2017 (S.I. No. 191 of 2017).

The developer should take note of the contents of **Felling and Reforestation Policy** document which provide a consolidated source of information on the legal and regulatory framework relating to tree felling; https://www.agriculture.gov.ie/media/migration/forestry/treefelling/FellingReforestationPolicy240517.pdf. As this development is within a forest lands particular attention should be paid to deforestation, turbulence felling and the requirement to afforest alternative lands.

In order to ensure regulated forestry operations in Ireland accord with the principles of sustainable forest management (SFM) , as well fulfilling the requirements of other relevant environmental protection laws, the Department (acting through its Forest Service division) must undertake particular consultations and give certain matters full consideration during the assessment of individual Felling Licence applications. This includes consultation with relevant bodies, the application of various protocols and procedures (e.g. Forest Service Appropriate Assessment Procedure), and the requirement for applicants on occasion to provide further information (e.g. a Natura Impact Statement).

Consequently, when the Forest Service is considering an application to fell trees, the following applies:

1. The interaction of these proposed works with the environment locally and more widely, in addition to potential direct and indirect impacts on designated sites and water, is assessed. Consultation with relevant environmental and planning authorities may be required where specific sensitivities arise (e.g. local authorities, National Parks & Wildlife Service, Inland Fisheries Ireland, and the National Monuments Service);

2. Where a tree Felling Licence application is received, the Department will publish a notice of the application before making a decision on the matter. The notice shall state that any person may make a submission to the Department within 30 days from the date of the notice. The notices for 2018 are published online at: https://www.agriculture.gov.ie/forestservice/publicconsultation/environmentalimpactassessmenteiapublicconsultationforafforestationforestroadconstructionandfellinglicenses2018/

3. Third parties that make a submission or observation will be informed of the decision to grant or refuse the licence and on request details of the conditions attached to the licence, the main reasons and considerations on which the decision to grant or refuse the licence was based, and where conditions are attached to any licence, the reasons for the conditions. Both third parties and applicants will be also informed of their right to appeal any decision within 28 days to the Forestry Appeals Committee. Felling Licence decisions for 2018 are published online at: https://www.agriculture.gov.ie/forestservice/publicconsultation/environmentalimpactassessment-2018registerofdecisions/

It is important to note that when applying to a Local Authority or An Bord Pleanàla for planning permission where developments are:

a) subject to an EIA procedure (including screening in the case of a sub-threshold development) and any resulting requirement to produce an EIAR; and/or

b) subject to an Appropriate Assessment procedure (including screening) and any resulting requirement to a Natura Impact Statement (NIS); and

c) the proposed development in its construction or operational phases, or any works ancillary thereto, would directly or indirectly involve the felling and replanting of trees, deforestation for the purposes of conversion to another type of land use, or replacement of broadleaf high forest by conifer species,

1. that there is a requirement inter alia under the EIA Directive for an overall assessment of the effects of the project or the alteration thereof on the environment to be undertaken, including the direct and indirect environmental impact of the project;

   and

2. pursuant to Article 2(3) of the EIA Directive the Department of Agriculture, Food and the Marine strongly recommends that notwithstanding the fact that a parallel consent in the form of felling licence may also have to be applied for, any EIAR and/or NIS produced in connection with the application for planning permission to the Local Planning Authority or An Bord Pleanàla should include an assessment of the impact of and measures, as appropriate, to prevent, mitigate or compensate for any significant adverse effects direct or indirect identified on the environment arising from such felling and replanting of trees, deforestation for the purposes of conversion to another type of land use, or replacement of broadleaf high forest by conifer species.

Yours sincerely,

_____

Breeda Hennebry

Breeda Hennebry | *Clerical Officer,**An tAonad um Chomhordú Timpeallachta, An Rannóg um Athrú Aeráide agus Beartas Bithfhuinnimh,***
Environmental Co-ordination Unit |Climate Change & Bioenergy Policy Division | environmentalco-ordination@agriculture.gov.ie
An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

Lárionad Gnó Grattan, Bóthar Bhaile Átha Cliath, Port Laoise, Co Laoise, R32 K857
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Disclaimer:

Department of Agriculture, Food and the Marine

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An Roinn Talmhaíochta, Bia agus Mara

Tá an t-eolais san ríomhphost seo, agus in aon ceangláin leis, faoi phribhléid agus faoi rún agus le h-aghaigh an seolaí amháin. D'fhéadfadh ábhar an seoladh seo bheith faoi phribhléid profisiúnta nó dlíthiúil. Mura tusa an seolaí a bhí beartaithe leis an ríomhphost seo a fháil, tá cosc air, nó aon chuid de, a úsáid, a chóipeál, nó a scaoileadh. Má tháinig sé chugat de bharr dearmad, téigh i dteagmháil leis an seoltóir agus scrios an t-ábhar ó do ríomhaire le do thoil.

An Roinn Cultúir,
Oidhreachta agus Gaeltachta
Department of Culture,
Heritage and the Gaeltacht

Your Ref: 180511
Our Ref: **G Pre00004/2019**
(Please quote in all related correspondence)

30 January 2019

Lorraine Meehan,
Environmental Scientist
McCarthy Keville O'Sullivan Ltd.,
Planning & Environmental Consultants,
Block 1, G.F.S.C.,
Moneenageisha Road,
Galway
H91 N8KK

Via email: jowens@mccarthykos.ie cc: lmeehan@mccarthykos.ie

Re: Environmental Impact Assessment (EIA) Scoping Consultation for Proposed Croagh Wind Farm which is located approximately 3.8 kilometres west of Drumkeeran, Co. Leitrim.

A chara

On behalf of the Department of Culture, Heritage and the Gaeltacht, I refer to correspondence received in connection with the above.

Outlined below are heritage-related observations/recommendations of the Department under the stated heading.

Nature Conservation

Please find below general scoping comments for Environmental Impact Assessment Report (EIAR), Appropriate Assessment (AA) screening and licensing requirements, followed by specific comments regarding the site in question.

These observations are intended to assist you in meeting the obligations that may arise in relation to European sites, other nature conservation sites, and biodiversity and environmental protection in general in the context of the current application. The observations are not exhaustive, and are made without prejudice to any recommendation that may be made by this Department in the future. Data collected and surveys carried out in connection with this proposed development may raise other issues that have not been considered here.

The National Parks and Wildlife Service (NPWS) website has recently been updated and should be consulted with regard to the impact of planning and development on nature conservation. Further details are accessible on the website at https://www.npws.ie/development%20consultations.

EIAR

Ecological survey

With regard to scoping for an EIAR for a proposed development, in order to assess impacts on biodiversity, fauna, flora and habitats an ecological survey should be carried out of the proposed development site including the route of any access roads, pipelines or cables etc. to survey the habitats and species present. Any improvement or reinforcement works required for access and transport anywhere along any proposed haul route(s) should be included in the EIAR and subjected to ecological impact assessment with the inclusion of mitigation measures, as appropriate. Where bridges require strengthening this may involve grouting of crevices which may function as bat roosts. Where ex-situ impacts are possible survey work may be required outside of the development sites. Such surveys should be carried out by suitably qualified persons at an appropriate time of the year depending on the species being surveyed for. The EIAR should include the results of the surveys and detail the survey methodology and timing of such surveys. It is expected by this Department that best practice will be adhered to with regard to survey methodology and if necessary non-Irish methodology adapted for the Irish situation. The EIAR should cover the whole project, including construction, operation and, if applicable, restoration or decommissioning phases. Alternatives examined should also be included in the EIAR. Inland Fisheries Ireland (IFI) should be consulted with regard to fish species if applicable. For information on Geological and Geomorphological sites the Geological Survey of Ireland should be consulted.

Specific reference should be made to the National Biodiversity Plan and any relevant County Biodiversity Plan. Any losses of biodiversity habitat associated with this proposed development (including access roads and cabling etc.) such as woodland, scrub, hedgerows and other habitats should be mitigated for.

In order to assess impacts it may be necessary to obtain hydrological and/or geological data. Any impact on water table levels or groundwater flows may impact on wetland sites some distance away. The EIAR should assess cumulative impacts with other plans or projects if applicable. Where negative impacts are identified suitable mitigation measures should be detailed as appropriate.

Hedgerows and related species

Hedgerows should be maintained where possible as they form wildlife corridors and provide areas for birds to nest in; hedgerow trees may provide roosting places for bats. Badger setts may be present. Hedgerows also provide a habitat for woodland flora. The EIAR should provide an estimate of the length of any hedgerow that will be lost. Where it is

proposed that trees or hedgerows will be removed there should be suitable planting of native species in mitigation incorporated into the EIAR. Where possible, hedgerows and trees should not be removed during the nesting season (i.e. March 1st to August 31st). Bird's nests can only be intentionally destroyed under licence issued under the Wildlife Acts of 1976 to 2012.

Watercourses and wetlands

Wetlands are important areas for biodiversity and ground and surface water quality and should be protected during construction and operation of the proposed development. Any watercourse or wetland impacted on should be surveyed for the presence of protected species and species listed on Annexes II and IV of the Habitats Directive. These species could include otters (Lutra /utra). which are protected under the Wildlife Acts and listed on Annexes II and IV of the Habitats Directive, salmon (Salmo salar) and Lamprey species listed on Annex II of the Habitats Directive, Freshwater Pearl Mussels (Margaritifera species) and White-clawed Crayfish (Austropotamobius pallipes) which are protected under the Wildlife Acts and listed on Annex II of the Habitats Directive, Frogs (Rana temporaria) and Newts (Trituris vulgaris) protected under the Wildlife Acts and Kingfishers (Alcedo atthis) protected under the Wildlife Acts and listed on Annex I of the Birds Directive (Council Directive 79/409 EEC).

One of the main threats identified in the threat response plan for otter is habitat destruction (see https://www.npws.ie/sites/default/files/publications/pdf/2009_Otter_TRP.pdf). A 10m riparian buffer on both banks of a waterway is considered to comprise part of the otter habitat. Therefore any proposed development should be located at least 10m away from a waterway.

Flood plains

Flood plains, if present, should be identified in the EIAR and left undeveloped to allow for the protection of these valuable habitats and provide areas for flood water retention (green infrastructure). If applicable the EIAR should take account of the guidelines for Planning Authorities entitled "The Planning System and Flood Risk Management" and published by the Department of the Environment, Heritage and Local Government In November 2009.

Bats

Bat roosts may be present in trees, buildings and bridges. Bat roosts can only be destroyed under licence under the Wildlife Acts and derogation under the Birds and Natural Habitats Regulations and such a licence would only be given if suitable mitigation measures were implemented. Any proposed migratory bat friendly lighting should be proven to be effective.

Alien invasive species

The EIAR should also address the issue of invasive alien plant and animal species such as Japanese Knotweed or piri piri burr, and detail the methods required to ensure they are not accidentally Introduced or spread during survey and/or construction. Information on alien

Invasive species In Ireland can be found at http://invasives.biodiversityireland.ie/ and at https://invasivespeciesireland.com/.

Bird surveys

Survey methodologies should follow best practice and if necessary be modified to reflect the Irish situation. Two full years of bird surveys is normally considered to be necessary. When survey results are being presented In an EIAR it is important that best practice is followed and that the full survey methodology, including dates and times are detailed. Furthermore, it is expected that bird survey data should be presented in context and records should be supported by basic environmental data such as hourly estimates of visibility, glare arcs, cloud cover and precipitation during Vantage Point (VP) survey and walk over survey periods. Results for species need to be referenced back to the overall populations and their dynamics as, in some cases even a small risk to a population of a species could be considered significant. It is important that bird migration routes are considered as well as routes of birds travelling on a daily basis between roosting and feeding areas.

Impact assessment

The impact of the proposed development on the flora/fauna and habitats present should be assessed with particular regard to:

Natura 2000 sites, i.e. Special Areas of Conservation (SAC) designated under the EC Habitats Directive (Council Directive 92/43/EEC) and Special Protection Areas (SPA) designated under the EC Birds Directive (Directive 2009/147 EC), other designated sites, or sites proposed for designation, such as Natural Heritage Areas (NHA) and proposed Natural Heritage Areas (pNHA), Nature Reserves and Refuges for Fauna or Flora designated under the Wildlife Acts 1976 to 2012, species protected under the Wildlife Acts including protected flora, 'Protected species and natural habitats', as defined in the Environmental Liability Directive (2004/35/EC) and European Communities (Environmental Liability) Regulations, 2008 including Birds Directive - Annex I species and other regularly occurring migratory species, and their habitats (wherever they occur) and Habitats Directive - Annex I habitats, Annex II species and their habitats, and Annex IV species and their breeding sites and resting places (wherever they occur), important bird areas such as those identified by Birdlife International, features of the landscape which are of major importance for wild flora and fauna, such as those with a "stepping stone" and ecological corridors function, as referenced in Article 10 of the Habitats Directive, other habitats of ecological value in a national to local context (such as those identified as locally important biodiversity areas within Local Biodiversity Action Plans and County Development Plans), Red data book species, and biodiversity in general.

Complete project details including Construction Management Plans (CMPs) need to be provided in order to allow an adequate EIAR and appropriate assessment to be undertaken. Applicants need to be able to demonstrate that CMPs and other such plans are adequate and effective mitigation supported by scientific information and analysis and

that they are feasible within the physical constraints of the site. The positions, locations and sizes of construction infrastructure and mitigation such as settlement ponds, disposal sites and construction compounds may significantly affect European and other designated sites, habitats and species in their own right and could have an effect for example on drainage, water quality, habitat loss, and disturbance. If these are undetermined at time of the assessment all potential effects of the development on the site are not being considered.

Construction Management Plans

Construction Management Plans should contain sufficient detail to avoid any post construction doubt with regard to the implementation of mitigation measures, timings and roles and responsibilities for same. There can be no doubts or lacunae regarding what is required for mitigation, pre-commencement surveys and/or licencing requirements.

Construction work should not be allowed to impact on water quality and measures should be detailed in the EIAR to prevent sediment and/or fuel runoff from getting into watercourses which could adversely impact on aquatic species. See the above “Flood Plains” section for details with regard to flooding risk.

Inland Fisheries Ireland (IFI) should be consulted with regard to impacts on fish species and the applicant may find it useful to consult their publication entitled "Planning for watercourses in the urban environment" which can be downloaded from their website.

If applicants are not in a position to state the exact location and details of cable routes at the time of application, then they need to consider the range of options that may be used within their assessment. Should the exact height and rotor diameter of the turbines not be known at EIAR stage then the assessment of impacts must be applicable to a variety of turbine heights and rotor diameters which could be used. This should be made clear in the EIAR.

It is important to note that unless post decision consultation with this Department is specifically stated as a condition of planning, this Department has no post consent role. However, regional staff are available for liaison regarding any associated licencing requirements and/or new information arising for specific species of concern.

Cumulative and ex situ impacts

A rule of thumb often used is to include all European sites within a distance of 15km. It should be noted however that this will not always be appropriate. In some instances where there are hydrological connections a whole river catchment or a groundwater aquifer may need to be included. Similarly where bird flight paths are involved the impact may be on an SPA more than 15 km away.

Other relevant Local Authorities should be consulted to determine if there are any projects or plans which, in combination with this proposed development, could impact on any European sites.

Appropriate Assessment

In order to carry out the Appropriate Assessment screening, and/or prepare a Natura Impact Statement (NIS), information about the relevant European sites including their conservation objectives will need to be collected. Details of designated sites and species and conservation objectives can be found on http://www.npws.ie/. Site-specific, as opposed to generic, conservation objectives are now available for many sites. Each conservation objective for a qualifying interest (QI) is defined by a list of attributes and targets and is often supported by further documentation. Where these are not available for a site, an examination of the attributes that are used to define site-specific conservation objectives for the same QIs in other sites can be usefully used to ensure the full ecological implications of a proposal for a site's conservation objective and its integrity are analysed and assessed. This Department advises, as per the notes and guidelines in the site-specific conservation objectives that any reports quoting conservation objectives should give the version number and date, so that it can be ensured and established that the most up-to-date versions are used in the preparation of Natura Impact Statements and in undertaking appropriate assessments.

The Departmental guidance document on Appropriate Assessment is available on the NPWS website at https://www.npws.ie/development-consultations and in the EU Commission guidance entitled "Assessment of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC' which can be downloaded from;
http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/natura_2000_assess_en.pdf.

CJEU and Irish case law has clarified some issues and should also be consulted.

Post construction monitoring

This Department recognises the importance of pre and post construction monitoring, such as recommended in Drewitt et al. (2006), and Bat Conservation Ireland (2012). The applicant should not use any proposed post construction monitoring as mitigation to supplement inadequate information in the assessment. Please refer to Circular Letter PD 2/07 and NPWS 1/07 on this issue. This can be downloaded from the Department's website https://www.npws.ie/sites/default/files/general/circular-pd-02-07.pdf.

The EIAR process should identify any pre and post construction monitoring which should be carried out. The post construction monitoring should include bird and bat strikes/fatalities including the impact on any such results of the removal of carcasses by scavengers. Monitoring results should be made available to the competent Authority and copied to this Department. A plan of action needs to be agreed at planning stage with the Planning Authority if the results in future show a significant mortality of birds and/or bat species. It is important to note again that unless post decision consultation with this Department is specifically stated as a condition of planning, this Department has no post consent role. However, regional staff are available for liaison regarding any associated licencing requirements and/or new information arising for specific species of concern.

Please note that any significant change to mitigation may require amendment and where a licence has expired; there will be a need for new licence applications for protected species.

Licences

Where there are impacts on protected species and their habitats, resting or breeding places, licences may be required under the Wildlife Acts or derogations under the Habitats Regulations. In particular bats and otters are strictly protected under annex IV of the Habitats Directive. A copy of Circular Letter NPWS 2/07 entitled "Guidance on Compliance with Regulation 23 of the Habitats Regulations 1997 – strict protection of certain species/applications for derogation licences" can be found on the Departmental website at https://www.npws.ie/sites/default/files/general/circular-npws-02-07.pdf.

It should be noted however that the Regulations of 1997 have since been revoked and that Part 6 of the European Communities (Birds and Natural Habitats) Regulations 2011-2015 is now the relevant part dealing with the protection of flora and fauna. In particular reference to Regulation 23 in the circular letter should be taken to mean Regulation 51 in the current Regulations.

In addition the planning authority will be required to take account of species protected under sections 21,22 and 23 of the Wildlife Acts if there are any impacts on other protected species or their resting or breeding places, such as on protected plants, badger setts or birds' nests. They will also need to be cognisant of article 5 (d) of the Birds Directive. For that reason vegetation, including hedges and trees, should not be removed during the nesting season (i.e. March 1st to August 31st).

In order to apply for any such licences or derogations as mentioned above the results of a survey should be submitted to the National Parks and Wildlife Service section of this Department. Such surveys are to be carried out by appropriately qualified person/s at an appropriate time of the year. Details of survey methodology should also be provided. Should this survey work take place well before construction commences, this Department recommends that an additional ecological survey of the development site should take place immediately prior to construction to ensure no significant change in the findings of the baseline ecological survey has occurred. If there has been any significant change mitigation may require amendment and where a licence has expired, there will be a need for new licence applications for protected species.

Baseline data

Other sources of habitat and species information beyond those already identified and the standard NPWS data request include (but are not be limited to) the National Biodiversity Data Centre (www.biodiversityireland.ie), Inland Fisheries Ireland (www.fisheriesireland.ie). BirdWatch Ireland (www.birdwatchireland.ie), Irish Raptor Study Group, Golden Eagle Trust, and Bat Conservation Ireland (www.batconservationireland.org). Data may also exist at a County level within the Planning Authority.

General guidance and useful references;

1. EU Guidance on Wind Energy Developments and Natura 2000
2. The Departmental Wind Energy Planning Guidelines
3. Windfarms on Peatland (2008-2010) Mires and Peat volume 4
4. Best Practice guidance for Habitat Survey and Mapping by George F Smith, Paul O'Donoghue, Katie O'Hora and Eamon Delaney, 2011. The Heritage Council
5. Pearce-Higgins, James W., Stephen, Leigh, Langston, Rowena H. W., Bainbridge, Ian P. and Bullman. Rhys (2009). "The distribution of breeding birds around upland wind farms". Journal of Applied Ecology, 46, 1323-1331
6. Johnson, Gregory D. and Arnett Edward 8. "A Bibliography of Bat Fatality Activity and Interactions with Wind Turbines" (June 2004 updated February 2010) Bat Conservation International
7. Pearce-Higgins, James W., Stephen, Leigh, Douse, Andy, and Langston, Rowena H. W. (2012). "Greater impacts of wind farms on bird populations during construction than subsequent operation: results of a multisite and multi-species analysis". Journal of Applied Ecology. 49.386-394
8. Rodrigues, Let ai, (2014). "Guidelines for consideration of bats in wind farm projects". Eurobats Publication Series NO.6 UNEP and Eurobats
9. The Departmental guidance document on Appropriate Assessment which is available on the NPWS website at https://www.npws.ie/protected-sites/guidance-appropriate-assessment-planning-authorities
10. The EU Commission guidance entitled "Assessment of plans and projects significantly affecting Natura 2000 sites, Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC" which can be downloaded from http://ec.europa.eu/environment/nature/natura2000/management/guidance_en.htm
11. Bat Conservation Ireland (2012) Wind Turbine/Wind Farm Development Bat Survey Guidelines. Version 2.8, December 2012
12. Drewitt, Allan Land Longston Rowena H. W. (2006) "Assessing the impacts of wind farms on birds". Ibis 148. 29-42

Further to the above general comments please find below specific observations relating to the site in question.

- This Department is not in a position to provide further data regarding the specific species listed at this time.
- More generally, in addition to the species already identified, in particular Hen Harrier; the application should give detailed consideration to but not be limited to Merlin and Golden Plover as species of concern.
- Please also note that the EIAR bird survey recommendations above suggest that bird survey data should be presented in context and records should be supported by basic environmental data such as hourly estimates of visibility, glare arcs, cloud

cover and precipitation during Vantage Point (VP) survey and walk over survey periods.

- The EIAR should also give specific consideration to the mobilisation of silt and changes to the stability of peat.
- Changes to the underlying Ph. balance arising from the importation of fill materials should be addressed comprehensively.
- This Department notes that the invasive species, piri piri burr (*Acaena novae-zelandiae*) has been recorded near this site and habitat surveys and invasive species protocols should be cognisant of this.

The above observations/recommendations are based on the papers submitted to this Department on a pre-planning basis and are made without prejudice to any observations that the Minister may make in the context of any consultation arising on foot of any development application referred to the Minister, by the planning authority, in her role as statutory consultee under the Planning and Development Act, 2000, as amended.

You are requested to send further communications to this Department's Development Applications Unit (DAU) at **manager.dau@chg.gov.ie** (team monitored); if this is not possible, correspondence may alternatively be sent to:

The Manager
Development Applications Unit (DAU)
Department of Culture, Heritage and the Gaeltacht
Newtown Road
Wexford
Y35 AP90

Is mise, le meas

Sinéad O' Brien

Sinéad O' Brien
Development Applications Unit

Lorraine Meehan

From: Property Management [mailto:PropertyManagement@defence.ie]
Sent: 06 February 2019 09:19
To: Lorraine Meehan <lmeehan@mccarthykos.ie>
Cc: Olive.Mulhall <Olive.Mulhall@defence.ie>
Subject: 180511 Croagh Wind Farm EIAR - Scoping

Hi,

I refer to application reference no: 180511. Re: Scoping document

Based on the information supplied, the Department of Defence have the following observations:

a. In all locations where windfarms are permitted it should be a condition that they meet the following lighting requirements
    1. Single turbines or turbines delineating corners of a windfarm should be illuminated by high intensity obstacle strobe lights (Red).
    2. Obstruction lighting elsewhere in a windfarm will be of a pattern that will allow the hazard be identified and avoided by aircraft in flight.
    3. Obstruction lights used should be incandescent or of a type visible to Night Vision Equipment. Obstruction lighting fitted to obstacles must emit light at the near Infra-Red (IR) range of the electromagnetic spectrum specifically at or near 850nanometres (nm) of wavelength. Light intensity to be of similar value to that emitted in the visible spectrum of lightObstruction lights used should be incandescent or of a type visible to Night Vision Equipment.

Kind Regards,

Joe Behan
Property Management
Dept of Defence
Station Road
Newbridge
Co. Kildare

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Lorraine Meehan

Subject: FW: 180511 Carrane Hill WF, Co Leitrim

From: John.Bagnall@eir.ie [mailto:John.Bagnall@eir.ie]
Sent: 11 September 2018 13:00
To: Lorraine Meehan <lmeehan@mccarthykos.ie>
Cc: MobileNetworksTXN@eir.ie
Subject: RE: 180511 Carrane Hill WF, Co Leitrim

Lorraine,

We have a one transmission link within the proposed area, that would be at risk, the end points of the transmission link are below, if you could keep a buffer of 100meters diameter away from this transmission path when placing you turbines and send on for further analysis. Turbine 10 & 11 seem to be within the buffer zone and could impact the transmission path if you could place them outside the buffer zone.

Link 1 – End point 1 - 54° 8'54.33"N 008°16'27.64"W, End point 2 – 54°15'32.71"N 008°11'12.79"W

Please keep sending new development analysis request to MobileNetworksTXN@eir.ie for Eir Mobile (formerly Meteor) network analysis.



Kind Regards,

John Bagnall
Transmission Design & Engineering

Lorraine Meehan

From: Paul McDonagh [mailto:paul.mcdonagh@esb.ie]
Sent: 20 September 2018 12:00
To: Lorraine Meehan <lmeehan@mccarthykos.ie>
Subject: RE: 180511 Carrane Hill WF, Co Leitrim

Hi Lorraine

I have analysed the propose area based on the co-ordinates provided and it indicates that there should be no impact on our Telecoms Network.

Regards

Paul

Lorraine Meehan

Subject: FW: 180511 Croagh Wind Farm EIAR - Scoping

From: planning applications [mailto:planning.applications@failteireland.ie]
Sent: 11 January 2019 16:40
To: Lorraine Meehan <lmeehan@mccarthykos.ie>
Subject: RE: 180511 Croagh Wind Farm EIAR - Scoping

Hello Lorraine,

Thank you for your recent email regarding the **proposed Croagh Wind Farm, Co Leitrim.**
Sorry for the delay in replying to your e-mail. Please see attached a copy of Fáilte Ireland's Guidelines for the treatment of tourism in an EIS, which we recommend should be taken into account in preparing the EIAR.

For future planning notifications, queries, or documents please send by email to planning.applications@failteireland.ie
This will ensure the information/notifications will get to the Environmental & Planning Unit and reviewed in a timely manner.

Regards & thanks,

Yvonne

Yvonne Jackson
Product Development-Environment & Planning Support | Fáilte Ireland
Áras Fáilte, 88/95 Amiens Street, Dublin 1. D01WR86
T +353 (0)1 884 7224 | **www.failteireland.ie**

Fáilte Ireland
National Tourism Development Authority

Regards & thanks,

Yvonne

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Fáilte Ireland
National Tourism Development Authority

Guidelines on the treatment of tourism in an Environmental Impact Statement

1. Introduction

Tourism is a significant component of the Irish Economy – estimated to employ approximately 205,000 people – and contributing €6.6 billion in spending to the economy in 2014. The environment is one of the main resources upon which this activity depends – so it is important that the EIS evaluates whether and how the interacting impacts of a project are likely to affect tourism resources.

The purpose of this short note is to provide guidance on how these impacts can be assessed through the existing EIA process. Undertaking an EIA is governed by the EIA Advice Notes published by the EPA. These Advice Notes contain detailed guidance on how to describe and evaluate the effects arising from a range of projects, including tourism projects.

These guidelines were written with the assistance of Conor Skehan, Head of Department of Environment and Planning, Dublin Institute of Technology.

2. Tourism and the Environment

There are two interactions between tourism and the environment.

1. Impacts caused by Tourism Projects
2. Impacts affecting Tourism (e.g. the quality of a destination or a tourism activity)

Impacts caused by Tourism Projects
Tourism projects can give rise to effects on the environment. These are specifically dealt with under a number of Project Types in the Advice Notes, specifically:

12 TOURISM AND LEISURE

a. Ski-runs, ski-lifts and cable-cars where the length would exceed 500 metres and associated developments. Project Type 20

b. Sea water marinas where the number of berths would exceed 300 and fresh water marinas where the number of berths would exceed 100. Project Type 10

c. Holiday villages which would consist of more than 100 holiday homes outside built-up areas; hotel complexes outside built-up areas which would have an area of 20 hectares or more or an accommodation capacity exceeding 300 bedrooms. Project Type 28

d. Permanent camp sites and caravan sites where the number of pitches would be greater than 100. Project Type 28

e. Theme parks occupying an area greater than 5 hectares. Project Type 29

Figure 1 The Advice Notes contain detailed descriptions on how to describe and evaluate the effects arising from a range of tourism projects.

Impacts affecting Tourism

Environmental effects of other projects on tourism are not specifically addressed in the Advice Notes. Taking account of the significance of tourism to the Irish economy a specialist topic of 'Tourism' has been prepared to facilitate a systematic evaluation of effects on this sector within the format laid down for other parts of the Environmental Impact Statement.

It is not intended that the assessment of effects on tourism should become a separate section of the Impact Statement, instead it is intended to become a specialist sub-section of the topic 'Human Beings' which is currently described in Section 2 of the Advice Notes

3. Tourism in the Existing Environment

Introduction

Visitor attitude surveys reveal that the following factors – in order of priority – are the reasons that tourists visit and enjoy Ireland:

- Beautiful scenery
- Friendly & hospitable people
- Safe & Secure
- Easy, relaxed pace of life
- Unspoilt environment
- Nature, wildlife, flora
- Interesting history & culture
- Plenty of things to see and do
- Good range of natural attractions

It is noteworthy that over half of the factors listed are environmental and that all others are related to the way of life of the people. The following describes how these factors are considered within an EIS, set out under EIA topic headings, and how they interact with tourism.

Beautiful scenery
This is covered in the '*Landscape*' Section. Particular attention needs to be paid to effects on views from existing purpose-built tourism facilities, especially hotels, as well as views from touring routes and walking trails. It is important to note that there appears to be evidence that the visitor's expectations of 'beautiful' scenery does not exclude an admiration of new modern developments – such as windfarms – which appear to be seen as indicative of an modern, informed and responsible attitude to the environment.

Friendly & hospitable people
This is not an environmental factor though it is indirectly covered under the '*Human Beings*' section of the EIS. The principal factor is the ratio of visitors to residents. This is of less significance in areas with long-established patterns of tourism.

Safe & Secure
This is not an environmental issue – though some of the factors that are sometimes covered under the heading of '*Human Beings'* – such as social inclusion or poverty – can point to likely effects and interactions.

Easy, relaxed pace of life
This is not an environmental issue though it is partially covered under '*Human Beings'* – see comments above.

Unspoilt environment
This is covered under the sections dealing with '*Landscape*', '*Flora*' and '*Fauna*' and to a lesser extent under emissions to '*Water*' and '*Air*'. In some instances traffic congestion, especially in rural areas, can be an issue, this is usually covered within '*Material Assets'*.

Nature, wildlife, flora
This is principally covered under the headings of '*Flora*' and '*Fauna*' and to a lesser extent by '*Landscape*', '*Water*' and '*Air*'. The principal issues being to avoid any effects that might reduce the health or extent of the habitats. This can occur either directly, by impinging on the site, or indirectly, through emission, that can affect the natural resources, like clean water, which the habitat depends on. It also considers effect on physical access to and visibility of these sites. Occasionally there are concerns about the disturbance or wear and tear of visitor numbers to such sites.

Interesting history & culture
This is principally covered under '*Cultural Heritage*' and, to a lesser extent, under '*Human Beings*'. The principal issues being to avoid damage to sites and structures of cultural, historical, archaeological or architectural significance – and to their contexts or settings. It also considers effect on physical access to and visibility of these sites. Occasionally there are concerns about the wear and tear of visitor numbers to such sites.

Plenty of things to see and do.
This is not an environmental issue though it is partially covered by the '*Human Beings*' section, where the tourism resources of an area are described and assessed.

Good range of natural attractions
This is covered by the '*Landscape*', '*Flora*', '*Fauna*', and '*Cultural Heritage*' sections of the EIS.

4. Project factors affecting Tourism

Introduction
Tourism can be affected both by the structures or emissions of new developments as well as by interactions between new activities and tourism activities – for example the effects of high volumes of heavy goods vehicles passing through hitherto quiet, scenic, rural areas. Tourism can be affected by a number of the characteristics of the new project such as:

- New Developments
- Social Considerations
- Land-uses and Activities

- *New Developments* - will the development stimulate or suppress demand for additional tourism development in the area? If so, what type, how much and where? Marinas, golf courses, other major sporting facilities as well as theme parks and larger conference facilities can all stimulate the emergence of new accommodation, catering and leisure facilities often within an extensive area around a new primary visitor facility. Extensive urbanisation and large scale infrastructure as well as certain processing and extractive industries all have the potential to suppress demand for additional tourism – but usually only in the immediate locality of the new development. It should be noted however, that some types of new or improved large scale infrastructure – such as roads – can improve the visitor experience – by increasing safety and comfort or can convey a sense of environmental responsibility – such as wind turbines.

- *Social Consideration* - will the development change patterns and types of activity and land use? Will it affect the demographics, economy or social dynamics of the locality?

- *Land-use* - will there be severance, loss of rights of way or amenities, conflicts, or other changes likely to ultimately alter the character and use of the tourism resources in the surrounding area?

Existing Tourism
In the area likely to be affected by the proposed development, the following attributes of tourism, or the resources that sustain tourism, should be described under the following headings.

Note that the detailed description and analysis will usually be covered in the section dealing with the relevant environmental topic – such as '*Landscape*'. Only the relevant finding as to the likely significance to, or effect on, tourism needs to be summarised in this section.

Context
Indicate the location of sensitive neighbouring tourism resources that are likely to be directly affected, and other premises which although located elsewhere, may be the subject of secondary impacts such as alteration of traffic flows or increased urban development. The following should be noted in particular:

- Hotels, conference centres, holiday accommodation – including holiday villages, holiday homes, and caravan parks.
- Visitor centres, Interpretive centres and theme parks
- Golf courses, adventure sport centres and other visitor sporting facilities
- Marinas and boating facilities
- Angling facilities
- Equestrian facilities
- Tourism-related specialist retailers and visitor facilities
- Historic and Cultural Sites
- Pedestrian, cycling, equestrian, vehicular and coach touring routes

Indicate the numbers of premises and visitors likely to be directly affected directly and indirectly.
Identify and quantify, where possible, their potential receptors of impacts, noting in particular transient populations, such as drivers, walkers, seasonal and other non-resident groups.

Describe any significant trends evident in the overall growth or decline of these numbers, or of any changes in the proportion of one type of activity relative to any other.

Indicate any commercial tourism activity which likely to be directly affected, with resultant environmental impacts.

Character
Indicate the occupations, activities or interests of principal types of tourism in the area. – Where relevant, describe the specific environmental resources or attributes in the existing environment which each group uses or values; where relevant, indicate the time, duration or seasonality of any of those activities. For example describe the number of guides, boats and anglers who use a salmon fishery and the duration of the salmon season as well as the quantity and type of local accommodation that is believed to be used by the anglers.

Significance
Indicate the significance of the principal tourism assets or activities likely to be affected. Refer to any existing formal or published designation or recognition of such significance. Where possible provide an estimate of the contribution of such

tourism activities to the local economy. For instance refer to the number of annual visitors to a tourism attraction or to the grading of a hotel.

Sensitivity
Describe any significant concerns, fears or opposition to the development known to exist among tourism interests. Identify, where possible, the particular aspect of the development which is of concern, together with the part of the existing tourism resource which may be threatened. For instance describe the extent of a potential visual intrusion onto a site of historic significance which is the main local tourist attraction.

5. Impacts on Tourism

"Do Nothing" Impact;
Describe how trends evident in the existing environment will continue and how these trends will affect tourism.

Predicted impact;

- Describe the location, type, significance, magnitude/extent of the tourism activities or assets that are likely to be affected.

- Describe how the new development will affect the balance between long-established and new dwellers in an area and it's affect on the cultural or linguistic distinctiveness of an area. For example describe the effect of a new multi-national population required for an international call-centre located in a Gaeltacht area.

- Describe how changes in patterns of employment, land use and economic activity arising from the proposed development will affect tourism, for example, illustrating how a new industrial development will diversify local employment opportunities thereby reducing the area's unsustainable over-reliance on seasonal tourism.

- Describe the consequences of change, referring to indirect, secondary and cumulative impacts on tourism; Examples can include describing how the new development may lead to a reduced assimilative capacity for traffic or water during the peak of the tourism season or how new urbanism combined with existing patterns of tourism may lead to unsustainable levels of pedestrian traffic through a sensitive habitat.

- Describe the potential for interaction between changes induced in tourism and other uses that may affect the environment – for instance increasing new tourism-related housing affecting water resources or structures

- Describe the worst case for tourism if all mitigation measures fail.

6. Mitigating adverse impact on Tourism

Describe the mitigation measures proposed to:

- *avoid* sensitive tourism resources – such as views, access, and amenity areas including habitats as well as historical or cultural sites and structures.

- *reduce* the exposure of sensitive resources to excessive environmental burdens arising from the development's emissions or volumes of traffic [pedestrian and vehicular], and/or losses of amenity arising from visually conspicuous elements of the development – for example by prioritizing visual screening of views from a hotel towards a quarry.

- *reduce* the adverse effects to tourism land uses and patterns of activities – especially through interactions arising from significant changes in the intensity of use or contrasts of character or appearance – for example by separating traffic routes for industrial and tourism traffic.

- *remedy* any unavoidable significant residual adverse effects on tourism resources or activities, for example by providing alternative access to tourism amenities – such as waterways or monuments.

Seirbhís Sláinte Comhshaoil - Sligeach / Liatroma / Iarthar an Chabháin
Ard Eoghain, Sligeach F91T25N
Tel: 071 91 45132

Environmental Health Service – Sligo / Leitrim / West Cavan,
Ardaghowen, Sligo F91T25N
Sligo.PEHO@HSE.ie

Environmental Health Service Consultation Report

(as a Statutory Consultee under the Planning and Development Acts 2000 (as amended)& Regulations made thereunder)

Report to: McCarthy Keville O Sullivan Ltd,
Block 1,
GFSC,
Moneenageisha Road,
Galway.

Type of consultation: Scoping

Planning Authority: Leitrim Co Co

Reference Number: Not Assigned. Application has not been made. Proceedings are at scoping stage as of yet.

EHIS Reference number: 0875

Applicant: Coillte

Proposed Development: Wind Farm at Carrane Hill, Garvagh, Killavoggy, Co. Leitrim.

Dear Sir/Madam,

The "Environmental Impact Assessment Scoping Document – Proposed Croagh Wind Farm, Co. Leitrim" (*File name - 181212 ENCH Scoping Document F – 180511*) has been read and the proposals, research work, studies and methodologies stated therein to be included in the final EIAR to accompany any future planning development are taken as given.

The possible impacts likely to be caused and the proposed mitigation measures under the following headings -

- Population and Health including shadow flicker
- Biodiversity: Flora and Fauna
- Biodiversity: Birds
- Land, Soils and Geology
- Hydrology and hydrogeology

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- Air and Climate
- Noise and Vibration
- Landscape and Visual;
- Archeological, Architectural and Cultural Heritage
- Material Assets
- Interaction of the Foregoing

will be awaited in the final submitted EIAR.

We will have particular interest in environmental impact studies, methodologies and proposed mitigation measures in the areas of ground and surface water quality and protection, at construction, operational and decommissioning phases. We would recommend that all surface waters and private wells affected be identified and that qualitative analysis of both surface and ground waters be as current as possible.

Likewise we will look with interest on studies, methodologies and proposed mitigation in the area of air pollution, particularly during construction and decommissioning.

We will also welcome details of surveys outlining impacts methodologies and mitigation measures in the area of noise and vibration, at construction operation and decommissioning stages. On the subject of noise surveys we would welcome actual "on the ground" noise readings at Noise Sensitive Locations when assessing background noise data, rather than a total reliance on modelled predictions. We would particularly welcome commentary on the cumulative noise environment at this general location due to the existence of wind farms already in the area. We would welcome undertakings for noise surveys in the future were the development to proceed.

We will welcome detailed studies and proposed mitigation measures in relation to peat stability particularly at construction but also at other later stages of the life of the site.

For the construction stage we would welcome an outline of staff numbers to be involved on site including details of staff facilities for resting, dining, water consumption and sanitary facilities and methods of disposal of staff generated waste.

Yours truly

Finán Ó Gallchobhair

Principal Environmental Health Officer

Lorraine Meehan

From: Ronnie O'Neill [mailto:Ronnie.ONeill@imaginegroup.ie]
Sent: 15 August 2018 12:02
To: Lorraine Meehan <lmeehan@mccarthykos.ie>
Cc: Miriam Casey <Miriam.Casey@imaginegroup.ie>; Karien Heron <Karien.Heron@imaginegroup.ie>
Subject: Re: FW: 180511 Carrane Hill WF, Co Leitrim

Hi Lorraine ,

Imagine have no network in this area .

Rgds,
Ronnie .

Iascach Intíre Éireann
Inland Fisheries Ireland

7th February 2019

Re. Project number 180511 Scoping Request for Croagh Windfarm.

Dear Sir/Madam,

Inland Fisheries Ireland has considered the preliminary information provided in relation to this scoping request and has the following comments to make. The information available to IFI about the proposed development at this stage is very limited and all comments below are made in this context.

Inland Fisheries Ireland, IFI (formerly the Central and Regional Fisheries Boards) is a statutory agency with responsibility under the provisions of the Fisheries Acts for the protection, management and conservation of Ireland's inland fisheries resource.

The area proposed for the development of this windfarm falls within two River Basin Districts and would therefore be within the jurisdiction of IFI Shannon RBD (Drumsna) and IFI Western RBD (Ballina) this is a joint submission from both RBD's, however all correspondence should continue to be sent to both the undersigned at the addresses below.

This proposed development spans a number of tributaries of the Bonet River which provides habitat for salmon, trout and perch. These tributaries provide valuable salmon and trout spawning and nursery habitat, which supports the Bonet River, Lough Gill and Garvogue River fisheries. This system is under environmental pressure and salmon stocks have now fallen below their conservation limit, i.e. the number of spawning salmon required to maintain the fishery. As a result angling in the system is now limited to catch and release only after the 12th May, this is a measure introduced to support the recovery of this natural resource. This site is directly hydrologically linked to the Lough Gill Special Area of Conservation which is designated for the protection of Atlantic salmon, white-clawed crayfish and lamprey species.

The Arigna holds good stocks of wild brown trout and the upper reaches of the Arigna River are important for spawning trout, the Arigna River also supports a variety of coarse fish (downstream of Arigna). The Arigna River flows into Lough Allen. Lough Allen supports stocks of the rare endangered and protected species Pollan, listed and protected under Annex 5 of the Habitats Directive. The Irish Pollan (*Coregonus Pollan)* is unique to the Island of Ireland with its current known distribution being limited to five lakes, Lough Neagh, Lower Lough Erne, Lough Ree and Lough Derg (Rosell *et al*. 1997) and Lough Allen (Harrison *et al.* 2009).

The Arigna River is popular with recreational anglers with the main trout angling stretches on the Arigna River upstream of Mount Allen bridge on the Drumkeeran road and downstream of the village of Arigna.

Iascach Intíre Éireann
Inland Fisheries Ireland

Instream works or other works that may give rise to high suspended solids in close proximity to these watercourse or may impact on the Bonet and Arigna Rivers, their tributaries and other salmonid tributaries will be subject to the closed season (i.e. they cannot take place from 1st October to 30th April, note this date may be extended by Legislative changes in the future.) This is to avoid impacting on the aquatic habitat during the spawning season, and to reduce the potential impact on salmon and trout populations. It would be important that appropriate scheduling of works is allowed for.

In September 2008, the Owengar River was severely polluted as a result of a catastrophic landslide caused by construction activities in association with wind farm and site road construction close to the Upper reaches of the Owengar River in Garvagh Glebe, Drumkeerin, Co. Leitrim. Water samples showed the impact of the pollution spread downstream through the Owengar River as far as Lough Allen over 9 kilometres downstream. The resulting pollution resulted in a fish kill of thousands of fish, mainly brown trout. The peaty material which was displaced into the watercourse led to the destruction of fisheries habitat on a massive scale. It will take many years for the impacted section of the river to recover.

IFI is seriously concerned over the potential for landslides in this area, based on the occurrence of two landslides in close proximity to this site during the construction and clear felling for the neighbouring Garvagh Glebe windfarm, which resulted in significant damage to the fisheries resource and water quality in the Owengar River. The Geological Survey of Ireland have also identified numerous landslides in this area, indicating significant risks from activities involved large scale earth works such as windfarms.

IFI require that an EIA will be produced for the development to measure and identify its potential impacts on the aquatic environment and mitigate against these to ensure that any impact is minimal or non-existent. The EIA must also consider the following:

1. All watercourses that will receive drainage from the construction sites of the turbines or the access roads must be assessed in terms of aquatic biodiversity with particular emphasis on fish, the food of fish, spawning grounds and fish habitat in general. In this regard changes to river morphology should be avoided.

2. The aquatic habitat and physical nature of any watercourse affected by the development must be fully described in detail. This includes areas of open water, pool riffle glide sequences, density and types of aquatic vegetation, description of riparian zones to depth of at least 10 metres on either bank etc. The extent of the surveys should be sufficiently long enough so as to be representative of the habitat contained in that watercourse. There should be a particular focus on sections upstream and downstream of any point where an impact on the watercourse is likely to arise. It may be appropriate to survey a tributary stream and the larger, more important streams it joins, and assess the effect the discharge might further have on biodiversity and fisheries in the larger streams. Surveys of un-impacted (control) streams should also be included in the Environmental Impact Assessment.

3. Electrofishing surveys will be required for all waters. Quantitative data in relation to all fish species should be compiled. The presence of salmonid species, crayfish and lamprey species will be of particular concern. In undertaking the electrofishing survey only experienced personnel should be employed. Appropriate permits for electrofishing must be obtained from the Department of Communications, Energy and Natural Resources. Authorised personnel must ensure that they comply with all the conditions contained in the permit.

4. IFI is concerned about soils, their structure and types around all the turbines, turbine pads, associated access roads and site development. A detailed geotechnical survey must be carried out by a qualified professional. The survey must include the impact that works on both the turbines, settlement ponds and access roads and other activities associated with windfarm construction will have either directly (excavations and depositions) or by vibration on the stability of the soils taking into consideration site slope, peat depth and soil type. IFI has serious concerns where it is proposed to construct wind turbines on peat soils especially if these peat soils are located on upland areas.

5. Excessive slopes will be an issue with all wind farm proposals regardless of soil type. The potential for soil movement and landslides should be assessed fully within the EIS.

6. Particular attention should be paid to the hydrology of any site where excavations including excavations for road construction are being undertaken. It is important that natural flow paths are not interrupted or diverted in such a manner as to give rise to erosion or instability of soils caused by an alteration in water movement either above or below ground.

7. Drainage systems must ensure collected waters are returned to the original catchment. A drainage plan should be produced during both the construction phase and the operational phase. This includes waters being pumped from foundations or other excavations. It is particularly important during the construction phase that sufficient retention time in the settlement pond is available to ensure no deleterious matter is discharged to any waters. Settlement ponds must be maintained during the operational phase to allow for the adequate settlement of suspended solids and sediments and prevent any deleterious matter from discharging into any natural waters. In constructing and designing silt traps particular attention should be paid to rainfall levels and intensity. The silt traps should be designed to minimise the movement of silt especially during intense precipitation events where the trap maybe hydraulically overloaded. It is essential that they are located with good access to facilitate monitoring sampling and maintenance.

8. IFI has serious concerns about the construction of roads as these will tend to provide preferential flow paths for surface waters. Considerable attention to detail must be provided in relation to the interception of surface water flows. Our concerns in relation to deleterious matter have been referred to above, but we also have concerns in relation to the flow patterns and to ensuring that normal flows are maintained both during and after

construction. Situations can arise where water transportation is significantly increased in certain watercourses thereby putting additional pressures on watercourses and interfering with the sustained flow of water particularly during dry weather. This must be prevented.

9. Serious consideration must be given to the disposal of all waste materials such that they will not give rise to any risk. In terms of risk, the placing of soils on adjacent ground should not be permitted unless all the area has been the subject of an in-depth risk assessment. This is of particular concern where peat soils are encountered. Furthermore drainage from disturbed and stockpiled soils will have to be considered in advance. It may be essential to carry out soil stockpiling operations in confined areas only and to ensure vegetation of the soils with suitable plants which will promote stability. Consideration must be given to leachate from any stockpiles.

10. Details in relation to site offices and associated services should form part of the EIA. In addition details relating to operations during the construction phase to contain pollutants should also be considered. It should be noted that cement leachate, hydrocarbon oils and other toxic poisonous materials will require full containment and should not be permitted to discharge to any waters. Please note that physical pollution of watercourses in terms of dumping of unsuitable gravel material or other construction debris in or stockpiling such materials near watercourses is not acceptable as this will interfere with the aquatic habitat.

11. Cabling and other works required for grid connection and the associated potential impacts should be fully considered within the EIA.

12. The use of sedimentary rocks, such as shale, in road construction should be avoided. This type of material has poor tensile strength and is liable to be crushed by heavy vehicles thereby releasing fine sediment materials into the drainage system which are difficult to precipitate and may give rise to water pollution. Specialist expertise should inform the type of material required for road construction bearing in mind the pressures that will arise during the construction phase and the necessity to avoid pollution due to fines washing out into the roadside drainage.

13. In relation to watercourse crossings please be advised that the IFI must be consulted a minimum of four weeks in advance in relation to all crossings of any watercourse or the use of any temporary diversions. The number and extent of watercourse crossings should be kept to a minimum. Instream structures or bridge crossings must be approved by IFI. In particular in designing crossings the length, slope and width of any instream structure will be important and should mimic the natural channel. Clear span bridges are the preferred option for all crossings especially in upland areas.

Iascach Intíre Éireann
Inland Fisheries Ireland

14. The EIS should indicate proposals to monitor the impact on all watercourses within the site. In the event that environmental damage to the aquatic habitat and associated riparian zone is caused, the EIS should indicate the steps that may be taken to rectify any damage to the aquatic habitat, including liaison with the appropriate authorities. In relation to wind farm structures and infrastructure it is important that a sufficient bank side riparian zone is maintained to absorb and attenuate overland flows. In deciding the extent of this riparian zone the following factors would be important.
    1. Type of soil and its depth and strength especially if the development is on an upland peat bog area.
    2. Stock piling or spreading of spoil on unstable soils especially if the soil is peat with a depth greater than 1metre thick. (Geotechnical survey and assessment at every stage of operation is essential).
    3. Degree or extent of the slope.
    4. Variations in the topography that will give rise to point flows (keep flow as diffuse as possible).
    5. Extent and nature of catchment above the area of operation. In particular meticulous care should be paid to avoid interfering with the catchment and altering the direction of flow, perhaps to another catchment.
    6. The importance of the water in fisheries and biodiversity terms. With reference to the aquatic habitat the impact over a distance downstream must also be kept in mind.
    7. Any other factors that will cause a deleterious effect to the watercourse.

With the above in mind for small streams in upland areas a distance of at least 50 metres (excluding watercourse crossings) should be considered as a bare minimum for a riparian zone free from any development. This should be increased if the factors above are involved and will require site specific survey.

This type of development will comprise works at a number of locations, but the entire development should be considered as a single site. Discussions should take place with the Environmental Section of the relevant County Councils regarding such discharges. All effluent should comply with appropriate quality standards. Cumulative effects of all discharges to each watercourse should be considered in the context of the Water Framework Directive, in this regard you may also need to refer to Roscommon County Council in relation to the Arigna River.

The discharge of polluting or deleterious matter to any watercourse except under and in accordance with a licence may be an offence under the Inland Fisheries Acts and/or under the Water Pollution Acts. It should be noted that even if an effluent does generally comply with the quality standards contained in a licence it may still cause pollution if the receiving water cannot provide sufficient assimilative capacity. With this in mind the environment impact assessment should also focus on the physical characteristics of watercourses and their ability to assimilate any pollutants discharged from the site, including the discharge of water from any foundation works.

Should works be approved a detailed method statement addressing the issues outlined above, including all mitigations measures, precautions and environmental incident procedures must be forwarded to and agreed with Inland Fisheries Ireland before works commence.

IFI look forward to further consultation upon receipt of more detailed information specific to this site. It should not be considered that addressing all of the above issues will influence the IFI in any decision it may make in relation to any development. Our concern is to protect the aquatic habitat, including water quality and the related riparian zone which is important in relation to the food of fish. The IFI reserves the right to request additional information in relation to the development should further points arise.

At all times the precautionary principle should be applied throughout for the entire development. Particular attention should be paid to the various environmental directives including the Water Framework Directive. The Inland Fisheries Acts in particular and the Local Government (Water Pollution) Acts and all other environmental legislation should be considered as appropriate. Site management and drainage of the site are crucial and with this in mind a Construction environment management plan, Surface Water Management Plan, Peat Management Plan, including any plans for borrow pits or peat deposition sites and Emergency Response plan must be produced to outline the control and management of these issues on site, especially during the construction phase. These issues should also receive due consideration when preparing and EIA.

A Construction Environmental Management Plan should be produced for the project to include strict control measures to prevent pollution of the aquatic environment during construction and submitted as part of any planning application.

An invasive species survey should be carried out and where species are identified a management plan must be drawn up. Provisions for biosecurity of the aquatic habitat should be included in the EIA.

All works should adhere to IFI's Guideline documents on road construction (attached) and Guidelines on protection of fisheries during construction work in and adjacent to waters http://www.fisheriesireland.ie/fisheries-and-construction-works.

Iascach Intíre Éireann
Inland Fisheries Ireland

We recommend that the above issues should be amongst the issues addressed in a comprehensive manner in the EIA. This concludes our observations at this time. Please do not hesitate to contact the undersigned should you have any queries.

Yours sincerely,

Catherine Kerins
Senior Fisheries Environmental Officer
Drumsna
Carrick on Shannon
Co. Leitrim

Aisling Donegan
Senior Fisheries Environmental Officer
Ardnaree House
Abbey Street, Ballina
Co. Mayo

Irish Aviation Authority
The Times Building
11–12 D'Olier Street
Dublin 2, D02 T449,
Ireland

Údarás Eitlíochta na hÉireann
Foirgneamh na hAmanna
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www.iaa.ie

03rd January 2019

McCarthy KOS
Received on
04 JAN 2019
180511
Lorraine Meehan

Ms Lorraine Meehan
McCarthy Keville O Sullivan
Planning & Environmental Consultants
Block 1, G.F.S.C.
Moneenageisha Road,
Co Galway

Development: ***The proposed Creagh Wind Farm, located approximately 3.8 kilometers west of Drumkeeran, Co. Leitrim. The majority of the site is located within Co. Leitrim, with the southern extent of the site extending into Co. Sligo. Ref: 180511***

Dear Lorraine

I refer to the request for planning permission for the above development, details of which were received by the Irish Aviation Authority from your company.

It is the observation of the Irish Aviation Authority that in the event of planning consent being granted, the applicant should be conditioned to contact the Irish Aviation Authority to:
(1) Agree an aeronautical obstacle warning light scheme for the wind farm development,
(2) Provide as-constructed coordinates in WGS84 format together with ground and tip height elevations at each wind turbine location

Turbine No.	*WGS-84 Co-ordinates*	*Ground elevation (Malin Head OD)*	*Blade tip elevation of turbine (Malin Head OD)*	*Height of turbine (height from ground level to blade tip)*	*Confirm if turbine has obstacle lighting.*
T1	53.346125, -6.258288	75m	225m	150m	No

(3) Notify the Authority of intention to commence crane operations with a minimum of 30 days prior notification of their erection."

Yours sincerely

pp:

Deirdre Forrest
Corporate Affairs

Bord Stiúrthóirí/Board of Directors
Michael McGrail (Cathaoirleach/Chairman),
Peter Kearney (Príomhfheidhmeannach/Chief Executive)
Marie Bradley, Ernie Donnelly, Michael Norton

Oifig Chláraithe:
Foirgneamh na hAmanna, 11-12 Sráid D'Olier
Baile Atha Cliath 2, D02 T449, Éire
Uimhir Chláraithe: 211082. Áit Chláraithe: Éire
Cuideachta Dliteanais Theoranta

Registered Office:
The Times Building, 11-12 D'Olier Street
Dublin 2, D02 T449, Ireland
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IRISH PEATLAND CONSERVATION COUNCIL

COMHAIRLE CHAOMHNAITHE PHORTAIGH NA hÉIREANN

Lullymore, Rathangan, Co. Kildare, Ireland R51 V293 Tel/*Teil*: +353-(0)45-860133
Liolach Mór, Rath Iomgáin, Co. Chill Dara, Éire, R51 V293 e-mail/*ríomhphost*: bogs@ipcc.ie web/*idirlíon*: www.ipcc.ie

Lorraine Meehan
McCarthy Keville O'Sullivan Ltd
Block 1, G.F.S.C
Moneenageisha Road
Galway
lmeehan@mccarthykos.ie

11th January 2019

Re: Proposed Croagh Wind Farm - County Leitrim

Dear Ms Meehan,

Thank you for consulting the Irish Peatland Conservation Council regarding the proposed Croagh Wind Farm. The Irish Peatland Conservation Council (IPCC) was established in 1982 and has 35 years of experience in peatland conservation. Our aim is to conserve a representative sample of intact peatlands. While it has been estimated that only 1% of Ireland's original extent of raised bogs remain, only 10% of this remains in a conservation worthy state. This is due to a number of factors including domestic/industrial peat extraction and habitat fragmentation (*Ireland's Peatland Conservation Action Plan 2020*, Malone & O'Connell, 2009).

Our work is guided by our 6th Action Plan, *Ireland's Peatland Conservation Action Plan 2020*, which was published in 2009. A copy of this document is available for download on our website at www.ipcc.ie. Many of the actions in our plan have been included within the National Peatlands Strategy which has been adopted by every Government Department and Local Authority. The National Peatlands Strategy can be downloaded from www.npws.ie.

Legal Obligations to Protect Peatlands - County Leitrim
We are legally bound by National and European legislation (The Wildlife Acts, E.U. Habitats and Bird's Directives) and international conventions (Ramsar, Bern Convention, Convention on Biological Diversity) to do our utmost to protect peatlands now and for future generations. In County Leitrim specifically, only 6.65% of the original extent of raised bog remain intact and only 20.72% of blanket bog remain intact (Bogs & Fens of Ireland Conservation Plan 2005, Foss, O'Connell, Crushell, 2001). Peatland habitats have been severely diminished in the country and this destruction is an issue in other legislation and conventions such as the UN Convention on Climate Change, Bonn Convention, World Heritage Convention, Water Framework Directive, Environment Liability Directive, Planning and Development Acts, National Monuments Acts, Environmental Directive, EIA and SEA. All of these legislative instruments have been adopted by Ireland and the IPCC ask that you assess your development with regard to these legal obligations.

Bogland
The IPCC would advise any developer planning construction in, or within close proximity to peatland habitat to be familiar with the Environmental Protection Agency funded project BOGLAND (www.ucd.ie/bogland). This project recommends the best practice guidelines to ensure no damaging development occurs on, or affects peat soils and peatlands of conservation/biodiversity value. We urge developers to properly assess and screen for any adverse impacts on the habitat or species utilising them that may occur during the construction of any infrastructural development such as solar farms. We would also implore developers to have proper plans in place for the habitat regarding after-use rehabilitation/restoration. The IPCC could not support a development that does not plan in a conservation responsible manner.

Designated Sites (Map 1)

There is a number of designated sites within 15km of the proposed wind farm. The sites within the immediate vicinity are...

Charity No/*Uimhir Carthanacht*: CHY6829 Registered in Ireland No/*Uimhir Cláraithe in Éirinn*: 116156 Registered Office/*Oifig Cláraithe*: Lullymore, Rathangan, Co. Kildare, R51 V293, Ireland
Governance Code Statement of Compliance: IPCC confirm that our organisation complies with The Governance Code for the Community, Voluntary and Charitable Sector in Ireland.

Company Secretary/*Rúnaí Comhlacht*: Rachel Kavanagh
Directors/*Stiúrthóirí*: Martin Kelly, Catherine O'Connell, Rachel Kavanagh, Jennifer Roche, Seán Ó Fearghail,

Patrons/*Pátrúnaí*: Pauline Bewick, Don Conroy, HRH Princess Irene of the Netherlands,
Eanna Ní Lamhna, Matthijs Schouten, His Excellency Mr Peter Kok Netherlands Ambassador to Ireland

Corry Mountain Bog NHA :- This site is an upland blanket bog and is already threatened and sustaining damage from peat cutting, grazing and a wind power generation facility. The site is utilised by Red Grouse (Annex II(I), III(II) of the EU Birds Directive, Hen Harrier (Annex I of the EU Birds Directive) and Golden Plover (Annex I, II(II), III(III) of the EU Birds Directive.

Carrane Hill Bog NHA :- Peat cutting, grazing, quads and forestry (some of which has failed) have all been listed as damaging activites within the NPWs site synopsis for this designated area.

Kilronan Mountain Bog NHA :- Habitat loss within this protected site has been caused by afforestation, peat cutting, burning and grazing. There has also been habitat loss from a wind farm installation. Altogether they have altered the hydrology of the site locally.

There are many sites which will be connected hydrologically to the location of the proposed wind farm, such as Meharth Lough (sitecode 01900) which contains rare fen habitat and is sensitive to any nutrient or hydrological changes.

Curlew (Map 2)
The Curlew is one of the most endangered species in Ireland and the breeding population has declined by 78% over the past 40 years with less than 130 breeding pairs left (Birdwatch Ireland I-WeBS Newsletter August 2017). The IPCC would like to remind you that this bird is listed as an ANNEX II section II bird species within the E.U. Birds Directive [Council Directive 79/409/EEC] and also has a national status of Red on the Birds of Conservation Concern in Ireland list. The National Curlew Task Force is working to bring this species back from near extinction in Ireland and we would urge developers to liaise with them. The conservation of this species is of utmost concern. There is currently a national initiative to protect this species. Map 2 shows the locations of previous curlew sightings (data from National Biodiversity Data Center).

Water Quality (Map 3)
Ireland has an obligation under the Water Framework Directive to ensure that our waterways are of "Good Ecological Status". The river network around the vicinity of the proposed site are varied in quality, ranging from poor to high. We would insist that, at the pre-planning stage, the effects of the construction and operation of a wind farm at Croagh will have on water quality be fully investigated. Please ensure that there will be adequate testing and contingency plans in place to make certain that these rivers are not damaged by developments but improved hydrologically and ecologically. There may also be waterways which have not been assigned or tested with the EPA's WFD programme and these should be monitored also for baseline levels and continuous assesment. Any affected river routes may also damage protected sites further afield which would be disastrous for Ireland's designated area network.

BirdWatch Ireland Species Sensitivity to Windfarms Score (Map 4 & 5)
The proposed site is overlapping with an area that BirdWatch Ireland has deemed sensitive to wind farm development as it would affect any Curlew in the area. The proposed site is also surrounded by areas regarded sensitive to wind farm development due to the species and habitats recorded.

Wetland Surveys Ireland (Map 6)
Wetland Surveys Ireland have data pertaing to the location of a number of wetland sites local to the proposed development. Please ensure that these sites have been given a full ecological and hydrological survey to guarantee that there will be no important species or habitats lost through poor development. Please liaise with Wetland Surveys Ireland about these sites.
WMI_LE321, WMI_LE322, WMI_LE320, WMI_LE378, WMI_SO346, WMI_LE323

Geological Survey of Ireland Landslide Susceptibility (Map 7)
This map shows that there is a high chance landslide events may occur within the locality of the proposed wind farm. Landsides are disastrous for wildlife (aquatic and terrestrial).

EPA National Soils DB - Peat
Most of the footprint of the proposed windfarm is situated on peat soils. Peat is very sensitive to development and will require extra stringent planning procedures. Peat sediments can make their way into the river network, pollution from construction spillages can affect the peatland flora and fauna and peat slippages may occur.

Invasive Species
Please refer to www.npws.ie, National Biodiversity Action Plan 2017-2021 and Ireland's Peatland Conservation Action Plan 2020 for information regarding the need to control invasives. Peatlands are susceptible to invasive species during and after construction works due to the use of vehicles from other construction sites that carry foreign soil into the area, increased traffic and damage/drainage to peatland. Any development planned on or near peatland should have a management plan in place to eliminate the risk of alien species and protect Ireland's native biodiversity through not only the construction phase but also the operational stage.

County Leitrim Development Plan
Map 9 shows that the proposed site is situated within an area described within the Counties Development Plan as an Area of High Visual Amenity and is surrounded by Areas of Outstanding Views.

Conclusion

The IPCC could not support this development as there is little intact blanket bog left in County Leitrim. The proposed site is situated in the middle of a vast area of protected reserves which already have many threats and pressures. The NPWS state in Site Synopses for the adjacent designated sites that wind power generation has already caused loss of habitat. This is unacceptable. The construction work and transport/access roads will cause more fragmentation to designated sites and the NPWS state "long term survival (of the designated areas) requires sensitive management".

As native breeding Curlew are extremely rare and the proposed footprint of the site is within an area deemed to be sensitive to wind farm development for Curlew the IPCC would not see it is a good idea to erect wind farms in this area. Curlew are extremely site loyal and any disturbance is likely to affect their behaviour in a way that is detrimental to the populations survival.

There is a high chance of landslides due to the area being upland peatland and as assessed by the Geological Survey of Ireland. This adds unnecessary risk to the protected sites adjacent to the proposed wind farm.

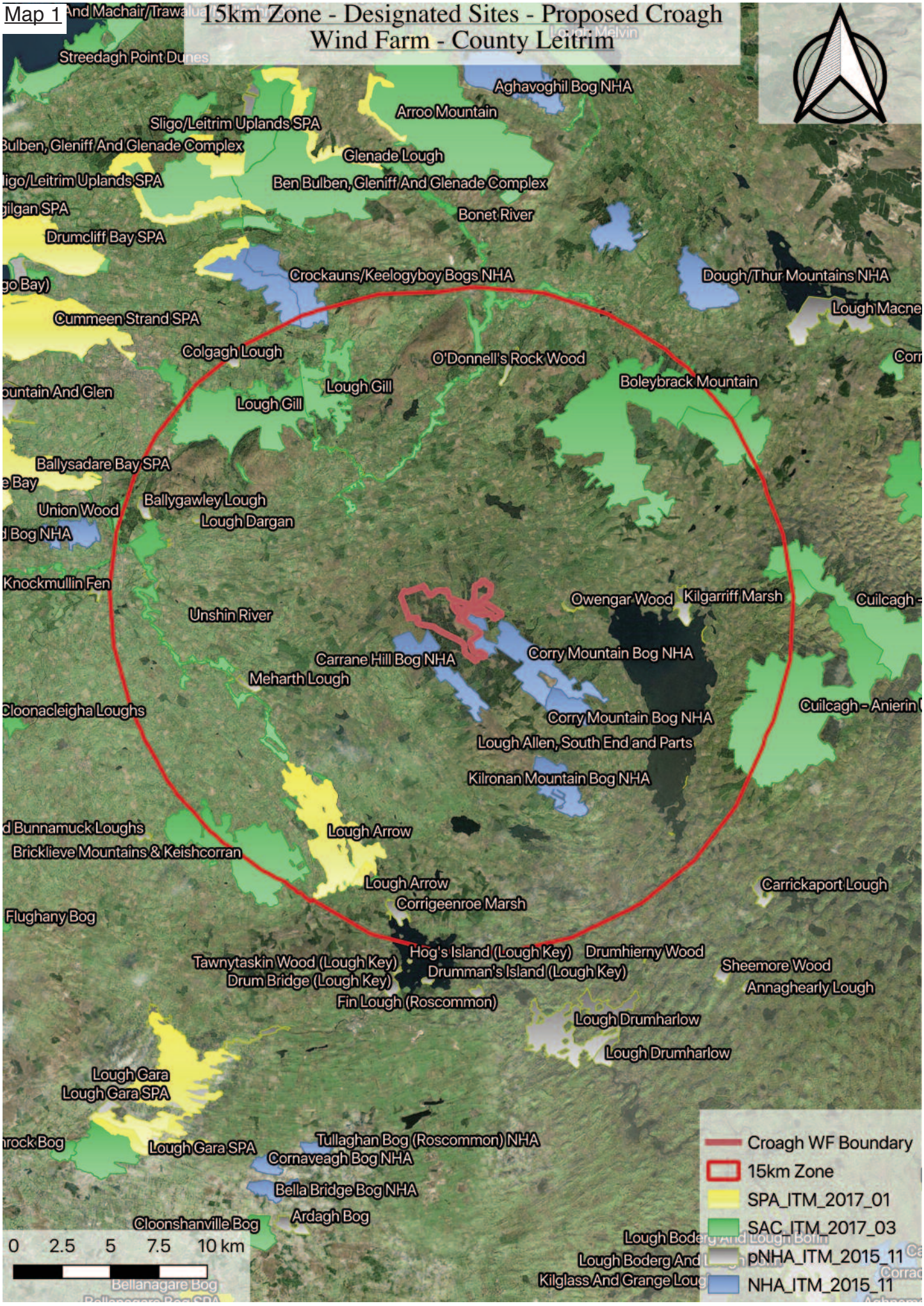
The County Development Plan describes the proposed site as being within Areas of Outstanding Views & Prospects and is an Area of High Visual Amenity. There are already windfarms in this area and any more is going to disrupt the intact wilderness.

Thank-you for taking the time to read this and please inform me if this project goes to planning.

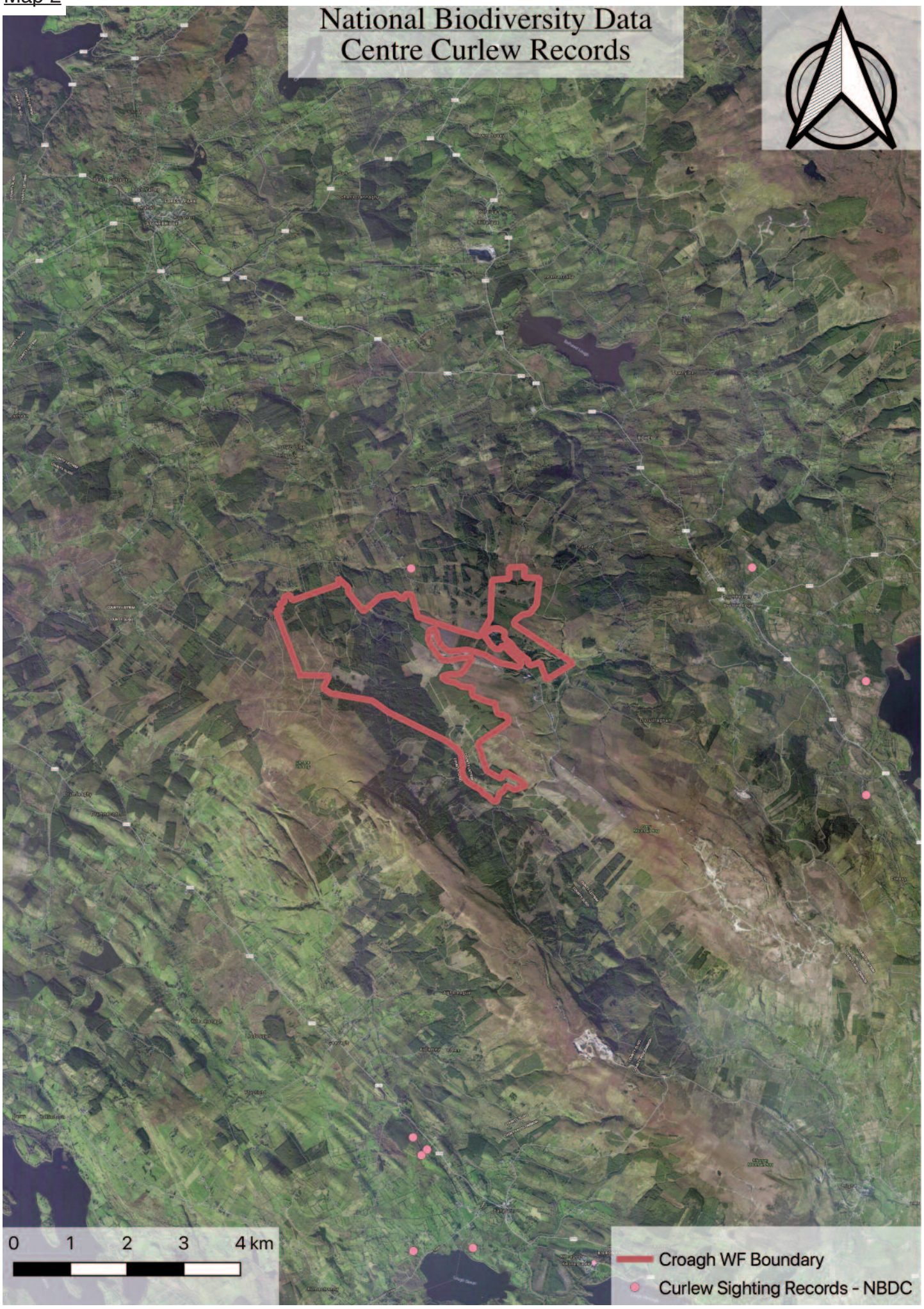


Tristram Whyte B.Sc (hons)
Conservation Policy & Fundraising Officer

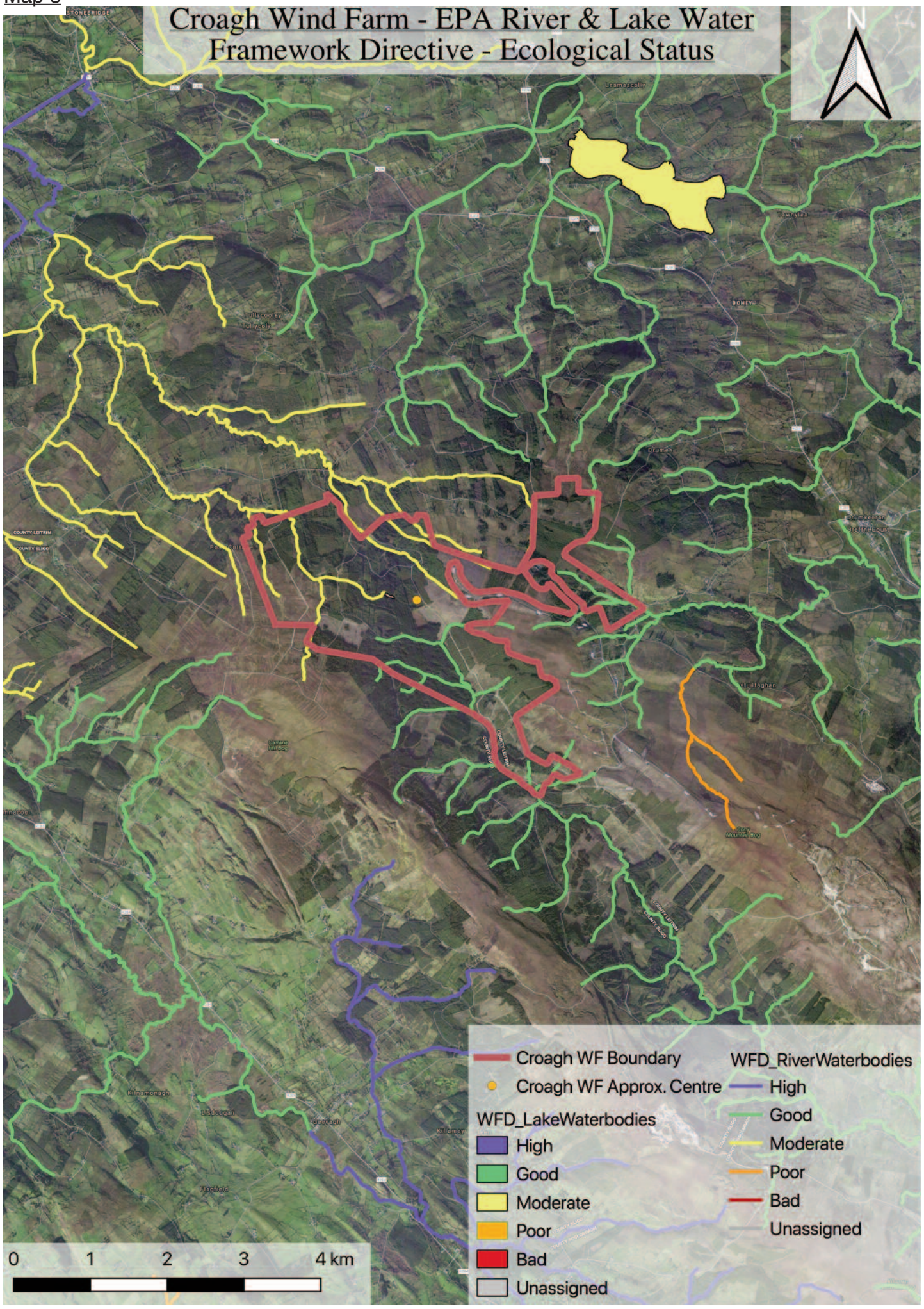
Map 1


15km Zone - Designated Sites - Proposed Croagh Wind Farm - County Leitrim
Streedagh Point Dunes
Aghavoghil Bog NHA
Arroo Mountain
Sligo/Leitrim Uplands SPA
Glenade Lough
Ben Bulben, Gleniff And Glenade Complex
Bonet River
Drumcliff Bay SPA
Crockauns/Keelogyboy Bogs NHA
Dough/Thur Mountains NHA
Cummeen Strand SPA
Colgagh Lough
O'Donnell's Rock Wood
Boleybrack Mountain
Lough Gill
Ballysadare Bay SPA
Ballygawley Lough
Union Wood
Lough Dargan
Knockmullin Fen
Owengar Wood
Kilgarriff Marsh
Unshin River
Carrane Hill Bog NHA
Corry Mountain Bog NHA
Meharth Lough
Cloonacleigha Loughs
Lough Allen, South End and Parts
Kilronan Mountain Bog NHA
Lough Arrow
Bricklieve Mountains & Keishcorran
Carrickaport Lough
Corrigeenroe Marsh
Flughany Bog
Hog's Island (Lough Key)
Drumhierny Wood
Tawnytaskin Wood (Lough Key)
Drumman's Island (Lough Key)
Sheemore Wood
Drum Bridge (Lough Key)
Annaghearly Lough
Fin Lough (Roscommon)
Lough Drumharlow
Lough Gara
Lough Gara SPA
Tullaghan Bog (Roscommon) NHA
Cornaveagh Bog NHA
Bella Bridge Bog NHA
Ardagh Bog
Cloonshanville Bog
Bellanagare Bog
0 2.5 5 7.5 10 km
Croagh WF Boundary
15km Zone
SPA_ITM_2017_01
SAC_ITM_2017_03
pNHA_ITM_2015_11
NHA_ITM_2015_11

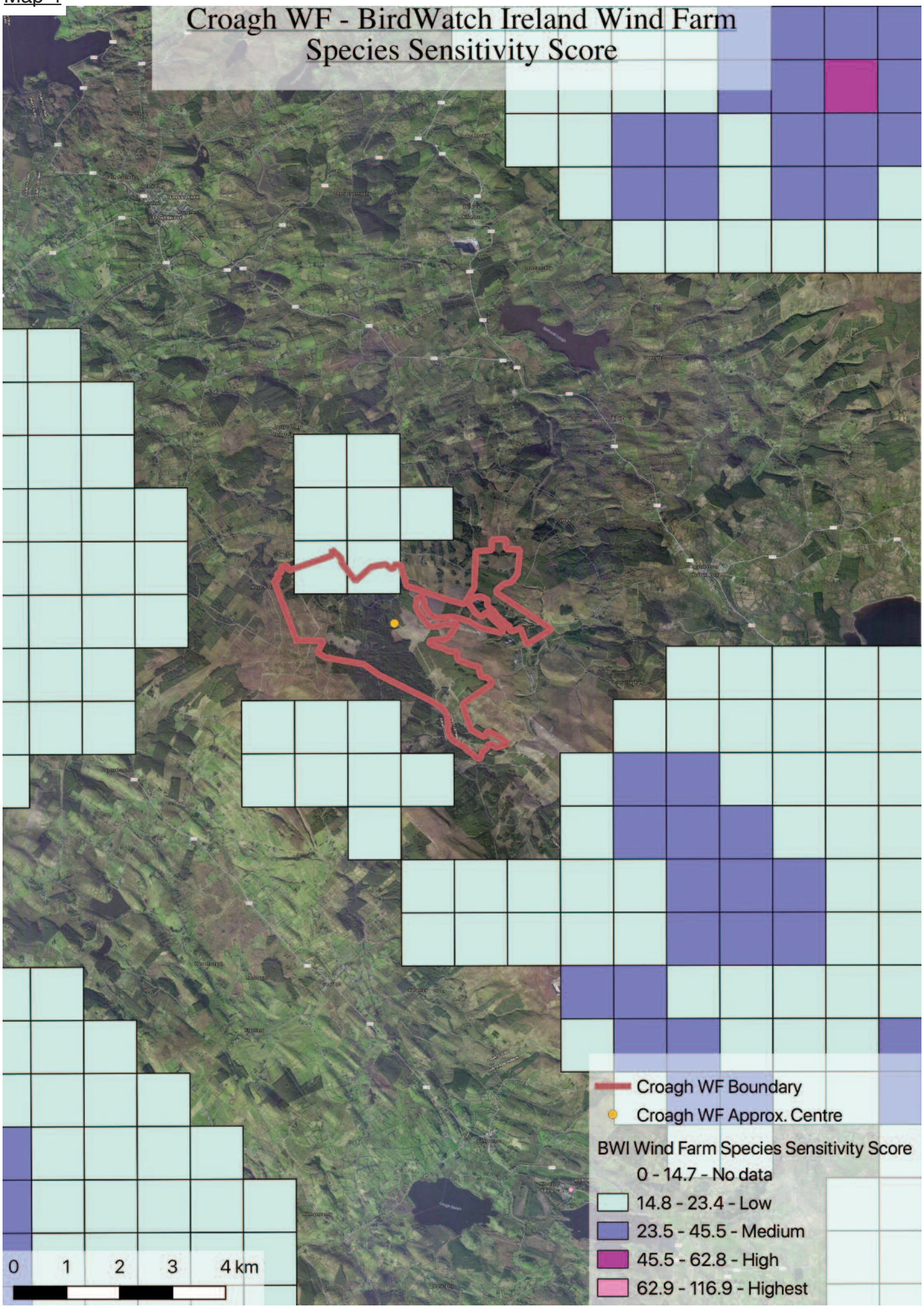
Map 2


National Biodiversity Data Centre Curlew Records
0 1 2 3 4 km
Croagh WF Boundary
Curlew Sighting Records - NBDC

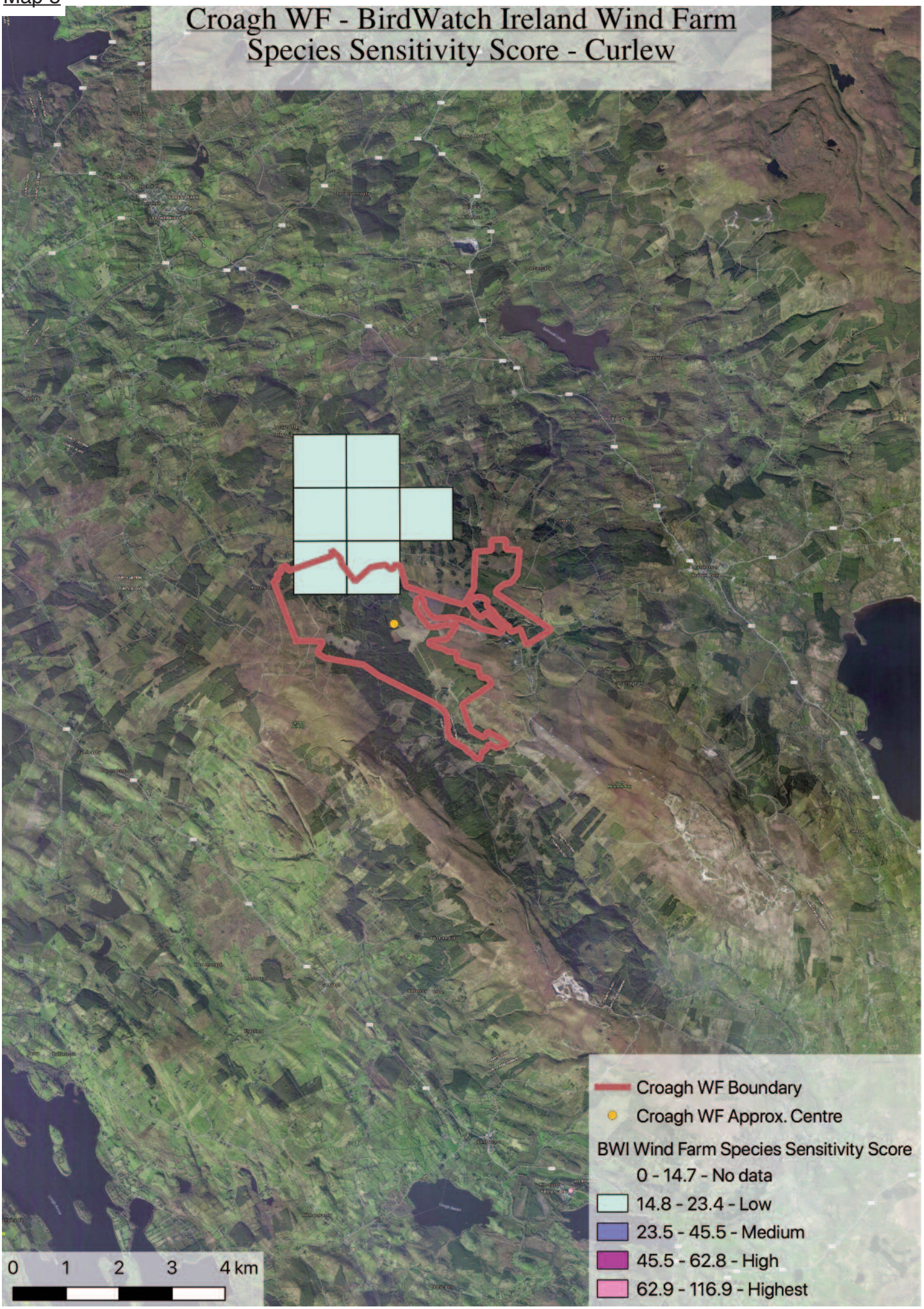
Map 3


Croagh Wind Farm - EPA River & Lake Water Framework Directive - Ecological Status
N
Croagh WF Boundary
Croagh WF Approx. Centre
WFD_LakeWaterbodies
High
Good
Moderate
Poor
Bad
Unassigned
WFD_RiverWaterbodies
High
Good
Moderate
Poor
Bad
Unassigned
0
1
2
3
4 km

Map 4


Croagh WF - BirdWatch Ireland Wind Farm
Species Sensitivity Score
Croagh WF Boundary
Croagh WF Approx. Centre
BWI Wind Farm Species Sensitivity Score
0 - 14.7 - No data
14.8 - 23.4 - Low
23.5 - 45.5 - Medium
45.5 - 62.8 - High
62.9 - 116.9 - Highest
0
1
2
3
4 km

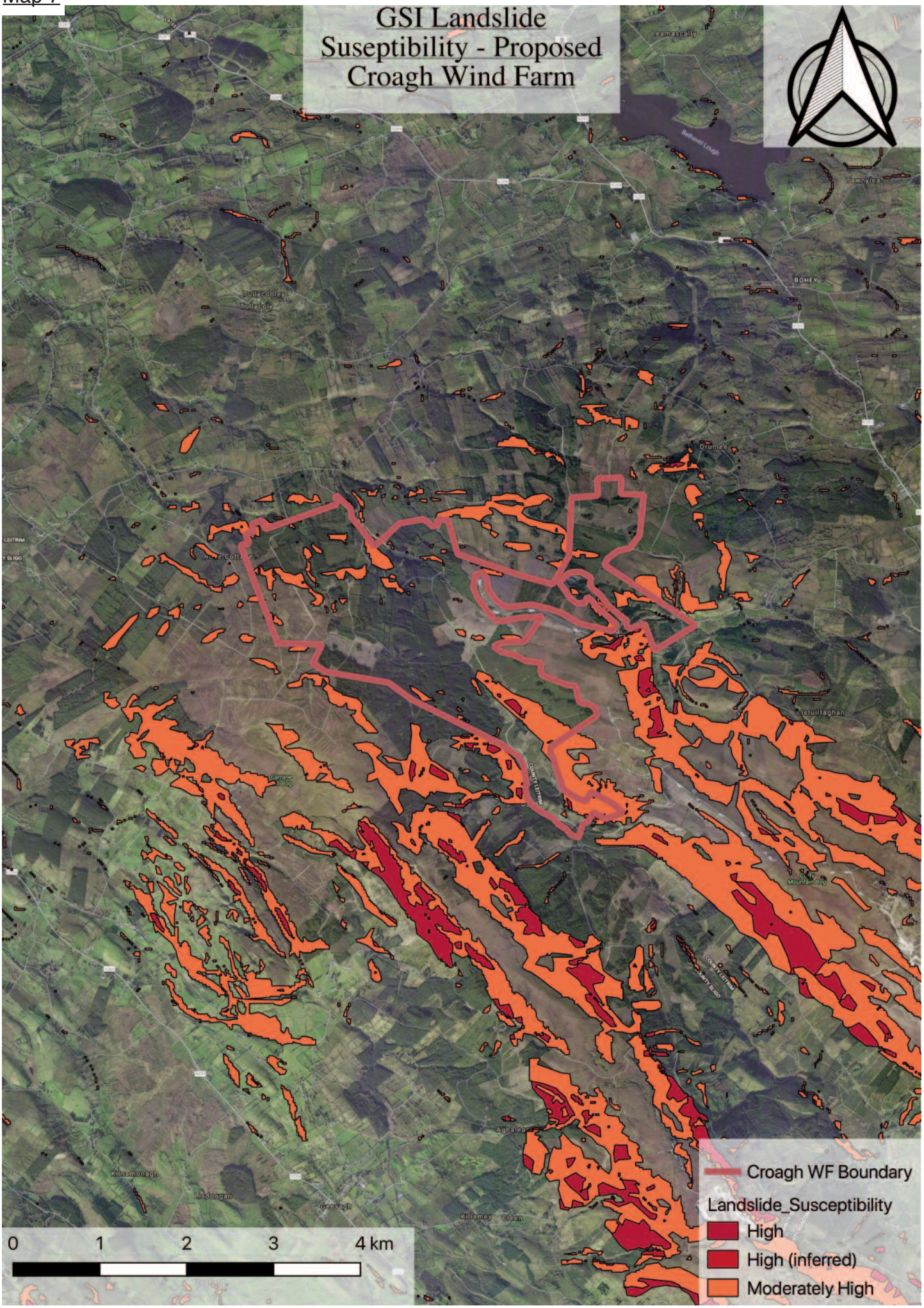
Map 5


Croagh WF - BirdWatch Ireland Wind Farm
Species Sensitivity Score - Curlew
Croagh WF Boundary
Croagh WF Approx. Centre
BWI Wind Farm Species Sensitivity Score
0 - 14.7 - No data
14.8 - 23.4 - Low
23.5 - 45.5 - Medium
45.5 - 62.8 - High
62.9 - 116.9 - Highest
0
1
2
3
4 km

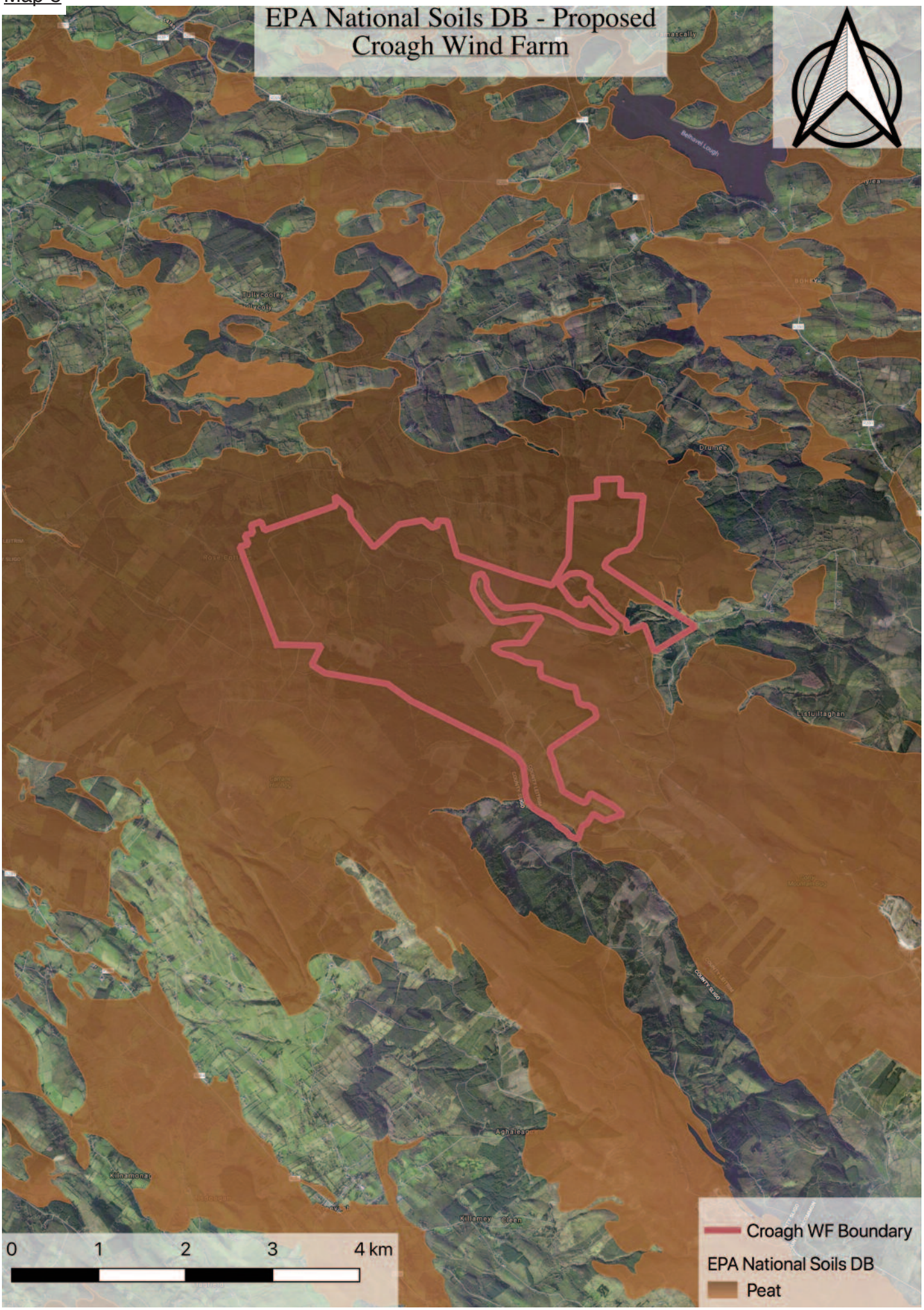
Map 6


Map
Satellite
R280
Drumee
COUNTY LEITRIM
COUNTY SLIGO
Carrane
Hill Bog
Google
Map data ©2019 Google Imagery ©2019 , DigitalGlobe, Landsat / Copernicus
Terms of Use

Map 7


GSI Landslide Suseptibility - Proposed Croagh Wind Farm
Croagh WF Boundary
Landslide_Susceptibility
High
High (inferred)
Moderately High
0
1
2
3
4 km

Map 8


EPA National Soils DB - Proposed
Croagh Wind Farm
Bellavel Lough
Tullycooley
Drumez
Aghalee
Killarney
0
1
2
3
4 km
Croagh WF Boundary
EPA National Soils DB
Peat

Map 9


LEITRIM
V19
V20
Drumkeeran
Dowra
B11
B7
Lough Allen
V21
V22
B8
N4
Lough Arrow
Drumshanbo
B9
B 9
V24
Lough Key
Leitrim
A7
V23
Lough Gara
V26
V27
Drumsna
Jamestown
B11
Lough Boderg
Lough Ree
N5
Kilglass Lough
A1 Areas of Outstanding Natural Beauty
B1 Areas of High Visual Amenity
V1 Outstanding Views and Prospects
Major Public Amenity Areas
Long Distance Walking Routes
0
5
10 Km

OPW
Oifig na nOibreacha Poiblí
The Office of Public Works

Ceann Oifig
Sráid Jonathan Swift
Baile Átha Troim
Co. na Mí
C15 NX36

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McCarthy KOS
Received on
11 JAN 2019
180511
Lorraine Meehan

Ms Lorraine Meehan
McCarthy Keville O'Sullivan
Block 1, G.F.S.C
Moneenageisha Road
Galway

Our Ref: 636 – 2018
Your Ref: 180511

Re: EIA Scoping Document for Proposed Croagh Wind Farm, Co. Leitrim

Dear Ms Meehan,

I refer to your letter dated 14/12/18 in relation to the above.

The proposed site boundaries of Croagh Wind Farm is located outside the boundary of the Bonet Catchment Drainage Scheme and does not interfere with scheme channels.
(See attached map below)

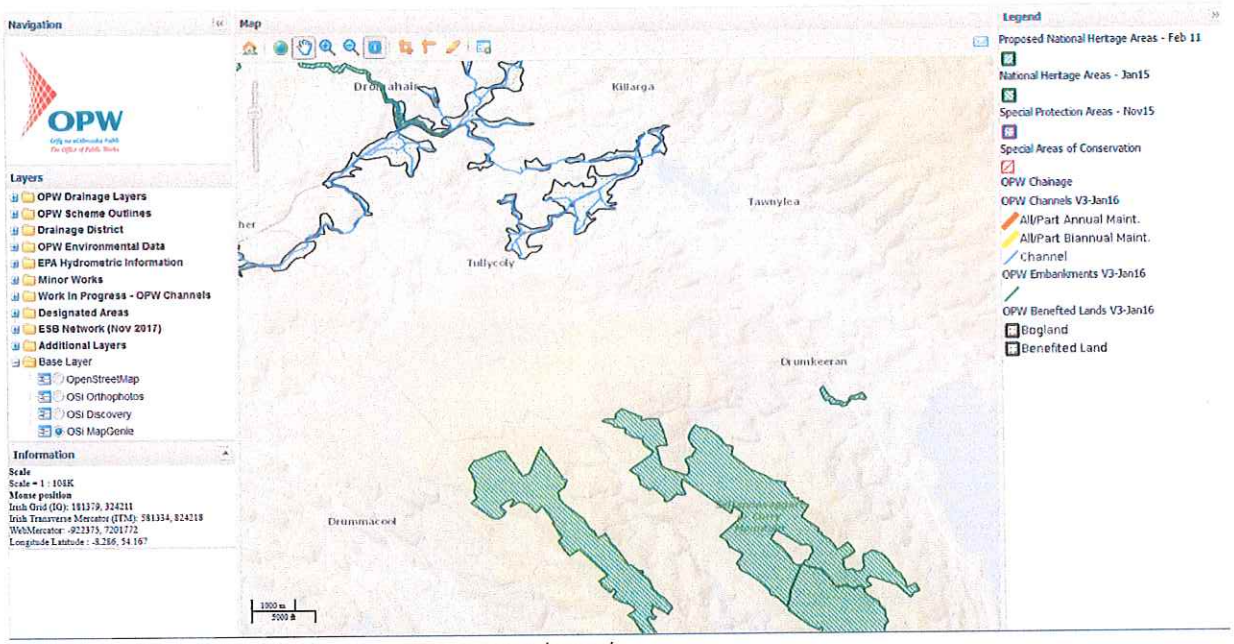
There are no records of flooding identified for this area, see attached map and summary report from the Flood Hazard Mapping website (www.floodmaps.ie). This office would recommend that no flooding should occur during or after construction of the proposed wind farm.

The attached Preliminary Flood Risk Assessment Maps (PFRA) indicates the areas that are prone to flooding for the 1% AEP (100-year) flood event for the Western CFRAM area, and as such further information will become available with public consultation of draft flood hazard mapping in 2015 and the flood risk report in 2016. Information is available at the following website: http://www.westcframstudy.ie/downloads.aspx

Under Section 50 of 1945 Arterial Drainage Act, No person, including a body corporate, shall construct any new bridge or alter, reconstruct, or restore any existing bridge over any watercourse without the consent of the Commissioners or otherwise than in accordance with plans previously approved of by the Commissioners. It will be a requirement of the applicant to apply for Section 50 consent for all culverts and bridges in accordance with the Act.

Yours sincerely

Karen Donovan
Engineering Services Administration Unit
9th January 2019



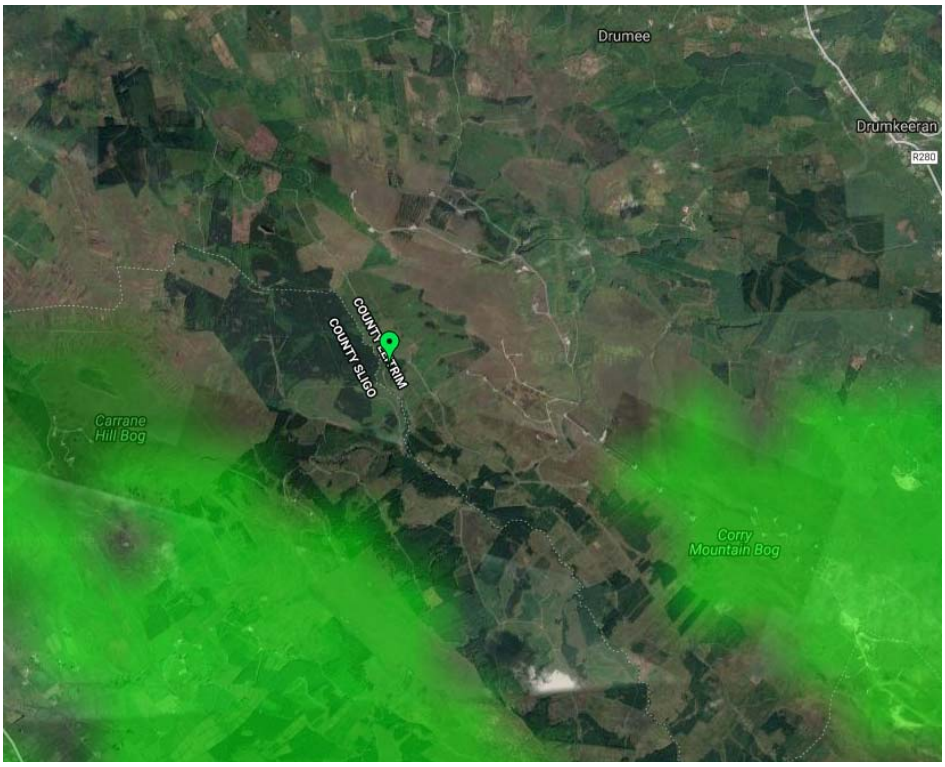
http://gis-demo/frm/drainage_programme/map/

Lorraine Meehan

From: Piotr Zurek [mailto:piotr.zurek@ripplecom.net]
Sent: 16 August 2018 17:10
To: Lorraine Meehan <lmeehan@mccarthykos.ie>
Cc: Denis Herlihy <denis.herlihy@ripplecom.net>; Adrian Carroll <adrian.carroll@ripplecom.net>
Subject: RE: 180511 Carrane Hill WF, Co Leitrim

Hi Lorraine,

Please find attached screenshot of our network coverage map for the mentioned area. We don't have any Point-to-Point links or customers present around there.



Kind Regards,

Kind Regards,

Piotr Zurek | Commercial Manager

Comhairle Contae
Ros Comáin
Roscommon
County Council

25th February, 2019

McCarthy Keville O'Sullivan Ltd,
Block 1, G.F.S.C.,
Moneenageisha Road,
Co. Galway.

Received on
27 FEB 2019
18511
Lorraine Meehan

RE: EIA Scoping Document for Proposed Croagh Wind Farm, Co. Leitrim

****

A Chara,

I acknowledge receipt of your scoping request for the proposed Wind Farm Development at Carrane Hill, Garvagh, Killavoggy, Co. Leitrim received on 25th February, 2019.

I wish to advise that your request has been referred to the North Roscommon Area Planner for consideration and comments (if any).

If you require any further information, please do not hesitate to contact me.

Yours sincerely,

David Caffrey
Administrative Officer,
Planning,
Aras an Chontae,
Roscommon.

Comhairle Contae
Ros Comáin
Roscommon
County Council

Lorraine Meehan,
McCarthy Keville O'Sullivan Ltd.,
Planning & Environmental Consultants,
Block 1, G.F.S.C.,
Moneenageisha Road,
Galway.

28 FEB
180511
L. Meehan

27th February, 2019
Your Ref.: 180511

Re: EIA Scoping Document for Proposed Croagh Wind Farm, Co. Leitrim.

A Chara,

Thank you for the opportunity to comment on the above. Roscommon County Council, Environment Section, has no comments to make in relation to this scoping document.

Is mise, le meas,

Kieran Madden

Kieran Madden,
Senior Engineer,
Environment, Assets & Energy Management

Áras an Chontae, Roscommon, F42 VR98
T 090 6637100 F 090 6625599 E customerservice@roscommoncoco.ie
W roscommon.ie RoscommonCountyCouncil @roscommoncoco

LCDC
Oifig Fiontair Áitiúil
Local Enterprise Office

Comhairle Contae
Ros Comáin
Roscommon
County Council

26th February, 2019

25 Feb 2019
180511
M. Watson

McCarthy Keville O'Sullivan Ltd,
Block 1, G.F.S.C.,
Moneenageisha Road,
Co. Galway.

RE: EIA Scoping Document for Proposed Croagh Wind Farm, Co. Leitrim

****

A Chara,

I refer to your scoping request for the proposed Wind Farm Development at Carrane Hill, Garvagh, Killavoggy, Co. Leitrim received on 25th February, 2019.

Roscommon County Council acknowledges the level of detail provided in the Scoping Report.

Roscommon County Council advises that the Roscommon Renewable Energy Strategy be referred to in relation to assessing wind energy developments and the associated potential environmental impacts.

If you require any further information, please do not hesitate to contact me.

Yours sincerely,

David Caffrey
Administrative Officer,
Planning,
Aras an Chontae,
Roscommon.

Comhairle Contae
Ros Comáin
Roscommon
County Council

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County Council

McCarthy Keville O'Sullivan Ltd,

Block 1, G.F.S.C

Moneenageisha Road,

Co Galway.

arthy KO
eceived
07 MAR 2019
180511
Lorraine Meehan

Re : EIA Scoping Document for Proposed Croagh Wind Farm, Co Leitrim

05.03.19

Dear Lorraine,

Thank you for the opportunity to comment on the proposed Croagh Wind Farm in Co Leitrim.

RCC Roads section would possibly have some concerns in relation to the roads network and drainage impacts.

Roads:

Our only concerns from a roads perspective would be that the transportation of heavy plant/abnormally large loads and materials would not adversely impact on the public road network or existing bridges/culverts if it is proposed to transport via RCC network. A structural integrity assessment may be required for identified structures that may be of risk. Junction layouts would also need assessment.

Drainage:

The impacts of any drainage works/re-contouring should be assessed to establish if there would be any knock on effects which may contribute to flooding issues in County Roscommon.

Regards

Denis

Denis Whyte

Assistant Engineer

Roads and Transportation

Roscommon County Council.

Lorraine Meehan

From: Johnny Evans [mailto:Johnny.Evans@2rn.ie]
Sent: 20 August 2018 12:05
To: Lorraine Meehan <lmeehan@mccarthykos.ie>
Subject: RE: 180511 Carrane Hill WF, Co Leitrim

Hi Lorraine,
Our telecoms links will be unaffected by anything within the rectangle in the shapefile. There would be a risk of disruption to TV viewers to the south of this zone though, and I would recommend that we have a protocol agreement in place. Thanks and regards, Johnny

Johnny Evans
Head of Projects and Coverage Planning
2RN
Block B, Cookstown Court, Old Belgard Road, Tallaght, Dublin 24, Ireland
D24 WK28
2rn Disclaimer: The information in this e-mail is confidential and may be legally privileged. It is intended solely for the addressee. Access to this e-mail by anyone else is unauthorised. If you are not the intended recipient, any disclosure, copying, distribution, or any action taken or omitted to be taken in reliance on it, is prohibited and may be unlawful. Please note that emails to, from and within 2rn may be subject to the Freedom of Information Act 2014 and may be liable to disclosure

COMHAIRLE CHONTAE SHLIGIGH
HALLA NA CATHRACH SLIGEACH

SLIGO COUNTY COUNCIL
CITY HALL SLIGO

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W www.sligococo.ie

McCarthy KOS
Received on
07 JAN 2019
18051
Lorraine Meehan

3rd January, 2019.

Ms. Lorraine Meehan,
McCarthy Keville O'Sullivan Ltd.,
Block 1, G.F.S.C.
Moneenageisha Road,
Galway.

Re:- EIA Scoping Document for Proposed Croagh Wind Farm, Co. Leitrim.

Dear Ms. Meehan,

I refer to your correspondence to this office dated 14th December, 2018 in relation to the above. I wish to advise you that Mr. Barry Ward, Executive Planner and Ms. Siobhan Ryan, Heritage Officer, have examined the EIA Scoping Document received by Sligo County Council on 17th December, 2018 and have the following comments to make in relation to same;-

Section 2.3 Designated Areas, states that "A Natura Impact Statement will also be prepared"

Sligo County Council comments that an NIS may not be required unless a pathway/pathways for potential impacts have been identified, in a Stage 1 Screening Report. What potential impacts have been identified to indicate that an Natura Impact Statement is required?

Section 4.2, Site Selection Criteria, Planning History Review, states that "The EIAR will include a comprehensive assessment of the potential for cumulative effects from the proposed wind farm in combination with all existing and permitted wind farms within 20 kilometres of the site.

Sligo County Council comments that it is essential that potential for cumulative effects of the proposed development and existing and permitted development in the area are assessed in EIAR. Particularly in terms of potential visual and environmental impacts.

Section 4.2, Site Selection Criteria, Ecological Desk Survey, states that, "Bird surveys are also underway".

Sligo County Council comments that the EIAR shall clarify which bird surveys were undertaken and was Bat survey carried out?

Section 4.2 Site Selection Criteria, Grid Connection Feasibility.
Sligo County Council comments that the EIAR shall clarify/confirm whether or not any part of the proposed grid connection will be laid/constructed in County Sligo.

Section 6.2.4 – 6.2.4.4 Description of the proposed development.

Sligo County Council comments that the proposed Construction and Environmental Management Plan shall include detail of an Ecological Clerk of Works.

Section 6.2.4.6 Biodiversity: Flora and Fauna,

Sligo County Council comment the EIAR shall address,

- Flora Protection Species
- Birds of Conservation concern
- Birds of Prey
- The Standard Methodology for Habitat Survey and Mapping in Ireland shall be to Fossit Level 3.

Section 6.2.4.13 Archaeological, Architectural and Cultural Heritage,

Sligo County Council comment that the EIAR shall,

- Clarify if the proposed haulage routes cross any historic bridges?
- If so, is bridge strengthening required? Potential impacts on Birds/Bats.
- Include a list of protected structures and associated cartilages.

Yours sincerely,

Karen Kennedy

P.

Janet McNamara,
Administrative Officer,
Planning.

Lorraine Meehan

Subject: FW: 180511 Carrane Hill WF, Co Leitrim

From: Thomas Barry [mailto:Tom.Barry@TETRAIRELAND.IE]
Sent: 22 August 2018 09:14
To: Lorraine Meehan <lmeehan@mccarthykos.ie>
Subject: RE: 180511 Carrane Hill WF, Co Leitrim

Lorraine,

The development as proposed presents no network/coverage concerns to TI.
Can you ensure that the proposal is reviewed by eir.

Regards,
Tom

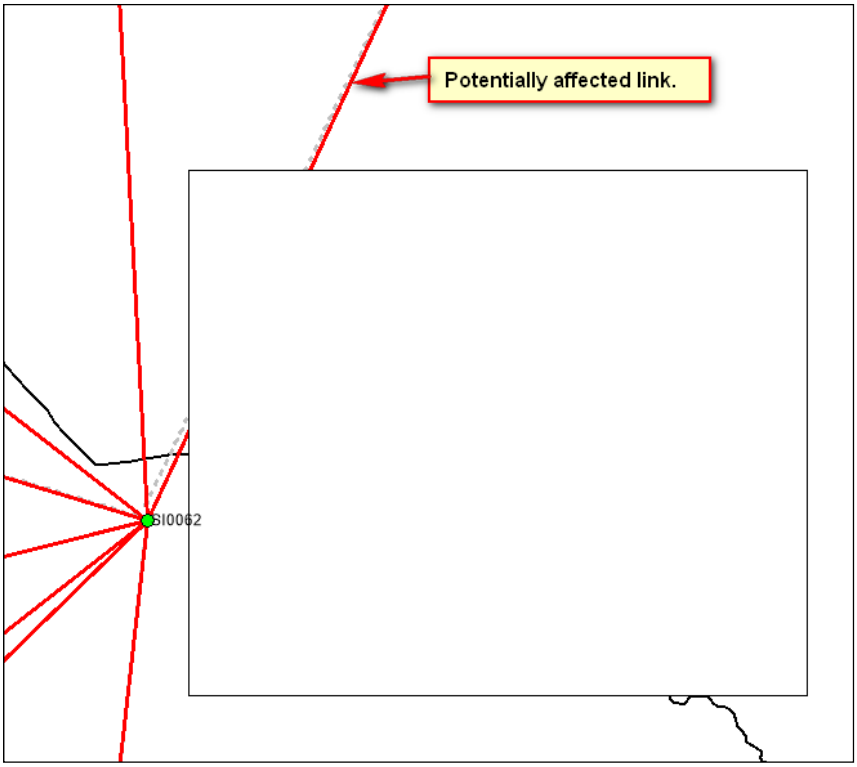
Lorraine Meehan

From: Gerry Callan [mailto:Gerry.Callan@three.ie]
Sent: 16 August 2018 10:55
To: Lorraine Meehan <lmeehan@mccarthykos.ie>
Cc: Alan Hutchinson <alan.hutchinson@three.ie>
Subject: RE: 180511 Carrane Hill WF, Co Leitrim

Hi Lorraine,

I can confirm that we have one link that traverses the planned development area, a 15GHz link from Killarga (187822, 334456) to Riverstown (182127, 322184).

We have a further 7 links west of the development, but none of them traverse the development area.



When you have confirmed turbine locations, do please let us know and we can conduct a more thorough analysis of any potential impact, but for now this is the only link likely to be affected by the development.

Best wishes,

Gerry Callan
Transmission Engineer

086 3884246
gerry.callan@three.ie

Make it count.

Lorraine Meehan

From: Rachel Hennessy [mailto:rachel.hennessy@towercom.ie]
Sent: 22 August 2018 17:12
To: Lorraine Meehan <lmeehan@mccarthykos.ie>
Subject: RE: 180511 Carrane Hill WF, Co Leitrim

Hi Lorraine,

Thank you for your email.

From initial review, the proposed location of the windfarm would not appear have a significant impact on Towercom's sites.

However, in order to fully assess any impact it may have, we would require plans and coordinates showing the proposed turbines finalised locations.

Until such time as you can confirm the coordinates of the locations, we cannot conclusively say if there will be an impact on Towercom's assets.

Kind regards,
Rachel

Rachel Hennessy
Towercom

Bonneagar Iompair Éireann
Transport Infrastructure Ireland

Ms. Lorraine Meehan
McCarthy Keville O'Sullivan Ltd.
Block 1
G.F.S.C.
Moneenageisha Road
Galway

McCarthy Keville
Received on
25 JAN 2019
180511
Lorraine Meehan

Dáta | Date	Ár dTag | Our Ref.	Bhur dTag | Your Ref.
23 January 2019	**TII18-104268**	**180511**

Re: EIA Scoping Request for proposed wind farm development at Croagh, Co. Leitrim with site extents in the Counties of Leitrim and Sligo on behalf of Coillte.

Dear Ms. Meehan,

Transport Infrastructure Ireland (TII) acknowledges receipt of your EIAR Scoping request in respect of the above proposed project.

National Strategic Outcome 2 of the National Planning Framework includes the objective to maintain the strategic capacity and safety of the national roads network. It is also an investment priority of the National Development Plan, 2018 – 2027, to ensure that the extensive transport networks which have been greatly enhanced over the last two decades, are maintained to a high level to ensure quality levels of service, accessibility and connectivity to transport users.

The issuing of this correspondence is provided as best practice guidance only and does not prejudice TII's statutory right to make any observations, requests for further information, objections or appeals following the examination of any valid application referred.

The approach to be adopted by TII in making such submissions or comments will seek to uphold official policy and guidance as outlined in the Spatial Planning and National Roads Guidelines for Planning Authorities (2012). Regard should also be had to other relevant guidance available at www.TII.ie.

In this instance, the proposal is stated to be located at a site of approximately 800 ha. at Croagh on the northeastern slopes of Carrane Hill, Garvagh, Killavoggy, Co. Leitrim. The site encompasses lands within Co. Sligo, but it is the stated intention of the applicant to locate all site infrastructure in Co. Leitrim and make application to that county for planning permission. It is stated that it is expected that 10 turbines will comprise the proposed windfarm that is undergoing final design.

Bonneagar Iompair Éireann
Ionad Gnó Gheata na Páirce
Sráid Gheata na Páirce
Baile Átha Cliath 8
Éire, D08 DK10

Transport Infrastructure Ireland
Parkgate Business Centre
Parkgate Street
Dublin 8
Ireland, D08 DK10

info@tii.ie
www.tii.ie
+353 (0)1 646 3600
+353 (0)1 646 3601

With respect to EIAR Scoping issues, the recommendations indicated below provide only general guidance for the preparation of EIAR, which may affect the National Roads Network. The developer should have regard, *inter alia*, to the following;

1. As set down in the Spatial Planning and National Roads Guidelines, it is in the public interest that, in so far as is reasonably practicable, that the national road network continues to serve its intended strategic purpose. The EIAR should should identify the methods/techniques proposed for any works traversing/in proximity to the national road network in order to demonstrate that the development can proceed complementary to safeguarding the capacity, safety and operational efficiency of that network.

2. Consultations should be had with the relevant local authority/National Roads Design Office with regard to locations of existing and future national road schemes.

3. In relation to cabling and potential connection routing, the scheme promoter should note locations of existing and future national road schemes and develop proposals to safeguard proposed road schemes. In the context of existing national roads, alternatives to the provision of cabling along the national road network, such as alternative routing or the laying of cabling in private lands adjoining the national road, should be considered in the interests of safeguarding the investment in and the potential for future upgrade works to the national road network. The cable routing should avoid all impacts to existing TII infrastructure such as traffic counters, weather stations, etc. and works required to such infrastructure shall only be undertaken in consultation with and subject to the agreement of TII, any costs attributable shall be borne by the applicant/developer. The developer should also be aware that separate approvals may be required for works traversing the national road network.

4. Clearly identify haul routes proposed and fully assess the network to be traversed. Separate structure approvals/permits and other licences may be required in connection with the proposed haul route and all structures on the haul route should be checked by the applicant/developer to confirm their capacity to accommodate any abnormal load proposed.

5. Where appropriate, subject to meeting the appropriate thresholds and criteria and having regard to best practice, a Traffic and Transport Assessment (TTA) be carried out in accordance with relevant guidelines, noting traffic volumes attending the site and traffic routes to/from the site with reference to impacts on the national road network and junctions of lower category roads with national roads. TII's TTA Guidelines (2014) should be referred to in relation to proposed development with potential impacts on the national road network. The scheme promoter is also advised to have regard to Section 2.2 of the TII TTA Guidelines which addresses requirements for sub-threshold TTA.

6. TII Standards should be consulted to determine the requirement for Road Safety Audit (RSA) and Road Safety Impact Assessment (RSIA).

7. Assessments and design and construction and maintenance standards and guidance are available at TII Publications that replaced the NRA Design Manual for Roads and Bridges (DMRB) and the NRA Manual of Contract Documents for Road Works (MCDRW).

8. The developer, in conducting Environmental Impact Assessment, should have regard to TII Environment Guidelines that deal with assessment and mitigation measures for varied environmental factors and occurrences. In particular;
    a. TII's Environmental Assessment and Construction Guidelines, including the *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (National Roads Authority, 2006),
    b. The EIAR should consider the Environmental Noise Regulations 2006 (SI 140 of 2006) and, in particular, how the development will affect future action plans by the relevant competent authority. The developer may need to consider the incorporation of noise barriers to reduce noise impacts (see *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* (1st Rev., National Roads Authority, 2004)).

Notwithstanding, any of the above, the developer should be aware that this list is non-exhaustive, thus site and development specific issues should be addressed in accordance with best practice.

I hope that the above comments are of use in your scoping process.

Yours sincerely,

Natasha Crudden
Regulatory & Administration Unit

Lorraine Meehan

From: Liam Allister [mailto:Liam.Allister@virginmedia.ie]
Sent: 16 August 2018 13:31
To: Lorraine Meehan <lmeehan@mccarthykos.ie>
Cc: Cathal O Donnell <Cathal.ODonnell@virginmedia.ie>
Subject: RE: 180511 Carrane Hill WF, Co Leitrim

Hi Lorraine,

Virgin Media do not have any radio links in or near the area outlined in the site location map. Can you please inform us if there is any change to the proposed site area.

Regards,
Liam Allister,
Transmission Engineer,
Virgin Media Ireland.
Liam.allister@virginmedia.ie

Lorraine Meehan

From: Gavin Byrne [mailto:gavin.byrne@netshare.ie]
Sent: 16 August 2018 16:58
To: Lorraine Meehan <lmeehan@mccarthykos.ie>
Cc: Kevin O'Neill <kevin.oneill@netshare.ie>; Darragh Dennehy <darragh.dennehy@netshare.ie>; Deirdre McDermott <deirdre.mcdermott@netshare.ie>
Subject: RE: 180511 Carrane Hill WF, Co Leitrim

Hi Lorraine,

This area is clear of Vodafone microwave links and should not be an issue.



Regards,

Gavin Byrne BE, MSc, MIEI
Transmission Planning & Strategy Engineer
Netshare Ireland
Iveagh Building, The Park, Carrickmines, Dublin 18

NetShare Ireland
The Future of Mobile Networks

Lorraine Meehan

From: Sabine Browne [mailto:Sabine.Browne@waterwaysireland.org]
Sent: 04 April 2019 14:49
To: Lorraine Meehan <lmeehan@mkoireland.ie>
Subject: RE: 180511 Croagh Wind Farm EIA - Scoping follow-up

Thanks for this Lorraine.

Waterways Ireland is the North/South Implementation Body for the inland navigable waterway systems of Ireland and was established under the British-Irish Agreement, 1999. The statutory remit of Waterways Ireland is to manage, maintain, develop and restore the inland navigable waterways, principally for recreational purposes.

The inland waterways under our remit are: the Grand Canal, the Royal Canal, the Barrow Navigation, the Shannon Navigation (Closest to the project – over 5 km away), the Shannon Erne Waterway, the Erne System and the Lower Bann Navigation.

Waterways Ireland has no comment in relation to the Croagh Wind Farm EIA as the project is outside its jurisdiction.

Kind regards,

Sabine Browne
Clerical Officer - Environment & Heritage

Waterways Ireland Western Regional Office
Dock Road, Drewsborough,
Scarriff, Co. Clare
V94 H7N1

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Community Report

Croagh Wind Farm

Co. Leitrim & Sligo

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1 INTRODUCTION

Coillte Cuideachta Ghníomhaíochta Ainmnithe (Coillte) is seeking planning permission from Leitrim County Council and Sligo County Council to construct and operate a commercially viable wind farm project on lands at Croagh, near Drumkeeran in Co. Leitrim and Co. Sligo.

From the project outset, Coillte consulted with the local community and commenced this engagement prior to the start of the project design and environmental assessment with the objective being to ensure that the views and concerns of all members of the local community were considered as part of the project design and the Environmental Impact Assessment process.

In relation to national guidance on community engagement and consultation for wind energy developments, the *Wind Energy Development Guidelines* (Department of Environment, Heritage and Local Government, 2006) state that:

"While it is not a mandatory requirement, it is strongly recommended that developers of a wind energy project should engage in active consultation and dialogue with the local community at an early stage in the planning process, ideally prior to submitting a planning application".

This was further addressed in the *Preferred Draft Approach to Wind Energy Development in Ireland*(June 2017) which stated the following with respect to planning applications for wind farms:

"Planning applications must contain a Community Report prepared by the applicant which will specify how the final proposal reflects community consultation. The Community Report must also outline steps taken to ensure that the proposed development will be of enduring economic benefit to the communities concerned".

The *Draft Revised Wind Energy Guidelines* (Department of Housing, Planning and Local Government, 2019) has retained this position stating the following:

"In order to promote the observance of best practice, planning authorities should require applicants to prepare and submit a Community Report with their planning application and a condition on any subsequent planning permission should require developers to carry out the development in accordance with the approved Community Report".

This Community Report outlines Coillte's engagement and liaison with the community local to the Croagh area and the proposed wind farm.

2 BACKGROUND

Coillte has a long history of working with communities and our experience around the country has generated an inherent understanding of the communities in which we operate. We aspire to work **with** the communities surrounding our energy sites and wish to build projects that are good for us as a commercial company, good for our neighbours, and that contribute to the fulfilment of national and global Climate Change objectives.

Coillte has developed four wind farms in Ireland over the past decade and has learnt many valuable lessons in relation to working with local communities and the importance of including local people in

decisions that affect them. In 2017, the Renewable Energy Team undertook a review of our Community Engagement process and embarked on the design of a radically enhanced approach with the support of AstonEco Management.

The key elements of this approach, referred to as our 'Fair Play' model are:

- Detailed and systematic engagement with all close neighbours to the project (within 2 km) from a very early stage of project design.
- Open, transparent dialogue and communications.
- Creating opportunities for open, two-way dialogue on key issues.
- Involvement of the local community at all stages of the project design process.
- Empowering local communities to be part of project discussions that affect them.
- Ensuring that the local community have access to all relevant information as soon as it is available, in an understandable format.

The approach emphasises a focus on the residents of dwellings within 2 km of the initial site boundary as these people will be closest to the development and will therefore be most sensitive to any potential effects caused by the development. In the past, engagement has commenced when the project is almost fully designed and being prepared for planning submission. In our 'Fair Play' approach we start engagement as soon as a site has been identified as suitable for detailed environmental studies within the Coillte internal screening process. The approach also recognises the need to keep people further away from the development informed about the project as details become more defined.

In order to build better projects we have recognised the imperative of enabling meaningful engagement between the project team and the local residents. This engagement has to pass beyond just information provision, and through open, transparent dialogue and the involvement of people in decisions that affect them, move towards a more collaborative approach to infrastructure design that has a National interest but a local impact.

What are our external drivers for Stakeholder Engagement?

- Actively engaging in the conversation helps raise awareness and provides insight that can ensure successful project outcomes for everyone.
- Active and open dialogue with our community stakeholders is essential for the success of our projects. It is through two-way dialogue that Coillte Renewable Energy can responsibly partner with local communities.
- Coillte Renewable Energy is committed to strengthening partnerships with local communities.
- Public support is achieved by actively working with communities towards mutually desirable goals. Meaningful communication with stakeholders creates trust and mutual respect, as well as a shared understanding and vision of what a successful project can look like.

- Timely, proactive, open and honest communication is a cornerstone of our Engagement Charter. This approach helps to minimise possible adverse impacts on our neighbours and instead helps to achieve positive social, economic and environmental outcomes.
- In line with national policy, Coillte Renewable Energy are committed to meaningful consultation, which brings about constructive local dialogue, as well as mutual trust and understanding.

3 COILLTE RESOURCES

In order to implement this 'Fair Play' approach Coillte have resourced this project with a number of dedicated staff from the outset. The following key personnel have been involved in Community Engagement on the Croagh Project from within Coillte:

Ciaran Mc Gill, a native of Sligo, is our Project Manager. A qualified Civil Engineer, Ciaran has worked for Coillte for nineteen years covering projects in both forest roads design and construction, as well as wind energy projects throughout the full process from concept design, through planning and onto construction.

Andy Fox is our Community Engagement Manager. Andy has spent the past 15 years working hand in hand with communities to drive towards sustainable local development. Andy leads a team of three and has full responsibility for the development and implementation of Coillte's Community Engagement Strategy and Policy, with a focus on enhancing social acceptance across Coillte Renewable Energy's portfolio of development projects.

Eamonn Keavney is our Community Liaison Officer. Eamonn has worked with Coillte in all aspects of forestry during a forty year tenure. He has vast experience of forestry and comes with a deep understanding of both the local community and the needs of the local area.

Carol Ryan is our Communications Manager. Carol has worked with Coillte since 2001 across various business units in communications and project management roles. She looks after communications across our suite of renewable energy projects.

Tom Costello has worked as a Forest manager for Coillte for over 30 years. Tom has recently been involved in Community Liaison work on various projects across the Coillte portfolio. He has extensive experience on community engagement and the implementation of Community Benefit Funds, Near Neighbour Schemes and Energy Efficiency Schemes. Tom has also been involved in all aspects of forestry and community engagement during his thirty five year service with Coillte.

Lorraine Meehan, is our consultant, McCarthy Keville O'Sullivan Ltd's (MKO) Project Manager. Lorraine Meehan is a Senior Environmental Scientist with over 13 years of experience who has worked with MKO since 2007. Lorraine has gained extensive experience, working primarily as an Environmental Scientist and Project Manager on a wide range of projects and plans requiring environmental assessment. Lorraine's key strengths and responsibilities relate to the efficient and effective management of projects, including coordination of multidisciplinary project teams, engagement with the relevant authorities, stakeholders and members of the public on proposed and ongoing projects, organisation of extensive scoping and consultation exercises, and coordination and production of final project outputs, including Environmental Impact Statements/Environmental Impact Assessment Reports, Strategic Environmental Assessment Environmental Reports, and Constraints & Feasibility and Site Selection Studies.

A major focus of the engagement approach has been to make the technical design team more accessible to local people. At various stages of the project the following specialists from MKO and their sub-contractors together with Coillte have engaged with local individuals and groups on topics including the following;

- Noise
- Visuals
- Ecology & Biodiversity, Birds
- Archaeology & Cultural Heritage
- Engineering layout & design
- Statutory & non-statutory consultation, including circulation of the scoping report and invitation for feedback, the proposed consultee list which was amended to add some tourism groups suggested by our neighbours. Feedback on all responses received together with preplanning meeting feedback was given at the larger group meetings.
- Community Benefit
- Recreation and Amenity

4 SUMMARY OF COMMUNITY ENGAGEMENT CARRIED OUT

4.1 INITIAL STAGE ENGAGEMENT

Engagement commenced in June 2018 with the appointment of Eamonn Keavney as the CLO for the proposed project. Eamonn, having worked and resided within the wider local area over a 40 year career was ideally placed to lead the engagement process with the near neighbours.

As outlined above, Coillte emphasises a focus on the residents of dwellings within 2 km of the site as these people will be closest to the development and will be most sensitive to any potential effects caused by the proposed development. In commencing the engagement, we needed to identify the 2 km zone to commence within. This was achieved through a twofold exercise;

a) Firstly, for the surrounding area, identification of all dwellings, lived in, vacant and with the potential to be occupied, mapping of all and establishment of a 750m buffer in which potential turbines would not be sited;

b) followed with the site itself, identification and collation of all known constraints within the proposed site and surrounding area, including streams, statutorily designated sites, recorded archaeological sites and monuments telecommunications links etc;

c) The combination of both sets of buffers was then utilised to develop a non-constrained area for investigation which was potentially suitable for turbine siting. An initial turbine layout was developed of ten potential turbines.

d) These ten locations were then buffered by 2 km to allow the 2 km area to be identified. Engagement then commenced with all houses within the 2 km area together with a number of houses located just outside the 2km area where neighbours indicated an interest in the proposed development.

The individual house engagement continued from June to date as thoughts and views form our neighbours were gathered. As part of this process, a low-call number and project email address were created to aid communication. All those who expressed an interest agreed to their inclusion in an email group for two-way traffic such as raising queries and receipt of answers in addition to facilitating updates and circulation of information to all parties. As the engagement continued, the list extended as other interested near neighbours, some from outside the 2 km area agreed to be added. For those who were unable to receive information digitally or preferred printed media, all information was circulated in print from the CLO, who was always available to answer any queries or bring concerns to the project team. Through the dual email and delivery approach, we were able to engage with all neighbours within the immediate zone and were very available for any queries.

4.2 GROUP MEETINGS

Small group meetings commenced in September 2018.

A site visit for neighbours was carried out in early October 2018, which was well attended. A few neighbours who were unable to attend the main day had individual visits hosted by the CLO.

Larger group meetings commenced in January 2019, and continued regularly until August 2019. Attendance varied at these events, with high attendances at the start, but tailed off for the last couple of meetings. Minutes were taken and circulated for all the larger group meetings and were circulated for comments or additions. Our planning and environmental consultants, MKO, were present at the larger group meetings together with specialists for various aspects of the ongoing studies. The Coillte Engagement Manager, the project CLO and Project Manager were also in attendance. Agendas were circulated in advance of meetings and after the first couple of meetings, in response to wishes raised, an update of the studies including the engineering layout and design was circulated in advance so that people had time to consider the updates and ask questions or raise issues accordingly. All meetings included time for questions and answers.

The larger group meetings coincided with the main environmental studies and statutory consultation process for the proposed project, with the proposed turbine layout fixed in June 2019. Post this layout fix, only minor alterations of the order of 20m were envisaged.

Due to low attendance at the last two larger group meetings, we reassessed our approach, in order that we were available and responsive to the near neighbours in a format that was as time efficient for our neighbours as possible. Feedback received also commented that the meetings were becoming repetitive and that the same people were asking the same questions at each meeting. Therefore we considered modifying our approach in that we would revert to individual engagements to explain the design and address any queries, which we emailed ordelivered to all our neighbours. No feedback suggested that our neighbours wished to continue the monthly meetings.

4.3 LAYOUT ITERATION

Maps of the proposed development were circulated, with four significant iterations, the initial layout, the identification of two new locations to the south west for detailed consideration, the preferred layout outlining the two turbines to the north east were likely to be removed and the current layout map. Please refer to section 5 below for further details.

4.4 INDIVIDUAL ENGAGEMENT

Individual engagement has continued since June 2018 and will continue into the future. All issues and queries are considered and feedback given. Information is also circulated in relation to related issues including notification of the issue of the Draft Wind Energy Guidelines for public consultation in December 2019 and how to input feedback within this consultation process.

4.5 WORKSHOPS

A number of workshops have occurred on the project as detailed below. Workshop handout materials are included in Appendix C.

4.5.1 Noise - AWN

Two noise workshops occurred, the first informal session in January 2019 introduced the noise sub consultants, outlined the proposed background noise measurement campaign, agreed monitoring locations and answered any queries. One effect of this first noise workshop was to increase the number of noise monitors to ten locations (a site of this size would typically only have 6 measurement locations). The second noise workshop was held in July 2019 and was designed with input from the near neighbours. The purpose of this workshop was to give people an understanding of noise and the terminology, set out the background noise measurements captured, outline the design of the

proposed wind farm using the background noise measurements and address concerns such as low frequency sound, infrasound, amplitude modulation and post construction compliance methodologies. A further noise workshop outlining the predicted noise results at individual house level and any mitigations required as a clinic type (based on a cluster of 4-5 houses in a similar geographic area) was planned but did not occur, due primarily to lack of clarity on what noise guidelines would be in place at the time of the planning application. Our neighbours had a strong feeling that without the new guidelines being adopted, a session based on the 2006 guidelines would not be meaningful.

4.5.2 Archaeology – MKO utilising materials from Tobar Archaeology & Ecology - MKO

Project workshops with the near neighbours were held as outline above on the following topics;

Two workshop sessions were held on archaeology and cultural heritage and ecology and ornithology based on feedback during the meetings. These occurred in July and August 2019, when many of the studies were completed and gave attendees an insight into the area and what the studies had uncovered.

4.5.3 Visual Impact - MKO

Many of our neighbours wished to know what the proposed wind farm would look like for their homes. To address this, we included a number of sessions on landscape and visual impact in our monthly meetings. Photomontages and visibility maps were presented and explained. In addition, visualisation software called “Trueview” was utilised to represent what the development would look like form individual houses. “Trueview” involves the use of an iPad which can be held vertically and tracked around to superimpose proposed turbines into the actual terrain. Proposed turbines can be shown stationary and moving to give a representation of views around a house. All interested neighbours were visited, even those where turbines would not be visible. Following these site visits, indicative prints were delivered to all houses as a record of the day and to allow further perusal. We acknowledge that the photos in particular are not to photomontage standard but the visual representation was worthwhile to get an idea of what the development would look like on an individual basis.

4.5.4 Property Values

A further workshop was planned on property values in a wind farm area, however this didn’t occur. The topic was discussed regularly during the larger group meetings, with evidence both proving and disproving an impact on property prices in an area due to wind farm development. The lack of quality Irish data, together with the very cyclical nature of the Irish property market, which would render any conclusions open to wide interpretation, resulted in the workshop not progressing.

4.6 NEWSLETTERS & BOOKLET

Two newsletters were circulated at the early engagement stages in August 2018, to introduce our team and our project, to outline our inclusive approach, to answer some of the early queries we had received together with circulation of contact details for the team. These newsletters were circulated to all within the 2 km zone. The subsequent individual engagements, the small group and larger group meetings provided updates and information post the initial newsletters.

When the planning design of the proposed project and the studies were largely completed, we compiled the data into a 24 page booklet, which was circulated to all houses within 5 km of any

proposed turbine in December 2019. The information contained within this booklet, together with photomontages and constraints maps are all available in the project website, launched in December 2019.

4.7 COVID-19

The outbreak of the Covid-19 virus resulted in protective restrictions to reduce the spread and impact of Covid-19 within our communities, which has impacted on planned engagements since restrictions came into force. However we remain committed to keeping our neighbours informed about the progress of the project as we continue to work towards a planning application.

As we continue to work in accordance with protective measures outlined by the HSE and Government, our commitment to keeping in contact is as important as ever, and we have been engaging through individual phone calls, group emails, texts and via posting all our updates for this project on the project website. We remain contactable through phone, text, email and by post if needs be.

The restrictions have impacted on our commitment to further workshop / individual house sessions planned when the EIAR, planning application and supporting documentation are compiled and ready for submission of a planning application. At these sessions, it was envisioned that the project team will visit individuals or groups, depending on their preference, to go through the complete set of documents, show people what is included and answer any queries, in hopefully a useful session to allow our neighbours to better understand the planning application, its various constituents and its format to facilitate any observations on the application. As the planning application will be submitted during the Covid restrictions, house visits will not be possible, but we still be available to go through the proposed documentation and answer any queries by phone or email.

4.8 PROJECT WEBSITE

The website went live on 19th December 2019.

The full suite of planning application documents will be made available to all our neighbours via our project website. Follow up sessions with neighbours will be carried out as requested.

4.9 CONSULTATION THEMES

The main themes captured during the course of the consultation included;

- The engagement process itself and how best to encourage all parties to maximise the benefit from it. A Proposed Engagement Plan or PEP was developed with the near neighbours throughout late 2018 and the first few months of 2019, which was deemed in good order for signing by all present who wished to in the April 2019 meeting. The PEP outlined the process which we all hoped to follow throughout engagement on the project. The PEP is appended to this Community Report and consisted of the following main sections;

    1. The Goal of the document
    2. Ground Rules for engagement
    3. What are the steps to be taken with the local neighbours by Coillte?
    4. What are the local neighbour's concerns?

5. The 7 zone model

- The environmental impact assessment used to enable transparent engagement
- Noise identified by all neighbours through multiple interactions as the major issue. Cumulative noise based on the noise issues felt by some neighbours from existing developments.
- Potential health effects from the turbines from noise, infrasound, low frequency sound and amplitude modulation. Are these fully understood? What evidence is there.
- What shadow flicker will there be from the development?
- The proposed size of the turbines relative to those already in situ locally and with reference to the wind energy guidelines dating from 2006. Does Leitrim already have its share of wind turbines? How many, how high and what type of turbines will be put in my neighbourhood (and exactly where)?
- The potential impact on tourism of the proposed development.
- Will the proposed development impact on the value of my property. Is there any evidence in an Irish context around this?
- What will the quality of life impact of this be on all neighbours?
- What are the impacts on water, plants, birds and animals?
- What are the impacts on climate and air quality?
- What are the impacts on local infrastructure and use of local roads?
- What are the impacts on mobile phone / mobile broadband / TV reception?
- What amount of energy and CO2 is involved in making the turbines?

These themes were discussed regularly throughout the engagement process, which we answered in a transparent and open manner and allowed healthy discussion around all areas. Ultimately not all themes could be or were addressed to the satisfaction of all our neighbours, but we remain open in trying to find fair and equitable solutions for all including sharing information sources at our disposal. The themes raised are also addressed in the relevant sections of the EIAR for the project.

4.10 SUMMARY TABLE

A summary of all engagements is included at Appendix A below and the main milestones are displayed schematically in Figure 1 below.

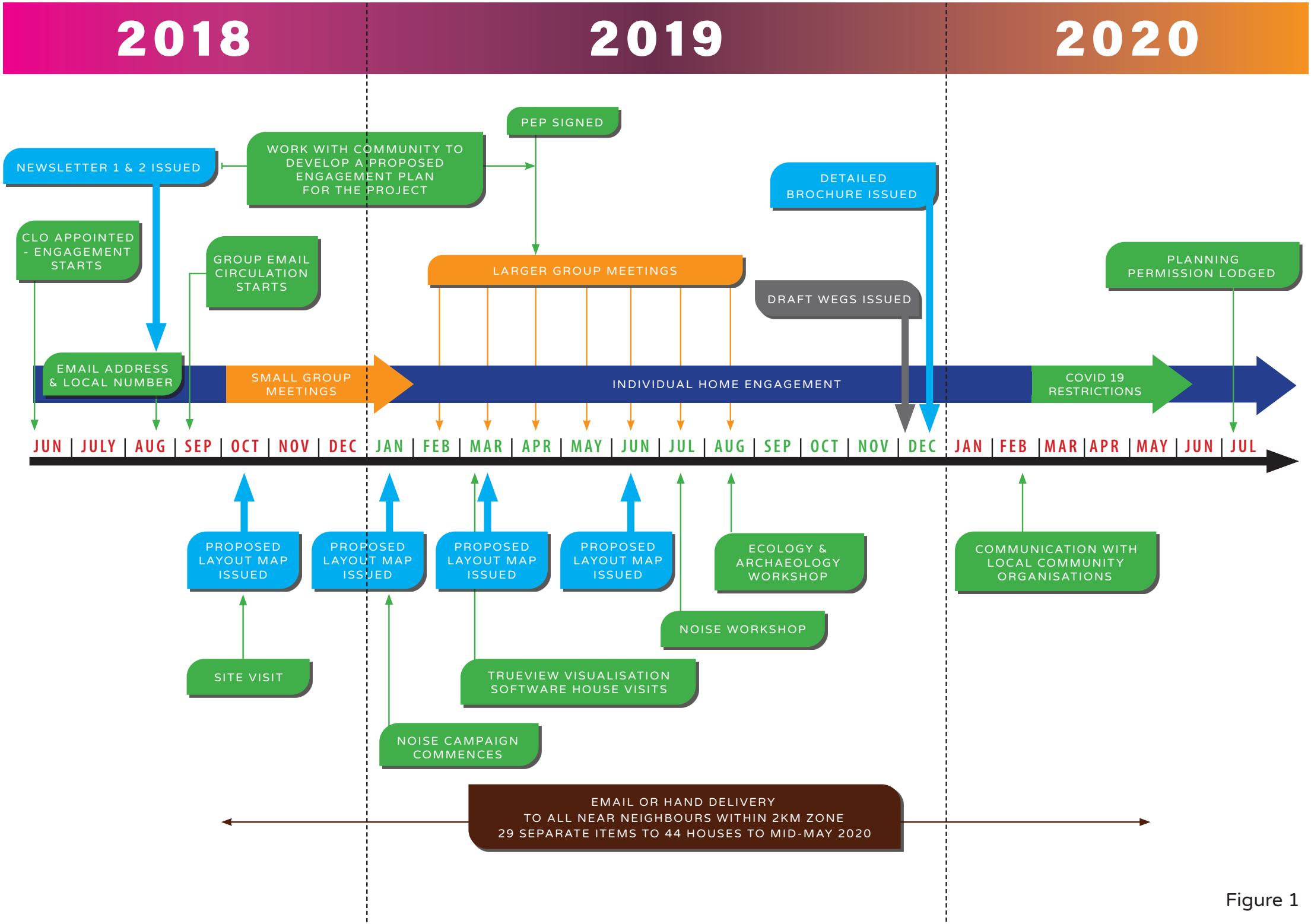

2018
2019
2020
NEWSLETTER 1 & 2 ISSUED
WORK WITH COMMUNITY TO DEVELOP A PROPOSED ENGAGEMENT PLAN FOR THE PROJECT
PEP SIGNED
DETAILED BROCHURE ISSUED
CLO APPOINTED - ENGAGEMENT STARTS
GROUP EMAIL CIRCULATION STARTS
LARGER GROUP MEETINGS
DRAFT WEGS ISSUED
PLANNING PERMISSION LODGED
EMAIL ADDRESS & LOCAL NUMBER
SMALL GROUP MEETINGS
INDIVIDUAL HOME ENGAGEMENT
COVID 19 RESTRICTIONS
JUN | JULY | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL
PROPOSED LAYOUT MAP ISSUED
PROPOSED LAYOUT MAP ISSUED
PROPOSED LAYOUT MAP ISSUED
PROPOSED LAYOUT MAP ISSUED
ECOLOGY & ARCHAEOLOGY WORKSHOP
COMMUNICATION WITH LOCAL COMMUNITY ORGANISATIONS
NOISE WORKSHOP
SITE VISIT
TRUEVIEW VISUALISATION SOFTWARE HOUSE VISITS
NOISE CAMPAIGN COMMENCES
EMAIL OR HAND DELIVERY
TO ALL NEAR NEIGHBOURS WITHIN 2KM ZONE
29 SEPARATE ITEMS TO 44 HOUSES TO MID-MAY 2020

Figure 1

5 INFLUENCE OF ENGAGEMENT ON THE EVOLUTION OF THE WIND FARM DESIGN

As outlined in Section 4 above, the engagement process undertaken on the proposed project has given the project team a detailed appreciation of the issues and concerns of the near neighbours. This close working relationship has facilitated the evolution of the project design to understand and alleviate the concerns expressed as far as possible.

The mains concerns expressed together with their impact on the design evolution are set out below.

5.1 'WRAP-AROUND' EFFECT

A cluster of homes in Beagh townland are located just north of the existing Garvagh Glebe windfarm, the closest existing turbine being approximately 780m from the closest house in a southerly direction. The proposed Croagh layout would see proposed turbines located to the east and west of the Beagh house cluster, at distances of between 750 and 1,000m separation to the closest houses. Please see Figure 2 below.

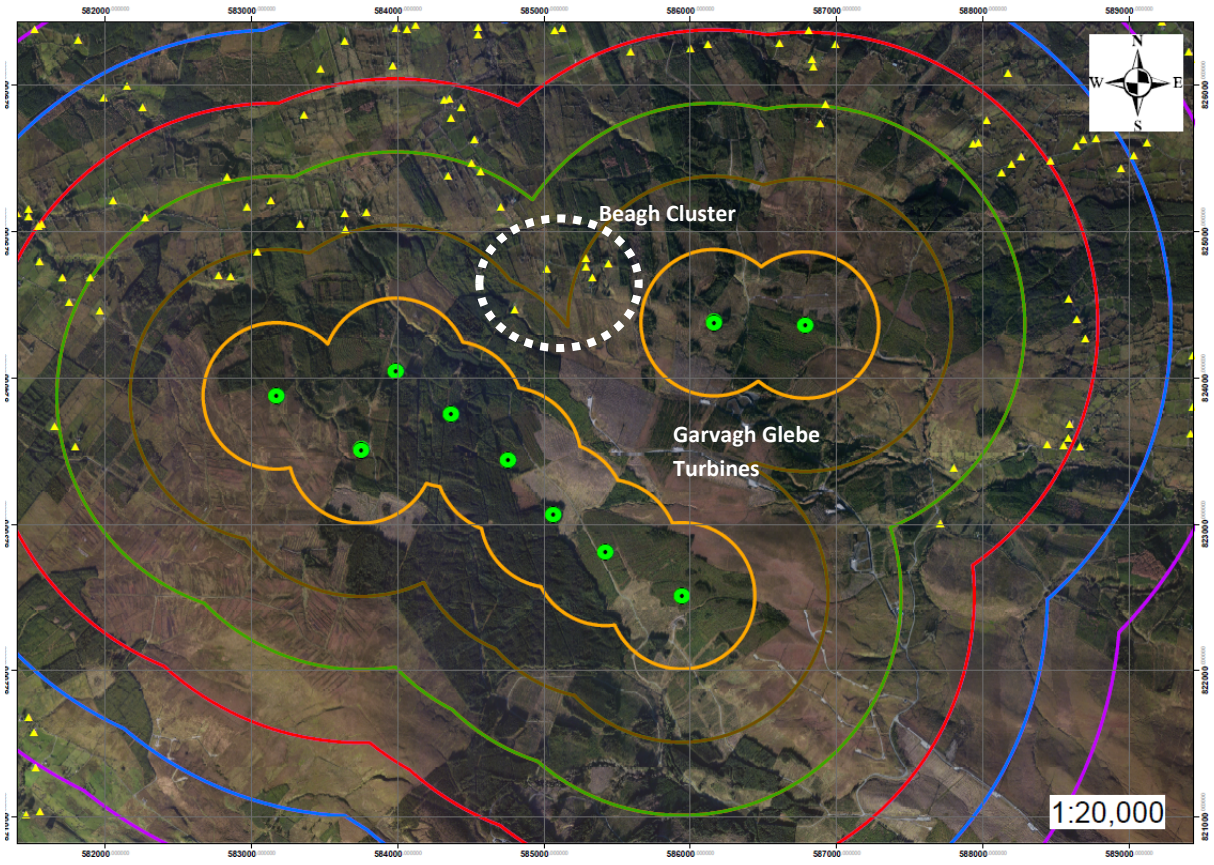


Figure 2 – Initial layout map showing Eircodes. The Beagh house cluster is circled with a white dashed line

Neighbours raised concerns regarding noise emissions from the existing turbines when the wind blew from a southerly location, but that southerly winds were not the prevailing wind and so were intermittent. The initial Croagh layout as proposed would mean that a combination of existing and proposed turbines would form an angle of almost 180 degrees around these houses. In effect the near neighbours felt that turbines would have a 'wraparound effect' on their homes; turbines

would be east, west and south of them and that this could give rise to noise emissions for winds from all these directions which would be the majority of the time. Visually, turbines would partially surround their homes.

Although the main views from all homes in the cluster are predominantly north, with views of Lough Gill, Benbulben etc. which would be uninterrupted by the proposed new locations, the design team recognised this concern and started to work with our neighbours to mitigate this affect.

The first iteration involved rotating the axis the two proposed turbines to the north east to a north/south orientation, which achieved a greater separation distance to homes on the eastern side but didn't improve the 'wraparound' impression. In addition, the site visit carried out at the time with neighbours allowed the design team to understand the issue.

The design team began looking at areas to the south east of the early turbine layout, to see if they were suitable for wind turbines, from a geotechnical, environmental and wind resource viewpoint. An added bonus of the area under consideration was the lack of neighbours to the southwest of the site. Figure 3 below indicates the area considered as two rectangular areas.

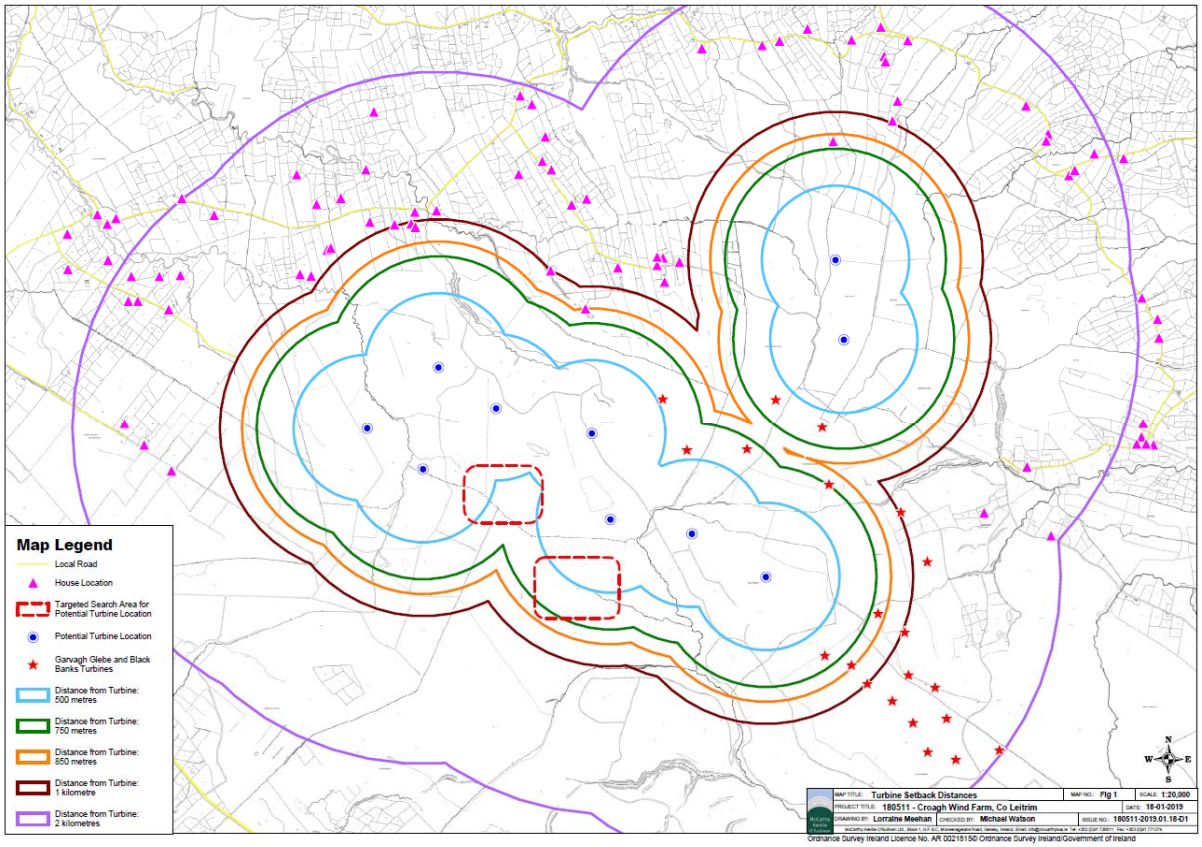


Figure 3 – Evolving Layout

The additional areas were included into the study area and over the course of a number of months studies, were deemed suitable for turbine siting. This stage of the design therefore identified that there were twelve potentially viable turbine sites.

From the earliest engagement the team had highlighted that Coillte were assessing a proposed ten turbine wind farm. As it had been verified that the two alternative locations were viable, Coillte were able to keep a proposed ten turbine layout, whilst also removing the wrap around effect to the Beagh house cluster. We fully briefed our neighbours and the layout evolutions together with the decision not to increase the proposed development size to a twelve turbine layout.

A map of the proposed ten turbine layout was shared and discussed at our June 2019 meeting, see Figure 4 below.

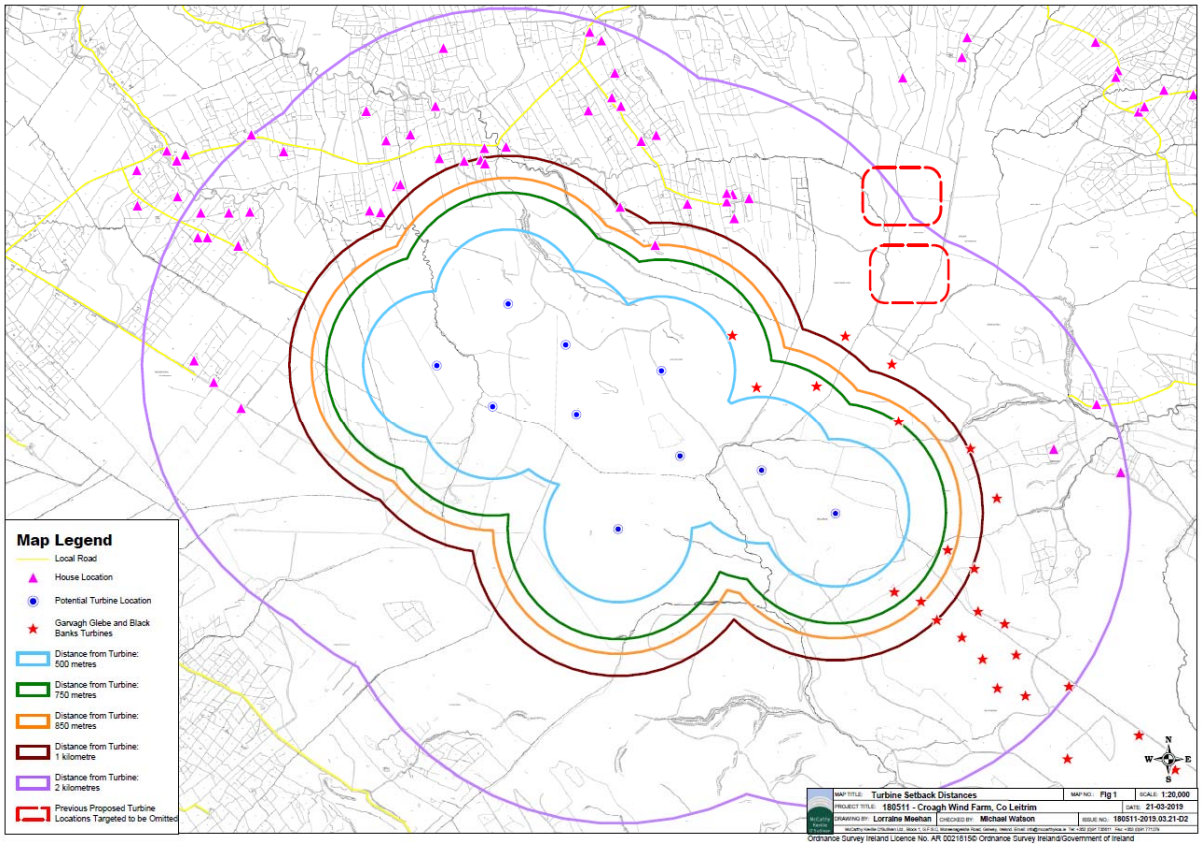


Figure 4 – June 2019 Design Iteration.

A further benefit of the evolved layout was that the number of properties within 2 km of a proposed turbine was reduced by 34.

5.2 PROXIMITY OF TURBINES TO DWELLINGS

In order to understand the number of residences in the area and to establish a buffer to properties, we started off with the Eircodes for the surrounding area. Notwithstanding the minimum 500m separation distance recommended in the 2006 Wind Energy Guidelines, Coillte utilised an initial 750m buffer to all Eircodes, when developing the initial developable area for the proposed project. In this way, the starting position was a minimum separation of 750m from any proposed turbine to any dwelling. The housing buffer and the environmental constraints were then utilised to develop our first proposed iteration of our 10 turbine layout.

Once the first iteration was developed, engagement started in June 2018. The following table details the number of Eircodes and their distance from any proposed turbines;

Distance, m	Count	Total
<1000	8	8
1500 - 2000	14	22
2000 - 2500	40	62
2500 - 3000	45	107
3000 - 3500	**25**	**164**

Table 1 – Eircodes within radii of Proposed Turbines (Note; additional dwellings were identified which didn't have Eircodes)

Our engagement within the area identified a number of other residences which didn't have Eircodes, which were added, together with a few just beyond the 2 km separation area, where neighbours were interested in the proposed development. Our near neighbour engagement group therefore consisted of 76 house locations. Of these, 52 are currently occupied, with 15 currently empty and a further 9 in a very poor state of repair. 9 dwellings were located between 750m and 1000km away from a proposed turbine, with the closest house just over 750m from a turbine location.

Our engagement identified the following two main themes;

- As outlined above, the Beagh housing cluster potentially had turbines to the east and west of it as distances of between 750 to 1000m each side, and these neighbours relayed these concerns to us in our engagement.
- A number of other neighbours expressed wishes that if further separation could be achieved to their dwellings that it would be welcomed.

The subsequent studies which drove the layout evolution were mindful of the neighbours' concerns where the design team tried to maximise separation distances to occupied residences.

The evolution of the design through the various design iterations, has actually increased the distance from 34 of the 76 house locations to greater than 2 km from a proposed turbine, leaving 42 house locations within 2 km of a proposed turbine. Of these, there is one occupied house located within 1km of a proposed turbine, at a separation of 850m, all other occupied houses are a minimum of 1,050m from any turbine. The current layout has 28 occupied dwellings within 2 km of any proposed turbine. Table 3 below demonstrates this.

	Original Layout		Current layout	
Distance, m	**Total number of houses (occupied & unoccupied)**	**Number of occupied Houses**	**Total number of houses (occupied & unoccupied)**	**Number of occupied Houses**
0-1,000	11	10	5	1
1,000 – 2,000	13	41	8	27
Total	**75**		**41**	

Table 2 – Comparison of the numbers of dwellings within 2km of the original and final layouts.

5.3 NOISE

The main concern identified from our engagement with the near neighbours was the impact of noise. The area is already well developed in terms of wind farm infrastructure, so residents are knowledgeable of wind farms, their construction and operation together with the effect of wind direction on noise propagation. The neighbours closest to existing wind farm developments also expressed issues with noise nuisance form existing turbines under certain wind directions.

Understanding the potential noise from the proposed development was therefore paramount for the design team.

- The first step here was taken at the earliest possible stage. The importance of noise and a robust background noise measurement campaign was clearly set out as a requirement when procuring consultants to deliver the project, and a specialist noise consultant with wide experience (AWN) formed part the appointed consultants team.
- The background noise measurement campaign was designed in consultation with the near neighbours including bringing the noise consultants to meet the neighbours in advance of the measurement campaign commencement. Existing noise issues together with sensitive noise locations were identified and a measurement campaign was undertaken at 9 separate locations picked by our neighbours (6 would be the normal number for a development of this size). The results of the campaign revealed that background noise levels in the area were quite low.
- The results of the background noise measurement campaign were shared with the near neighbours at a workshop, designed in consultation with the community, to provide a non-technical outline of the theory of wind turbine noise.
- The sound power levels form the proposed turbine is required to identify predicted noise levels at various wind speeds and directions. The Croagh scheme was designed with reference to modern turbine technology which has seen the evolution of much quieter turbines over existing, older wind turbine models. The newer turbines are larger yet more efficient than older models and are much quieter on a per MW basis. The starting point of the layout was therefore to maximise the potential of the site, in tandem with the lowest possible potential for noise impacts.
- All dwellings were utilised for development of the predicted noise levels, and mitigation strategies were developed as required to comply with the guidance.
- Added to this is the fact that distance from a wind turbine is the most effective design phase method of mitigation of noise impacts. 2km is widely regarded as a rule of thumb distance where noise impacts reduce to close to background levels.
- The layout evolution as described in Section 5.2 above allowed the number of dwellings with 2km to be reduced by 45%, newer turbine technology resulted in the number of point sources of noise to be much reduced by using a smaller number of larger turbines. The net result of this is that the proposed development is designed to be as quiet as possible and therefore to have as little potential for noise issues to arise.
- Added to this the scheme proposes regular operational noise monitoring, together with a clear and simple issue capture system to ensure that the operational wind farm is in full compliance with planning conditions.

Therefore, in engagement with our neighbours, we recognised the existence of wind farm noise in area already, we designed the layout to maximise separation distance from proposed turbines

to minimise any impacts. We also utilised our engagement to increase neighbours understanding of noise and noise measurement to help alleviate concerns.

5.4 VISUAL IMPACT

There were two main concerns identified by near neighbours in relation to visual impacts from the proposed development;

- The proposed turbines were larger than those in existence in the area, the proposed turbines would overshadow houses and would not be in keeping with existing wind farms.
- The Beagh house cluster would be visually surrounded by turbines

The initial layout had two turbines located to the north east somewhat separate to the main cluster. This had the potential to create a disjointed effect of two clusters, and impacted the Beagh houses in particular. Through the design evolution, the two separate turbines were removed, resulting in a much more visually coherent single cluster with greater separation to existing homes and appeared less disjointed form a very local perspective.

Early photomontages were developed and discussed with the near neighbours through a series of engagements, showing a representation of the scheme for neighbours to see and understand potential impacts. These are included in Appendix B.

In response to queries from our neighbours in relation what the proposed scheme would look like from individual homes, particularly as the tip heights were taller than those of existing wind turbines in the area, visualisation software called “Trueview” was utilised to represent what the development would look like form individual houses. All interested neighbours were visited, even those where turbines would not be visible. Indicative prints were delivered to all houses following the site visits as a record of the day and to allow further perusal. In this way we were able to demonstrate what the proposed development would look like, and take screening and lower visibility areas into account. The exercise also demonstrated how the proposed new turbines blend in with the existing turbines. These indicative prints are included in Appendix E.

In addition to the above, a detailed visual impact assessment supported by photomontages and screening assessments was completed for the proposed wind farm layout to mitigate the potential for visual impact.

In this way the proposed wind farm was designed to minimise the visual impact on local dwellings and roads in addition to the wider area.

5.5 TOURISM

Some of the near neighbours are involved in the tourism business, so the impact of the proposed wind farm on tourism in the wider area was raised as a concern.

The design was cognisant of these concerns and the layout was designed to mitigate any impacts including;

Photomontages are presented in the Landscape & Visual Chapter of the EIAR from a wide variety of locations surrounding the site. These were selected based on consultation with our near neighbours, other stakeholders and from a scenic view impact assessment. Views from Lough Gill, Killerry, Carrowkeel and other tourist attractions were visited and assessed for impacts.

The proposed wind farm was scoped with Faillte Ireland and their response was taken on board in the design.

The proposed wind farm was scoped with local tourist organisations, identified by our neighbours, but no response was received from these bodies.

All surrounding historical sites were visited by our archaeologists and visuals team to identify any impacts on setting and mitigate accordingly.

In this way the proposed development has been designed to work with existing wind farms and the tourism potential of the area.

6 COMMUNITY ENGAGEMENT IN THE WIDER AREA

Figure 5 below shows the proposed project relative to local communities and settlements and outlines the area within 10 km of the proposed farm.

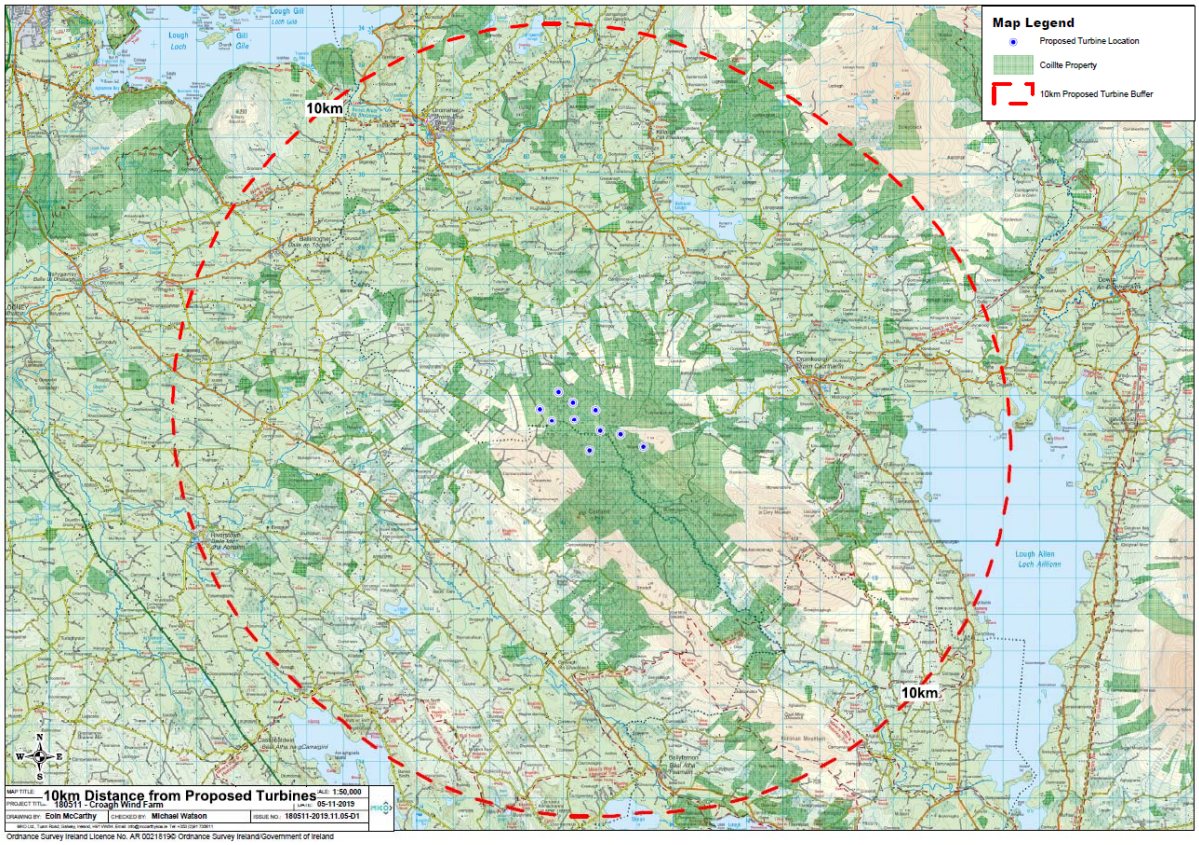


Figure 5 – Map outlining a 10km distance form proposed turbines

A list of all community groups within 10km of the proposed site was compiled throughout January & February 2020 with approximately 70 community groups identified in the area within the 10 km radius. All of these were contacted via post or email on 19th February 2020 with details on the proposed project, via the project brochure, and invited to be included on the stakeholder list for the project and to raise any queries or issues. Appendix D includes a list of these organisations. The project team will continue to build relationships with these groups.

7 ONGOING LIAISON AND CONTACT

A number of different phases have been detailed below with differing levels of engagement anticipated depending on the levels of project activity. Underpinning all of the engagement below will be a dedicated Community Liaison Officer for the project who is contactable by email and phone. These details will remain on the project website which will be in place for the duration of the project. As the project progresses, regular updates will be posted to this website.

Post Planning submission until 6 months pre-construction

During this period (12 -24 months) a number of key community related activities will continue to be progressed. The first is a participatory design process for the Croagh Community Benefit Fund (CBF). Approximately 2 months after the project has been submitted into the planning system the team will start a process of reaching out initially to residents within the 2km zone and then slightly further afield, in order to bring together a small group of people who are interested in working on the design and structure of a community based entity that would ultimately run this Community Benefit Fund. This process will start with a scoping exercise followed by a series of facilitated workshops. It is hoped that representatives involved in existing local development initiatives will be stakeholders in this process and will therefore contribute to this strategy.

The second piece of work is to explore the potential for Community Investment in the project as outlined in the new Renewable Energy Support Scheme (RESS). This will probably follow on from the CBF work stream and will look at the best ways to promote awareness about this opportunity in advance of it coming online.

Pre- Construction and Construction phase

6 months prior to the commencement of construction on the project we will initiate the set-up of a liaison group. The project will meet with this group on a monthly basis to prepare for the construction phase and monitor activities during construction. This group will develop plans on communicating effectively with residents directly impacted by construction activities and deliveries, especially traffic planning to minimise disruption.

The project will also engage with local suppliers prior to the construction phase in order to outline the projects future needs and promote the use of local suppliers and service providers wherever possible. This may take the form of a “meet the buyer” event.

Operational Phase

The project will continue with a proposed annual meeting with the liaison group to update the group on project performance and address any issues identified. The Community Liaison Officer will also be available throughout this period to directly address any issues raised by local residents. As stated above, the project website will also be maintained as a method of providing regular, up to date information on the project.

Decommissioning Phase

A year prior to the commencement of decommissioning of the project, the project team will engage with the established liaison group as well as all residents within the 2km zone to outline the decommissioning plan and address any issues identified at that time.

In line with the Governments Code of Practice 2016 (XX) the project will publish an annual report of all engagement activities on the project website.

8 POTENTIAL ENDURING BENEFITS OF THIS PROJECT

Croagh Wind Farm has the potential to bring significant positive benefit to the local community. The project will create sustainable local employment, it will contribute annual rates to the local authority and it will provide opportunity for local community investment in the project in line with the new Renewable Energy Support Scheme. As with all wind farm projects which Coillte develop, a community benefit fund will be put in place for the lifetime of the project to provide direct funding to those areas surrounding the project.

8.1 COMMUNITY BENEFIT FUND

Two important areas of Government policy development are nearing completion which will have a bearing on the establishment of future community benefit funds, the updated Wind Energy Guidelines and the Renewable Energy Support Scheme (RESS). Both sets of policy are expected to be finalised during Q2/Q3 2020 which will provide the Government requirements on future community benefit funds for renewable energy projects. We will fully take into account these two important policies as we present the Coillte approach to community benefit.

Coillte expects that for each megawatt hour (MWh) of electricity produced by the wind farm, the project will contribute €2 into a community fund for the RESS period i.e. first 15 years of operation and €1 per MWh for the remaining lifetime of the wind farm.

If this project is constructed as currently designed we estimate that a total of approximately 5 million euro will be available in the local area for community funding over the lifetime of the project. The above figure is indicative only and will be dependent on the generation capacity of the wind farm which is influenced by a number of factors including:

1. Number of wind turbines.

2. Capacity and availability of energy production of those turbines.

3. Quantity of wind.

How the fund will be used and administered?

The Community Benefit Fund belongs to the local community. The premise of the fund is that it should be used to bring about significant, positive change in the local area. To make this happen, our first task will be to form a benefit fund development working group that clearly represents both the close neighbours to the project as well as nearby communities. This group will then work on designing the governance and structure of a community entity that would administer the Community Benefit Fund. We aim to commence this work in summer 2020.

8.2 COMMUNITY INVESTEMENT OPPORTUNITY

What is meant by Community Investment?

The proposed Renewable Energy Support Scheme (RESS) sets out that future renewable energy project proposals enable the possibility for local communities to invest in projects in a meaningful way as a means to directly gain from the financial dividends that a project can provide should it be consented, built and operated. In response to this, Coillte have been working hard with external agencies to develop workable models of Community Investment. As with the benefit fund, we aim to take this work into the community during 2020, to continue to explore this exciting possibility and see how best to embed its design within the community.

8.3 EMPLOYMENT OPPORTUNITIES

It is estimated that the proposed project will create approximately 80-100 jobs during the construction phase and 2-3 jobs during the operational and maintenance phases of the proposed development. During construction, additional employment will be created in the region through the supply of services and materials to the development. In addition to this, there will also be income generated by local employment from the purchase of local services i.e. travel and lodgings.

8.4 RECREATION

There are number of features which the proposed project has the ability to unlock under a recreation opportunity. The timing of the project is beneficial as many of the areas of mature conifer plantation within the site have been clear-felled over the past few years which have unlocked some hidden gems including;

- Lough Nacroagh situated in the middle of the site
- Scenic views from the site particularly to the north
- Streams within the site

It is proposed to develop some recreational walks as part of the development of the project. These proposed walks will utilise existing forest tracks, new wind farm roads and trails, a boardwalk area together with a picnic area adjacent to Croagh lough, and viewing / seating areas. In addition, areas will be targeted for planting with broadleaves and berried trees to create areas of interest for small birds and increase the biodiversity habitat of the area.

Please see Chapter 4 of the EIAR for more details.

The site is very well placed within the wider recreational area with the existing Miners Way very close to the site. Coillte is already active in this area with Sligo & Leitrim County Councils and we propose that the project support the development of the wider area which could be uncovered as part of a wider regional strategy.

9 CONCLUSION / COMMITMENT

As outlined throughout this Community Report, there has been very active engagement on the project throughout the planning design phase to date. Many of our neighbours are supportive of the project, while others wish that the project doesn't proceed. We have achieved much in terms of making the proposed project a better project for all through our engagement, however we did not progress to a point where a full stakeholder group was formed and already working on the Community Benefit Fund and Community Investment work-streams. We fully recognise however that development of a proposed wind farm is a long and complex process and that there is ample time to jointly develop our community offerings with our near neighbours and other stakeholders, and we will be progressing these throughout the planning adjudication and decision phases as well as in the pre-construction phase should the project receive planning consent.

It is Coillte's intention to adhere to this community report for the lifetime of the development, in compliance with the Code of Practice for Wind Energy Development in Ireland Guidelines for Community Engagement issued by the Department of Communications, Climate Action and Environment (December 2016) or updated revision.

Appendix A – Engagement Completed Record

Appendix A – Engagement Completed Record

Date	Engagement (Describe)	Small group Meetings (Attendees)	Larger Group Meetings (Attendees)	Emails	Workshops	Site Visits	Layout Map circulated	Meeting Summary
04/06/2018	CLO Appointed							
07/06/2018	Engagement Started – house visits commenced.						Early draft on aerial photo, houses shown	
07/08/2018	Email Address goes live							
07/08/2018	Lowcall number goes live							
14/08/2018	Brochure #1 delivery commences. Introduces the team, invites contact, how to get in touch.							
14/08/2018	Brochure#2 delivery commences. Queries raised to date, outlines next steps, map of the proposed development study area.							
14/08/2018	Letter to near neighbours outlining Coillte aspirations for the project.							
04/09/2018				Email sharing email addresses for all those satisfied to appear on a group mailing list.				
12/09/2018				Email to Beagh house cluster in relation to proposed name of the windfarm, potential number of turbines, potential tip height, other plans for the area.				
18/09/2018				Email to one nearby household re turbine sizes existing at the site, together with the distance from their home.				
27/09/2018				Email to circulation list and delivery to all other neighbours within near neighbour zone, to identify suitable dates for a site visit.				
10/10/2018						9	Layout Map on Aer photo - 10 WTG layout	
17/10/2018						1		
11/10/2018						1		

Date	Engagement (Describe)	Small group Meetings (Attendees)	Larger Group Meetings (Attendees)	Emails	Workshops	Site Visits	Layout Map circulated	Meeting Summary
01/11/2018		7						Introduction of all parties, neighbours, Coillte & consultants. Proposed engagement strategy, separation distance to homes, turbine size, health, noise, existing turbines, bats, traffic management, community WF, timelines of studies, Proposed engagement Plan (PEP) introduced, near neighbours to form a local group for engagement. Noise was agreed by all to be the single largest issue to be tackled.
09/11/2018				Minutes Issue. Email to circulation list. Delivery to all others within near neighbour zone.				
28/11/2018		2						
03/12/2018				Proposed Scoping consultee list shared with all near neighbours. EIAR study timeline issued to all near neighbours. Email to circulation list. Delivery to all others within near neighbour zone.				
11/12/2018				Email to Beagh house cluster in relation to noise monitor location and explaining what's measured. Delivery to all others who accepted a noise monitor.				
08/01/2019				Formal Notification of decision by Beagh Residents to engage with Coillte & Coillte response.				
21/01/2019		4			Noise AWN - locating the noise monitors		Layout on 5000 scale background, original 10 WTG plus study area for 2 additional locations	EIAR studies update, scoping responses received to date, grid connection, preplanning meetings proposed, early stage photomontages presented and left for perusal, discussion on trueview visualisation software, Noise (AWN sub consultant in attendance for this session); monitoring campaign, monitor locations, predictions, how existing noise is modelled, shadow flicker, update on engagement process, Q&A.
21/01/2019		9			Noise AWN - locating the noise monitors			

Date	Engagement (Describe)	Small group Meetings (Attendees)	Larger Group Meetings (Attendees)	Emails	Workshops	Site Visits	Layout Map circulated	Meeting Summary
21/01/2019 & 24/01/2019	Erection of noise monitors at dwellings. Liaison with residents as part of process.							
18/02/2019				Email Enclosing the EIAR scoping document and the draft PEP. Answering queries arising from 21/01/19 meeting. Email to circulation list. Delivery to all others within near neighbour zone.				
20/02/2019				Confirmation of meeting issued to circulation list.				
21/02/2019			16					PEP, EIAR studies update, potential for turbine relocation, Q&A covering noise, infrasound, Coillte long-term strategy, workshop design, WEGS, wider engagement outside the 2km zone.
06/03/2019				Email informing about the visualisation software visit to near neighbour houses. Site visits to all interested houses to allow them to "see" what the current layout iteration would look like for individual houses.				
13/03/2019				Minutes Issue. Email to circulation list. Delivery to all others within near neighbour zone.				
13/03/2013				Email inviting near neighbours to become involved in design of community workshops.				
20/03/2019				Draft meeting agenda issued to circulation list.				
21/03/2019			9	Map V3 circulated		Layout Map on 5000 scale background, 2 turbines to NE potentially not proceeding, 10 WTG now in single cluster.		EIAR Studies update, potential to relocate 2 WTG to avoid 180 degree affect, turbine size, studies, number of dwellings, update on the noise campaign, update on the PEP process, Q&A.

Date	Engagement (Describe)	Small group Meetings (Attendees)	Larger Group Meetings (Attendees)	Emails	Workshops	Site Visits	Layout Map circulated	Meeting Summary
24/03/19, 25/03/19, 09/04/19, 25/04/19					Site visits to all interested houses to allow them to "see" what the current layout iteration would look like for individual houses. Trueview software utilised.			
02/04/2019				Minutes Issue. Email to circulation list. Delivery to all others within near neighbour zone (4th & 5th April).				
17/04/2019				Meeting Agenda and Project Update Issue. Email to circulation list. Delivery to all others within near neighbour zone.				
25/04/2019			15					EIAR studies update, Trueview software and its limitations and benefits, vibration and landslides, noise, existing noise, noise workshop design, community funds to benefit near neighbours - not all want a community fund, health, property values, PEP signed, fires, bats, Q&A.
26/04/2019				Emails in relation to venue and rotating chair for future meetings.				
03/05/2019				Update on Met mast informing that it had been tampered with causing it's collapse. Email to circulation list. Delivery to all others within near neighbour zone.				
07/05/2019				Minutes Issue. Email to circulation list. Delivery to all others within near neighbour zone.				
15/05/2019		2						
07/06/2019				Meeting Agenda and Project Update Issue. Email to circulation list. Delivery to all others within near neighbour zone.				
12/06/2019			9				10 WTG in single cluster, 2 to NE not proceeding.	EIAR studies update, WEGS - tip height discussion in reference to the 2006 guidelines, Photomontages tabled and left for perusal, tourism, planning process, LCC preplanning meeting, noise - workshop design;

Date	Engagement (Describe)	Small group Meetings (Attendees)	Larger Group Meetings (Attendees)	Emails	Workshops	Site Visits	Layout Map circulated	Meeting Summary
								use of the 2006 WEGS in absence of new WEGS, 2 proposed turbines in NE not proceeding, property values workshop, Q&A.
13/06/2019				Noise Workshop Agenda. Email to circulation list. Delivery to all others within near neighbour zone.				
24/06/2019				Minutes Issue. Email to circulation list. Delivery to all others within near neighbour zone.				
02/07/2019					Noise AWN (6 attendees)			
16/07/2019				Meeting Agenda and Project Update Issue. Email to circulation list. Delivery to all others within near neighbour zone.				
18/07/2019			3					EIAR & Studies update, noise and noise workshop, community benefit fund, community ownership, preplanning meetings with Leitrim & Sligo Co Co, property values, recreational potential as part of proposed project.
19/07/2019				Noise Workshop Presentation. Email to circulation list. Delivery to all others within near neighbour zone.				
01/08/2019				Minutes Issue. Email to circulation list. Delivery to all others within near neighbour zone.				
12/08/2019				Confirming meeting email to circulation list. Text to others.				
14/08/2019			3		Ecology & Archaeology MW-MKO			
21/08/2019				Archaeology & Ecology presentations email to circulation list. Delivery to all others within near neighbour zone.				

Date	Engagement (Describe)	Small group Meetings (Attendees)	Larger Group Meetings (Attendees)	Emails	Workshops	Site Visits	Layout Map circulated	Meeting Summary
01/10/2019				Email outlining that due to very low attendance, monthly meetings were not useful to people and outlining that we would revert to individual engagements to explain the design and address any queries. Email to circulation list. Delivery to all others within near neighbour zone. No feedback that suggested that neighbours wished to continue the monthly meetings.				
12/12/2019				Email enclosing details on the new WEGS. Email to circulation list. Delivery to all others within near neighbour zone.				
09 - 19/12/19	Brochure Delivery. Delivery to all within 5km of the proposed development. Delivered by the project CLO, who was available to answer any queries.							
13/12/2019	Letter to Elected representatives, TDs, County Councillors, MEPs proximate to the proposed project. Brochure enclosed, request for meeting to discuss the proposed project.							
19/12/2019	Website Goes Live							
08/01/2020				Email giving update on expected planning submission date and upcoming met mast planning application. Email to circulation list. Delivery to all others within near neighbour zone.				
19/02/2020	Letter enclosing brochure to all community organisations within 10km of the proposed WF. Invitation to outline any queries in relation to the proposed project, to invite the group to become stakeholders.							
01/04/2020	Email giving update on progress of the planning application preparation and outlining that a submission would not be before the start of May. Details given and link attached to Government provisions on public consultations to be extended. Email to circulation list, text to others within near neighbour zone.							
June 2018 to January 2019, ongoing and then main focus from October 2019 to date	Individual house engagements by the CLO.							

Appendix B – Early Stage Photomontages

Map Legend

- Distance from Proposed Turbines
- Proposed Turbine (Dec. 2018)
- Photo Location

10 KM

5 KM

PL04

PL05

PL01

PL08

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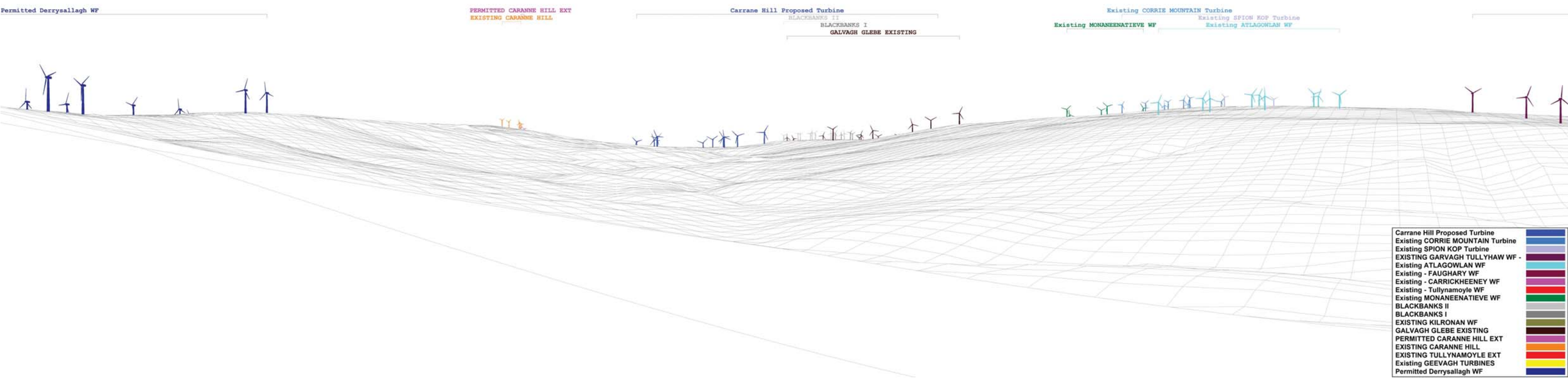
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DRAWING BY: **Lorraine Meehan**	CHECKED BY: **Michael Watson**		ISSUE NO.: **180511-2018.11.30-D1**

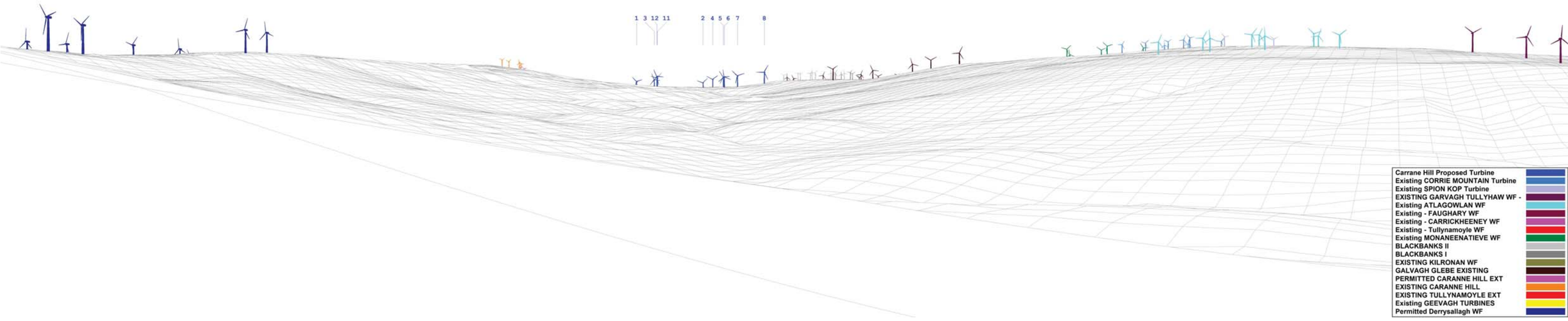
McCarthy Keville O'Sullivan

McCarthy Keville O'Sullivan Ltd., Block 1, G.F.S.C, Moneenageisha Road, Galway, Ireland. Email: info@mccarthykos.ie Tel: +353 (0)91 735611 Fax: +353 (0)91 771279



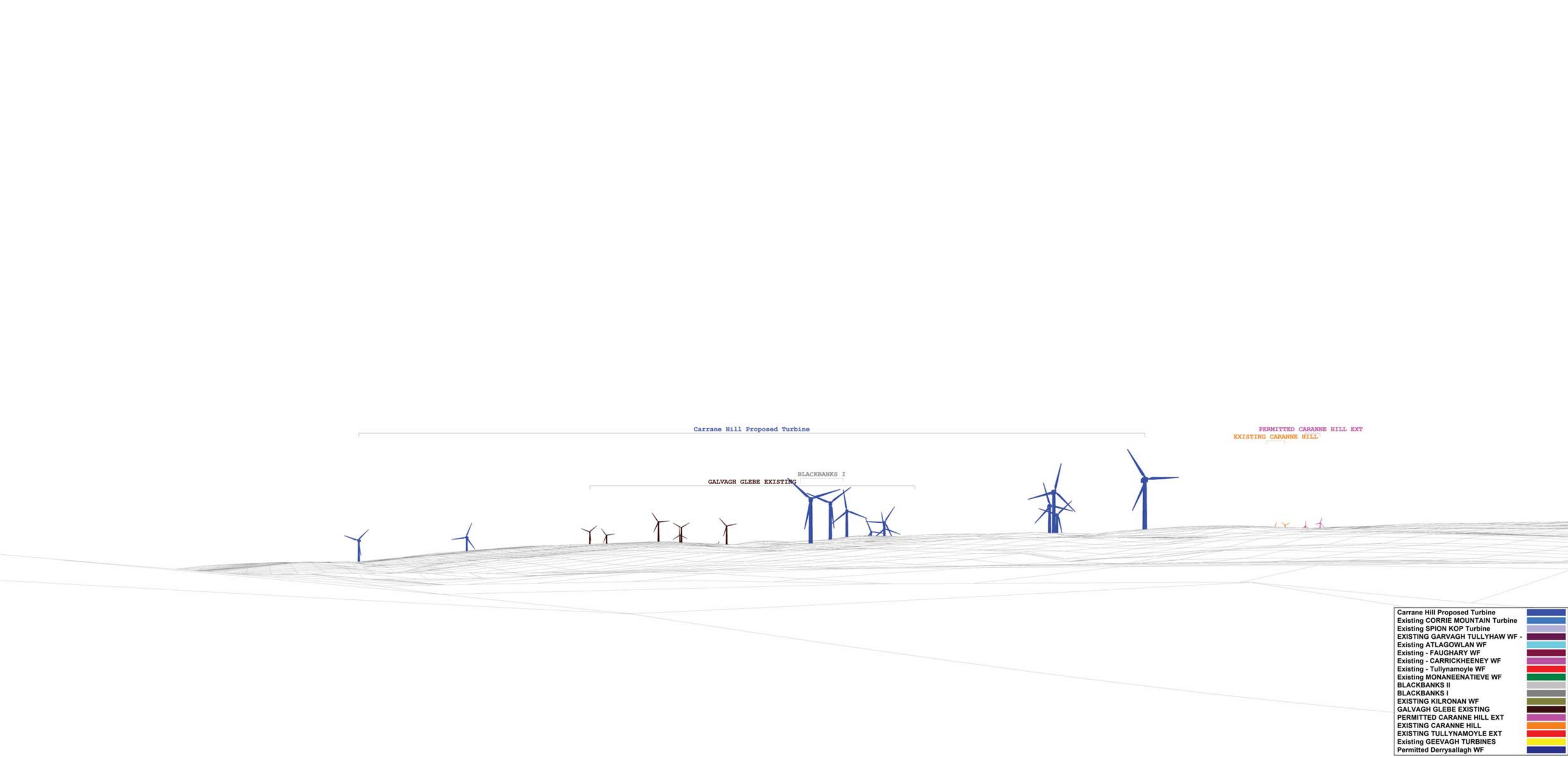


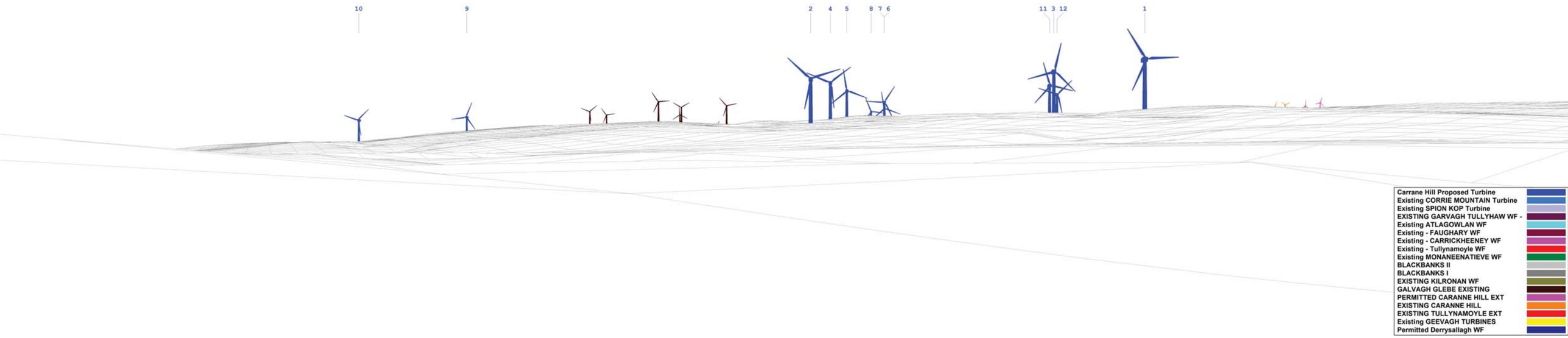

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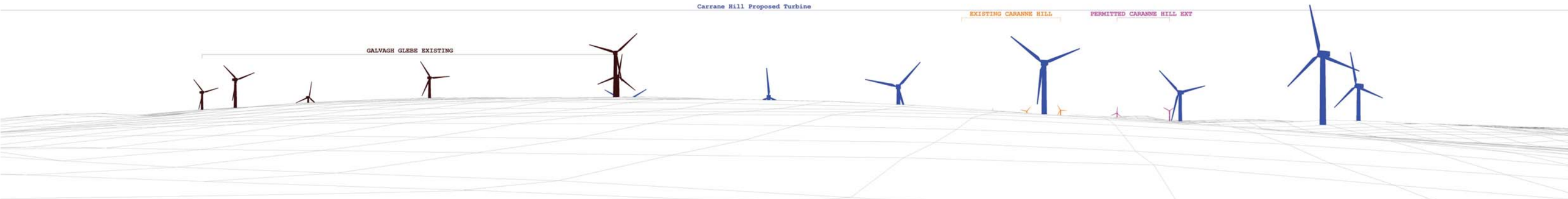



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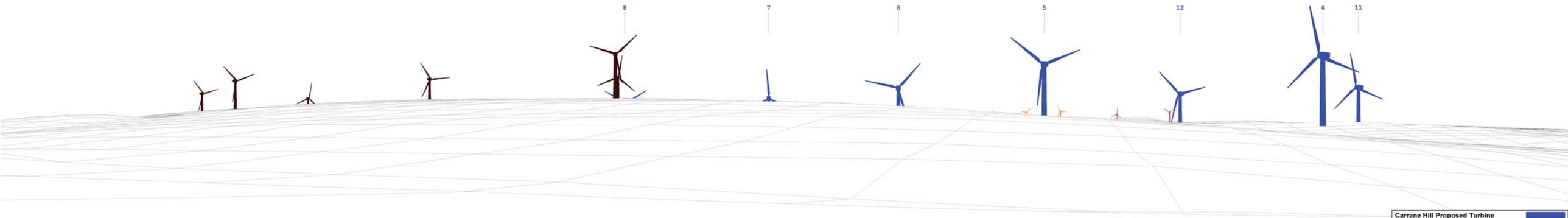

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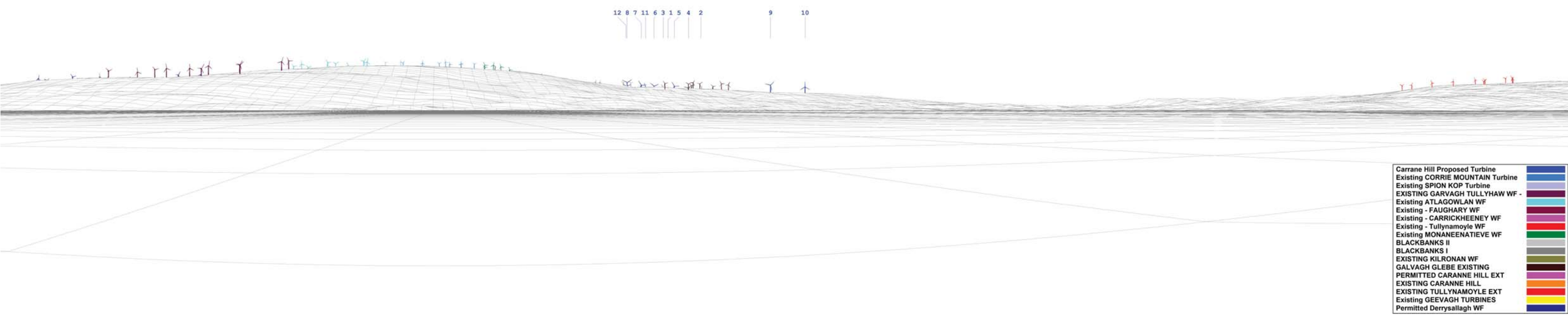


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Appendix C – Workshop Handouts

Croagh Wind Farm – Noise Workshop 2nd July 2019

Wind Farm Noise Assessment

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1

AWN is responsible for the noise and vibration assessment associated with the construction and operation of the proposed development, this role involves:

Establishing the appropriate assessment methodology to be used;
Completing a background noise monitoring survey of the site;
Reviewing outputs from interim noise model; and
Preparing the Noise and Vibration Chapter of the Environmental Impact Assessment Report (EIAR).

The EIAR chapter will present full details of the assessment undertaken. This information contained in the Chapter is technical due to the nature of the assessment – the details are required for transparency.

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2

Overview of Presentation - Key Items of the Operational Phase

3

1. The Decibel Scale
2. Assessment Guidelines & Noise Criteria
3. Background Noise Surveys
4. Assessment of Turbine Noise Impacts
5. Brief Summary
6. Other Topics
7. Questions

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3

1. The Decibel Scale

4

- The Decibel Scale is a logarithmic scale used for measuring and comparing energies or powers.
- Expressed in dB
- Convenient due to the very large range of audible sound pressures:
  - Audible sound pressure scale (Pascals) of 5 million:1 is compressed into a more manageable range of ~120 dB.
  - Similar to the Richter Scale for measuring earthquakes.

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The Richter Scale

Understanding the Richter Scale:

Richter Magnitude	Feels like KG of TNT	Extra Information
0-1	0.6-20 kilograms of dynamite	We can not feel these
2	600 kilograms of dynamite	Smallest Quake people can normally feel
3	20,000 kilograms of dynamite	People near the epicenter feel this quake
4	60,000 kilograms of dynamite	This will cause damage around the epicenter. It is the same as a small fission bomb
5	20,000,000 kilograms of dynamite	Damage done to weak buildings in the area of the epicenter
6	60,000,000 kilograms of dynamite	Can cause great damage around the epicenter
7	20 bilion kilograms of dynamite	Creates enough energy to heat New York city for one year. Can be detected all over the world. Causes serious damage
8	60 bilion kilograms of dynamite	Causes death and major destruction. Destroyed San Francisco in 1906
9	20 trillion kilograms of dynamite	Rare, but would causes unbelievable damage!

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The Decibel Scale

- Tenfold increase in sound intensity = +10dB
- Sound intensity ratio expressed in dB
  - 100 = 20 dB,
  - 1000 = 30 dB,
  - 10000 = 40 dB
  - 100000 = 50 dB

A 10 dB increase is equal to a tenfold increase in sound intensity energy. A 10 dB increase in noise is perceived by most people as being twice as loud.

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Addition of Decibels (dB)

- Combining Decibels (dB)
- Decibels do not follow the rules of ordinary arithmetic
  - 40 dB + 40 dB = **43 dB** (+3 dB just noticeable difference).
  - 40 dB + 45 dB = **46 dB** (+1 dB ~imperceptible change).
  - 40 dB + 50 dB = **50 dB** (no change to the higher level, 10 dB rule).
  - (40 dB + 40 dB = **43 dB)** + 50 dB = **51 dB.**

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Addition of Multiple Noise Sources

Doubling the number of identical noise sources?



All things being equal this results in a 3 dB increase in noise (i.e. just noticeable). A detailed assessment of wind turbine noise will considered many factors, the source sound power, distance to receiver, height etc. Addition sources = potential change to the noise environment

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A-Weighted Decibels (dBA)

- A-weighting is a standardised frequency correction applied to noise.
- Based on the human response to noise at different frequencies (equal loudness studies in 1950's, ISO 226:2003).
- Used for the vast majority of noise measurements, referenced in standards and regulations e.g. roads, aircraft, wind turbine noise etc.
- Common criticism is that it undervalues effects of low frequency noise as it apply more correction at lower frequencies.

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Acoustical Parameters

dB(A) **an "A" weighted decibel value**

L_{Aeq} **the equivalent continuous sound level - a type of "average"**

L_{A90} **used to quantify background noise level. The L_{A90} parameter is used for the assessment of wind turbine noise.**

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2. Assessment Guidelines



- Section 5.6 of the "*Planning Guidelines on Wind Energy*" published by the Department of the Environment, Heritage and Local Government (DoEHLG) published in 2006 outlines the appropriate noise criteria in relation wind farm developments.

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Assessment Guidance

ETSU-R-97

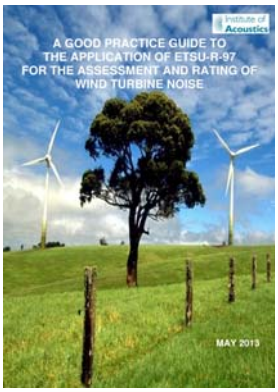
- ETSU-R-97 document '*The Assessment and Rating of Wind Farms*' was published in 1996
- Provides a methodology for generating noise limits for a wind turbine and wind farms – referenced by the UK Government in current UK legislation.
- The nose criteria set out in the 2006 Irish Guidelines are based on ETSU-R-97.

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Assessment Guidance



IOA Good Practice Guide (GPG)

- Published in 2013.
- Presents comprehensive advice on how to apply ETSU-R-97.
- Recognised as current best practice in the field.
- Informs the assessment methodology for this project.
- With the noise criteria taken from the 2006 DoEHLG Guidance.

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2006 DoEHLG Noise Criteria

- Noise criteria is based on the existing background noise level in the environment. The following noise criteria are contained in the guidance:
  - 35 to 40dB $L_{A90,10min}$ for quiet daytime environments of less than 30dB $L_{A90,10min}$;
  - 45dB $L_{A90,10min}$ for daytime environments greater than 30dB $L_{A90,10min}$, or a maximum increase of 5dB(A) above background noise, whichever is the highest; and,
  - 43dB $L_{A90,10min}$ for night time.

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3. Background Noise Survey

- Background noise surveys undertaken at 10 locations in early 2019 in accordance with the IOAGPG guidance.
- Identify background noise levels in order to set turbine noise limits (criteria) at noise sensitive locations (i.e. houses and amenity areas)
- Noise from existing wind turbines; IOA GPG:

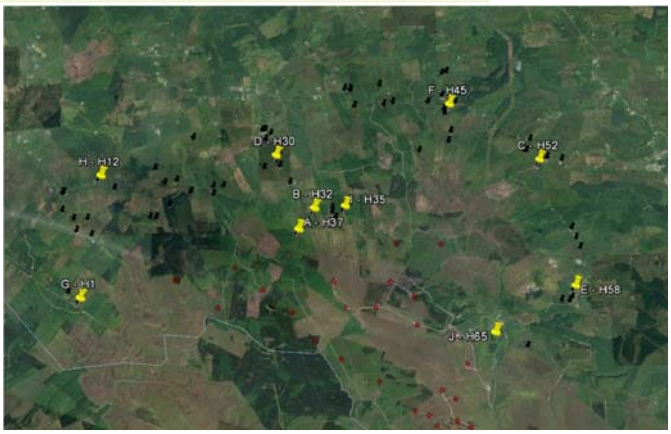
SB3: Any contribution to background noise levels of noise from an existing wind farm must be excluded when assigning background noise and setting noise limits for a new development.

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Locations of Background Noise Monitoring Location



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Analysis of Noise Data

Background noise levels are measured until adequate data sets are obtained across a range of windspeeds. Screened in line with best practice guidance for:

- quiet periods of day and night.
- removing periods affected of rainfall.
- removing atypical noise sources.
- removing noise from existing turbines.

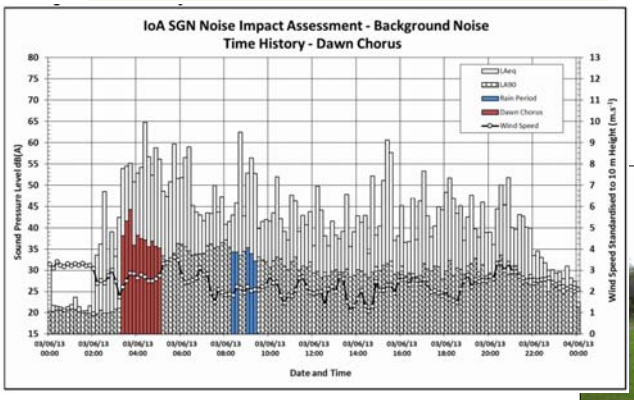
The above steps yield a conservative assessment to ensure that background noise levels are not elevated.

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Measured Noise Data



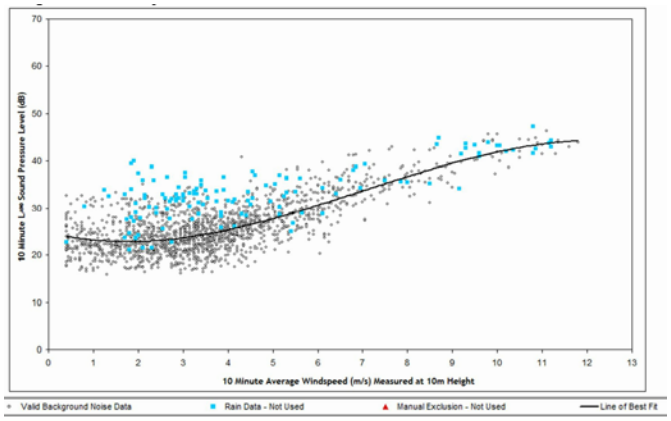


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Screened Data Sets for Deriving Background Noise Levels

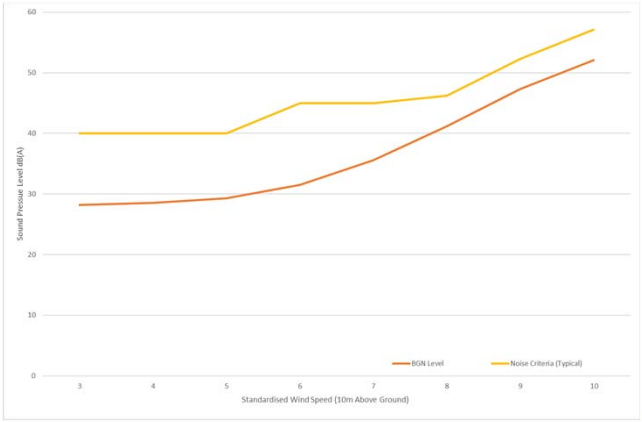


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Noise Criteria Curve Derived from Background Noise Levels



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Noise Criteria Curve Derived from Background Noise Levels

- Cumulative turbine noise levels (proposed and existing turbines) should not exceed the criteria curves.
- The developer has no control over existing wind turbine noise.
- Consider the relevant increase in turbine noise level (existing + proposed turbines) as part of the impact appraisal.

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4. Assessment of Turbine Noise

- Receive turbine layout and details from Coillte:
  - Turbine noise emissions at various operational Wind speed from the manufacturer;
  - Assessment Hub Height (HH) for the turbine; and
  - Noise Sensitive Locations (NSL) and Topography data (height lines).
- Develop a detailed noise prediction model using noise prediction calculation software in accordance with international standards (ISO1613) and the procedures set out in the IOAGPG. All details reported in the EIAR.

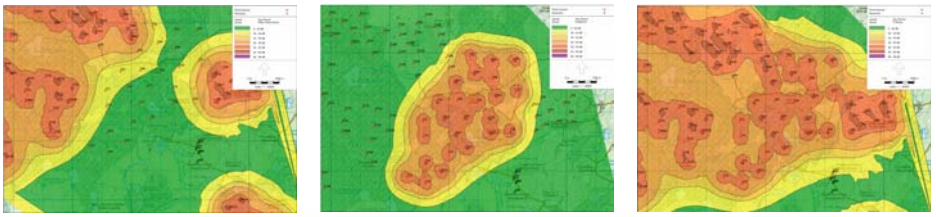
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Assessment of Turbine Noise

- Noise predictions are compared against the noise criteria for all NSL's for both day and night.
- Cumulative noise predictions include existing turbines.
- Initial omni-directional predictions are a worst-case - consider directionality propagation due to wind direction.



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Assessment of Turbine Noise

- Do the cumulative noise predictions comply with the noise limits (criteria)?
- If yes, the assessment is complete subject to any changes to the design.
- If not, slight exceedances can be mitigated with curtailment i.e. running turbines in low noise modes – if significant exceedances, this may require redesign of turbine layout.
- Comment on the predicted impacts - significance of effects at nearest NSL's. The information contained in the EIAR presents the relevant info for all NSL's.

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5. Brief Summary

- Determine the study area and identify monitoring locations;
- Assess the background noise to establish appropriate turbine noise limits;
- Predict turbine noise levels, do they comply with the noise limits?
- If not - mitigate or redesign scheme.
- If yes - report results of assessment.

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6. Other Topics

1. Amplitude Modulation
2. Low Frequency Noise (LFN)
3. Infrasound
4. WHO Guidelines
5. Future Irish Guidelines

A detailed discussion on each of these topics will be presented in the EIAR Chapter the following information is provided to give an overview.

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Amplitude Modulation (AM)

- What is it? Periodic fluctuations in the level of audible noise from a wind turbine (or wind turbines).
- Amplitude depth of fluctuations excessive.
- It is not possible to predict AM in wind turbines.
- Research has shown that occurrences at sites are rare and AM will typically only presents in specific conditions (wind speed/direction).
- Complaints relating to AM associated with the proposed development will be investigated in line with best practice.

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Mitigation for AM

- The turbine manufacture and operator shall investigate the potential causes of the AM and implement appropriate adjustments to mitigate for it, this may ultimately involve curtailment of some turbines under specific conditions where no other engineering solutions can be found.

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Low Frequency Noise (LFN)

- A-weighting not used in assessment of LFN.
- In the unlikely event that an issue with low frequency noise is associated with the proposed development.
- Recommend assessment of LFN if potential issues presents.
- EPA document Guidance Note for Noise: *Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)* (EPA, 2016).
- Salford University document *Procedure for the assessment of low frequency noise complaints*, Revision 1, December 2011.



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Infrasound

- Published documents from the Environmental Protection Agency (EPA) Ireland, UK Heath Protection Agency, South Australian EPA and the World Health Organisation (WHO) have shown that there is no credible evidence that infrasound from wind turbines can be perceived or that it is associated with any negative heath impacts.



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Infrasound

- Infrasound can be measured (ISO 7196:1995 – dB(G)).
- A recent study undertaken in Germany at a number of wind farm sites showed that the dB(G) measured in the vicinity of the sites were found to be below thresholds of perceptibility.
- At 700m no difference in dB(G) with turbines on/off.
- On the limited number of wind farm sites where AWN has conducted infrasound measurements there was no evidence of perceptible infrasound associated with operation of the wind turbines found.

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World Health Organisation (WHO) 2018 Guidelines

- Recommended to serve as the basis for a policy-making process e.g. inform new guidelines.
- The L_{den} parameter reference by the WHO is a yearly average level and is considered to be a poor characterisation of wind turbine noise.
- In relation to wind turbine noise the WHO recommendations are 'conditional' as the quality evidence available for research is low.

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Future Changes to the Guidelines

- The 'Preferred Draft Approach' was issued as an Information Note by the Department of Environment, Community and Local Government (DECLG) in June 2017.
- The noise limits discussed are similar to the current guidelines in that a lower threshold of 35 dB L_{90} is suggested with an allowable increase of 5 dB relative to the background noise.
- Updated guidelines are yet to be published.

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7. Questions

- Please ask any question you may have.



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archaeological services

- Miriam Carroll and Annette Quinn of Tobar Archaeological Services will complete the archaeology & Cultural Heritage Assessment

- Miriam and Annette both graduated from University College Cork in 1998 with a Masters degree in Methods and Techniques in Irish Archaeology.

- Both are licensed by the Department of Culture, Heritage and the Gaeltacht to carry out excavations and are members of the Institute of Archaeologists of Ireland.



Archaeology & Cultural Heritage

- The intention is to assess potential effects on archaeological, architectural and cultural heritage
- European Convention on the Protection of the Archaeological Heritage (Valletta Convention). This was ratified by Ireland in 1997.
- Completed within the framework set out by
  - *National Monuments Acts 1930 to 2004*
  - *Cultural Institutions Act 1997*
  - *The Record of Monuments and Places (RMP)*
  - *Heritage Act (1995) (architectural heritage)*
  - *Granada Convention*
  - *County Development Plan Obligations*

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TOBAR archaeological services

Sources of Information

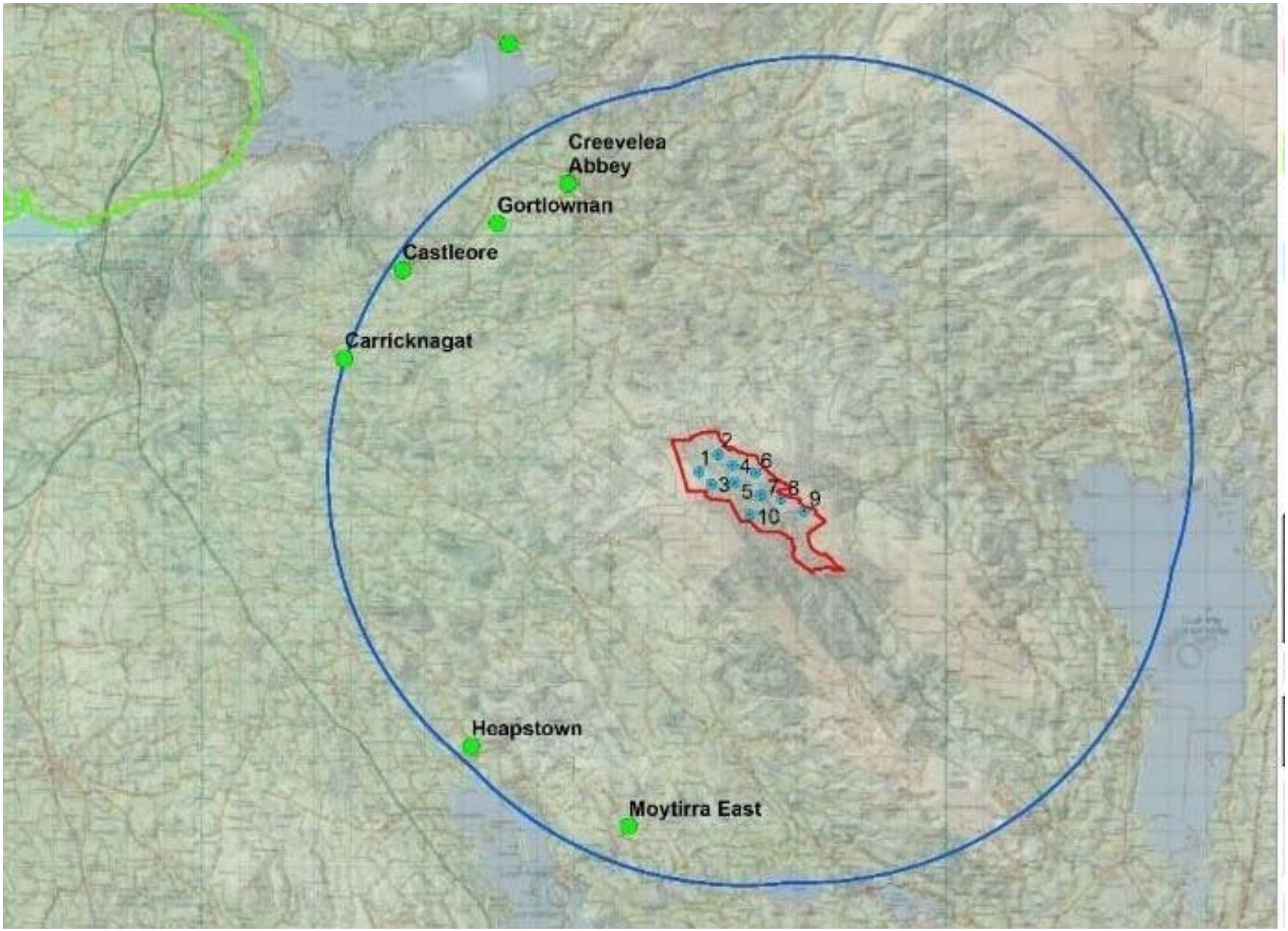
- Records of Monuments and Places
- www.webgis.archaeology.ie/historicenvironment
- Cartographic Sources & Aerials
- www.OSI.ie
- National Museum of Ireland
- www.heritagemaps.ie
- Leitrim & Sligo County Development Plans
- www.sligococo.ie/planning/DevelopmentPlans/
- http://www.leitrimcoco.ie/eng/Services_A-Z/Planning-and-Development/Development-Plans/
- Excavations Locally
- www.excavations.ie
- National Inventory of Architectural Heritage (NIAH)
- www.buildingsofireland.ie



Field Surveys

- Collating data to confirm the desk survey and looking for any unknown features
- Four site visits completed in February 2019
- Walkover Inspection of the site and surrounds
- Visit to National Monuments within 10km of the site





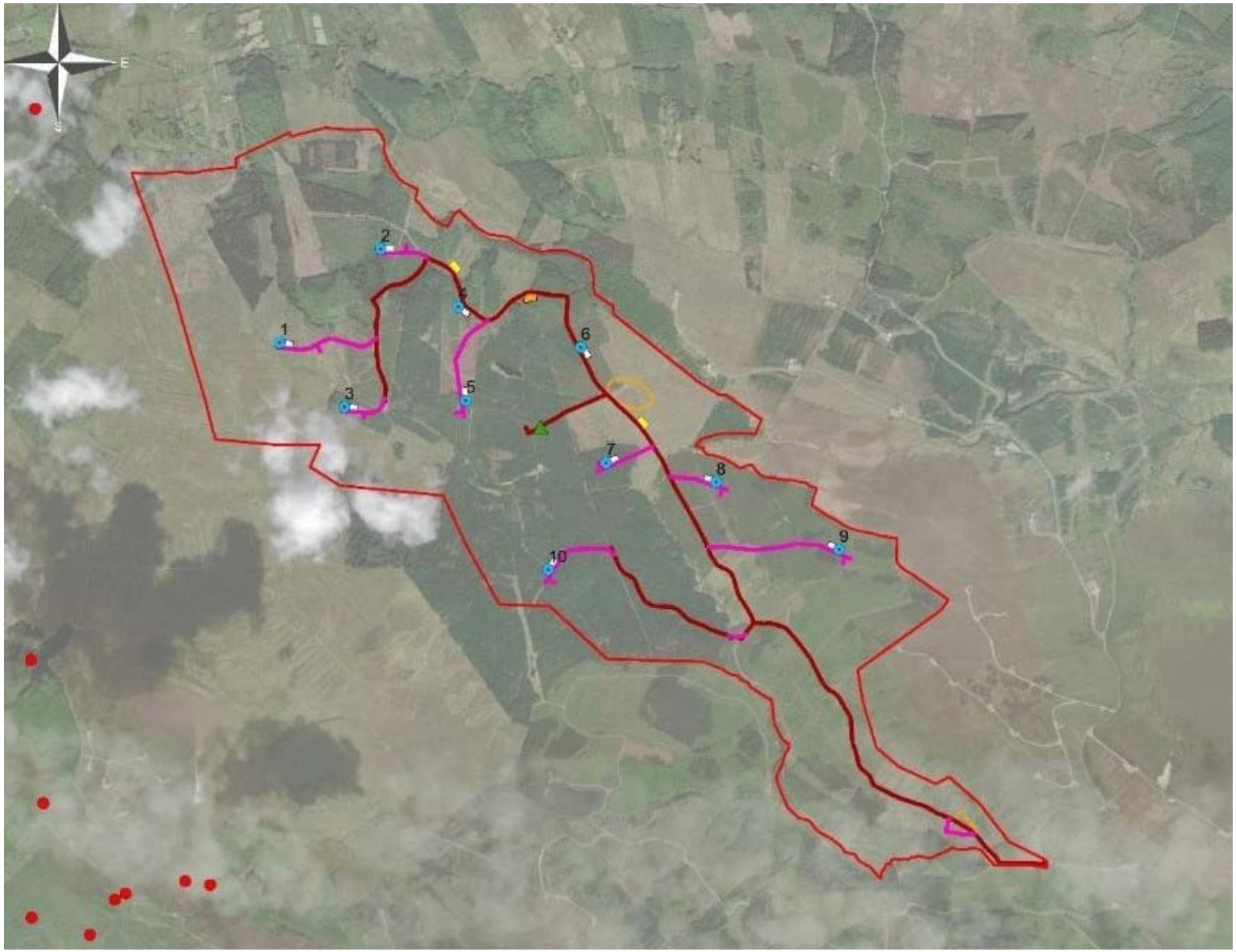
National Monuments in State Care

National Monuments

- NM 69 (Franciscan) LE014-004001 Creevelea Abbey Friary
- NM 277 SL021-012 Gortlownan Motte
- NM 277 SL021-028 Castleore Cashel
- NM 277 SL021-104 Carricknagat Megalithic Tombs SL021-062
- NM 152 Heapstown Cairn SL034-128



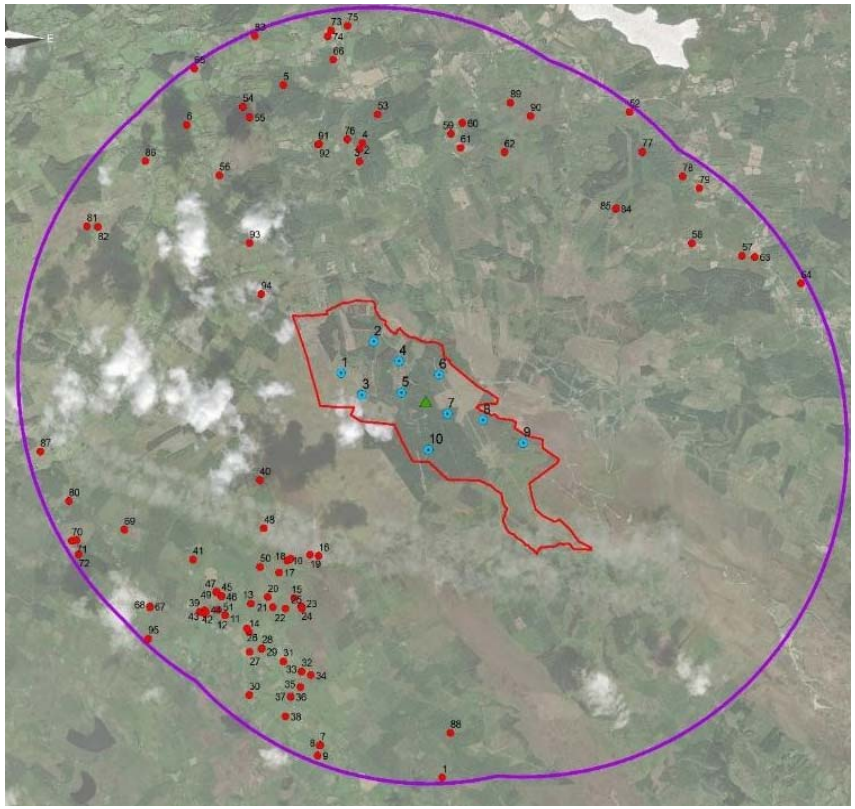
Interior of Cashel, National Monument 277 at Castleore.



Croagh – Closest Record of Monuments & Places

Record of Monuments & Places

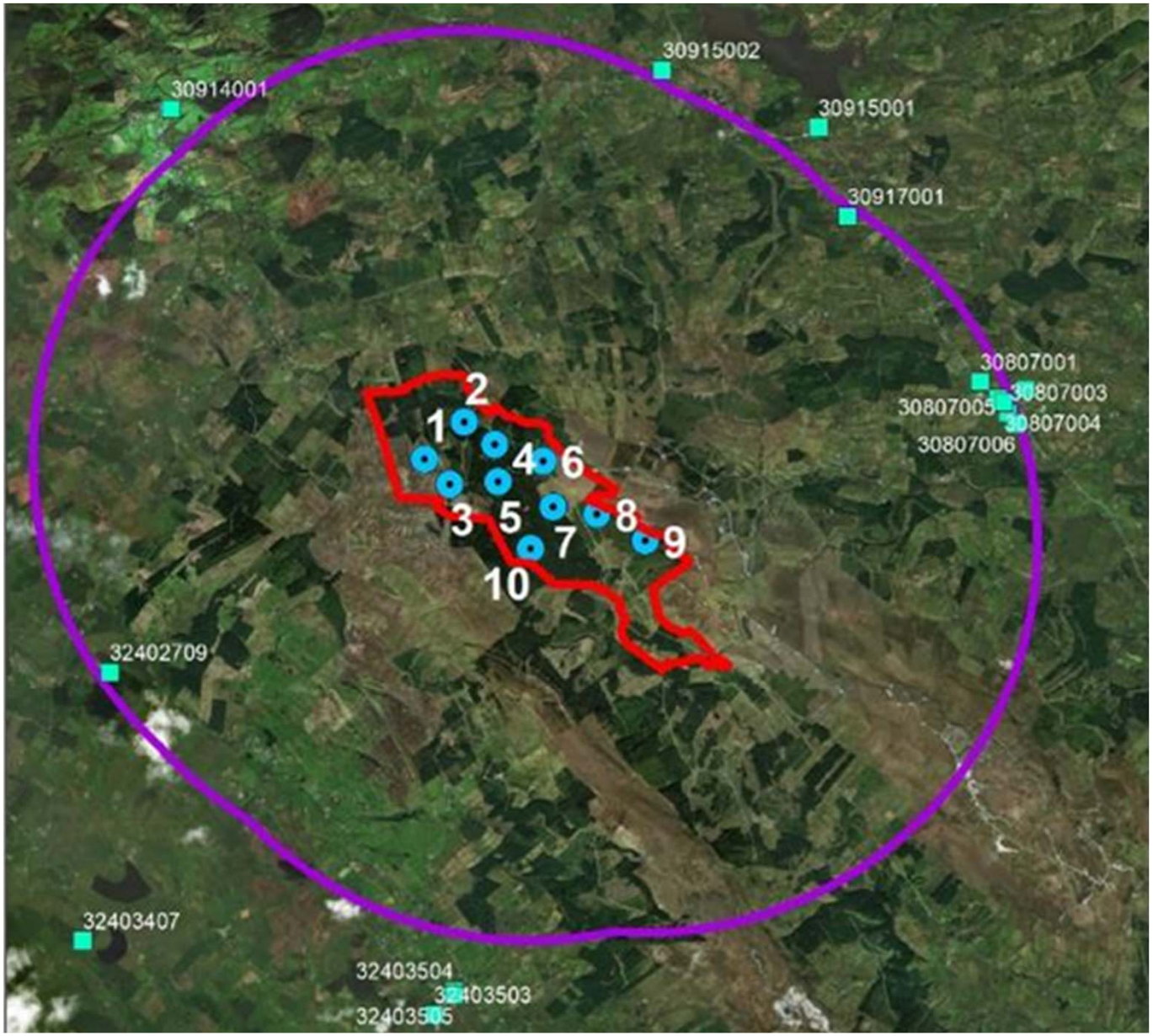
- None within or adjacent the site boundary
- 1 between 1km & 2km of a turbine
- 11 between 2km & 3km
- 38 between 3km & 4km
- Majority are between 4km & 5km



RMPs within 5km

Architectural & Cultural Heritage

NIAH	NAME	TOWNLAND	ITM E	ITM N	Distance
30917001	Glasdrumman House	Glasdrumman More	588720	826734	4.8km to T9
30807001	water pump	Drumkeeran [Drum. By.]	590413	824618	4.8km to T9
30807003	Kelly House	Lugmeen	590642	824410	4.8km to T9
30807005	House (Sheena)	Sheena	590769	824220	4.9km to T9
30807006	Drumkeeran Church of Ireland Church	Sheena	590873	824089	4.9km to T9
30807004	Drumkeeran Court House	Lugmeen	590718	824360	4.9km to T9
32402709	Saint Columbs Roman Catholic Church	Drumnasoohy	579305	820913	4.9km to T3



Built Heritage – 5km

Local Excavations

- 2008:756 - Garvagh Glebe and Tullnahaw, Leitrim
  - August to December 2008
  - Site type: No archaeological significance

- 2010:437 - Garvagh Glebe (Leitrim) and Tullnahaw (Roscommon), Leitrim
  - August 2008 until July 2010
  - Site type: No archaeological significance

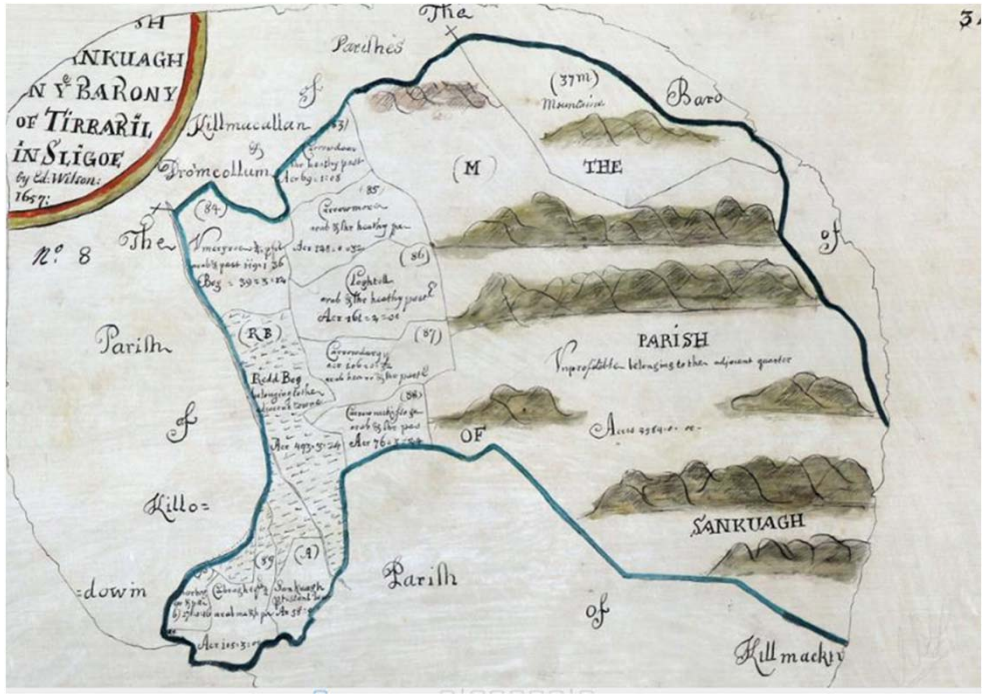
Impact Assessment

- Direct Effects (Known Features) –
  - These are generally avoided and or separation distances set
- Direct Effects (Unknown Features)
  - Protection against impacts on unknown features is achieved primarily by archaeological monitoring during earthworks
- Indirect Effects (Setting of Features)
  - Potential effects on the setting of features is assessed



Down Survey map (http://downsurvey.tcd.ie/down-survey-maps.php#bm=Drumaheir&c=Leitrim&p=Killarga)

Area of the proposed wind farm as mountainous and bog and depicted as Protestant lands



Down Survey map of 1657 showing the south-western section of the site in bog and mountainous pasture.

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Thank You!

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About MKO

- **MKO** delivers challenging and complex planning and environmental projects for our clients.
- Our team of over **65 professionals** work across **5 specialist teams**



MKO Planning and Environmental Consultants

Five specialist teams











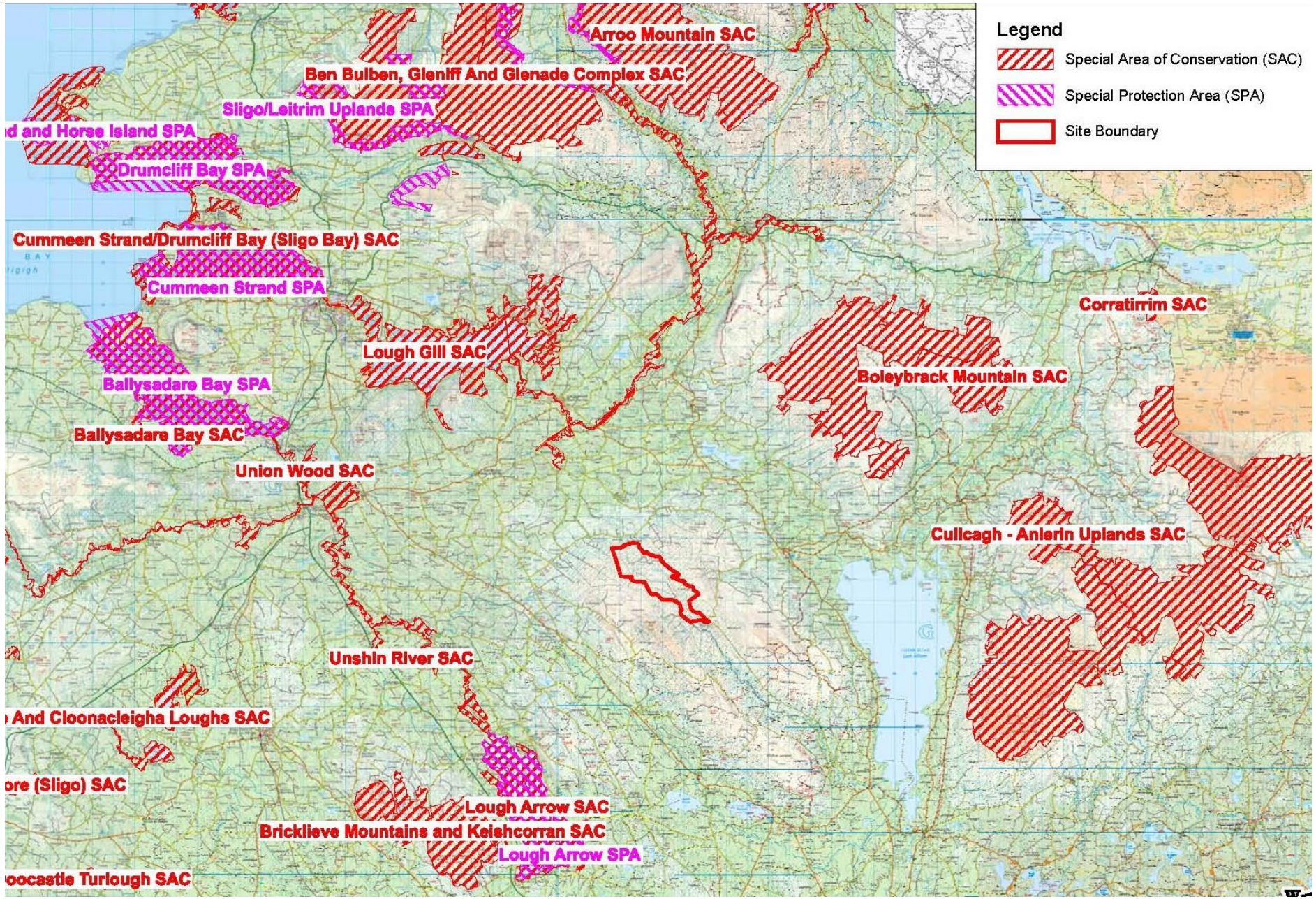
Ecological Assessment - EIA

- Done within a framework to comply with legislation
- EIA Directive - European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment
  - Preparation of an EIAR Report
- In accordance with domestic legislation and latest guidance documents
  - *Irish Wildlife Acts 1976 to 2017*
  - *EPA (2017). Draft revised guidelines on the information to be contained in Environmental Impact Statements. Environmental Protection Agency.*
  - *CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal, and Marine.*

Ecological Assessment - NIS

- EU Habitats Directive and Birds Directive
  - Preparation of Natura Impact Assessment
  - Assesses potential impacts on European Designated Sites
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)

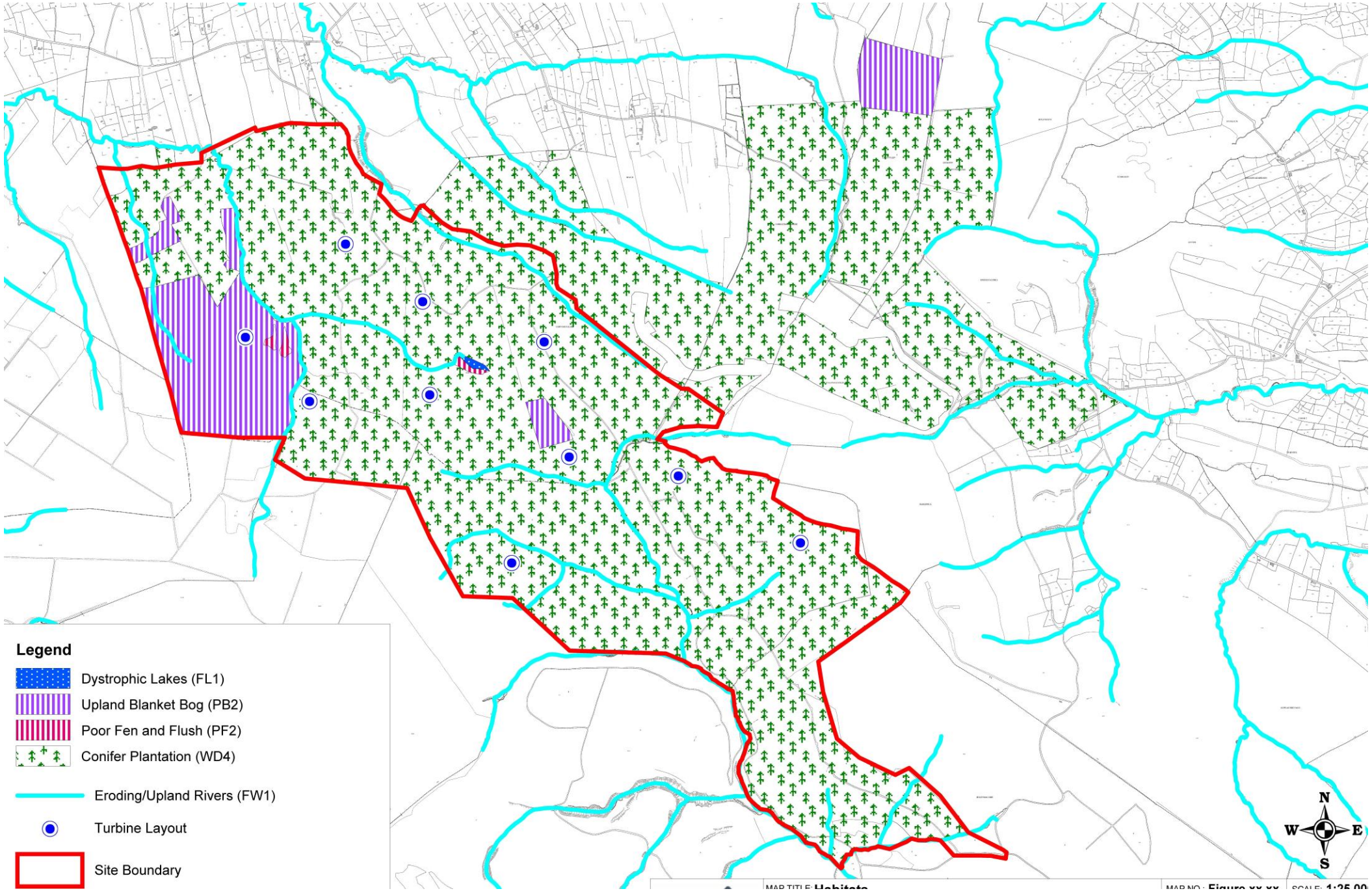



Legend
Special Area of Conservation (SAC)
Special Protection Area (SPA)
Site Boundary
Arroo Mountain SAC
Ben Bulben, Gleniff And Glenade Complex SAC
Sligo/Leitrim Uplands SPA
d and Horse Island SPA
Drumcliff Bay SPA
Cummeen Strand/Drumcliff Bay (Sligo Bay) SAC
Cummeen Strand SPA
Lough Gill SAC
Corratirrim SAC
Boleybrack Mountain SAC
Ballysadare Bay SPA
Ballysadare Bay SAC
Union Wood SAC
Cuilcagh - Anierin Uplands SAC
Unshin River SAC
And Cloonacleigha Loughs SAC
ore (Sligo) SAC
Lough Arrow SAC
Bricklieve Mountains and Keishcorran SAC
Lough Arrow SPA
oocastle Turlough SAC

Ecological Surveys

- Collating data to assess potential impacts on ecology
  - Terrestrial (Habitats & Terrestrial Mammals)
  - Bats
  - Birds
  - Aquatic
- Using most up-to-date guidance and best practice
  - *National Survey of Upland Habitats (Perrin et al. 2014)*
  - *Recommended bird survey methods to inform impact assessment of onshore wind farms. (Scottish Natural Heritage, 2017)*




Legend
Dystrophic Lakes (FL1)
Upland Blanket Bog (PB2)
Poor Fen and Flush (PF2)
Conifer Plantation (WD4)
Eroding/Upland Rivers (FW1)
Turbine Layout
Site Boundary
N
W
E
S





Impact Assessment

- Done in accordance with EPA and Transport Infrastructure Ireland Guidance documents
  - TII/NRA (2009). Guidelines for Assessment of Ecological Impacts of National Road Schemes (Revision 2).
  - EPA (2017). Draft revised guidelines on the information to be contained in Environmental Impact Statements. Environmental Protection Agency
- Potential Direct Impacts
  - Habitats loss, turbine collision
- Potential Indirect Impacts
  - Surface water impacts, disturbance, displacement



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Thank You!



Appendix D – List of Community groups Contacted

Voluntary Community Groups

Arigna

Association

Arigna Recreational Enhancement Association

Arigna Heritage

Arigna Foroige

Arigna Miners Way and Historical Trail- Walking Group

Strabaggan NS Parents Committee

Greaghnafarna NS Parents Committee.

Ballyfarnon

Tidy Towns
Ballyfarnon Community Group
GAA
Parish Council

Ballintogher

Tidy Towns
GAA
Hall Committee
Development Association

Dromahair

Killenummery Hall Committee
Killenummary Womens Group.
Killennumary Old Church Committee
Dromahair Dev. Tidy Towns.
Dromahair Anglers.
Active Age.
Dromahair Arts and Recreation.
Ladies GAA
Mens GAA
Ardvarney Parents Association.
Drumlease P association
Dromahair Soccer Club
Gun Club
Lough Gill Players
Drumlease Residents Association
Dromahair Heritage Group

Drumkeeran

Tidy Towns
Rowanberry Services
GAA

Mc Kenna Commemoration.
Womens Club.
Pastoral Council and Finance
Drama Society
Tourism Committee
Fair Day commemoration
Handball Club
Drumkeeran Friendship Club.

Geevagh

Mens Shed
G.L.A.D (Geevagh Local Area Development.
Corrig, Graveyard Committee.
Carrownadargny Group Water Scheme.
Carn hill walking group.
Community Alert
Gun Club
Community Resource.
First Friends Play School
GAA
Valley Rovers Soccer Club
Community Games
Geevagh/Highwood Group Water Scheme.
Geevagh Playground.
Historical Society
Mother and Toddler
Legion Of Mary

Gleann

C.L.A.S.P. Community of Lough Arrow Social Project.

Killargue

Community Centre
Fas Schemes
Bowling Club

Riverstown

Tidy Towns Committee
Sligo Folk Park.
Sligo Agricultural Show
I.C.A.
GAA
Arrow Harps Soccer Club
St Patricks Day Parade committee
Playground Group.
Community Park
Xmas Lights Committee

Appendix E – Indicative Trueview Images

Garvagh, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Garvagh, Sligo, County Leitr...
Location	582599 825068
Distance To	2.8 km
Observer Altitude	160.0 m
Camera Altitude	161.5 m
Heading	136.0°
Date	2019-04-09
Time	13:26:14
Angle Of View	65.11°

Image from east of House 15

Published on 18/04/2019 17:02:40

F91 H340, Sligo, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	F91 H340, Sligo, Ireland
Location	583060 824731
Distance To	2.2 km
Observer Altitude	192.3 m
Camera Altitude	198.8 m
Heading	152.0°
Date	2019-04-09
Time	13:30:41
Angle Of View	65.11°

true view visuals

Image from near Mass rock

Published on 18/04/2019 16:31:34

F91 RY65, Sligo, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	F91 RY65, Sligo, Ireland
Location	581911 824848
Distance To	3.3 km
Observer Altitude	161.2 m
Camera Altitude	162.7 m
Heading	123.0°
Date	2019-04-09
Time	11:48:22
Angle Of View	65.11°

Greaghnafarna, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Greaghnafarna, Sligo, Count...
Location	581811 823538
Distance To	3.1 km
Observer Altitude	234.5 m
Camera Altitude	236.0 m
Heading	70.0°
Date	2019-04-09
Time	13:42:52
Angle Of View	65.11°

true view visuals

Image from House 11 - No Visability, Screened by Trees

Published on 18/04/2019 16:24:56

Tullynascreen, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Tullynascreen, Sligo, County ...
Location	581610 825080
Distance To	3.6 km
Observer Altitude	135.0 m
Camera Altitude	136.5 m
Heading	116.0°
Date	2019-04-09
Time	11:40:32
Angle Of View	65.11°

Image from House 11 - No Visability, Screened by Trees

Published on 18/04/2019 16:24:56

Tullynascreen, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Tullynascreen, Sligo, County ...
Location	581610 825080
Distance To	3.6 km
Observer Altitude	135.0 m
Camera Altitude	136.5 m
Heading	116.0°
Date	2019-04-09
Time	11:40:32
Angle Of View	65.11°

Tullynascreen, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Tullynascreen, Sligo, County ...
Location	582271 825083
Distance To	3.1 km
Observer Altitude	159.5 m
Camera Altitude	161.0 m
Heading	140.0°
Date	2019-04-09
Time	13:19:54
Angle Of View	65.11°

Greaghnafarna, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version : a4 e	Alternatives V5
Nl age : a4 e	Greaghnafarna, Sligo, Count...
I oLation	581218 83. 238
cistanLe Do	. k. m4
TOserver Altitube	316k. 4
Ca4 era Altitube	330k8 4
deabing	85k07
cate	3016°09'06
Di4 e	1. -50-12
Angle Tf VieH	25k117

Beagh, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Beagh, Sligo, County Leitrim...
Location	584337 825904
Distance To	2.4 km
Observer Altitude	149.8 m
Camera Altitude	151.3 m
Heading	180.0°
Date	2019-04-09
Time	10:14:54
Angle Of View	65.11°

Beagh, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Beagh, Sligo, County Leitrim...
Location	845543 478837
Distance To	729 0m
Observer Altitude	9. k2k m
Camera Altitude	9. 928 m
Heading	9412k°
Date	7k93-k5-k3
Time	9k:77:86
Angle Of View	68299°

true view visuals

Image from House 29 - No Visability, Screened by Trees

Published on 18/04/2019 16:15:11

Beagh, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Beagh, Sligo, County Leitrim...
Location	584468 825476
Distance To	2.0 km
Observer Altitude	176.1 m
Camera Altitude	177.6 m
Heading	194.0°
Date	2019-04-09
Time	10:28:09
Angle Of View	65.11°

Beagh, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Beagh, Sligo, County Leitrim...
Location	584468 825476
Distance To	2.0 km
Observer Altitude	176.1 m
Camera Altitude	177.6 m
Heading	194.0°
Date	2019-04-09
Time	10:28:09
Angle Of View	65.11°

Greaghnafarna, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Na0 e	Alternatives V5
l0 age Na0 e	Greaghnafarna, Sligo, Count...
Location	581222 832. 83
Distance To	km4 60
Observer Altitude	15km7 0
Ca0 era Altitude	152m5 0
Heading	11km7°
Date	3719-72-79
Ti0 e	13:38:21
Angle Of View	. 5m11°

Greaghnafarna, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Na0 e	Alternatives V5
l0 age Na0 e	Greaghnafarna, Sligo, Count...
Location	581222 832. 83
Distance To	km4 60
Observer Altitude	15km7 0
Ca0 era Altitude	152m5 0
Heading	11km7°
Date	3719-72-79
Ti0 e	13:38:21
Angle Of View	. 5m11°

Beagh, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Beagh, Sligo, County Leitrim...
Location	587512 835°98
Distance To	0.9 km
Observer Altitude	082.9 m
Camera Altitude	089.9 m
Heading	300.4-
Date	3409:47:49
Time	046°5644
Angle Of View	15.00-

Beagh, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Beagh, Sligo, County Leitrim...
Location	587512 835°98
Distance To	0.9 km
Observer Altitude	082.9 m
Camera Altitude	089.8 m
Heading	084.4-
Date	3409:47:49
Time	046°7651
Angle Of View	15.00-

true view visuals

Image from House 31

Published on 18/04/2019 16:18:54

Beagh, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Beagh, Sligo, County Leitrim...
Location	584686 825164
Distance To	1.6 km
Observer Altitude	213.1 m
Camera Altitude	214.6 m
Heading	188.0°
Date	2019-04-09
Time	10:42:23
Angle Of View	65.11°

true view visuals

Image from Back Door of House 32

Published on 30/45/243° 39:09:5°

Beagh, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Beagh, Sligo, County Leitrim...
Location	585437 829709
Distance To	3.2 km
Observer Altitude	297.4 m
Camera Altitude	298.5 m
Heading	233.41
Date	243°-49-4°
Time	34:5°:34
Angle Of View	65.331

Beagh, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Beagh, Sligo, County Leitrim...
Location	585433 837229
Distance To	0.3 km
Observer Altitude	377.8 m
Camera Altitude	371.° m
Heading	304.4-
Date	3409:47:49
Time	00643600
Angle Of View	15.00-

F91 CPN1, Sligo, Ireland



VIEWPOINT INFORMATION	
Versign 4ame	Alternatives V5
omaSe 4ame	F91 H3410 , tiSg0 orelanl
Lgcatign	5d8d16 d28895
Distance Tg	7.9 km
Observer Altitul e	2°1.7 m
Hamera Altitul e	2°2.5 m
Ceal inS	276.7-
Date	2719:78:79
Time	18N1N29
AnSle Of View	°5.11-

F91 CPN1, Sligo, Ireland



VIEWPOINT INFORMATION	
Versign 4ame	Alternatives V5
omaSe 4ame	F91 H3410 , tiSg0 orelanl
cgDatign	5d8d16 d28895
TistanDe Og	7.9 km
buserver AltitCl e	2°1.7 m
Hamera AltitCl e	2°- .2 m
f eal inS	16d.7:
Tate	2719N78N79
Oime	18L11L25
AnSle bwVieP	°5.11:

Beagh, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Beagh, Sligo, County Leitrim...
Location	585090 824344
Distance To	7.2 km
Observer Altitude	245.6 m
Camera Altitude	243.7 m
Heading	290.9°
Date	2971-94-91
Time	77:91:24
Angle Of View	65.77°

Image of Entrance of House 38 - Turbines Screened to left

Published on 04/35/730° 04658601

Beagh, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Beagh, Sligo, County Leitrim...
Location	585434 872922
Distance To	0.7 km
Observer Altitude	725.1 m
Camera Altitude	72°.3 m
Heading	018.3-
Date	730°:32:3°
Time	0063°604
Angle Of View	15.00-

Image of Entrance of House 38 - Turbines Screened to Right

Published on 04/35/730- 02634633

Beagh, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Beagh, Sligo, County Leitrim...
Location	585434 872922
Distance To	0.7 km
Observer Altitude	725.1 m
Camera Altitude	729.0 m
Heading	771.3°
Date	730-:32:3-
Time	0063-647
Angle Of View	15.00°

Image from House 40 - No Visibility, Screened by trees

Published on 18/04/2019 16:05:55

Corratimore Glebe, Sligo, County Leitrim, F91, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Corratimore Glebe, Sligo, Co...
Location	586088 826281
Distance To	2.9 km
Observer Altitude	152.7 m
Camera Altitude	154.2 m
Heading	205.0°
Date	2019-04-09
Time	10:00:14
Angle Of View	65.11°

Image from House 40 - No Visibility, Screened by trees

Published on 18/04/2019 16:05:55

Corratimore Glebe, Sligo, County Leitrim, F91, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Corratimore Glebe, Sligo, Co...
Location	586088 826281
Distance To	2.9 km
Observer Altitude	152.7 m
Camera Altitude	154.2 m
Heading	205.0°
Date	2019-04-09
Time	10:00:14
Angle Of View	65.11°

Image from House 41 - No Visibility, Screened by Trees

Published on 18/04/2019 16:09:17

Killavoggy, Sligo, County Leitrim, F91, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Killavoggy, Sligo, County Leit...
Location	585981 826270
Distance To	2.9 km
Observer Altitude	153.0 m
Camera Altitude	154.5 m
Heading	224.0°
Date	2019-04-09
Time	10:06:20
Angle Of View	65.11°

Killavoggy, Sligo, County Leitrim, F91, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Killavoggy, Sligo, County Leit...
Location	585981 826270
Distance To	2.9 km
Observer Altitude	153.0 m
Camera Altitude	154.5 m
Heading	224.0°
Date	2019-04-09
Time	10:06:20
Angle Of View	65.11°

Corratimore Glebe, Sligo, County Leitrim, F91, Ireland



VIEWPOINT INFORMATION	
Versign - ah e	Alternatives V5
:h aCe - ah e	Ggrratih gre f le, eS oliCgS Cgu
Ngl atign	5..8812 ..38381
Listanl e cg	2.3 kh
D, server AltitTOe	n54.1 h
Gah era AltitTOe	n56.2 h
beaOlnC	33m10
Late	31m7°14°17
cih e	1794792...
AnCle Dd VieH	85.nm0

Lisgavneen, Carrick-on-Shannon, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Lisgavneen, Carrick-on-Shan...
Location	586903 826186
Distance To	3.3 km
Observer Altitude	180.4 m
Camera Altitude	183.7 m
Heading	212.0°
Date	2019-04-09
Time	09:41:48
Angle Of View	65.11°

N41 C650, Carrick-on-Shannon, Ireland



VIEWPOINT INFORMATION	
Versi..n Lame	Alternatives V5
:maNe Lame	Lg, Cc5k- CarricSh..nh86ann9
I ..oati..n	50c3c5 0250c5
Distanoe T...	1., Sm
Observer Altitude	, 03.1 m
Camera Altitude	, 32.c m
HeadinN	2k4.k7
Date	2k, 3hkgHk3
Time	k3°12°5,
AnNe Of View	c5., , 7

Greaghnafarna, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Na7 e	Alternatives V5
I7 age Na7 e	Greaghnafarna, Sligo, Count...
Location	581235 8. k5. m
Distance To	464 07
Observer Altitude	1216° 7
Ca7 era Altitude	12. 65 7
Heading	1. k6°9
Date	. °1m°k-°m
Ti7 e	1. :k4:°°
Angle Of View	356119

Greaghnafarna, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Na7 e	Alternatives V5
I7 age Na7 e	Greaghnafarna, Sligo, Count...
Location	58123. 8km554
Distance To	46m07
Observer Altitude	1..6° 7
Ca7 era Altitude	1.86m7
Heading	13m639
Date	k31°-3m3°
Ti7 e	1k:48:32
Angle Of View	.56119

Greaghnafarna, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Na7 e	Alternatives V5
I7 age Na7 e	Greaghnafarna, Sligo, Count...
Location	58123. 8km554
Distance To	46m07
Observer Altitude	1..6° 7
Ca7 era Altitude	1.86m7
Heading	13m639
Date	k31°-3m3°
Ti7 e	1k:48:32
Angle Of View	.56119

Image from House 66 - No Visibility, Screened by Trees

Greaghnafarna, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Na0 e	Alternatives V5
I0 age Na0 e	Greaghnafarna, Sligo, Count...
Location	581232 825. 11
Distance To	km4 60
Observer Altitude	1k. m7 0
Ca0 era Altitude	1k2m1 0
Heading	1kkm°
Date	2. 149. - 9. 4
Ti0 e	12:1k:58
Angle Of View	75m11°

Greaghnafarna, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Na0 e	Alternatives V5
I0 age Na0 e	Greaghnafarna, Sligo, Count...
Location	581232 825. 11
Distance To	km4 60
Observer Altitude	1k. m7 0
Ca0 era Altitude	1k2m1 0
Heading	1kkm °
Date	2. 149. - 9. 4
Ti0 e	12:1k:58
Angle Of View	75m11 °

Greaghnafarna, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Na0 e	Alternatives V5
I0 age Na0 e	Greaghnafarna, Sligo, Count...
Location	58123. 8km m3
Distance To	248 60
Observer Altitude	1m84m0
Ca0 era Altitude	1m747 0
Heading	11843°
Date	k31793m937
Ti0 e	1k-k1-17
Angle Of View	: 5411°

Letter, Carrick-on-Shannon, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Versi- n : ame	Alternatives V5
Nnal e : ame	Letterg , arriCck- nkoSann- ngh
L- Cati- n	5..8698 ..00633
DistanCe T-	21. cm
Observer Altitude	. 6616 m
, amera Altitude	03. 19 m
Headinl	0... 134
Date	03. 6k39k36
Time	367. 872...
Anl le Of View	°51. . 4

Greaghnafarna, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Na° e	Alternatives V5
I° age Na° e	Greaghnafarna, Sligo, Count...
Location	581823 8. km54
Distance To	60. 7°
Observer Altitude	1m604 °
Ca° era Altitude	1mk05 °
Heading	1. 5049
Date	.413-4k-43
Ti° e	16:44:54
Angle Of View	m50119

Greaghnafarna, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Na° e	Alternatives V5
I° age Na° e	Greaghnafarna, Sligo, Count...
Location	581823 8. km54
Distance To	60. 7°
Observer Altitude	1m604 °
Ca° era Altitude	1mk05 °
Heading	1. 5049
Date	.413-4k-43
Ti° e	16:44:54
Angle Of View	m50119

Greaghnafarna, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Na0 e	Alternatives V5
I0 age Na0 e	Greaghnafarna, Sligo, Count...
Location	581238 8.kkm
Distance To	m41 60
Observer Altitude	18742 0
Ca0 era Altitude	18.4k 0
Heading	1.147°
Date	.71297k972
Ti0 e	1.-k2-k3
Angle Of View	:5411°

Beagh, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Beagh, Sligo, County Leitrim...
Location	584337 825950
Distance To	7.5 km
Observer Altitude	227.4 m
Camera Altitude	222.1 m
Heading	733.9°
Date	2971-94-91
Time	79:59:74
Angle Of View	65.77°

Image from Road between Houses 31 and 36

Published on 73/94/2971 70:07:72

Beagh, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Beagh, Sligo, County Leitrim...
Location	584337 825950
Distance To	7.5 km
Observer Altitude	227.4 m
Camera Altitude	222.1 m
Heading	290.9°
Date	2971-94-91
Time	79:59:73
Angle Of View	65.77°

F91 A3X7, Sligo, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	F91 A3X7, Sligo, Ireland
Location	583943 826090
Distance To	2.7 km
Observer Altitude	140.5 m
Camera Altitude	142.0 m
Heading	163.0°
Date	2019-03-21
Time	14:13:38
Angle Of View	65.11°

F91 K242, Sligo, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	F91 K242, Sligo, Ireland
Location	582970 824726
Distance To	2.3 km
Observer Altitude	190.9 m
Camera Altitude	192.4 m
Heading	141.0°
Date	2019-06-12
Time	16:03:52
Angle Of View	65.11°

F91 K242, Sligo, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	F91 K242, Sligo, Ireland
Location	582917 824728
Distance To	2.3 km
Observer Altitude	187.8 m
Camera Altitude	189.3 m
Heading	139.0°
Date	2019-06-12
Time	16:00:37
Angle Of View	65.11°

F91 K242, Sligo, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	F91 K242, Sligo, Ireland
Location	582919 824668
Distance To	2.3 km
Observer Altitude	192.2 m
Camera Altitude	193.7 m
Heading	139.0°
Date	2019-06-12
Time	15:57:30
Angle Of View	65.11°

Garvagh, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Garvagh, Sligo, County Leitr...
Location	582847 825010
Distance To	2.5 km
Observer Altitude	165.0 m
Camera Altitude	166.5 m
Heading	134.0°
Date	2019-06-12
Time	16:21:16
Angle Of View	65.11°

Beagh, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Beagh, Sligo, County Leitrim...
Location	584537 825908
Distance To	. k0 1m
Observer Altitude	. 87k0 m
Camera Altitude	. 80k0 m
Heading	2. . k ° -
Date	2 ° . 0: ° 4: ° 0
Time	. ° 6956 ° °
Angle Of View	35k. . -

Beagh, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Beagh, Sligo, County Leitrim...
Location	584537 825908
Distance To	. k0 1m
Observer Altitude	. 87k0 m
Camera Altitude	. 80k8 m
Heading	. 8°k°-
Date	2°. 0: °4: °0
Time	. °694653
Angle Of View	35k. . -

Beagh, Sligo, County Leitrim, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Beagh, Sligo, County Leitrim...
Location	848621 425. 8k
Distance To	303 °m
Observer Altitude	2880k m
Camera Altitude	28. 08 m
Heading	2. 10k9
Date	2k31-k6-22
Time	3k:82:68
Angle Of View	. 80339

true view visuals

Image from West of St. Michael's Church

Published on 25/04/2019 11:26:17

Killavoggy & Beagh, Sligo, County Leitrim, F91, Ireland



VIEWPOINT INFORMATION	
Version Name	Alternatives V5
Image Name	Killavoggy & Beagh, Sligo, Co...
Location	584158 826452
Distance To	3.0 km
Observer Altitude	110.3 m
Camera Altitude	112.8 m
Heading	176.0°
Date	2019-03-21
Time	13:55:23
Angle Of View	65.11°



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7. Layout plans show typical Turbine rotor diameter as per turbine drawing.
8. Final levels may vary depending on local ground conditions.
9. Exact location of grid connection cable/joint bay in the road curtilage to be subject to ESB specifications and agreement with Leitrim County Council.

Drawing Legend

- Planning Application Boundary (Leitrim County Council)
- Planning Application Boundary (Sligo County Council)

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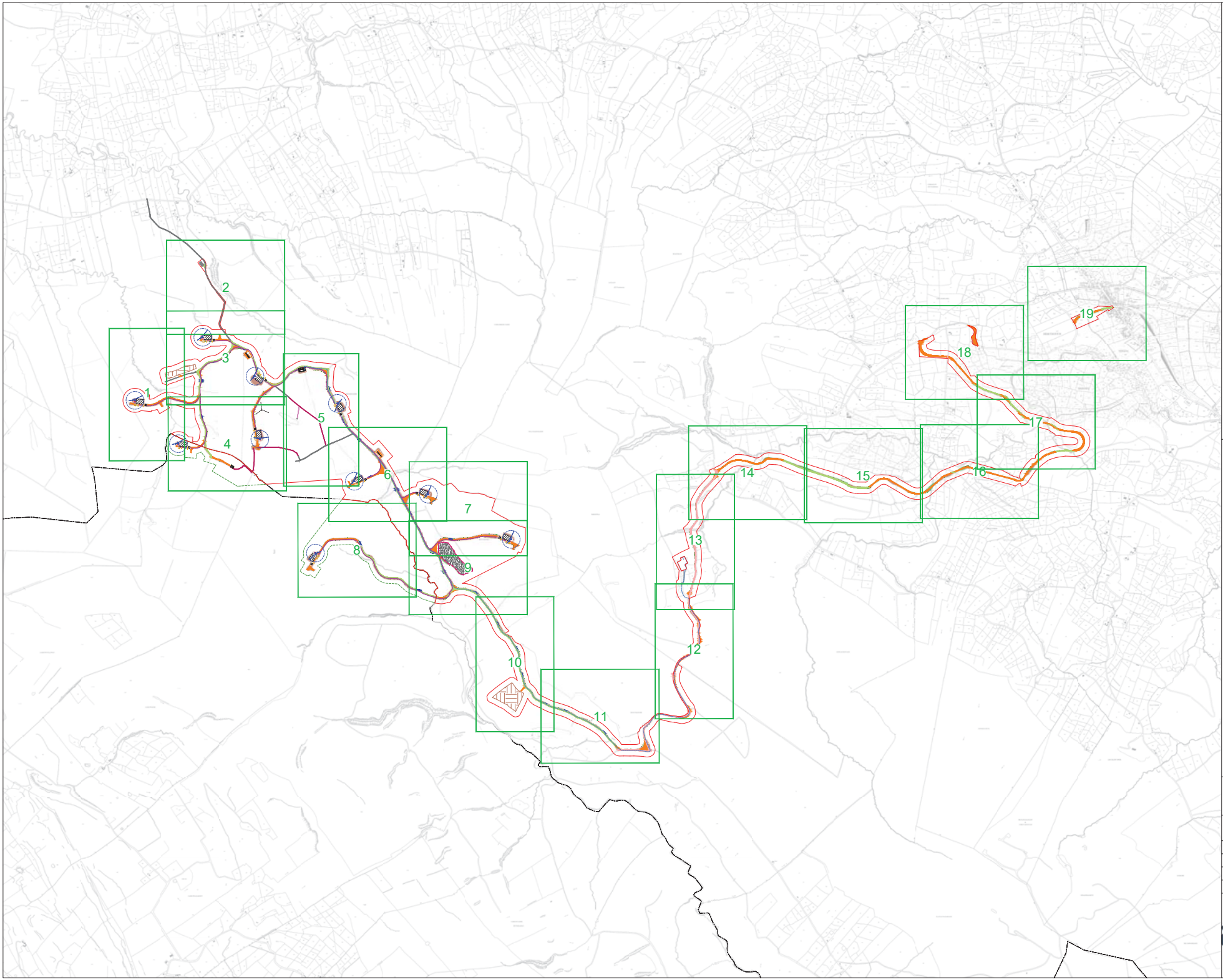
N

DRAWING TITLE:

Location Context Map

PROJECT TITLE:	Croagh Wind Farm, Co. Leitrim/ Co. Sligo
DRAWING BY: Joseph O Brien	CHECKED BY: Michael Watson
PROJECT No.: 180511	DRAWING No.: 180511 - 01
SCALE: 1:50,000 @ A3	DATE: 06.07.2020
OS SHEET No.:	OS1630, OS1632, OS1830, OS1832

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7. Layout plans show typical Turbine rotor diameter as per turbine drawing.
8. Final levels may vary depending on local ground conditions.
9. Exact location of grid connection cable/joint bay in the road curtilage to be subject to ESB specifications and agreement with Leitrim County Council.

Drawing Legend

- Planning Application Boundary (Leitrim County Council)
- Planning Application Boundary (Sligo County Council)
- Existing Road to be Upgraded
- Proposed Road
- Passing Bay
- Existing Road no Upgrade Proposed
- Existing Local Road - Upgrade Proposed
- Internal Electrical Cabling Trench
- Soft Levelled Area
- Crane Pad Hardstanding Area
- Turbine Foundation
- Turbine Sweep Area
- Borrow Pit
- Peat & Spoil Repository
- Amenity Walkway
- Amenity Boardwalk
- Underground Grid Connection Cabling Route
- County Boundary

N

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DRAWING TITLE:

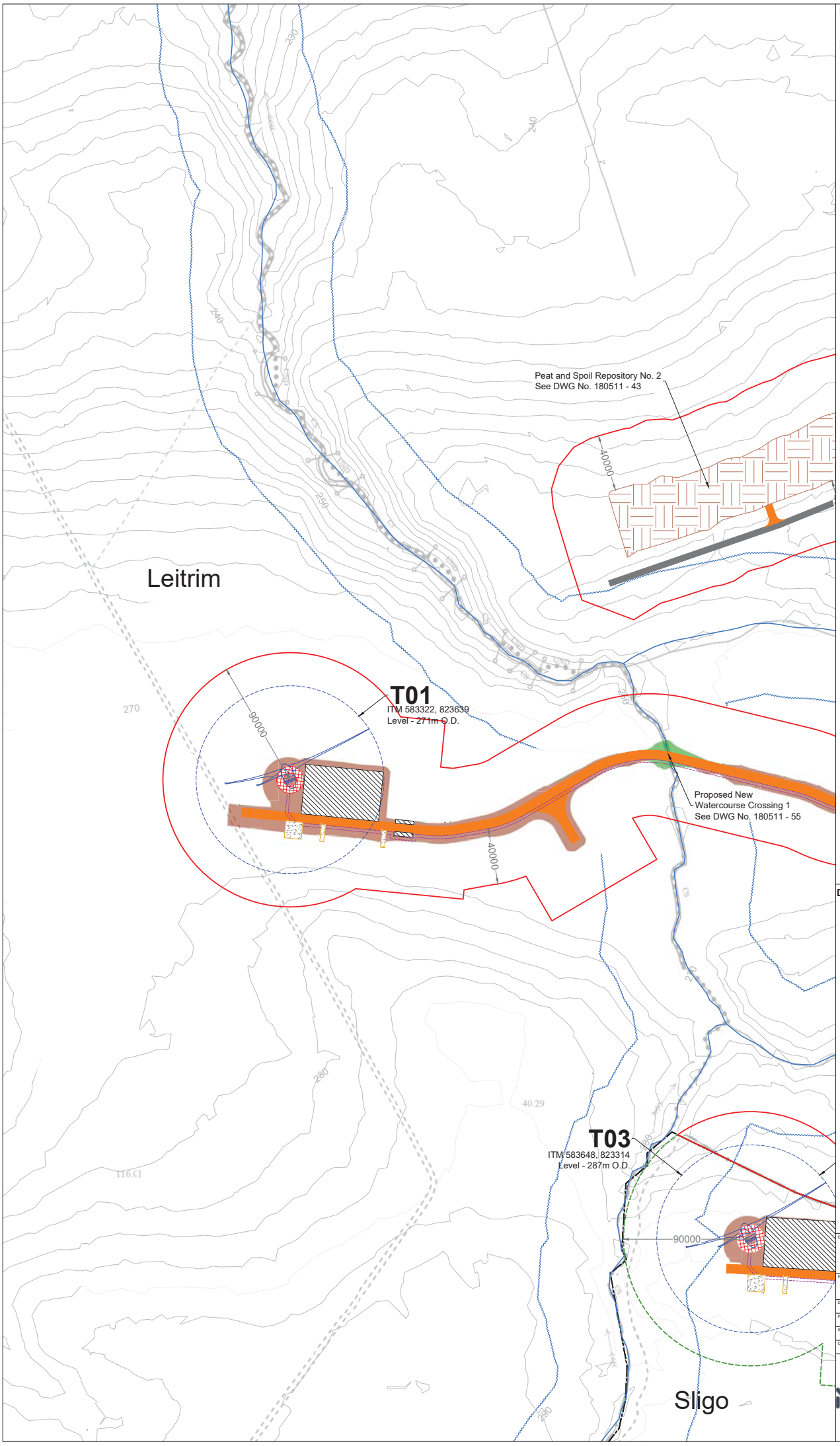
Site Layout Key Plan

PROJECT TITLE:

Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY:	CHECKED BY:
Joseph O Brien	Michael Watson
PROJECT No.: 180511	DRAWING No.: 180511 - 03
SCALE: 1:12,500 @ A1	DATE: 28.07.2020
OS SHEET No.: 1196, 1197, 1198, 1262, 1263, 1264, 1331, 1332, 1333	

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6. The use of or reliance upon this drawing shall be deemed to be acceptance of these conditions of use unless otherwise agreed in writing, such written agreement to be sought from and issued by the copyright holder to the use or reliance upon this drawing.
7. Layout plans show typical Turbine rotor diameter as per turbine drawing.
8. Final levels may vary depending on local ground conditions.
9. Exact location of grid connection cable/joint bay in the road curtilage to be subject to ESB specifications and agreement with Leitrim County Council.

Drawing Legend

- Planning Application Boundary (Leitrim County Council)
- Planning Application Boundary (Sligo County Council)
- Existing Road to be Upgraded
- Proposed Road
- Existing Road no Upgrade Proposed
- Internal Electrical Cabling Trench
- River/Stream
- River/Stream 50m Buffer
- Soft Levelled Area
- Crane Pad Hardstanding Area
- Turbine Foundation
- Turbine Sweep Area
- Peat & Spoil Repository
- Cut
- Fill
- County Boundary

N

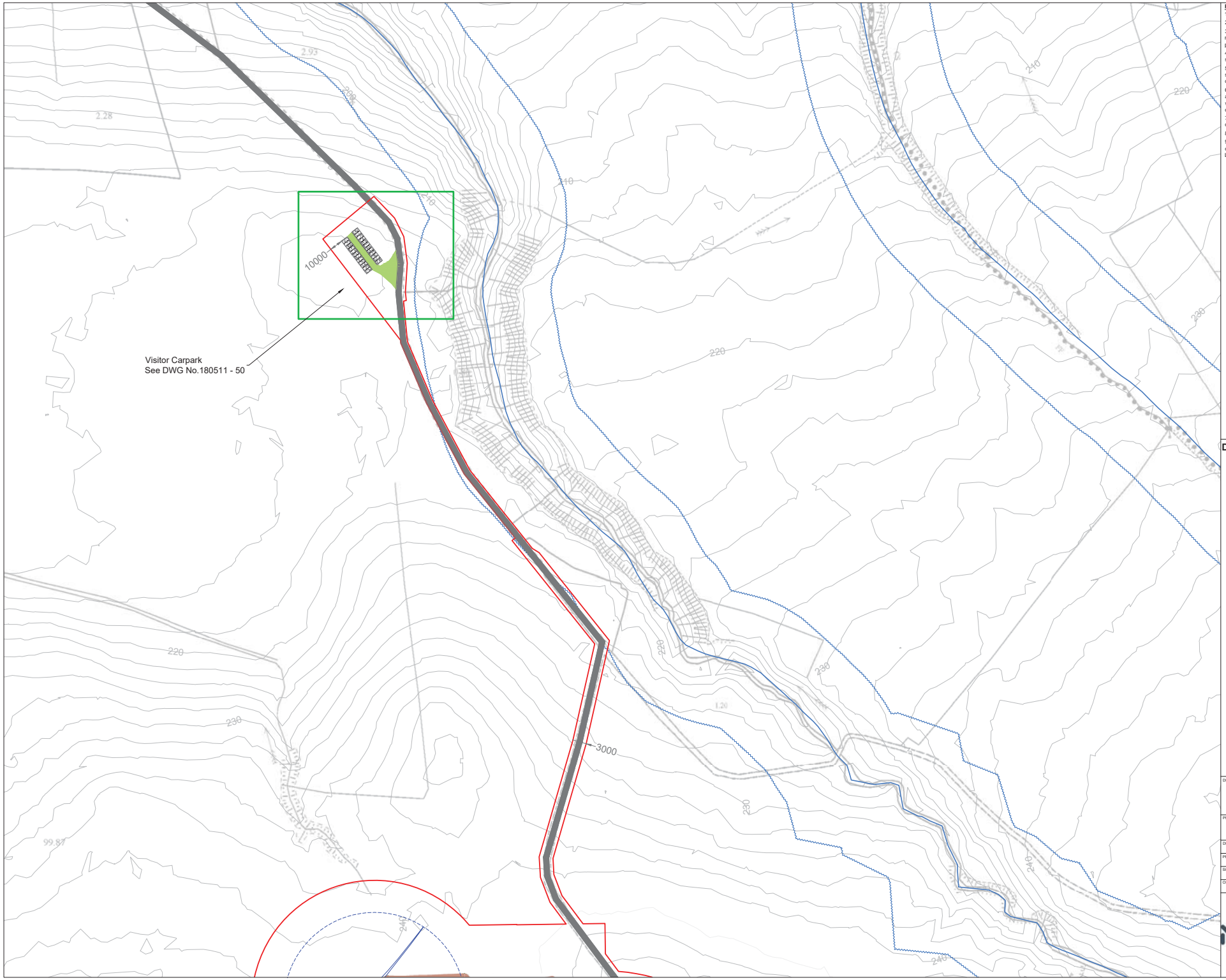
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DRAWING TITLE:
Site Layout Sheet 1 of 19

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY: Joseph O Brien	CHECKED BY: Michael Watson
PROJECT No.: 180511	DRAWING No.: 180511 - 04
SCALE: 1:2,500 @ A3	DATE: 28.07.2020
OS SHEET No.: 1196, 1197, 1198, 1262, 1263, 1264, 1331, 1332, 1333	

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7. Layout plans show typical Turbine rotor diameter as per turbine drawing.
8. Final levels may vary depending on local ground conditions.
9. Exact location of grid connection cable/joint bay in the road curtilage to be subject to ESB specifications and agreement with Leitrim County Council.

Drawing Legend

- Planning Application Boundary (Leitrim County Council)
- Existing Road to be Upgraded
- Existing Road no Upgrade Proposed
- River/Stream
- River/Stream 50m Buffer
- Turbine Sweep Area

N

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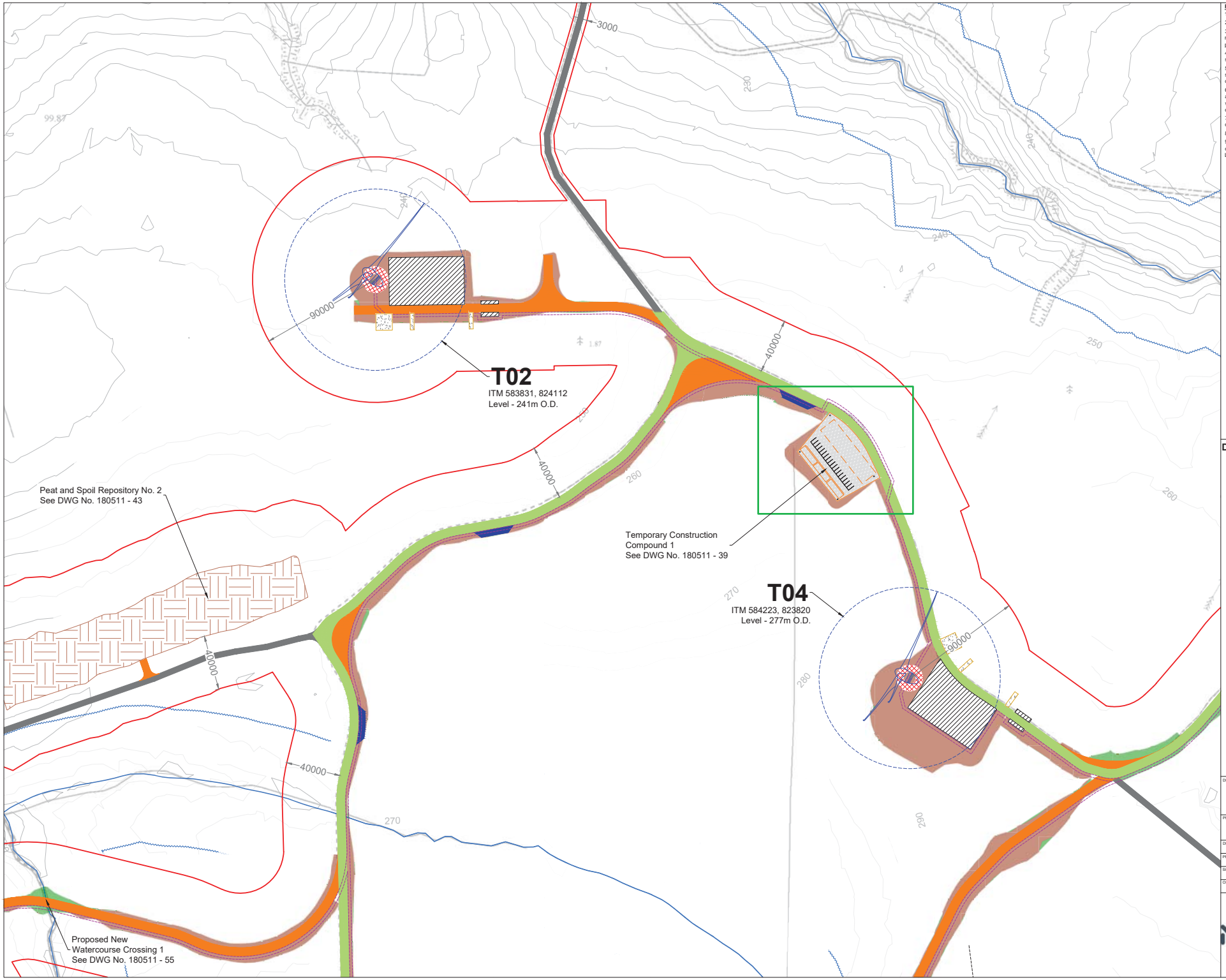
DRAWING TITLE:
Site Layout Sheet 2 of 19

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY:	CHECKED BY:
Joseph O Brien	Michael Watson
PROJECT No.: 180511	DRAWING No.: 180511 - 05
SCALE: 1:2,500 @ A3	DATE: 28.07.2020

OS SHEET No.:
1196, 1197, 1198, 1262, 1263, 1264, 1331, 1332, 1333

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8. Final levels may vary depending on local ground conditions.
9. Exact location of grid connection cable/joint bay in the road curtilage to be subject to ESB specifications and agreement with Leitrim County Council.

Drawing Legend

- Planning Application Boundary (Leitrim County Council)
- Existing Road to be Upgraded
- Proposed Road
- Passing Bay
- Existing Road no Upgrade Proposed
- Internal Electrical Cabling Trench
- River/Stream
- River/Stream 50m Buffer
- Soft Levelled Area
- Crane Pad Hardstanding Area
- Turbine Foundation
- Turbine Sweep Area
- Peat & Spoil Repository
- Cut
- Fill

N

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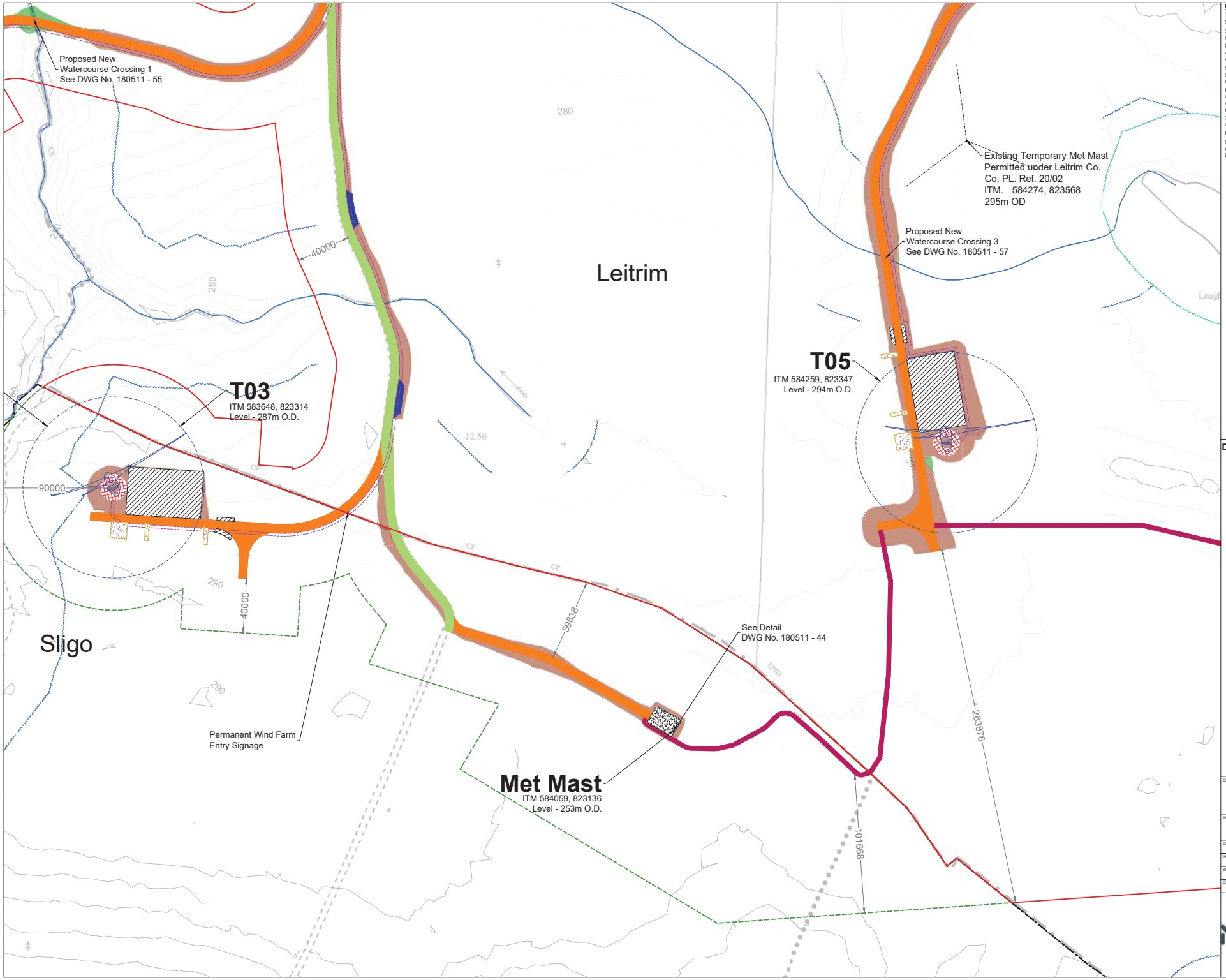
DRAWING TITLE:
Site Layout Sheet 3 of 19

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY:	CHECKED BY:
Joseph O Brien	Michael Watson
PROJECT No.: 180511	DRAWING No.: 180511 - 06
SCALE: 1:2,500 @ A3	DATE: 28.07.2020

OS SHEET No.:
1196, 1197, 1198, 1262, 1263, 1264, 1331, 1332, 1333

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8. Final levels may vary depending on local ground conditions.
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Drawing Legend

- Planning Application Boundary (Leitrim County Council)
- Planning Application Boundary (Sligo County Council)
- Existing Road to be Upgraded
- Proposed Road
- Passing Bay
- Amenity Walkway
- Internal Electrical Cabling Trench
- River/Stream
- River/Stream 50m Buffer
- Soft Levelled Area
- Crane Pad Hardstanding Area
- Turbine Foundation
- Turbine Sweep Area
- Cut
- Fill
- County Boundary

N

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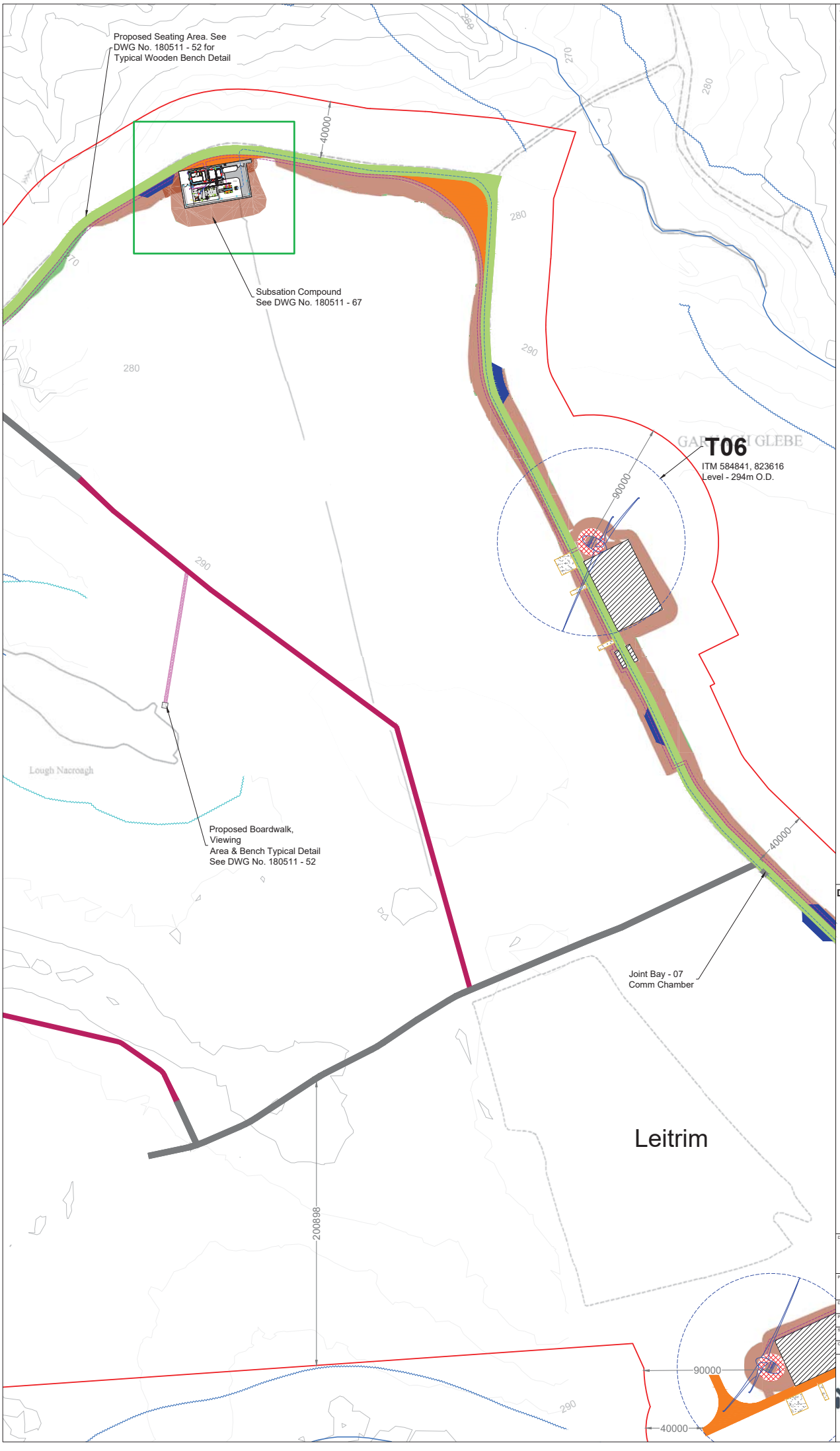
DRAWING TITLE:
Site Layout Sheet 4 of 19

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY: Joseph O Brien	CHECKED BY: Michael Watson
PROJECT No.: 180511	DRAWING No.: 180511 - 07
SCALE: 1:2,500 @ A3	DATE: 28.07.2020

OS SHEET No.: 1196, 1197, 1198, 1262, 1263, 1264, 1331, 1332, 1333

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Drawing Legend

- Planning Application Boundary (Leitrim County Council)
- Existing Road to be Upgraded
- Proposed Road
- Passing Bay
- Existing Road no Upgrade Proposed
- Amenity Walkway
- Amenity Boardwalk
- Internal Electrical Cabling Trench
- Underground Grid Connection Cabling Route
- River/Stream
- River/Stream 50m Buffer
- Lakes 50m Buffer
- Soft Levelled Area
- Crane Pad Hardstanding Area
- Turbine Foundation
- Turbine Sweep Area
- Cut
- Fill

N

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DRAWING TITLE:
Site Layout Sheet 5 of 19

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY:	CHECKED BY:
Joseph O Brien	Michael Watson
PROJECT No.: 180511	DRAWING No.: 180511 - 08
SCALE: 1:2,500 @ A3	DATE: 28.07.2020
OS SHEET No.: 1196, 1197, 1198, 1262, 1263, 1264, 1331, 1332, 1333	

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Drawing Legend

- Planning Application Boundary (Leitrim County Council)
- Planning Application Boundary (Sligo County Council)
- Existing Road to be Upgraded
- Proposed Road
- Passing Bay
- Existing Road no Upgrade Proposed
- Internal Electrical Cabling Trench
- Underground Grid Connection Cabling Route
- River/Stream
- River/Stream 50m Buffer
- Soft Levelled Area
- Crane Pad Hardstanding Area
- Turbine Foundation
- Turbine Sweep Area
- Cut
- Fill
- County Boundary

N

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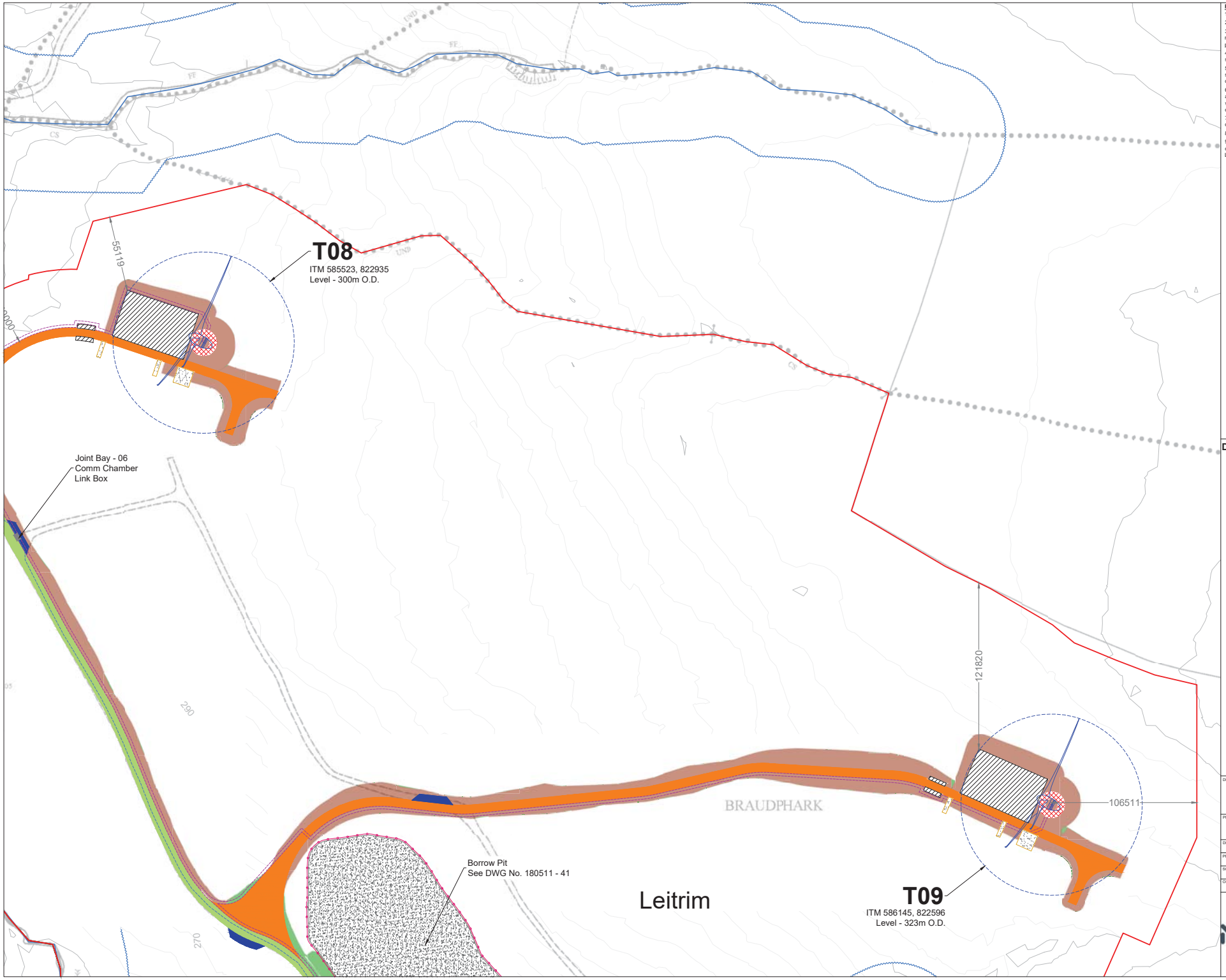
DRAWING TITLE:
Site Layout Sheet 6 of 19

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY:	CHECKED BY:
Joseph O Brien	Michael Watson
PROJECT No.: 180511	DRAWING No.: 180511 - 09
SCALE: 1:2,500 @ A3	DATE: 28.07.2020

OS SHEET No.: 1196, 1197, 1198, 1262, 1263, 1264, 1331, 1332, 1333

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Drawing Legend

- Planning Application Boundary (Leitrim County Council)
- Existing Road to be Upgraded
- Proposed Road
- Passing Bay
- Internal Electrical Cabling Trench
- Underground Grid Connection Cabling Route
- River/Stream
- River/Stream 50m Buffer
- Soft Levelled Area
- Crane Pad Hardstanding Area
- Turbine Foundation
- Turbine Sweep Area
- Borrow Pit
- Cut
- Fill
- County Boundary

N

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DRAWING TITLE:
Site Layout Sheet 7 of 19

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY:	CHECKED BY:
Joseph O Brien	Michael Watson
PROJECT No.: 180511	DRAWING No.: 180511 - 10
SCALE: 1:2,500 @ A3	DATE: 28.07.2020

OS SHEET No.: 1196, 1197, 1198, 1262, 1263, 1264, 1331, 1332, 1333

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Drawing Legend

- Planning Application Boundary (Leitrim County Council)
- Planning Application Boundary (Sligo County Council)
- Existing Road to be Upgraded
- Proposed Road
- Passing Bay
- Internal Electrical Cabling Trench
- Underground Grid Connection Cabling Route
- River/Stream
- River/Stream 50m Buffer
- Soft Levelled Area
- Crane Pad Hardstanding Area
- Turbine Foundation
- Turbine Sweep Area
- Cut
- Fill
- County Boundary

N

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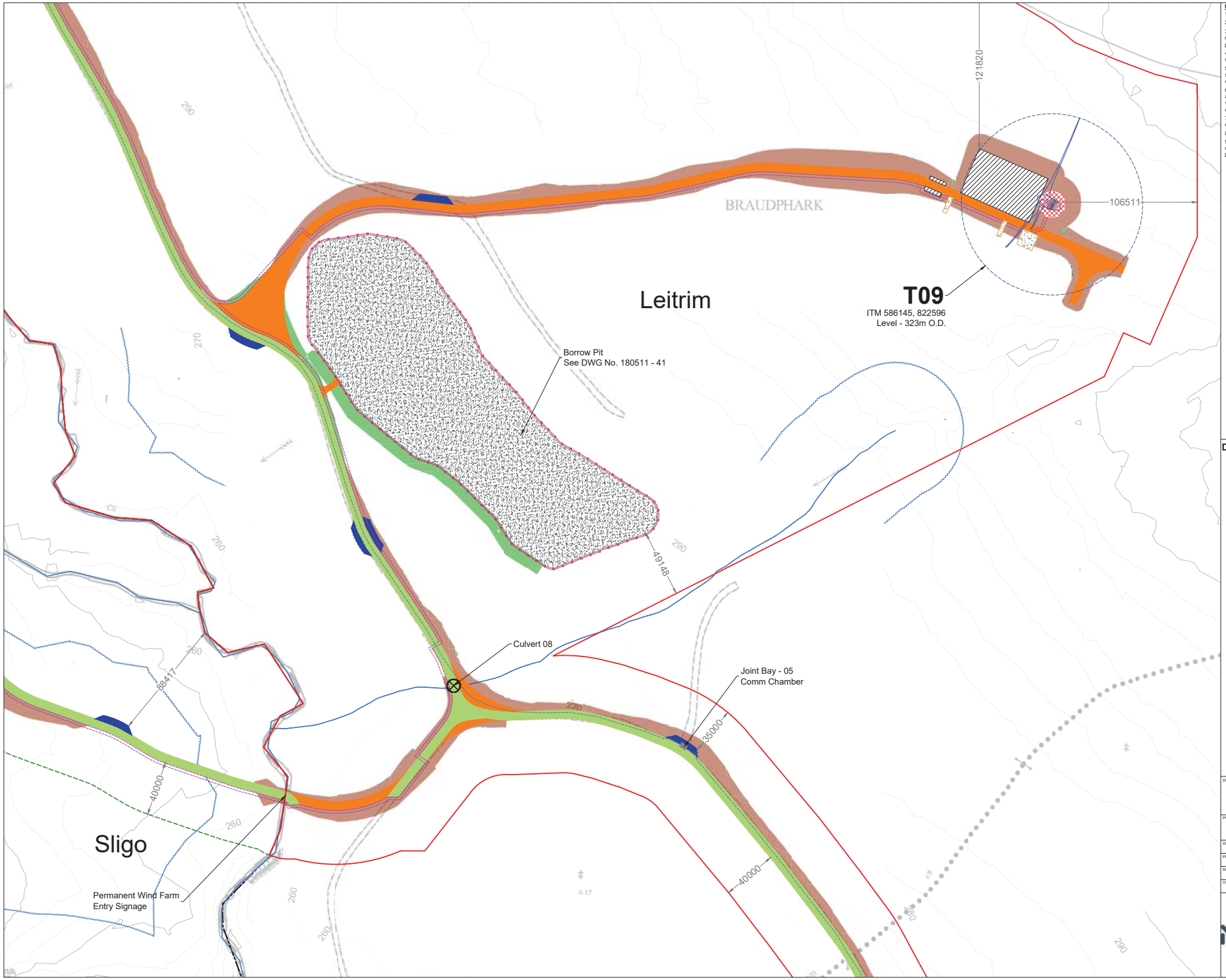
DRAWING TITLE:
Site Layout Sheet 8 of 19

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY:	CHECKED BY:
Joseph O Brien	Michael Watson
PROJECT No.: 180511	DRAWING No.: 180511 - 11
SCALE: 1:2,500 @ A3	DATE: 28.07.2020

OS SHEET No.: 1196, 1197, 1198, 1262, 1263, 1264, 1331, 1332, 1333

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Drawing Legend

- Planning Application Boundary (Leitrim County Council)
- Planning Application Boundary (Sligo County Council)
- Existing Road to be Upgraded
- Proposed Road
- Internal Electrical Cabling Trench
- Underground Grid Connection Cabling Route
- River/Stream
- River/Stream 50m Buffer
- Soft Levelled Area
- Crane Pad Hardstanding Area
- Turbine Foundation
- Turbine Sweep Area
- Borrow Pit
- Cut
- Fill
- County Boundary

N

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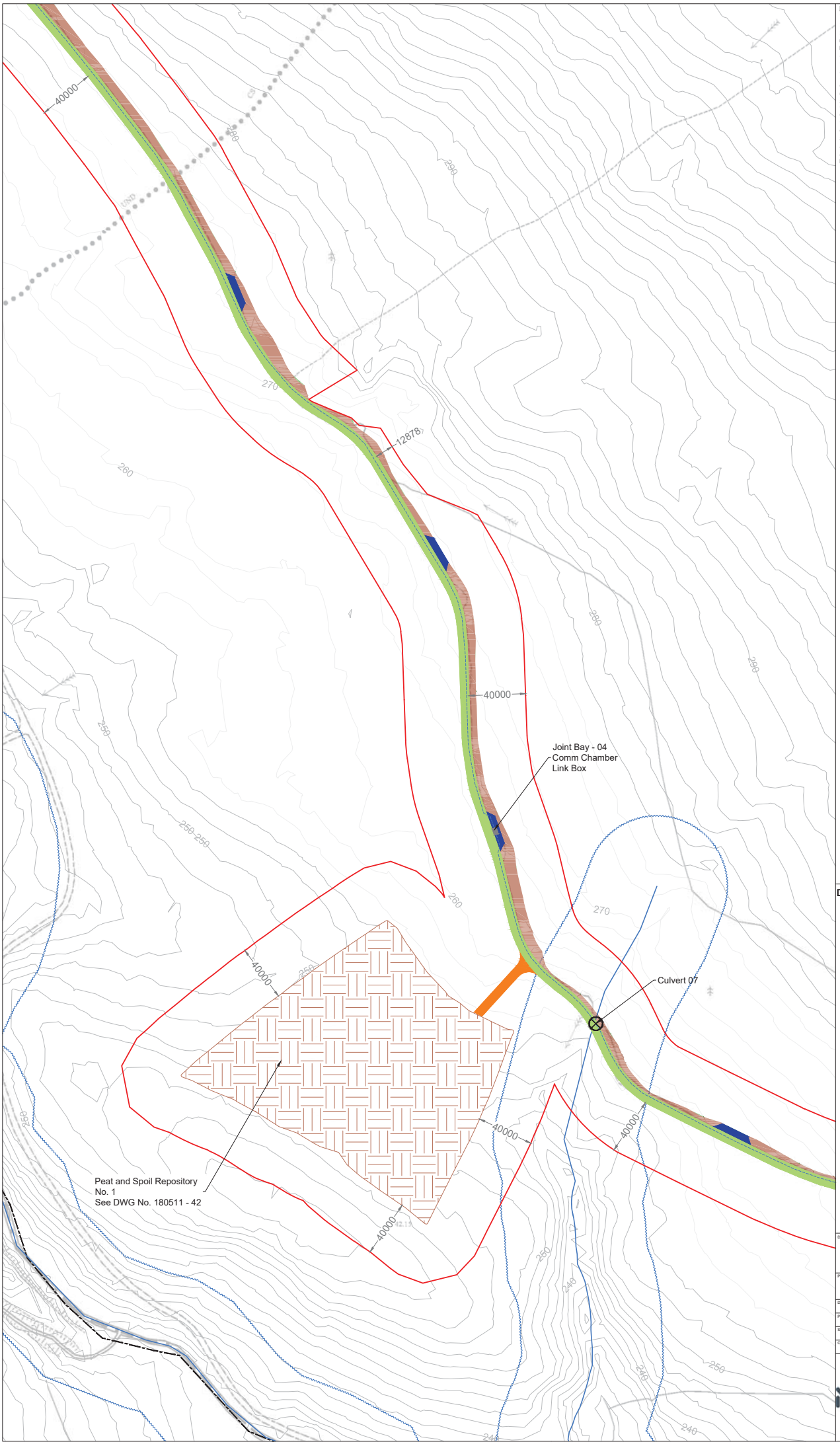
DRAWING TITLE:
Site Layout Sheet 9 of 19

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY:	CHECKED BY:
Joseph O Brien	Michael Watson
PROJECT No.: 180511	DRAWING No.: 180511 - 12
SCALE: 1:2,500 @ A3	DATE: 28.07.2020

OS SHEET No.:
1196, 1197, 1198, 1262, 1263, 1264, 1331, 1332, 1333

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Drawing Legend

- Planning Application Boundary (Leitrim County Council)
- Existing Road to be Upgraded
- Proposed Road
- Underground Grid Connection Cabling Route
- River/Stream
- River/Stream 50m Buffer
- Peat & Spoil Repository
- Cut
- Fill

N

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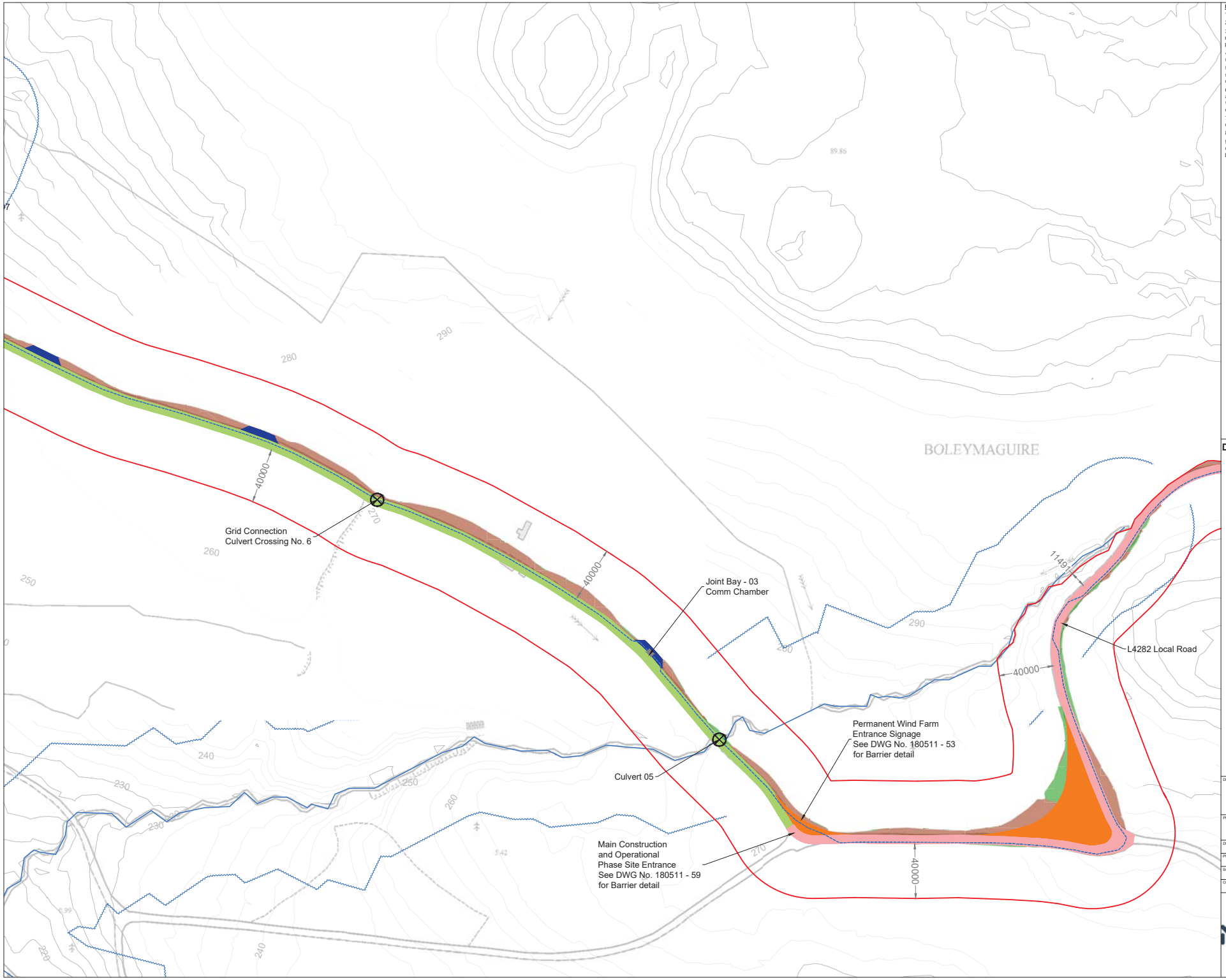
DRAWING TITLE:
Site Layout Sheet 10 of 19

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY:	CHECKED BY:
Joseph O Brien	Michael Watson
PROJECT No.: 180511	DRAWING No.: 180511 - 13
SCALE: 1:2,500 @ A3	DATE: 06.07.2020

OS SHEET No.: 1196, 1197, 1198, 1262, 1263, 1264, 1331, 1332, 1333

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Drawing Legend

- Planning Application Boundary (Leitrim County Council)
- Existing Road to be Upgraded
- Proposed Road
- Passing Bay
- Existing Local Road - Upgrade Proposed
- Underground Grid Connection Cabling Route
- River/Stream
- River/Stream 50m Buffer
- Cut
- Fill

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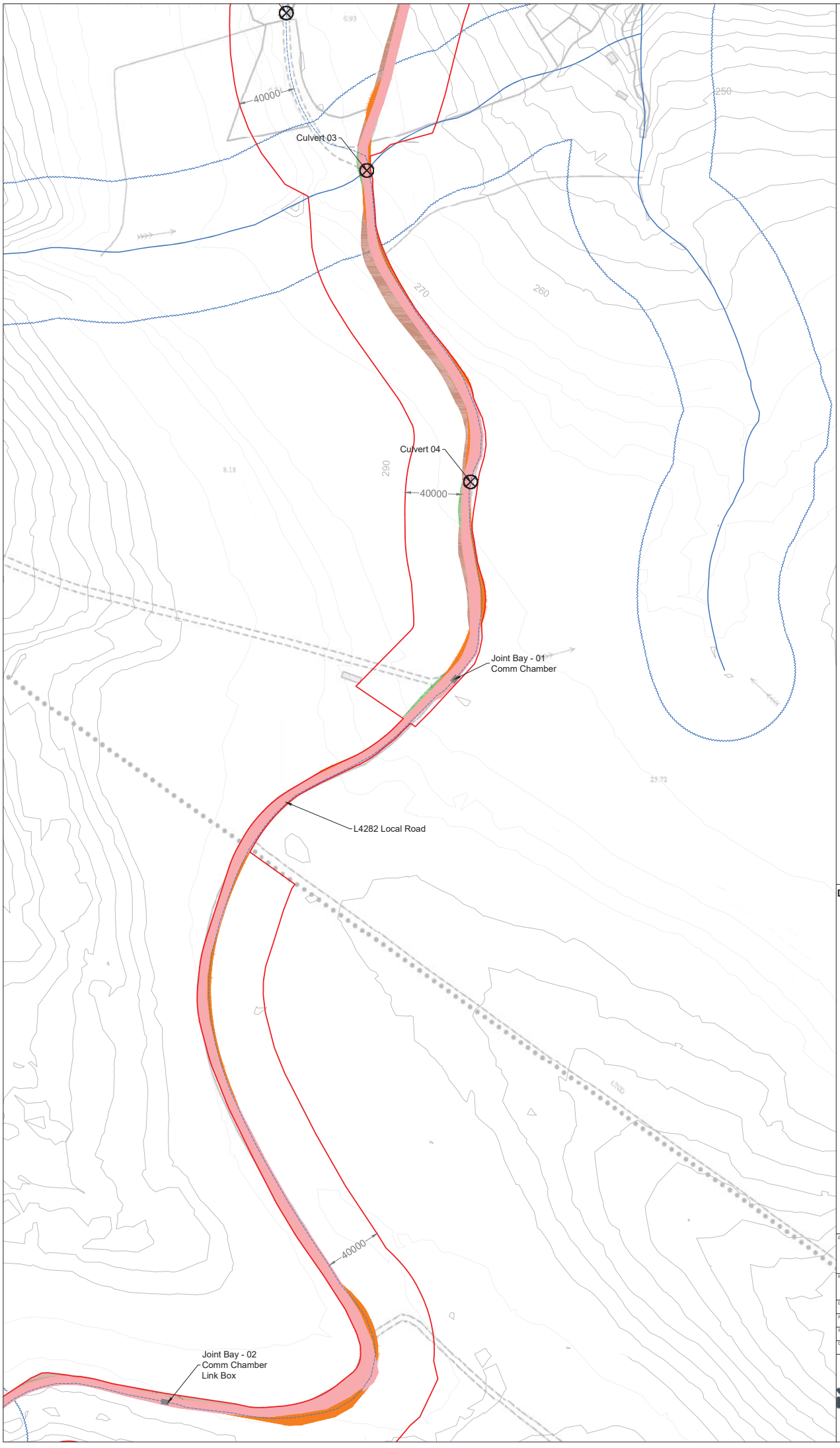
DRAWING TITLE:
Site Layout Sheet 11 of 19

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY:	CHECKED BY:
Joseph O Brien	Michael Watson
PROJECT No.: 180511	DRAWING No.: 180511 - 14
SCALE: 1:2,500 @ A3	DATE: 24.07.2020

OS SHEET No.: 1196, 1197, 1198, 1262, 1263, 1264, 1331, 1332, 1333

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Drawing Legend

- Planning Application Boundary (Leitrim County Council)
- Proposed Road
- Existing Local Road - Upgrade Proposed
- Underground Grid Connection Cabling Route
- River/Stream
- River/Stream 50m Buffer
- Cut
- Fill

N

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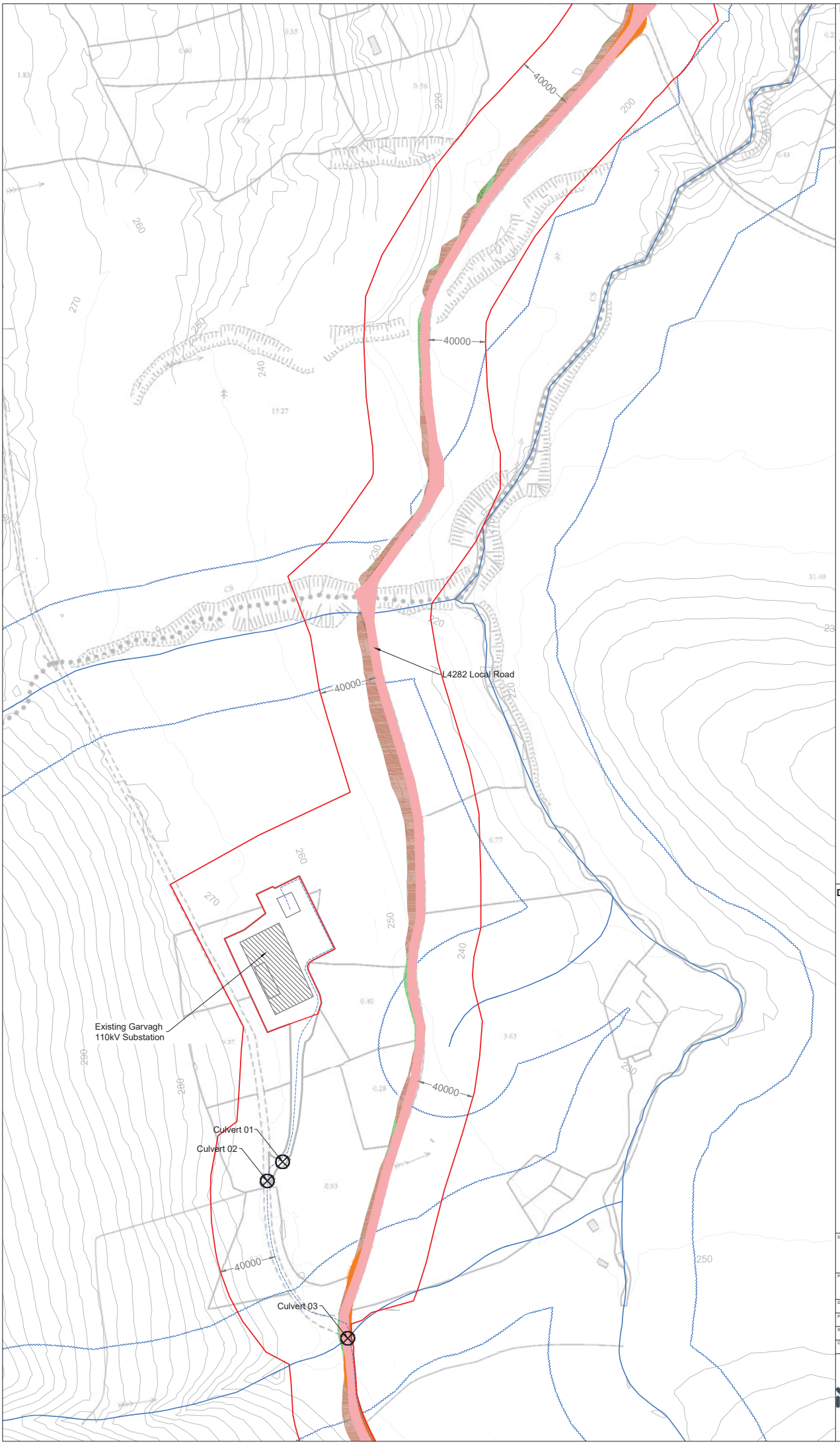
DRAWING TITLE:
Site Layout Sheet 12 of 19

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY:	CHECKED BY:
Joseph O Brien	Michael Watson
PROJECT No.: 180511	DRAWING No.: 180511 - 15
SCALE: 1:2,500 @ A3	DATE: 06.07.2020

OS SHEET No.: 1196, 1197, 1198, 1262, 1263, 1264, 1331, 1332, 1333

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Drawing Legend

- Planning Application Boundary (Leitrim County Council)
- Proposed Road
- Existing Local Road - Upgrade Proposed
- Underground Grid Connection Cabling Route
- River/Stream
- River/Stream 50m Buffer
- Cut
- Fill

N

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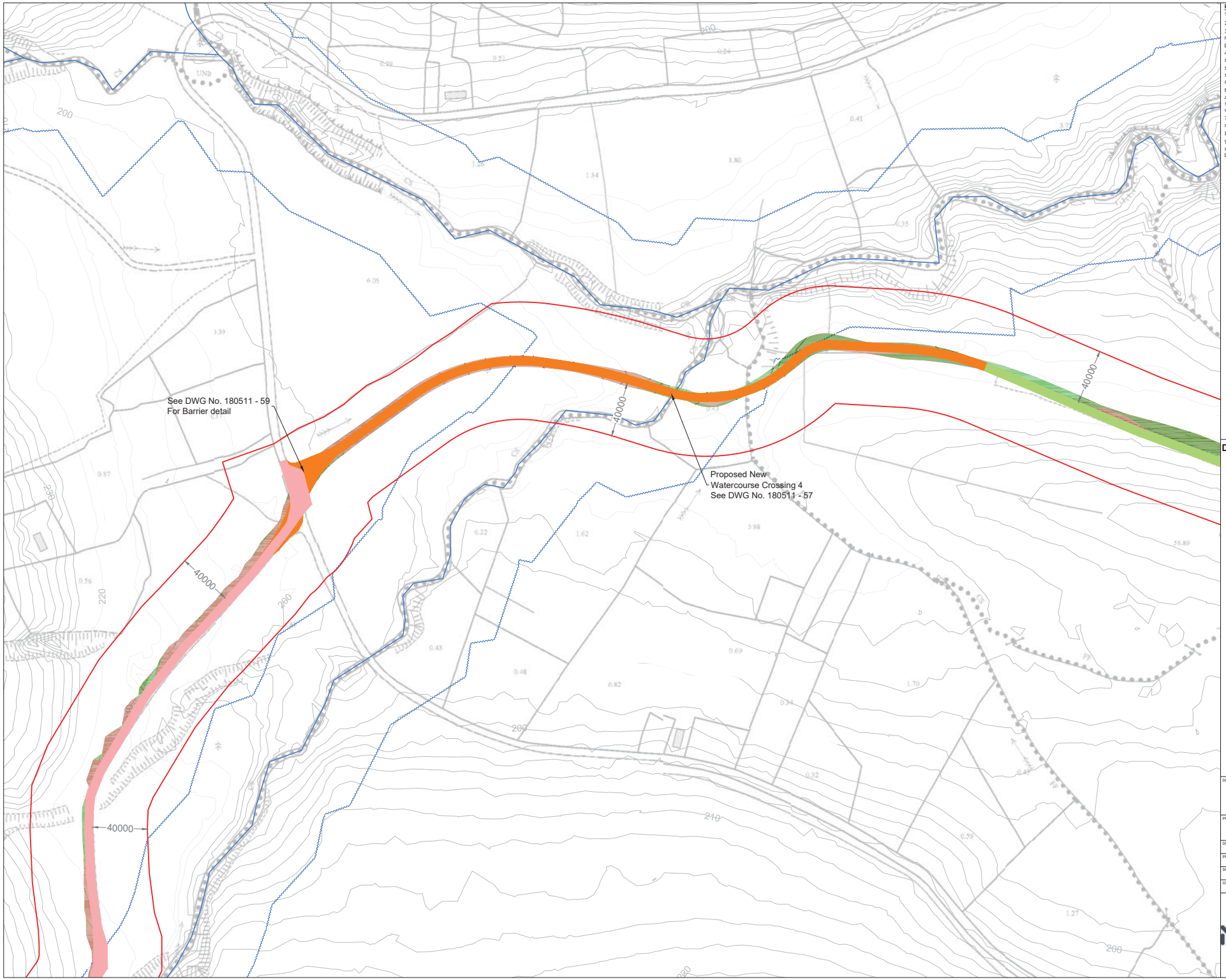
DRAWING TITLE:
Site Layout Sheet 13 of 19

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY:	CHECKED BY:
Joseph O Brien	Michael Watson
PROJECT No.: 180511	DRAWING No.: 180511 - 16
SCALE: 1:2,500 @ A3	DATE: 06.07.2020

OS SHEET No.: 1196, 1197, 1198, 1262, 1263, 1264, 1331, 1332, 1333

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Drawing Legend

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- Existing Road to be Upgraded
- Proposed Road
- Existing Local Road - Upgrade Proposed
- River/Stream
- River/Stream 50m Buffer
- Cut
- Fill

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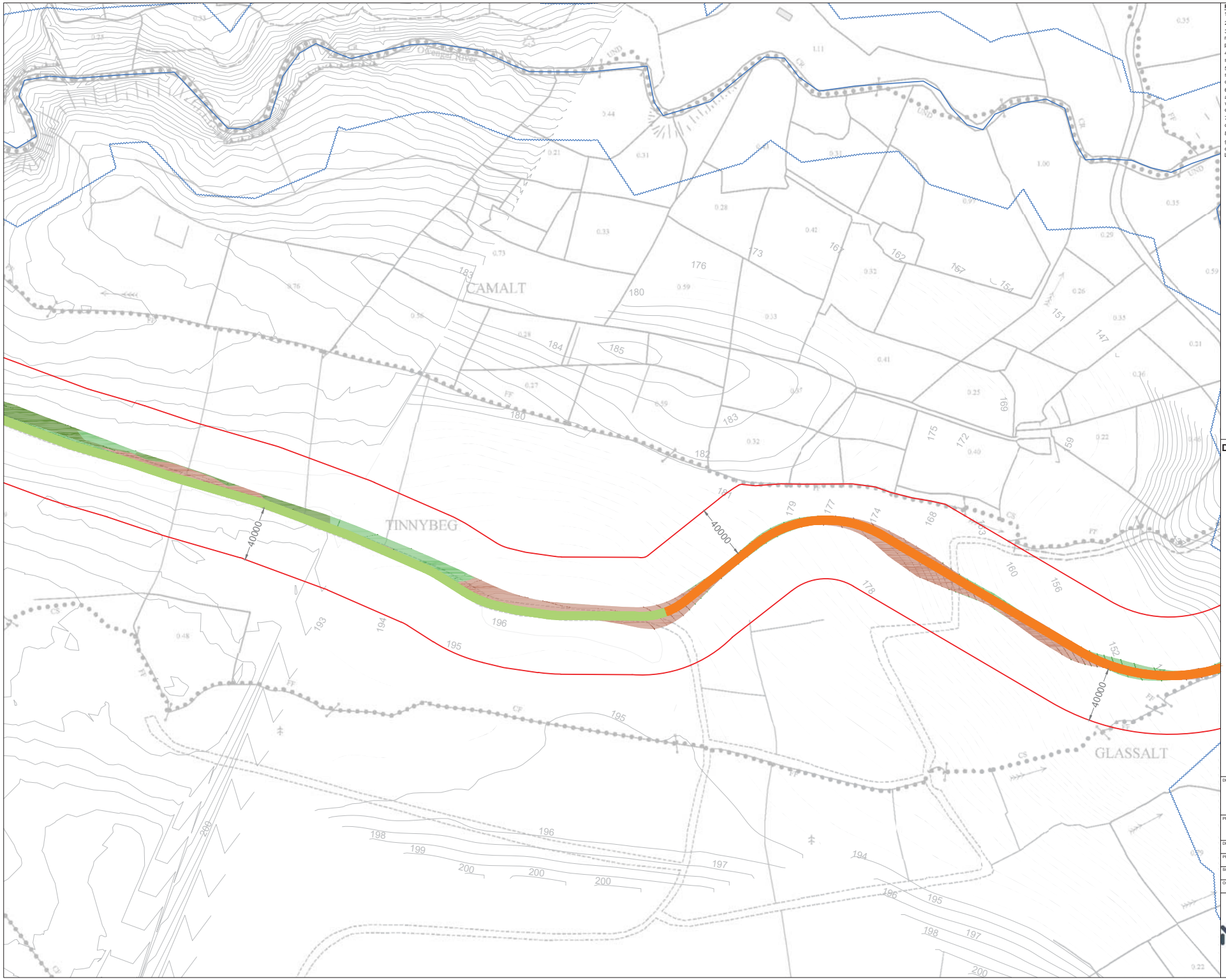
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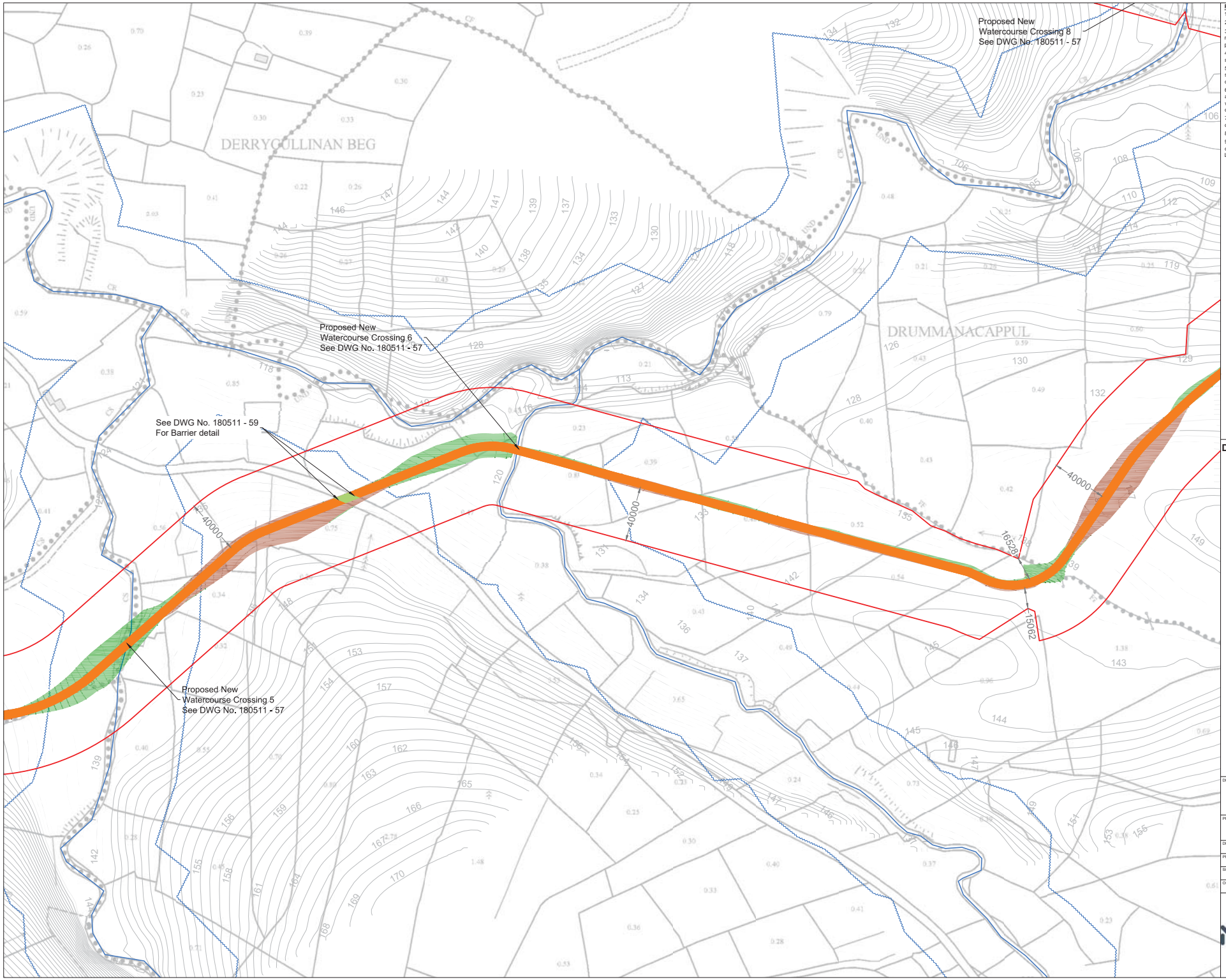
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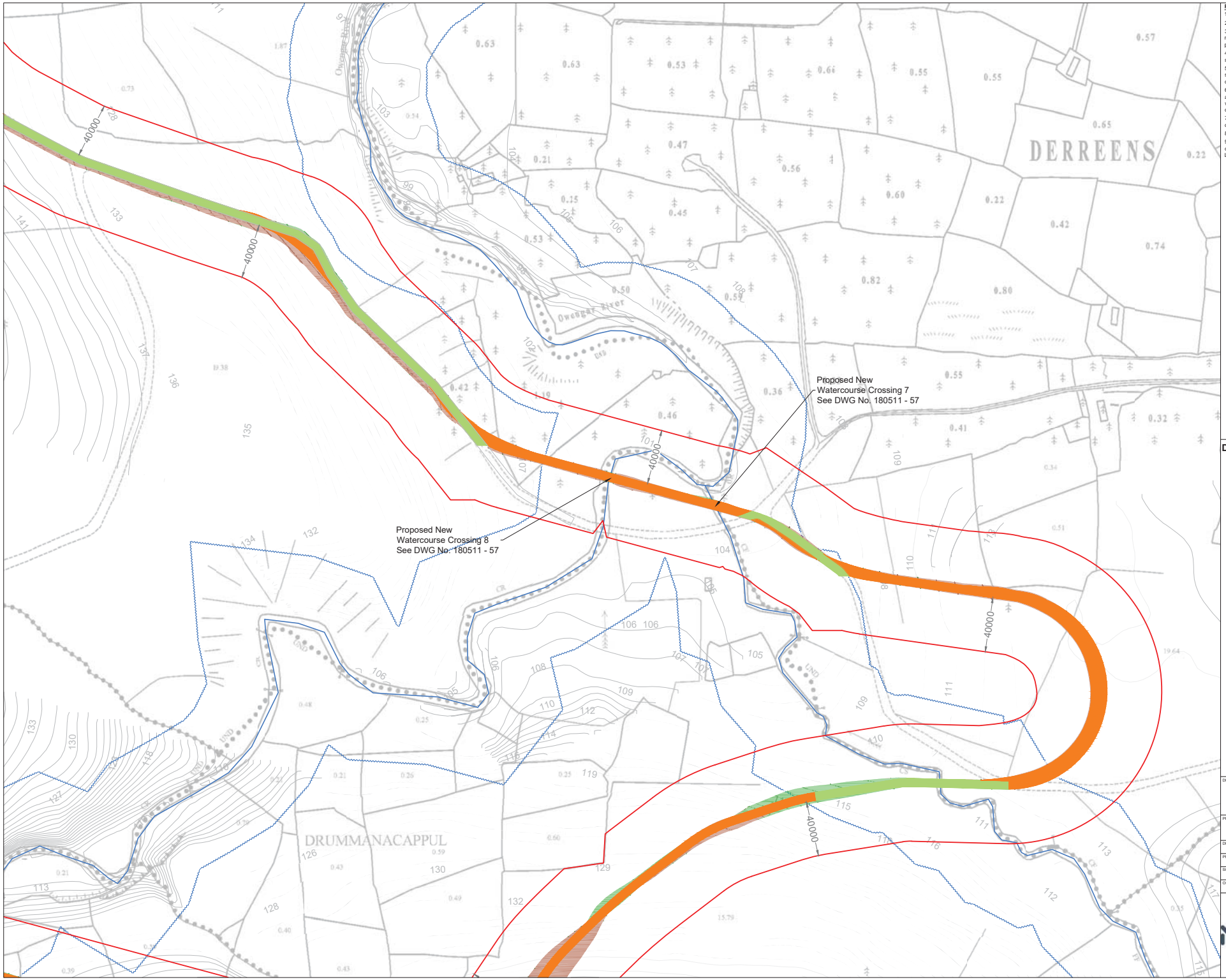
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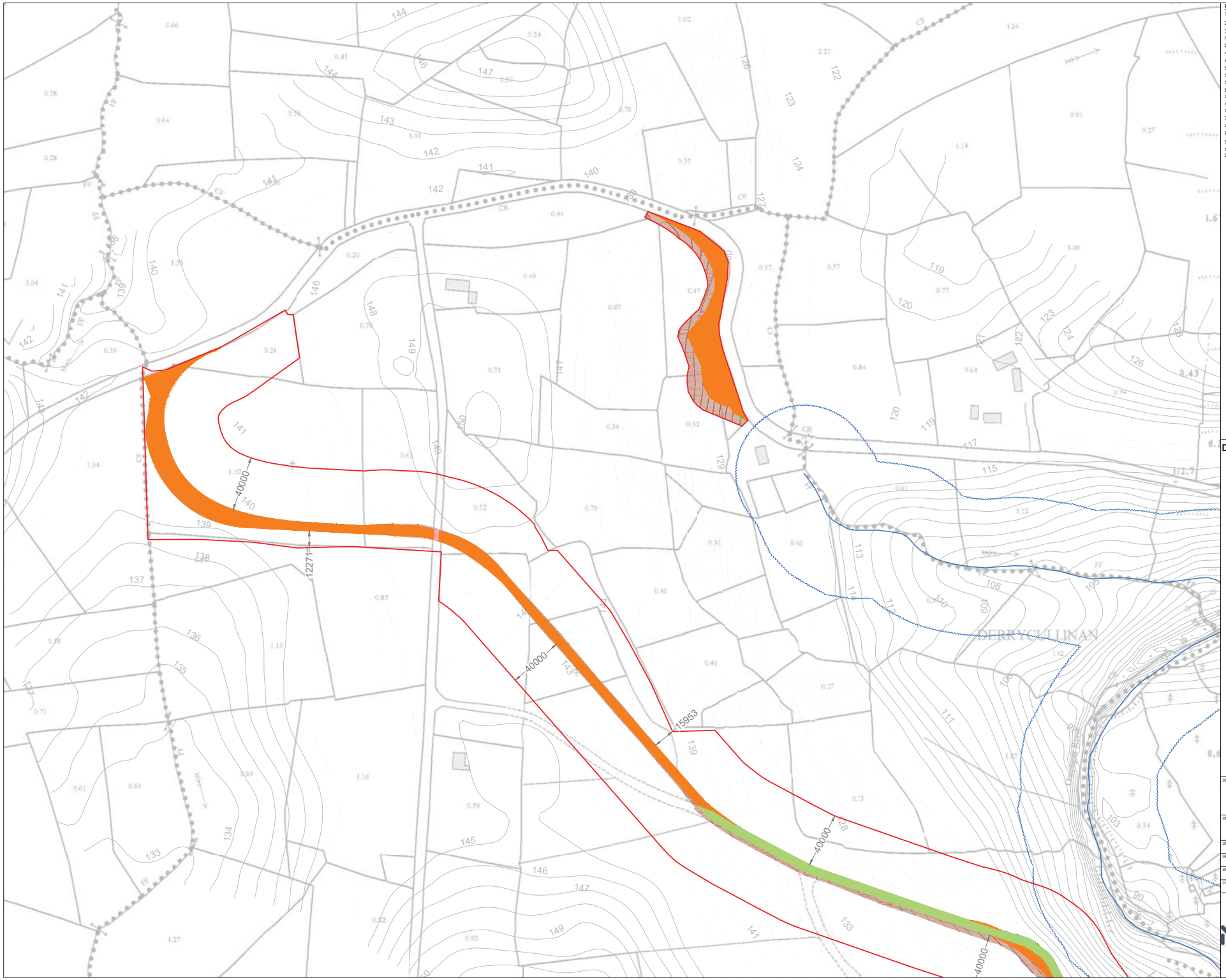
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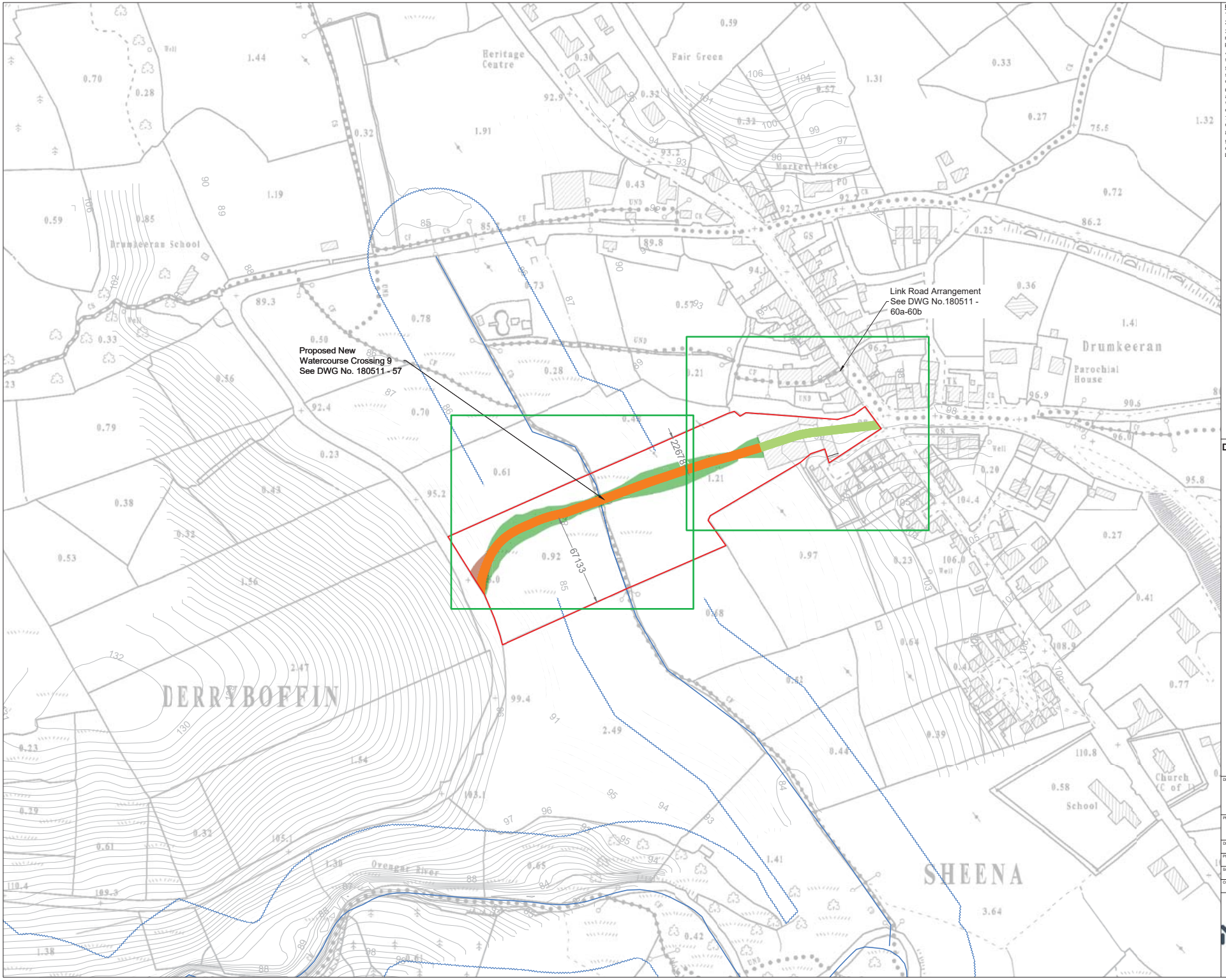
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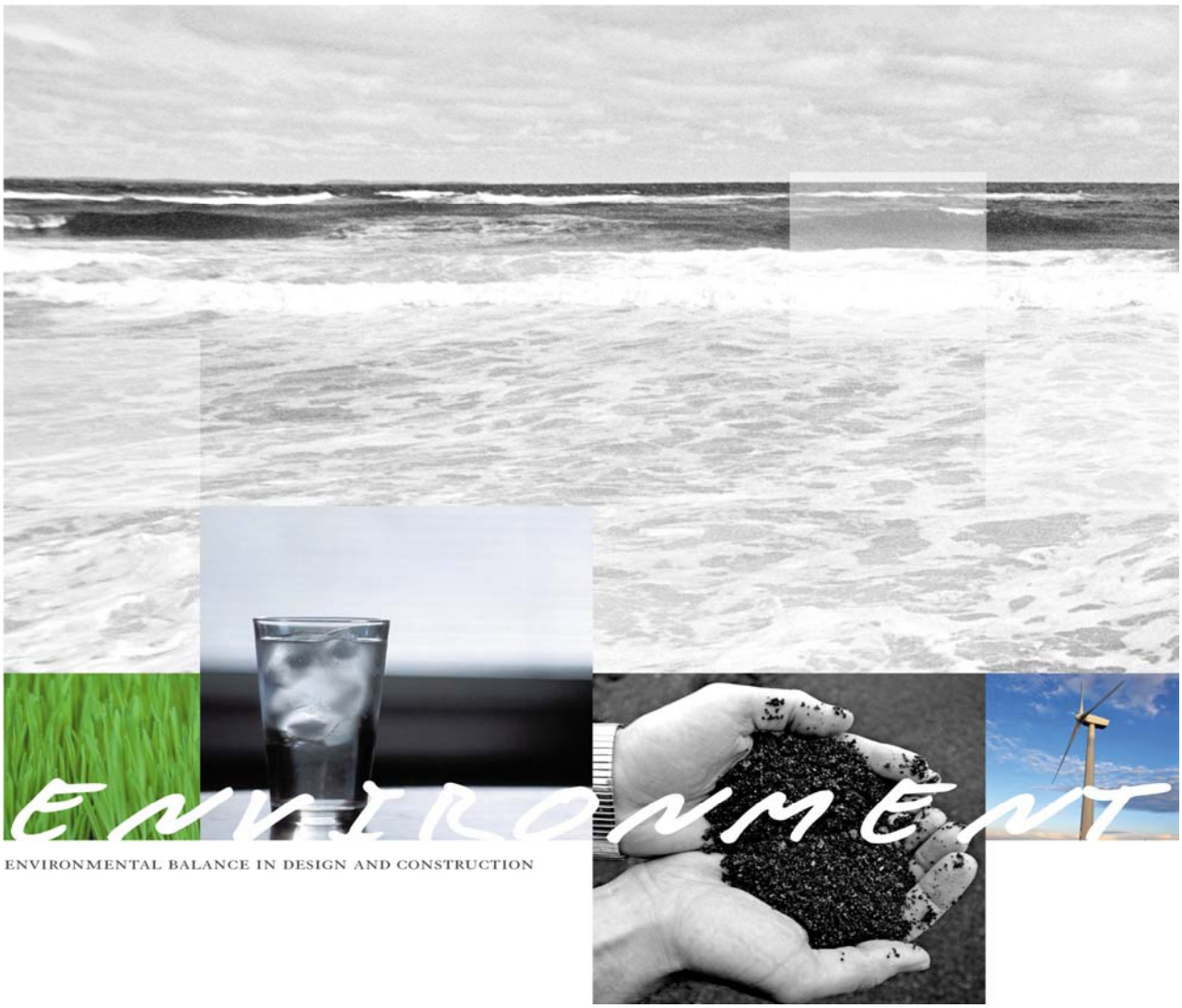
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PEAT & SPOIL MANAGEMENT PLAN FOR

CROAGH WIND FARM, COUNTY LEITRIM/SLIGO

McCarthy Keville O'Sullivan

JUNE 2020

MKO

FEHILY TIMONEY
30 YEARS

Peat & Spoil Management Plan for Croagh Wind Farm, County Leitrim / Sligo

McCarthy Keville O'Sullivan

User is Responsible for Checking the Revision Status of This Document

Rev. Nr.	Description of Changes	Prepared by:	Checked by:	Approved by:	Date:
0	Issued to client for comment	GK	IH	BdH	4 Dec 2019
1	Updated with revised met mast location and entrance road	IH	PJ	BdH	20 Mar 20
2	Updated following Client comments	IH	PJ	BdeH	22 May 20
3	Alteration to access road	IH	PJ	BdeH	19 Jun 20

Client: McCarthy Keville O'Sullivan

Keywords: Peat, Spoil, Management, Excavation, Floated, Borrow Pit, Repository Area

Abstract: Fehily Timoney and Company (FT) were engaged in August 2018 by McCarthy Keville O'Sullivan to compile a Peat & Spoil Management Plan (PSMP) for Croagh wind farm in County Leitrim/Sligo. The purpose of this report is to provide a Peat & Spoil Management Plan for the construction phase of the wind farm. The report describes how peat and spoil which will be excavated from infrastructure locations such as turbine bases and roads and will be handled and placed/reinstated onsite. The report also provides construction details for the types of roads which will be put in place at the site and proposed peat and spoil placement/reinstatement areas which will be developed at the site. In addition, the report contains a cut and fill assessment for the site which quantifies and graphically presents the total volume of cut and fill earthworks required for the construction of the development.

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1 INTRODUCTION

1.1 Background and Experience

Fehily Timoney and Company (FT) formerly Applied Ground Engineering Consultants Ltd (AGEC) were engaged in August 2018 by McCarthy Keville O'Sullivan to compile a Peat & Spoil Management Plan (PSMP) for the proposed Croagh wind farm in County Leitrim/Sligo.

FT/AGEC have been involved in over 100 wind farm developments in both Ireland and the UK at various stages of development i.e. preliminary feasibility, planning, design, construction and operational stage and have established themselves as one of the leading engineering consultancies in peat stability assessment, geohazard mapping in peat land areas, investigation of peat failures and site assessment of peat.

The proposed Croagh wind farm site is located on the boundary of County Sligo and County Leitrim, adjacent to the village of Drumkeeran.

The site is within the northwest part of the Lough Allen upland, which typically comprises plateaux and ridges with steep sides separated by valleys. The approximate development area for the site is 6.7km^2. A number of existing wind farm developments are located in the area of the site.

The proposed wind farm will comprise 10 no. turbines with a tip height of up to 170 metres and all associated foundations and hardstanding areas, access roads including upgrade of existing site roads and provision of new roads, 1 no. onsite electrical substation, excavation of 1 no. borrow pit, underground electrical and communications cabling connecting the turbines to the proposed onsite substation, underground cabling connecting the onsite substation to the existing Garvagh substation, 2 no. temporary construction compounds, 1 no. permanent anemometry mast, recreational car park, trails and signage, demolition of 1 no. derelict building, site drainage and all associated works.

The purpose of this report is to provide a Peat & Spoil Management Plan (PSMP) for the construction phase of the Croagh wind farm. The intention of the report is to describe how peat and spoil which will be excavated from infrastructure locations such as turbine bases and roads and will be handled and placed/reinstated onsite. The report also provides construction details for the types of roads which will be put in place at the site and proposed peat and spoil placement/reinstatement areas which will be developed at the site.

The PSMP contains some drainage guidelines for construction works and for management of peat and spoil on site. It should be noted that the control of water quality and drainage measures for site is outlined in the Environmental Impact Assessment Report (EIAR), Chapter 4 and Chapter 9.

This report also contains a cut and fill assessment for the site which quantifies and graphically presents the total volume of cut and fill earthworks required for the construction of the development.

As work is carried out on site the contents of the PSMP and peat stability monitoring programme will be updated in the Construction & Environmental Management Plan (CEMP) for the construction phase.

1.2 Scope of Report

This report contains the following:

(1) Road construction types for site

(2) Methodology for the construction of each type of access road along with section drawings for each type of access road

(3) Methodology for the excavation and placement/reinstatement of peat and spoil arising's

(4) Summary of repository areas and borrow pit on site along with construction guidelines and drawings

(5) General recommendations for good working practice on site

(6) Monitoring instrumentation programme and guidelines

(7) Contingency plan should peat instability/failure occur at the site

(8) Cut & fill assessment methodology and associated drawings and findings

2 CONSTRUCTION ACTIVITIES COVERED BY PEAT & SPOIL MANAGEMENT PLAN

2.1 Construction Activities

For the construction phase of Croagh wind farm the activities that will generate peat and spoil are as follows:

(1) Upgrade of existing access tracks (excavate and replace and floating tracks)

(2) Construction of new excavated roads through peat

(3) Construction of floating roads over peat (will not generate peat & spoil but the methodology for construction is included for completeness)

(4) Excavation and placement/reinstatement areas for peat and spoil

(5) Excavations in peat for turbine bases, hardstandings, met mast, substation, temporary construction compounds, repository areas and borrow pit

Peat and spoil management of the above construction activities are covered individually in this report.

2.2 Road Construction Types

To provide access within the site and to connect the wind turbines and associated infrastructure existing tracks will need to be upgraded and new access roads will need to be constructed. The road construction preliminary design has taken into account the following key factors:

(1) Buildability considerations

(2) Maximising use of existing infrastructure

(3) Serviceability requirements for construction and wind turbine delivery and maintenance vehicles

(4) Minimise excavation arisings

(5) Requirement to minimise disruption to peat hydrology

The road construction types proposed for the Croagh wind farm site are summarised in Table 2-1.

It should be noted that this report does not include a detailed design for the access roads on the Croagh wind farm site. This report includes the most suitable type of road construction envisaged for each section of access road based on the ground/site conditions recorded during the site walkovers. Where floating roads are proposed in this report, a typical methodology is presented however a confirmatory ground investigation will be carried out prior to construction on site.

Table 2-1: General Road Construction Techniques

Construction Method	Construction Type	Ground Conditions		Comment
		Typical Peat Depth (m)	Typical Slope Inclination (degs)	
Upgrade of existing access tracks	Type A	<3.0	Varies	Upgrade existing excavated access track to the required width and finished with a layer of selected granular fill – Figure 2-1
	Type B	>3.0	Varies	Upgrade existing floated access track to the required width and finished with a layer of geogrid and stone fill – Figure 2-1
Construction of new excavated roads through peat	Type C	Typically, <2.5, locally up to 4.5	Varies	New access road construction technique envisaged for various locations on site – Figure 2-1
Construction of floating road over peat	Type D	>1.5	Typically, <5	New access road construction technique envisaged for various locations on site – Figure 2-1

Further details on access road construction types A to D are given in Sections 3, 4 and 5 of the report.

Figure 2-1: Plan Drawing of Wind Farm with Road Construction Type

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Existing Forestry Roads
Visitor Carpark
Temporary Construction Compound 1
Substation Location
Site Boundary
Repository Area 2
T01
T02
T03
T04
T05
T06
T07
T08
T09
T10
Proposed Turbine Location
Proposed Walkway
Temporary Construction Compound 2
New Proposed Access Track
Proposed Met Mast
Proposed Boardwalk
Borrow Pit
Existing Access Track
Repository Area 1
Site Boundary

Road Type Legend:

Type A - Upgrade of Existing Excavated Access Tracks

Type B - Upgrade of Existing Floated Access Tracks

Type C - New Excavate & Replace Access Road

Type D - New Floated Access Road

0m 120m 240m 360m 480m 600m 720m 840m 960m 1080m 1200m

Scale 1:24000

Scale 1:24000

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FIGURE 2-1 : PLAN DRAWING OF WIND FARM WITH ROAD CONSTRUCTION TYPE

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Checked - IH

Rev - E

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Friday 3 July 2020

3 UPGRADE OF EXISTING ACCESS TRACKS – TYPE A AND B

Up to 11.1km of existing access tracks requiring upgrade are present across the Croagh wind farm site and based on Coillte records have been in operation for a significant number of years. The existing access tracks were constructed using both excavate and replace and floated construction techniques. Based on the site walkover carried out by FT the existing access tracks were typically noted as been in relatively good condition. Upgrading works will involve both widening and resurfacing of the existing access track. The proposed locations for upgrading of the existing access tracks on site are shown in Figure 2-1 and details are shown in Figures 3-1 and 3-2.

Two different types of existing access tracks are present on site which were constructed using both excavate and replace and floated construction techniques (Appendix A – Photos 1 and 2). Upgrading for each is proposed as per details for type A and B respectively.

3.1 Upgrading Existing Access Tracks Construction Methodology

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 considerations, which are discussed in detail in Section 4.7 of the EIAR.

(1) For upgrading of existing excavated access tracks (Type A – Figure 3-1) the following guidelines apply:

- (a) Excavation will be required on one or both sides of the existing access track to a competent stratum.
- (b) Granular fill to be placed and compacted in layers in accordance with the designer's specification.
- (c) The surface of the existing access track should be overlaid with up to 500mm of selected granular fill.
- (d) Access roads to be finished with a layer of capping across the full width of the road.
- (e) A layer of geogrid/geotextile may be required at the surface of the existing access road in areas where the existing track shows signs of excessive rutting, etc.
- (f) For excavations in peat and spoil, side slopes shall be not greater than 1 (v):3 (h). Where areas of weaker peat are encountered then slacker slopes will be required to ensure stability.

(2) For upgrading of existing floated access tracks (Type B – Figure 3-2) the following guidelines apply:

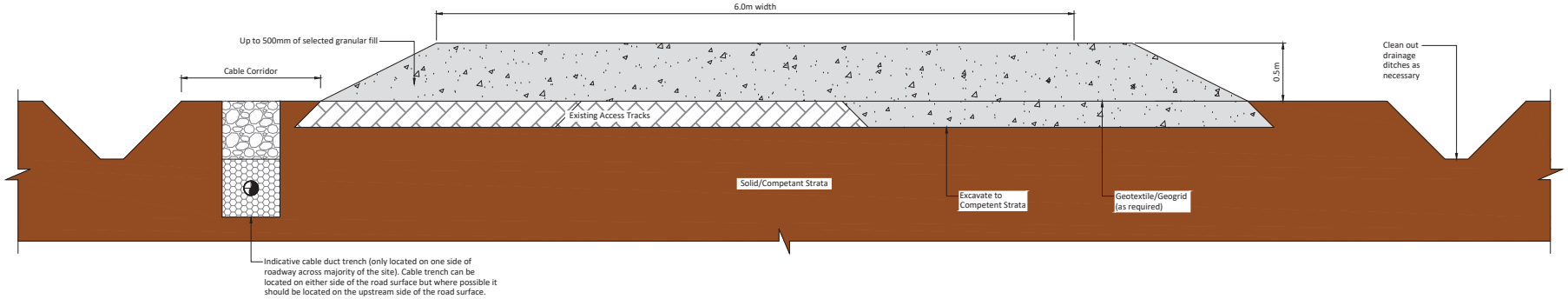
- (a) The make-up of the existing floating access roads on site is generally locally tree brash/trunks laid directly onto the peat surface and/or geotextile overlain by up to 500mm of coarse granular fill/till type (fine granular/cohesive) site won material. It should be noted that there are localised variations in the make-up of the existing floated access tracks on site, frequently no tree brash/trunks were used in the make-up and the presence of a geogrid was also noted in localised sections of the existing track.
- (b) The surface of the existing access track should be levelled prior the placement of any geogrid/geotextile, where necessary (to prevent damaging the geogrid/geotextile).
- (c) Where coarse granular fill has been used in the existing floated access road make-up, a layer of geogrid should be placed on top of the existing floated access track.
- (d) Where fine granular/cohesive type material has been used in the existing floated access road make-up (as is the case on some of the existing access roads in the southeast of the site), a layer of geotextile is likely to be required as a separator layer with a layer of geogrid.
- (e) The geogrid will be overlaid with up to 500mm of selected granular fill. Granular fill to be placed and compacted in layers.

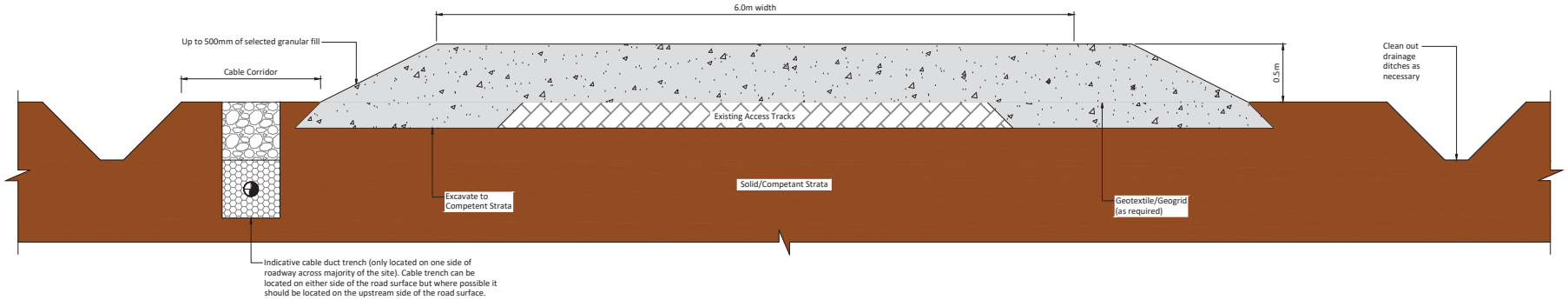
(3) The finished road width will have a running width of 5m, with wider sections on bends and corners.

(4) On side long sloping ground any road widening works required will be done on the upslope side of the existing access road, where possible.

(5) At transitions between new floating and existing excavated roads a length of road of about 10 to 20m 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, to provide a road profile and graded to accommodate wind turbine construction and delivery traffic.





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FIGURE 3-1 : TYPE A - UPGRADE OF EXISTING EXCAVATED ACCESS TRACKS

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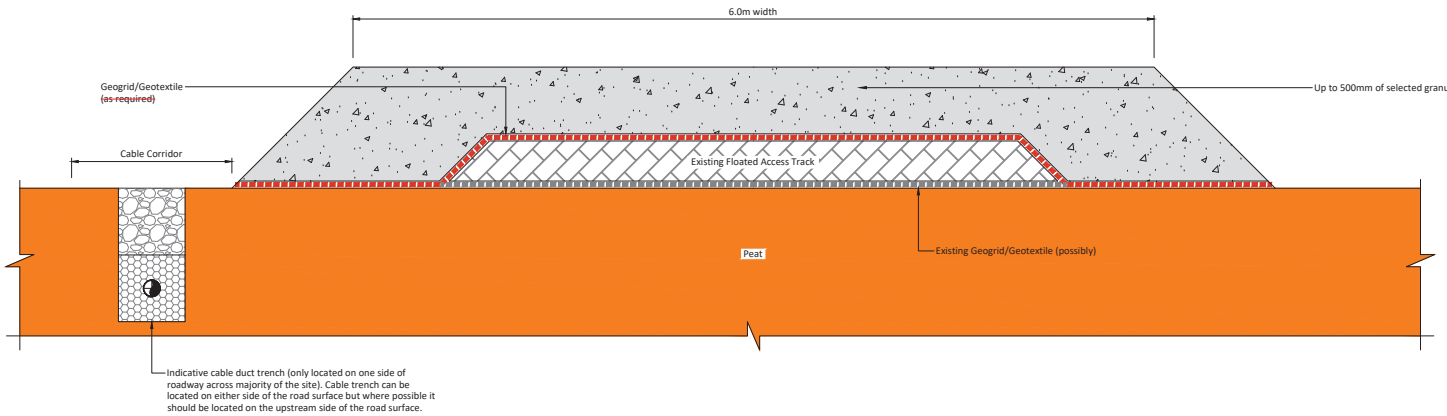
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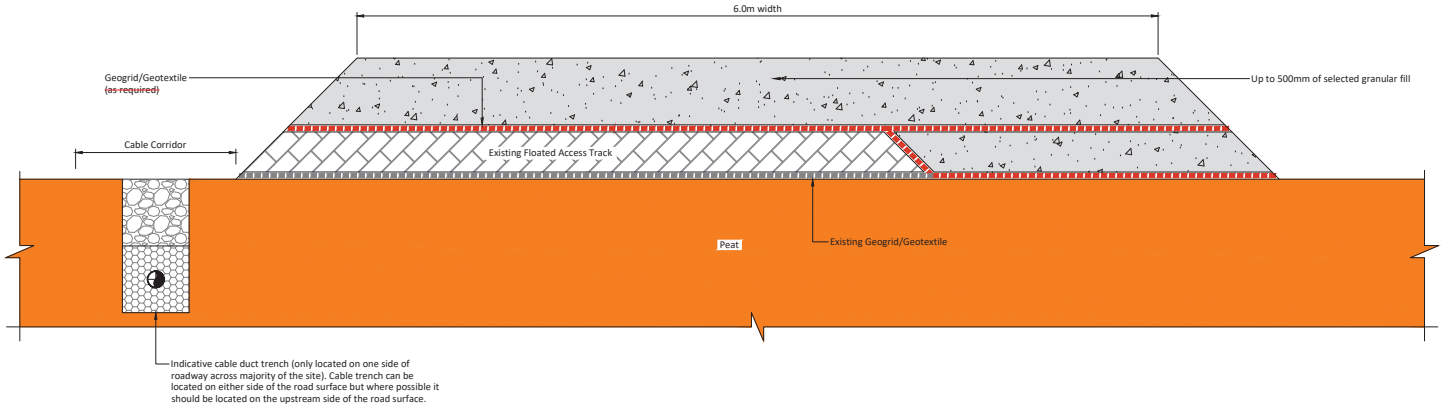
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FIGURE 3-2 : TYPE B - UPGRADE OF EXISTING FLOATED ACCESS TRACKS

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4 CONSTRUCTION OF NEW EXCAVATED ROADS THROUGH PEAT – TYPE C

The excavation of peat and spoil and founding of access roads on competent stratum (below the peat) for new access roads will be carried out at various locations on the site. The proposed locations for new excavated access roads on site are shown in Figure 2-1 and details are shown in Figure 4-1.

Excavate and replace type access roads are the conventional method for construction of access roads on peatland sites and the preferred construction technique provided sufficient placement/reinstatement capacity is available on site for the excavated peat.

4.1 Excavated Road Construction Methodology

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 considerations, which are discussed in Section 4.7 of the EIAR.

(1) Prior to commencing road construction movement monitoring posts will be installed in areas where the peat depth is greater than 2m.

(2) Interceptor drains will be installed upslope of the access road alignment to divert any surface water away from the construction area.

(3) Excavation will take place to a competent stratum beneath the peat.

(4) Road construction will be carried out in sections of approximately 50m lengths i.e. no more than 50m of access road should be excavated without replacement with stone fill.

(5) Excavation of materials with respect to control of peat stability.

  (a) Acrotelm (top about 0.3 to 0.4m of peat) is generally required for landscaping and shall be stripped and temporarily stockpiled for re-use as required. Acrotelm stripping shall be undertaken prior to main excavations.

  (b) Where possible, the acrotelm shall be placed with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation.

  (c) All catotelm peat (peat below about 0.3 to 0.4m depth) shall be transported immediately on excavation to the borrow pit or peat repositories.

(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 will be carried out as the excavation progresses.

(7) The excavated access road will be constructed of up to 1000mm of selected granular fill.

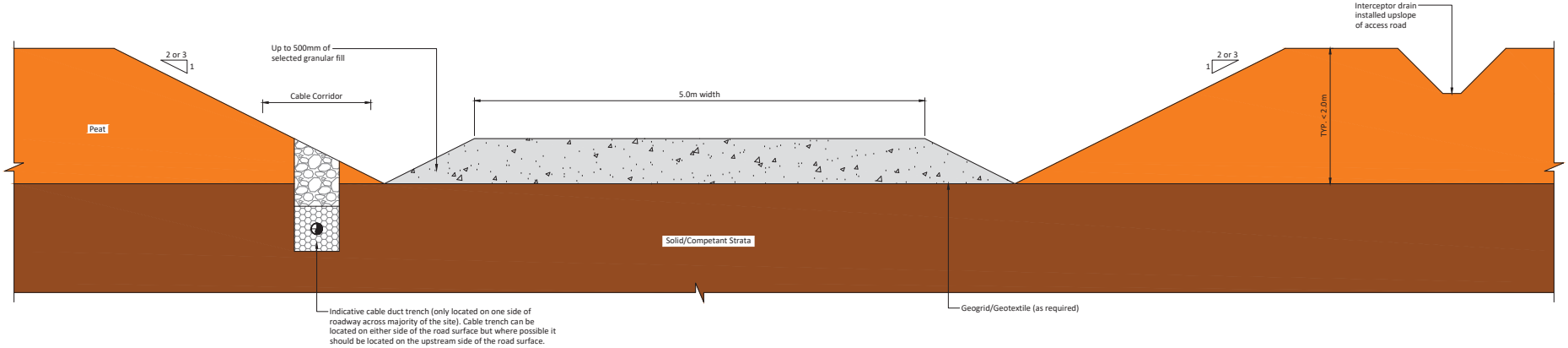
(8) Access roads to be finished with a layer of capping across the full width of the road.

(9) A layer of geogrid/geotextile may be required at the surface of the competent stratum.

(10) At transitions between floating and excavated roads a length of road of about 10 to 20m 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.

(11) Where steeper slopes are encountered along with relatively deep peat (i.e. typically greater than 1m) 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.

(12) A final surface layer shall be placed over the excavated road and graded to accommodate wind turbine construction and delivery traffic.



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FIGURE 4-1 : TYPE C - NEW EXCAVATE AND REPLACE ACCESS ROAD

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5 CONSTRUCTION OF NEW FLOATING ROADS OVER PEAT – TYPE D

It will be necessary to construct floating roads over peat at various locations across the site. The use of new floated access tracks will be limited on site to areas of typically flatter terrain. The proposed locations for the new floating access roads on site are shown in Figure 2-1 and details are shown in Figure 5-1.

A confirmatory stability analysis to confirm the conditions predicted in this EIAR will be carried out where it is proposed to install floating access roads over the peat prior to any construction work commencing on site.

Floating roads minimise impact on the peat, particularly peat hydrology. Also, as there is no excavation required no peat arisings are generated. However, where the underlying peat has insufficient bearing capacity or due to topographic restrictions an excavate and replace type access road may be more suitable (see Section 6), although this is not anticipated at the location of the floated roads.

5.1 Floating Road Construction Methodology

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 considerations, which are discussed in Section 4.7 of the EIAR.

Note: Details of geogrid arrangement will be provided by the specialist geogrid provider/designer.

(1) Prior to commencing floating road construction movement monitoring posts will be installed in areas where the peat depth is greater than 3m.

(2) Base geogrid to be laid directly onto the existing peat surface along the line of the road in accordance with geogrid provider's requirements.

(3) The typical make-up of the new floated access road is a minimum of 1000mm of selected granular fill with 2 no. layers of geogrid with possibly the inclusion of a basal layer of tree trunks/brash (See Figure 5-1).

(4) Granular fill to be placed in layers and compacted in accordance with the TII Specification for Road Works.

(5) During construction of the floated access roads it may be necessary to include pressure berms either side of the access road in some of the deeper/weaker peat areas. The inclusion of a 2 to 5m wide pressure berm (typically 0.5m in height) either side of the access road at such locations will reduce the likelihood of potential bearing failures beneath the access road.

(6) The finished running width of the road will be 5m, with wider sections on bends and corners.

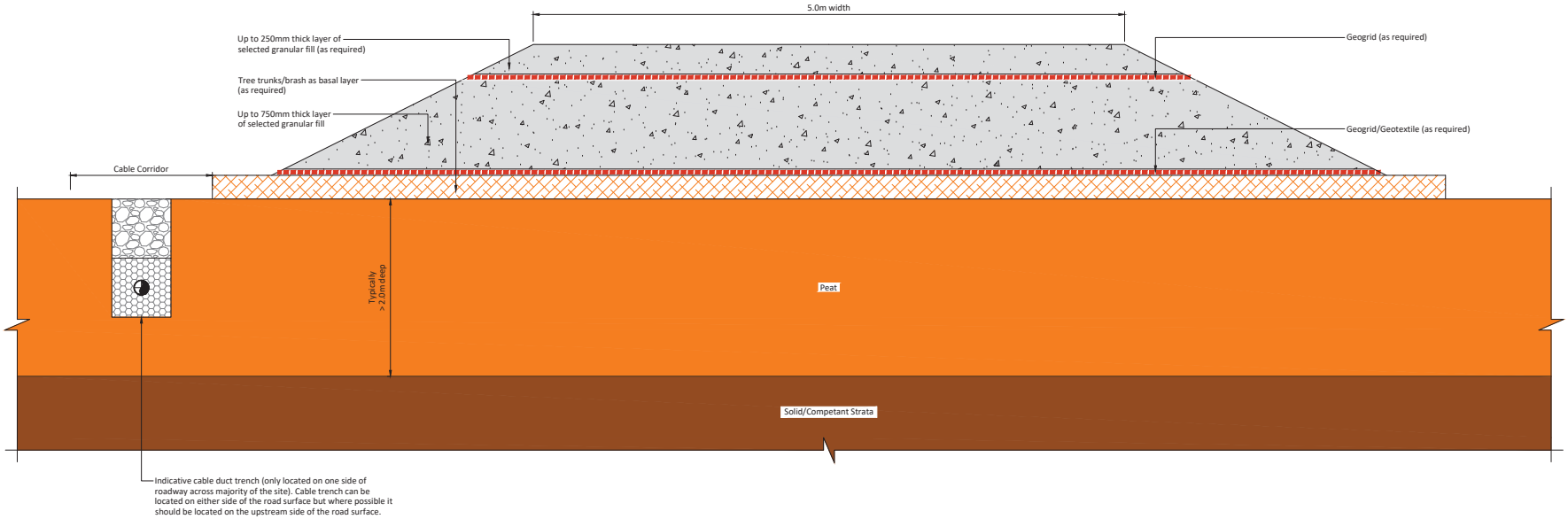
(7) Stone delivered to the floating road construction shall be end-tipped onto the constructed floating road. Direct tipping of stone onto the peat shall not be carried out.

(8) 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.

(9) Where it is not possible to end-tip over a 10m length of constructed floating road due to the presence of weak deep peat 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.

(10) Following end-tipping a suitable bulldozer shall be employed to spread and place the tipped stone over the base geogrid along the line of the road.

(11) A final surface capping layer shall be placed over the full width of the floating road, as per design requirements, to provide a road profile and graded to accommodate wind turbine construction and delivery traffic.



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FIGURE 5-1 : TYPE D - NEW FLOATED ACCESS ROAD

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6 GENERAL CONSTRUCTION GUIDELINES FOR ACCESS ROADS

The following general construction guidelines are given for the access roads on site.

(1) Where an open ditch is present alongside an existing/proposed floating access track, the ditch will need to be filled prior to upgrading/constructing the access track. The ditch shall be filled with suitable drainage stone. As applicable, a perforated pipe shall be laid into a ditch prior to filling so as to maintain water flow within the ditch.

(2) Where existing drainage crosses the road then it will be necessary to ensure that this drainage is not affected by settlement of the upgraded access road. Cross drains comprising flexible perforated pipes within a permeable stone fill surround will be used to maintain the existing drainage.

(3) No excavations (e.g. drainage, peat cuttings) shall be carried out within a minimum 5m distance of a completed floated access road edge, or at a distance determined following site inspection by the Contractor. The presence of excavations can destabilise the road. Temporary excavations should be excavated in short lengths and backfilled as soon as practicable.

(4) No stockpiling of materials shall take place on or adjacent to floated access roads so as to avoid bearing failure of the underlying peat.

(5) End-tipping of stone onto the road during the construction/upgrading of the access road should be carefully monitored to ensure that excessive impact loading, which may adversely affect the underlying peat, is limited.

(6) Due to the nature of floating road construction it will be necessary to monitor the settlement/movement of the road. Survey points will be located along the road at 10m intervals in areas of deep peat (greater than 3m). These survey points shall be surveyed on a weekly basis, and more frequently when construction activities are ongoing in the area.

(7) The construction and upgrading of access roads in areas of deep peat (greater than 3m) shall be inspected on a routine basis during the works, particularly before/following trafficking by heavy vehicular loads.

(8) In the event of excessive vertical displacement of the road during/following construction then remedial measures will be required to ensure the stability of the road. These would include:

(a) Introduction of pressure berms either side of the road (that is 2 to 5m wide by 0.5m deep stone layer).
(b) Where peat is relatively shallow then excavate peat and replace with suitable fill.
(c) Slowing the rate of construction.

(9) Settlement of a floated access road is expected and will likely be in the order of several 100mm in the deeper peat areas; as such it will be necessary to re-level the road at convenient intervals during the works. The magnitude and extent of settlement is likely to be greater in areas of deeper peat with the rate of settlement reducing over time. Prior to completion of the works measures shall be taken to re-level the road, as necessary.

7 EXCAVATION AND PLACEMENT OF ARISINGS

7.1 Excavation and Placement/Reinstatement Methodology

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 considerations, which are discussed in Section 4.7 of the EIAR.

(1) All excavated peat and spoil shall be transported immediately on excavation to one of the 2 no. repository areas or borrow pit on site (see Figure 2-1).

(2) Further details on the construction and reinstatement of the borrow pit is given in Section 7.4.

(3) Further details on the placement of excavated material in the repository areas is given in Section 7.5.

(4) Some of the peat in particular the acrotelm (upper layer of the peat) excavated during construction will be used for landscaping purposes.

7.2 Summary of Excavated Peat and Spoil Volumes on Site

A summary of the excavated peat and spoil volumes calculated for the Croagh wind farm site are given in Table 7-1.

Table 7-1: Summary of Excavated Peat and Spoil Volumes on Site

Infrastructure Element (1)	Typical Dimensions	Peat Volume (m^3)	Spoil (non-peat) Volume (m^3) (2)	Comment
10 no. Turbines and Hardstands	23m diameter excavation footprint for turbine foundation with 55 x 35m hardstand area	65,925	48,635	Hardstanding area and foundation footprint
Access Roads	5m running surface with 6m wide development footprint	103,500	93,550	Excludes proposed floating sections of access road where no excavation of peat will take place (see Figure 2-1)
Substation	Hardstanding area of 65 x 40m	2,810	17,095	-
Meteorological Mast	Foundation footprint within 14 x 21m hardstanding area	425		-
Temporary Construction Compounds	Hardstanding areas of 60 x 40m	7,490		Hardstanding areas
Borrow Pit	1 no. borrow pit	14,820	34,580	-
Repository Areas	2 no. repository areas	15,000	3,000	Beneath footprint of perimeter buttresses
	Total =	**209,970m^3**	**196,860m^3**	**Total = 406,830m^3 (peat and spoil volume) (3)**

Note (1) The location of the infrastructure elements on site are shown on Figure 2-1.
Note (2) The excavated spoil volumes have been determined based on a cut-fill assessment carried out for the site, see section 13 of this report for further details.
Note (3) It should be noted that the excavated rock volume is not included in the total volume quoted above in Table 7-1, see the cut-fill assessment in Section 13 of this report for further details.

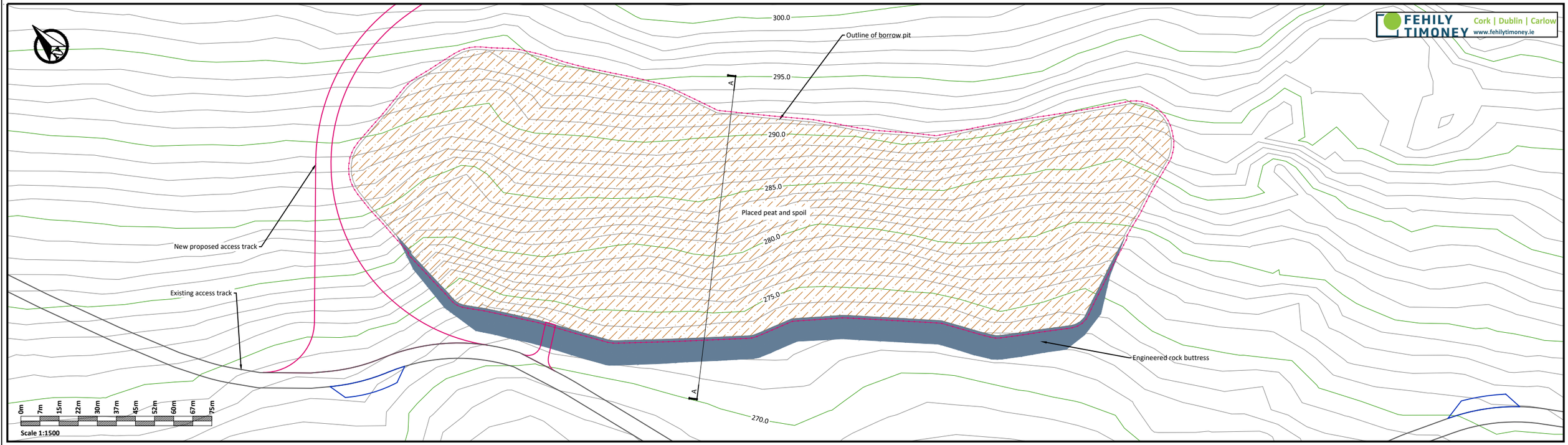
7.3 Summary of Peat and Spoil Placement/Reinstatement Areas on Site

A summary of the potential peat and spoil placement/reinstatement areas at the Croagh wind farm site are given in Table 7-2.

Table 7-2: Summary of Peat and Spoil Placement/Reinstatement Areas on Site

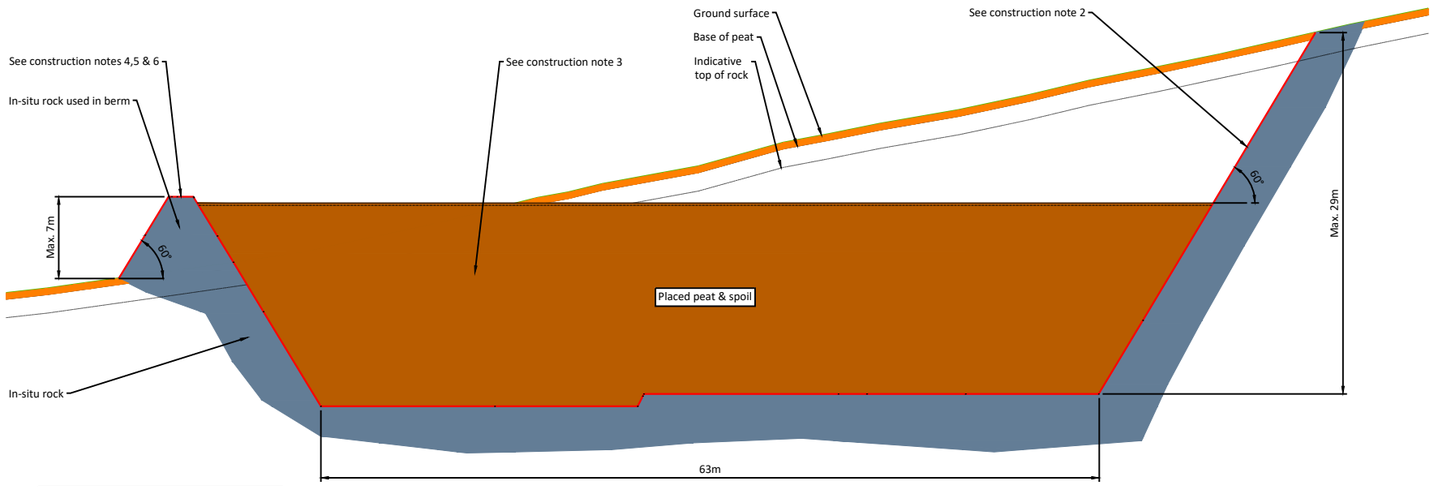
Location (1)	Peat and Spoil Volume (m^3)	Comment
Borrow Pit	298,000	See Figure 7-1 for further details
Repository Area 1	82,000	See Figure 7-2 for further details
Repository Area 2	18,000	See Figure 7-3 for further details
Landscaping (2)	10,000	Approximately 1,000m^3 of peat will be required for landscaping purposes at each of the 10 no. turbine locations
Total =	**408,000m^3**	

Note (1) The location of the proposed borrow pit and repository areas at the site are shown on Figure 2-1.
Note (2) Some of the acrotelm (upper layer of the peat) excavated during construction will be used for landscaping purposes.



Plan

Scale 1:1500



Section Scales:

1:1 Horizontal
1:1 Vertical

(No exaggeration on vertical scale i.e. true scale)

0m 3m 5m 8m 10m 13m 15m 18m 20m 23m 25m

Scale 1:500

Section

Scale 1:500

Construction Notes Borrow Pit:

(1) It is proposed to construct the borrow pit so that the base of the borrow pit is below the level of the adjacent section of access road.

(2) Slopes within the excavated rock formed around the perimeter of the borrow pit will be formed at stable inclinations to suit local in-situ rock conditions.

(3) Infilling of the peat & spoil will commence at the back edge of the borrow pit and progress towards the borrow pit entrance/rock buttress. Leaving in place upstands/segments of intact rock which will help to retain the placed peat & spoil and will allow the borrow pit to be developed and infilled in cells.

(4) A rock buttress is required at the downslope edge of the borrow pit to safely retain the infilled peat and spoil. The height of the rock buttresses constructed should be greater than the height of the infilled peat & spoil to prevent any surface peat & spoil run-off. A buttress up to 7m (approx.) in height is likely to be required.

(5) The rock buttress will be founded on competent strata. The founding stratum for the rock buttress should be inspected and approved by the project geotechnical engineer.

(6) In order to prevent water retention occurring behind the buttresses, the buttresses will be constructed of coarse boulder fill with a high permeability.

(7) The surface of the placed peat & spoil will be shaped to allow efficient run-off of surface water from the placed arising's.

(8) Control of groundwater within the borrow pit will be required.

(9) Further guidelines on the construction of the borrow pit are included within Section 7.4 of the Peat & Spoil Management Plan.

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FIGURE 7-1 : BORROW PIT - PLAN & CROSS SECTION DETAILS

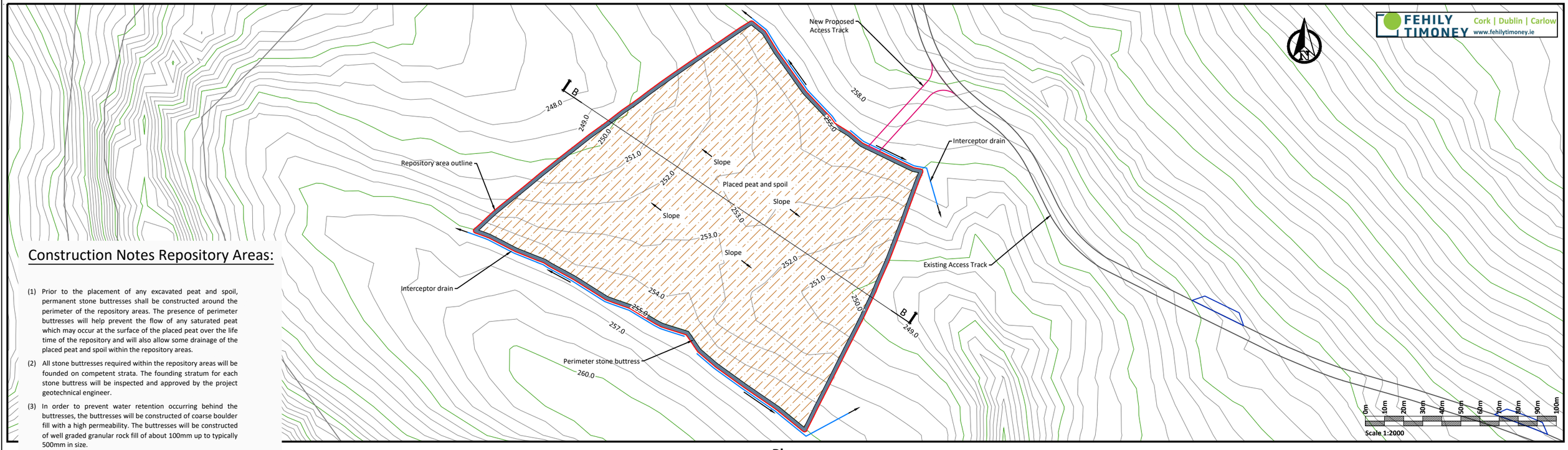
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Friday 26 June 2020



Plan

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Construction Notes Repository Areas:

(1) Prior to the placement of any excavated peat and spoil, permanent stone buttresses shall be constructed around the perimeter of the repository areas. The presence of perimeter buttresses will help prevent the flow of any saturated peat which may occur at the surface of the placed peat over the life time of the repository and will also allow some drainage of the placed peat and spoil within the repository areas.

(2) All stone buttresses required within the repository areas will be founded on competent strata. The founding stratum for each stone buttress will be inspected and approved by the project geotechnical engineer.

(3) In order to prevent water retention occurring behind the buttresses, the buttresses will be constructed of coarse boulder fill with a high permeability. The buttresses will be constructed of well graded granular rock fill of about 100mm up to typically 500mm in size.

(4) The height of the stone buttresses constructed will be greater than the height of the stored peat and spoil to prevent any surface run-off.

(5) The side slopes of the stone buttresses will be constructed at typically 45 degrees. The stone buttresses will be widened to allow construction traffic access for tipping purposes during the placement of the excavated peat and spoil.

(6) An interceptor drain will also be installed upslope of the repository areas.

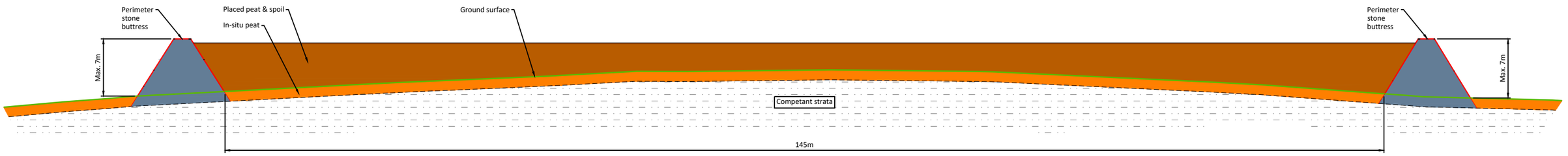
(7) A silting pond will be required at the lower side of the repository areas.

(8) The placement of the excavated spoil will commence at the downslope edge of the repository area against the stone buttress and placement will then continue upslope.

(9) It is important that the surface of the stored spoil be shaped to allow efficient run-off of water from the stored spoil.

(10) Supervision by the project geotechnical engineer or appropriately competent person is recommended for the construction of the repository area.

(11) Further guidelines on the construction of the repository area are included within Section 7.5 of the Peat & Spoil Management Plan.



Section B - B

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FIGURE 7-2 : REPOSITORY AREA 1 - PLAN & CROSS SECTION DETAILS

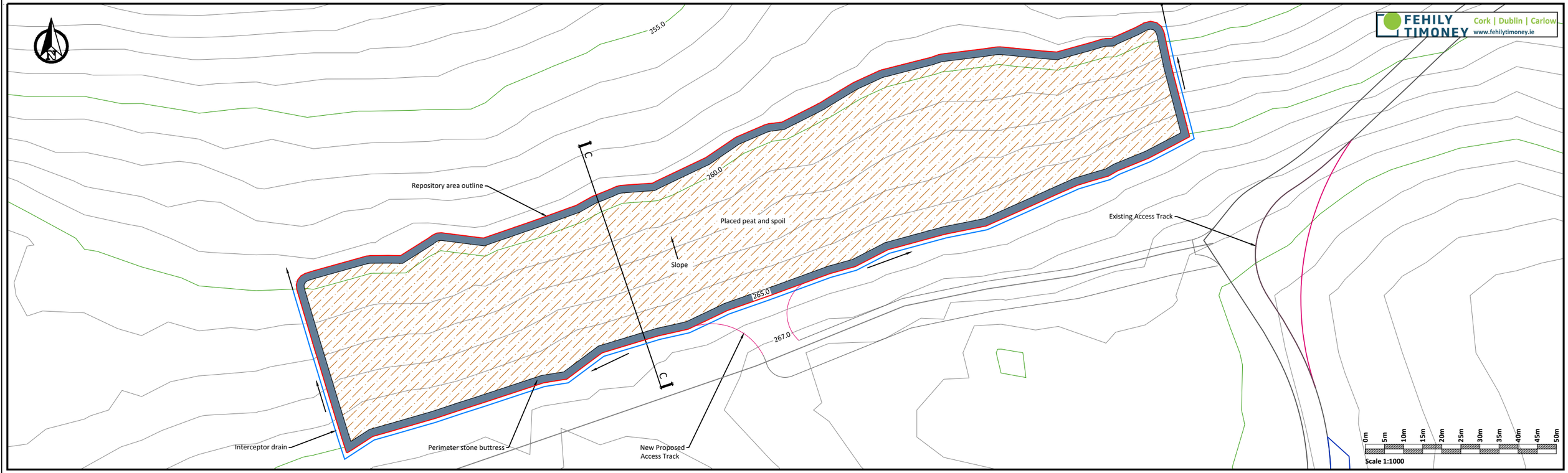
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Friday 26 June 2020



Plan

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Construction Notes Repository Areas:

(1) Prior to the placement of any excavated peat and spoil, permanent stone buttresses shall be constructed around the perimeter of the repository areas. The presence of perimeter buttresses will help prevent the flow of any saturated peat which may occur at the surface of the placed peat over the life time of the repository and will also allow some drainage of the placed peat and spoil within the repository areas.

(2) All stone buttresses required within the repository areas will be founded on competent strata. The founding stratum for each stone buttress will be inspected and approved by the project geotechnical engineer.

(3) In order to prevent water retention occurring behind the buttresses, the buttresses will be constructed of coarse boulder fill with a high permeability. The buttresses will be constructed of well graded granular rock fill of about 100mm up to typically 500mm in size.

(4) The height of the stone buttresses constructed will be greater than the height of the stored peat and spoil to prevent any surface run-off.

(5) The side slopes of the stone buttresses will be constructed at typically 45 degrees. The stone buttresses will be widened to allow construction traffic access for tipping purposes during the placement of the excavated peat and spoil.

(6) An interceptor drain will also be installed upslope of the repository areas.

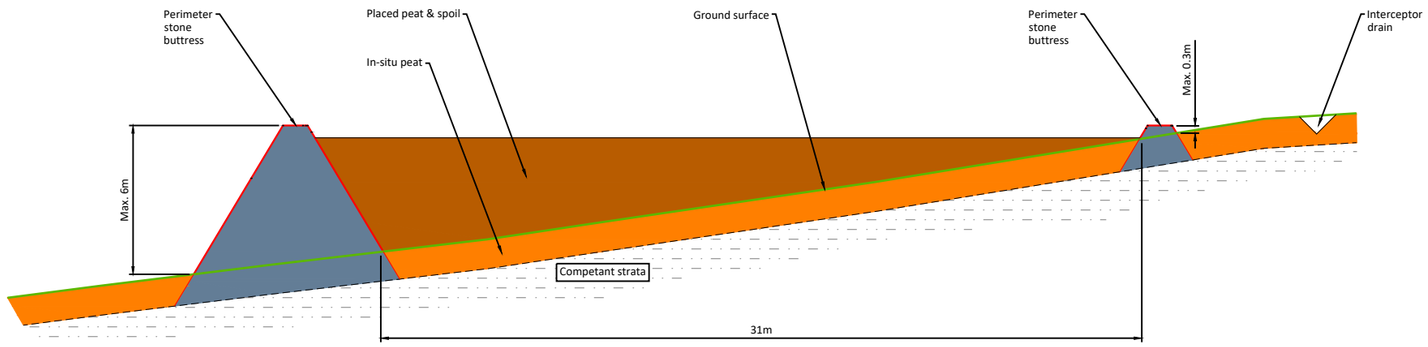
(7) A silting pond will be required at the lower side of the repository areas.

(8) The placement of the excavated spoil will commence at the downslope edge of the repository area against the stone buttress and placement will then continue upslope.

(9) It is important that the surface of the stored spoil be shaped to allow efficient run-off of water from the stored spoil.

(10) Supervision by the project geotechnical engineer or appropriately competent person is recommended for the construction of the repository area.

(11) Further guidelines on the construction of the repository area are included within Section 7.5 of the Peat & Spoil Management Plan.



Section C - C

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FIGURE 7-3 : REPOSITORY AREA 2 - PLAN & CROSS SECTION DETAILS

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7.4 Guidelines for the Construction and Reinstatement of Borrow Pit

A location has been identified as a borrow pit and is shown on Figure 2-1. Peat depths recorded within the footprint of the borrow pit range from 0.5 to 1.7m.

Upon removal of the rock from the borrow pit, it is proposed to reinstate the borrow pit using excavated peat & spoil within cells located inside the borrow pit. The excavated rock from the borrow pit will be used in the construction of the infrastructure elements (turbine bases, roads, etc.) at the wind farm. It is proposed to construct cells within the borrow pit for the placement of the excavated peat and spoil. This is to allow for the safe placement and grading of the peat and spoil using dumper trucks and excavators.

It should be noted that there are significant excavations works required in order to develop this borrow pit at the site. Excavation works will be undertaken and supervised by an experienced contractor and suitably qualified personnel. The text below provides some design and construction guidelines for the borrow pit.

Figure 7-1 shows the construction details for the borrow pit.

The borrow pit shall be constructed as follows:

(1) The rock within the borrow pit footprint will be removed by a combination of breaking and blasting, depending on its excavatability, which will be determined from confirmatory ground investigation carried out at the borrow pit.

(2) It is proposed to construct the borrow pit so that the base of the borrow pit is below the level of the adjacent section of access road. Localised deepening of the borrow pit floor may be required depending on extraction operations.

(3) Depending on the condition of the rock present in the borrow pit it may be possible to excavate the rock from the borrow pit whilst leaving in place upstands/segments of intact rock which will help to retain the placed peat and spoil. The upstands/segments of intact rock will essentially act as engineered rock buttresses within the borrow pit.

(4) Slopes within the excavated rock formed around the perimeter of the borrow pit will be formed at stable inclinations to suit local in-situ rock conditions. Exposed sections of the rock slopes will be left with irregular faces and declivities to promote re-vegetation and provide a naturalistic appearance.

(5) The stability of the rock faces within the borrow pit will be inspected by competent personnel upon excavation to ensure stability during construction works and in the long term. This inspection will allow unfavourable rock conditions to be identified and suitable mitigation measures to be applied such as removal of loose rock, in line with best practice guidelines.

(6) Infilling of the peat and spoil will commence at the back edge of the borrow pit and progress towards the borrow pit entrance/rock buttress. Leaving in place upstands/segments of intact rock which will help to retain the placed peat spoil and will allow the borrow pit to be developed and infilled in cells.

(7) A rock buttress is required at the downslope edge of the borrow pit to safely retain the infilled peat and spoil. The height of the rock buttresses constructed will be greater than the height of the infilled peat and spoil to prevent any surface peat and spoil run-off. A buttress up to 7m (approx.) in height will be required.

(8) The rock buttress will be founded on mineral soil or bedrock i.e. competent strata. The founding stratum for the rock buttress should be inspected and approved by the Project Geotechnical Engineer.

(9) In order to prevent water retention occurring behind the buttresses, the buttresses will be constructed of coarse boulder fill with a high permeability. The buttress will be constructed of well graded granular rock fill of about 100mm up to typically 500mm in size. Alternatively, drains will be placed through the buttresses to allow excess water to drain.

(10) The rock buttress will be wide enough to allow construction traffic access for tipping and grading during the placement of the excavated peat and spoil. The side slopes of the rock buttress will be constructed at between 45 to 60 degrees.

(11) The use of temporary access ramps and long reach excavators during the placement of the excavated peat and spoil will be required.

(12) The surface of the placed peat and spoil will be shaped to allow efficient run-off of surface water from the placed arising's.

(13) A layer of geogrid to strengthen the surface of the placed peat and spoil within the borrow pit may be required.

(14) An interceptor drain will also be installed upslope of the borrow pit. This drain will divert any surface water away from the borrow pit and hence prevent run-off from ponding and lodging in the reinstated area.

(15) Control of groundwater within the borrow pit may be required and measures will be determined as part of the confirmatory ground investigation programme. A temporary pump and suitable outfall locations are likely to be required during construction. Refer to EIAR Chapter 4 and 9 for drainage details.

(16) A settlement pond will be required at the lower side/outfall location of the borrow pit.

(17) Supervision by a geotechnical engineer or appropriately competent person is required for the development of the borrow pit.

(18) All the above-mentioned general guidelines and requirements will be confirmed by the Contractor prior to construction.

7.5 Guidelines for the Construction of the Repository Areas

Two locations have been identified as repository areas and are shown on Figure 2-1. The peat depth within the footprint of the repository areas is generally less than 1.5m.

Both repository areas have a perimeter buttress which will contain and ensure the placed peat and spoil remains stable in the long-term. Prior to the placement of any excavated peat and spoil, the permanent stone buttresses shall be constructed around the perimeter of the repository areas. Construction details for each of the repository areas are shown on Figures 7-2 and 7-3.

The presence of perimeter buttresses will help prevent the flow of any saturated peat which may occur at the surface of the placed peat over the lifetime of the repository and will also allow some drainage of the placed peat and spoil within the repository areas.

The repository areas, in particular the stone buttresses, should be constructed as follows:

(1) All stone buttresses required within the repository areas will be founded on mineral soil or bedrock i.e. competent strata. The founding stratum for each stone buttress will be inspected and approved by a geotechnical engineer or competent person.

(2) In order to prevent water retention occurring behind the buttresses, the buttresses will be constructed of coarse boulder fill with a high permeability. The buttresses will be constructed of well graded granular rock fill of about 100mm up to typically 500mm in size. Alternatively, drains will be placed through the buttresses to allow excess water to drain.

(3) The height of the stone buttresses constructed will be greater than the height of the stored peat and spoil to prevent any surface run-off. The height of the stone buttresses will be a minimum of 0.5m above the height of the placed peat and spoil to prevent any potential for saturated peat to flow out of the repository area.

(4) The side slopes of the stone buttresses shall be constructed at 45 degrees. The stone buttresses will be widened to allow construction traffic access for tipping purposes during the placement of the excavated peat and spoil.

(5) An interceptor drain will also be installed upslope of the repository areas. The drain will divert any surface water away from the repository area and hence prevent water from ponding in the area.

(6) A settlement pond will be required at the lower side of the repository areas.

(7) A granular layer of material will be required at the base of the stored spoil immediately upslope of the stone buttresses to act as a drainage layer. This drainage layer will aid in preventing a build-up of pore water pressure behind the stone buttress.

(8) The placement of the excavated spoil will commence at the downslope edge of the repository area against the stone buttress and placement will then continue upslope.

(9) It is important that the surface of the stored spoil be shaped to allow efficient run-off of water from the stored spoil.

(10) Supervision by a geotechnical engineer or appropriately competent person is required for the construction of the repository area.

8 EXCAVATIONS IN PEAT AND SPOIL

The works require that most of the turbine bases are to be founded on competent founding strata which will require excavation through peat and spoil. Some turbine bases may require a piled solution following confirmatory ground investigations by the Contractor.

Similarly, crane hardstandings, temporary construction compounds and substation platforms and the met mast foundations are to be founded on competent mineral soil and/or rock which will also require excavation through peat and spoil.

Excavations for the borrow pit and perimeter buttresses for the repository areas will also require the removal of peat and spoil overlying the rock.

8.1 Methodology

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, which are covered in Chapter 4 and 9 of the EIAR.

(1) With respect to placement of arisings from excavation the guidelines given in Section 7 are to be followed.

(2) All excavations within peat are to be adequately supported or peat slopes are to be battered to a safe slope inclination of 1 (v): 3 (h).

(3) Excavations shall be kept reasonably free from water at all times. Water should be prevented from being impounded within excavations by either using drainage channels cut into the excavation face or by pumping.

(4) Where water is channelled or pumped from an excavation then this water is to be fed into an appropriately located outfall following suitable treatment, as noted in Section 4 and 9 of the EIAR.

9 EXCAVATIONS FOR UNDERGROUND CABLES

It is proposed to construct a 38kV substation within the site and to connect from here to the existing Garvagh substation, located approximately 730m east of the site. Connection will be via underground cabling located within existing forestry roads. The cabling route measures approximately 6.1km in total.

The proposed grid connection construction methodology, including proposals for water crossings on the underground cabling routes is described in Chapter 4 of the EIAR.

The cable trench route will encounter peat. It is proposed to excavate the trenches for the underground cable at a uniform depth in peat or non-peat overburden material. The trenches will be approximately 900mm wide and 1220mm deep.

9.1 Methodology

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, which are discussed in Chapter 4 and 9 of the EIAR.

(1) With respect to placement of arisings from excavations the guidelines given in Section 7 are to be followed.

(2) It is proposed to excavate the trenches for the underground cable at a uniform depth in peat or other overburden material.

(3) All excavations within peat for the cable trench are to be adequately supported or peat slopes are to be battered to a safe slope inclination typically of 1 (v): 3 (h). Where areas of weaker peat are encountered then slacker slopes will be required.

(4) Similarly, all excavations within non-peat overburden for the cable trench are to be adequately supported or battered to a safe slope inclination typically of 1 (v): 1.5 or 2 (h).

(5) Excavations shall be kept reasonably free from water at all times.

(6) Any material excavated from the cable trench which is deemed suitable for reinstatement of the trench will be used for this purpose i.e. stockpiled locally to the works and reused for backfilling.

(7) Any material not deemed suitable for the reinstatement of the cable trench will be transported to the borrow pit or peat repository.

10 GENERAL RECOMMENDATIONS FOR GOOD CONSTRUCTION PRACTICE ON SITE

To minimise the risk of construction activity causing potential peat instability the Construction Method Statements (CMS's) for the project will also take into account, but not be limited, to the general recommendations below together with the specific recommendations above.

(1) Avoidance of uncontrolled concentrated water discharge onto peat slopes identified as being unsuitable for such discharge. All water discharged from excavations during work shall be piped over areas specifically assessed as being unsuitable and hence directed into suitable drainage lines. See Chapter 4 and 9 of the EIAR.

(2) Avoidance of unstable excavations. All excavation shall be suitably supported to prevent collapse and development of tension cracks.

(3) Avoidance of placing fill and excavations in the vicinity of steeper peat slopes, that is at the crest or toe of the slope.

(4) Installation and regular monitoring of geotechnical instrumentation, as appropriate, during construction in areas of possible poor ground, such as deeper peat deposits (see Section 11).

(5) Site reporting procedures to ensure that working practices are suitable for the encountered ground conditions. Ground conditions to be confirmed by suitably experienced geotechnical engineer.

(6) Regular briefing of all site staff (e.g. toolbox talks) to provide feedback on construction and ground performance and to promote reporting of any observed change in ground conditions.

(7) Routine inspection of wind farm site by Contractor and Project Geotechnical Engineer to include an assessment of ground stability conditions (e.g. cracking, excessive floating road settlement, disrupted surface, closed-up drains) and drainage conditions (e.g. blocked drains, absence of water in previously flowing drains, springs, etc.).

11 INSTRUMENTATION

11.1 Movement Monitoring Posts

To monitor possible peat movements, it is proposed to install sighting posts upslope and downslope of the access roads at staggered intervals at locations where the peat depth is greater than 2m for excavated access roads and 3m for floated access roads. Additional monitoring locations will be required at infrastructure locations with deeper peat deposits. Details of sighting posts are given below.

(1) A line of sighting posts shall comprise:

(a) A line of wooden stakes (typically 1 to 1.5m long) placed vertically into the peat to form a straight line.

(b) The sighting line shall comprise 6 nos. posts at 5m centres that is a line some 25m long.

(c) A string line shall be attached to the first and last posts and all intervening posts shall be adjusted so they are just touching the string line.

(2) Lines of sighting posts shall be placed across the existing slope about 5m away from the area to be worked. The posts shall be located along the road at 10m intervals in areas of deep peat (greater than 2m). Where there are relatively steeper slopes or softer ground a sighting line shall be placed down the slope, or at any location where monitoring would be deemed useful.

(3) Each line of sighting posts shall be uniquely referenced with each post in the line given a reference. The post reference shall be marked on each post (e.g. reference 1-1, 1-2, 1-3, 1-4, 1-5, and 1-6 for posts in line 1).

(4) The sighting lines shall be monitored at the beginning of each working day, and during the day where considered appropriate (e.g. when working activity is concentrated at a specific location).

(5) Monitoring of the posts shall comprise sighting along the line and recording any relative movement of posts from the string line.

(6) Where increased movements are recorded the frequency of monitoring shall be increased.

(7) A monitoring record shall be kept of the date, time and relative movement of each post, if any. This record shall be updated and stored as a spreadsheet.

12 CONTINGENCY MEASURES

12.1 Excessive Movement

Where there is excessive 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 activities (if any) 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 activities shall only start following a cessation of movement and agreement with all parties (Resident Engineer, Contractor and Client).

12.2 Onset of Peat Slide

In the unlikely event 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 activities (if any) in the area should cease and all available resources will be diverted to assist in the required mitigation procedures.

(2) 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 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.

12.3 Check Barrage

Whilst it is not anticipated from the analysis undertaken that a peat slide will occur on site, as a contingency a check barrage procedure is included below.

The check barrage procedure deals with preventing a peat slide from moving downstream within a watercourse.

The most effective method of preventing excessive peat slide debris from travelling downstream in a watercourse is the use of a check barrage. A check barrage comprises the placement of rock fill across a watercourse. The check barrage is a highly permeable construction that will allow the passage of water but will prevent peat debris from passing through. Rock fill should comprise well-graded coarse rock pieces from about 300mm up to typically 1000mm.

The rock fill for the check barrage could be sourced from the borrow pit on site, preferably the closest borrow pit, or where rock level is close to/at the ground surface.

The size of the barrage will vary depending on the scale of the peat debris to be contained and the geometry of the watercourse at the barrage location. In general, due to the low speed of a peat slide there is generally little impact force and most of the lateral load is due to fluid pressure on the upslope face of the barrage.

Typically, the check barrage should fill the entire channel width of the watercourse up to a height of 3 to 4m with a crest width of typically 2m and side slopes of about 45 degrees depending on the geometry of the barrage location.

The check barrage procedure is as follows:

(1) Access to the check barrage location shall be along the existing access roads on the wind farm site and/or along public roads, where possible. When it is necessary to form the barrage then rock fill will be placed across the watercourse to effectively block the passage of peat debris.

(2) Operatives employed to carry out the construction of the check barrage would need to be inducted by means of a briefing by on-site supervisors as to the proposed location of the check barrage.

(3) The check barrage provides containment for peat debris in the unlikely event of a major peat slide. Further remedial measures, should they be required, will be assessed by the Contractor and the Project Geotechnical Engineer and carried out as soon as physically possible when the location and extent of the failure is established.

(4) Where a barrage was constructed as a precaution and no peat debris reached the watercourse then the barrage should be removed as soon as any measures to prevent further peat sliding is agreed with all parties.

13 CUT AND FILL EARTHWORKS ASSESSMENT

FT carried out an assessment for the site which quantifies the total volume of cut and fill earthworks required for the construction of the wind farm. The cut and fill assessment is graphically presented in Figure 13-1.

The outputs from the cut and fill earthworks assessment includes the following:

- Plan drawings of the entire site showing an outline of cut & fill earthworks at all infrastructure elements (Figure 13-1)
- Cut and fill earthwork volumes (see Table 13-1 of this report)

A summary of the basis for the cut and fill earthworks assessment are included in Appendix B of this report.

A summary of the cut and fill earthwork volumes is given in Table 13-1.

13.1 Commentary on Earthwork Volumes

This section of the report should be read in conjunction with Sections 7.2 and 7.3 of the report which summarise the peat and spoil volumes for site and the placement/reinstatement areas on site.

In summary:

1) The total net earthwork volume (cut minus fill) which includes peat, non-peat superficial deposits and rock for the scheme is estimated at 762,585m^3 (Cut). Fill requirements for the scheme are relatively minor, see Table 13-1.

2) The total net earthwork volume (cut minus fill) excluding peat (i.e. non-peat overburden and rock) for the scheme is estimated at 552,650m^3 (Cut).

3) The estimated quantity of available rock within the borrow pit is 372,600m^3, based on the information gathered from site investigations.

4) The total volume of non-peat superficial deposits only requiring placement/reinstatement on site is estimated at 196,860m^3. This material will be excavated and placed/reinstated to one of the 2 no. repository areas or the borrow pit.

5) No bulking or contingency factors have been applied to the excavation volumes presented in Table 13-1.

Table 13-1: Summary of Cut and Fill Earthwork Volumes

Infrastructure Element	Description	Total Earthwork Volume [1] - Peat & non-peat overburden (spoil) & rock			Earthwork Volume [2] - Estimated non-peat material only (non-peat overburden and rock)			Earthwork Volume [3] - Estimated rock volume only	Comment
		Cut (m^3)	Fill (m^3)	Net Volume (m^3) = Cut - Fill	Cut (m^3) [2]	Fill (m^3)	Net Volume (m^3) = Cut - Fill	Cut (m^3)	
10 no. Turbines and Hardstands	23.2m diameter excavation footprint for turbine foundation with 55 x 35m hardstand area	114,580	20	114,560 (Cut)	48,655	20	48,635 (Cut)	-	Hardstanding area and turbine foundation footprint
Access Roads	5m running surface with 6m wide development footprint	197,050	16,810	180,240 (Cut)	93,550	16,810	76,740 (Cut)	-	Excludes proposed and existing floating sections of access road where no excavation of peat will take place (see Figure 2-1).
Various Infrastructure Locations	Includes substation, 2 no. temporary construction compounds and met mast	28,395	610	27,785 (Cut)	17,705	610	17,095 (Cut)	-	-
Borrow Pit	Borrow pit footprint of 24,700m^2	422,000	-	422,000 (Cut)	407,180	-	407,180 (Cut)	372,600 (Cut)	Potential rock volume from the borrow pit is 372,600m^3.
Repository Areas	Repository Area 1 and 2	18,000	-	18,000 (Cut)	3,000	-	3,000 (Cut)	-	
	Total =	**-**	-	**762,585 m^3 (Cut)**	**-**	-	**552,650 m^3 (Cut)**	**372,600 m^3 (Cut)**	

Notes

Note (1) The total earthwork volumes includes peat, non-peat superficial deposits and rock from the borrow pit.
Note (2) The earthwork volumes quoted for the non-peat material were calculated based on the total earthwork volume (peat and non-peat material) minus the peat volumes calculated and presented in Table 7-1 within Section 7.2 of this report.
Note (3) The in-situ rock volume from the borrow pit was estimated based on the available ground investigation to define rockhead level.
Note (4) It should be noted that the earthwork volumes given in Table 13-1 are subject to confirmatory design.
Note (5) No bulking or contingency factors have been applied to the earthwork excavation volumes presented above.

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Existing Forestry Roads
Visitor Carpark
Temporary Construction Compound 1
Substation Location
Site Boundary
Repository Area 2
T01
T02
T03
T04
T05
T06
T07
T08
T09
T10
Proposed Turbine Location
Proposed Walkway
Temporary Construction Compound 2
New Proposed Access Track
Proposed Met Mast
Proposed Boardwalk
Borrow Pit
Existing Access Track
Repository Area 1
Site Boundary

Cut / Fill Legend:

Areas of Cut

Areas of Fill

0m 120m 240m 360m 480m 600m 720m 840m 960m 1080m 1200m

Scale 1:24000

Scale 1:24000

Applicable : Ordnance Survey Ireland Licence No. EN 0001217 © Ordnance Survey Ireland and Government of Ireland

Scale (@ A3)
1:24000

Date - 03.07.20

FIGURE - 13-1 : PLAN DRAWING OF CUT FILL EARTHWORKS FOR SITE

Drawn - POR
Checked - IH
Rev - F

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Friday 3 July 2020

Appendix A

Photos from Site Walkover











Photo 1 Example of an existing excavated access track on site



Photo 2 Example of an existing floating access track on site

Appendix B

Basis for Cut and Fill Earthworks Assessment



Basis for Cut and Fill Earthwork Assessment

Main Infrastructure Locations

Appendix B provides a summary of the main assumptions for the cut and fill earthworks assessment.

Table B1 provides a summary of the dig depths adopted for the cut and fill assessment for the main infrastructure elements at Croagh wind farm.

The assumed excavation footprint for the turbine foundation is the turbine base diameter of 19m plus 2m working room all around the base i.e. 23m.

Table B1: Summary of the dig depths at the main infrastructure locations

Turbine	Easting	Northing	Average Peat Depth for Turbines (m)	Dig depth for Turbine Foundation (m) (1)	Average Peat Depth for Crane Hardstands (m)	Max Dig depth for Associated Crane Hardstand (m) (2)
T1	583322	823639	2.0	3.0	2.1	2.4
T2	583831	824112	2.4	3.4	2.4	2.7
T3	583648	823314	2.2	3.2	1.2	1.5
T4	584223	823820	0.8	3.0	0.8	1.1
T5	584259	823347	0.8	3.0	1.1	1.4
T6	584841	823616	2.0	3.0	3.3	3.6
T7	584968	823032	2.4	3.4	3.0	3.3
T8	585523	822935	3.5	4.5	4.7	5.0
T9	586144	822595	3.2	4.2	3.9	4.2
T10	584676	822493	0.9	3.0	1.6	1.9
Infrastructure Element	**Easting**	**Northing**	**Average Peat Depth (m)**	**Max Dig depth for Infrastructure Element (m) (3) & (4)**		
Substation	584584	823867	1.2	1.5		
Temporary Construction Compound 1	584170	823980	1.2	1.5		
Temporary Construction Compound 2	585150	823232	1.6	1.9		
Met Mast	548059	823136	1.2	2.2		
Borrow Pit	585697	822449	0.5	Varies		

Notes

(1) Based on ground investigation information, founding depths for the turbines were assumed to be the average peat depth + 1m to a competent stratum. A minimum dig depth of 3m is assumed for each turbine foundation. For the

purpose of this assessment it is assumed that all turbine foundations will be gravity type founded bases i.e. no piled foundations. If piled foundations are required, then the calculated excavation volumes will be reduced.

(2) Founding depths for the crane hardstands were assessed to be the average peat depth + 0.3m to a competent stratum.

(3) For the temporary construction compounds and substation, the founding depth was assessed to be the average peat depth +0.3m to a competent stratum.

(4) For the met mast the founding depth was assumed to be the average peat depth +1.0m to a competent stratum.

(5) Note the maximum dig depths stated in Table B1 form the basis of this assessment and are subject to confirmation at detailed design stage following a ground investigation.

(6) It is not anticipated that the proposed amenity trails will generate any spoil.

Access Roads

The following basis for the cut and fill assessment is given in relation to the access roads.

- Typical gradient requirements from turbine suppliers were assumed for the cut and fill assessment i.e. maximum gradients of 10 to 12%. A maximum gradient of 12% has been used for straight sections of access road on site.
- For the purpose of the assessment, the average width of the existing access tracks has been taken as 4m.
- There are 4 types of access tracks/roads proposed/present on site, which include:
    - Existing excavated and replace type access tracks - some excavation works as a result of localised widening will be required. It has been assumed that widening will typically take place on both sides of the road as per Figure 3.1. In areas of side long ground/steeper terrain (greater than 5% gradient), widening of existing tracks will take place on the upslope side of the road as per Figure 3.1. Estimated dig depth to competent strata for both cases is 0.3m below the base of the peat.

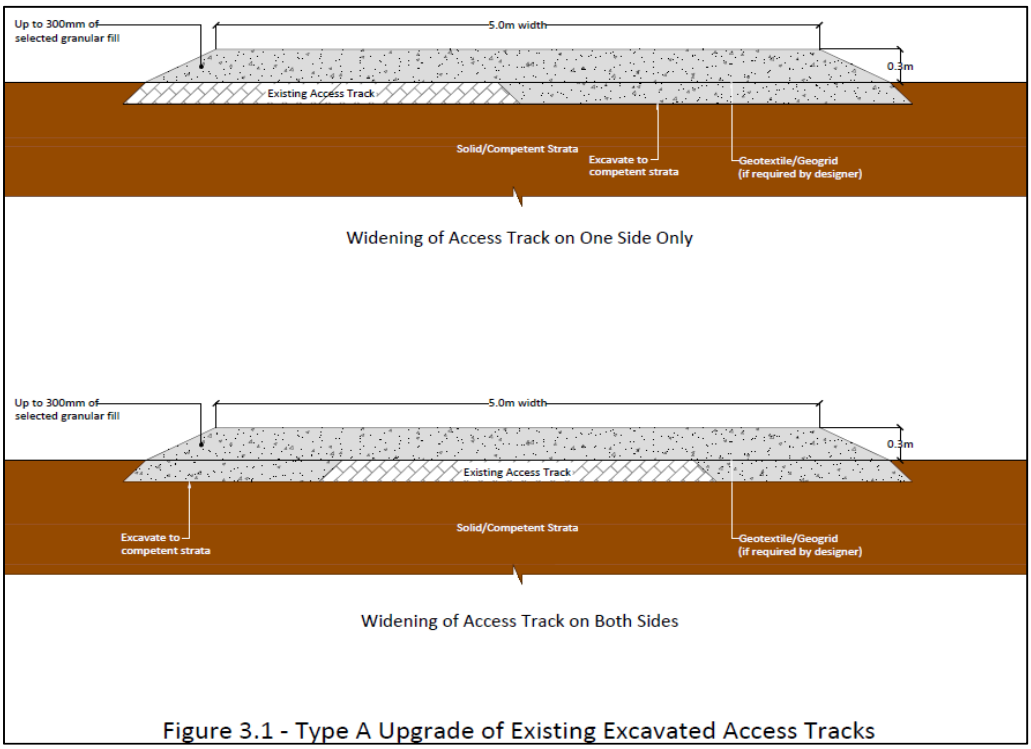


Figure 3.1 - Type A Upgrade of Existing Excavated Access Tracks

    - Existing floating type access tracks – minimal/no excavation will be required
    - New proposed floating access roads - no excavation will be required

- New proposed excavate and replace type access roads – excavation work will be required. Estimated dig depth to competent strata was 0.3m below the base of the peat

Borrow Pit

The cut and fill assessment for the borrow pit is based on the cross-section drawing (Figures 7-1) included in this report. The borrow pit was sized to allow for the reinstatement of some of the excavated peat and spoil volume generated on site and to accommodate the estimated site-won stone fill requirements.

General Assumptions

No spoil is anticipated from the proposed amenity facilities (walkways/trails).

A 1(v): 2(h) configuration for all excavation faces was used in the cut and fill earthworks assessment, except for excavations in rock at the borrow pit where a configuration of 1(v): 0.7(h) i.e. 60 degrees was used. These configurations are considered reasonable based on the ground conditions encountered on the site, and in line with best practice guidelines.

Planning and Environmental Consultants

Assessment of Forestry Replacement Lands

Proposed Croagh Wind Farm, Co. Leitrim & Co. Sligo



DOCUMENT DETAILS

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1. INTRODUCTION

This forestry replacement assessment report has been prepared by MKO on behalf of Coillte who intend to apply to both Leitrim County Council and Sligo County Council (the local authorities) for planning permission to construct a wind energy development 'Croagh Wind Farm', which straddles the border between Co. Leitrim and Co. Sligo comprising up to 10 no. wind turbines and associated infrastructure near Drumkeeran, Co. Leitrim.

Construction of the proposed wind farm will require felling of 55.1 hectares of forestry. In line with the Forest Service's published policy on granting felling licenses for wind farm developments, areas permanently cleared of forestry for turbine bases, access roads, and any other wind farm-related uses will have to be replaced by the planting of forestry at an alternative location. The Forest Service policy requires replanting on a hectare for hectare basis.

A total of 55.1 hectares of new forestry will therefore be replaced as a condition of any felling licence that might issue in respect of the proposed wind farm development. Replanting is a requirement of the Forest Service and is primarily a matter for the statutory licensing processes under the Forestry Act 2014 that are under the control of the Minister for Agriculture, Food and the Marine and the Forest Service.

The replacement of forestry can occur anywhere in the State subject to licence. Bare replacement lands are therefore required to be obtained by the applicant and ringfenced for the replacement of forestry felled as part of the construction of wind energy developments. These lands are subject to an application for Technical Approval by the Forest Service. Should technical approval be granted, the lands can be left bare until a felling licence for the wind farm to which they are linked has been acquired. Bare replacement lands can also be planted ahead of a felling licence being acquired for the wind farm as long as they are held specifically for the purpose of replacing forestry felled as part of the wind farm development.

Three potential forestry replacement areas have been identified and are located at Stranamart, Co. Cavan, Brackloon, Co. Roscommon and Ballard, Co. Wicklow. The total replanting area granted Forest Service Technical Approval for afforestation at these three sites is 59.33 hectares, which is more than sufficient to accommodate the wind farm replanting requirement. If these replacement lands become unavailable, other similarly approved replant lands will be identified for replanting should the proposed wind farm be developed.

1.1 Report Structure

This report provides a description of the proposed replacement lands and an assessment of the potential impacts, including cumulative impacts, associated with afforestation at this location. The main sections of this report are presented as follows:

- Section 2: Project Background and Description
- Section 3: Planning Policy and Planning History
- Section 4: Impact Assessment Methodology
- Section 5: Biodiversity
- Section 6: Land, Soils and Geology
- Section 7: Hydrology and Hydrogeology
- Section 8: Landscape
- Section 9: Cultural Heritage
- Section 10: Air, Climate and Noise
- Section 11: Population and Human Health
- Section 12: Material Assets

In this report, these replacement lands are assessed cumulatively with any existing, permitted or proposed developments located in the immediate vicinity of the replacement lands. The replacement lands are assessed cumulatively with the proposed Croagh wind farm development in Chapters 5 to 14 of the Environmental Impact Assessment Report (EIAR).

2. PROJECT BACKGROUND AND DESCRIPTION

2.1 Background

2.1.1 Afforestation Approval

Replanting or off-site afforestation is a requirement of the Forestry Act 2014 and its consent is regulated by the Forestry Regulations 2017 (SI No 191 of 2017). Under the Forestry Regulations 2017, all applications for licences for afforestation require the prior written approval of the Minister for Agriculture, Food and the Marine. Before the Minister can grant approval, he must first determine if the project is likely to have a significant environmental effect. The lands assessed in this document have been granted Technical Approval by the Forest Service for afforestation.

The application for approval for afforestation is known as Pre-Planting Approval – Form 1 and is subject to the following procedures as outlined in S.I. No. 191/2017 - Forestry Regulations 2017:

- The application is referred to the relevant Forest Service Inspector for assessment and recommendations;
- If there are any environmental considerations identified, the application is referred to the relevant external body, e.g. National Parks and Wildlife Services, National Monuments Service, Regional Fisheries Boards, Local Authorities, etc., for consideration;
- If the proposed development is greater than 25 hectares the application is referred to the relevant Local Authority;
- If the site is greater than 2.5 hectares the application is advertised on the Department's website;
- If the site is greater than 50 hectares an Environmental Impact Assessment and planning permission are required (Part 3, Article 5 (2)(c) of S.I. 191/2017)

The Pre-Planting Approval – Form 1 requires a wide range of details in relation to the proposed area to be forested. Notwithstanding the size of the proposed application, the environmental considerations which must be answered/considered for the Forest Service approval are listed in Table 2.1 below. The Pre-Planting Approval – Form 1 notes that, if present, all items listed may require the Department to consult with prescribed bodies, while those in bold type may require the Department to undertake public consultation.

Table 2-1 Environmental Considerations in Afforestation Applications for Approval – Form 1

Environmental Considerations	
1	Water Quality
1.1	Is the area designated potentially acid sensitive by this Department (DAFM)?
1.2	Is the area >5 ha and sensitive for fisheries?
1.3	Is the area non-sensitive for fisheries and >40 ha?

1.4	Is the area >10 ha and within a catchment area of a Local Authority designated water scheme?
2	Designated Habitats
2.1	**Is the area within a NHA, pNHA, SAC, SPA or National Park?**
2.2	If the area is within an NHA, is a completed notifiable Action Form/ Action Requiring Consent Form (consent from National Parks and Wildlife Service) included?
2.3	If the area within a Hen Harrier SPA, will operations occur between the 1st of April and the 15th August inclusive?
2.4	Is the area within a NPWS referral zone for NHA, pNHA, SAC or SPA?
2.5	Is the area within 3 km upstream of a NHA, pNHA, SAC, SPA or National Park?
2.6	Is the area within a Fresh Water Pearl Mussel 6 km zone? If yes, the Forestry and Fresh Water Pearl Mussel Requirements Forms A and B should be included with the Application
2.7	Is the area within a Freshwater Pearl Mussel Catchment?
2.8	Does the area contain a current REPS plan habitat?
3	Archaeology
3.1	**Does the area contain an archaeological site or feature with intensive public usage?**
3.2	Does the area contain or adjoin a listed archaeological site or monument?
4	Landscape
4.1	**Is the area within a prime scenic area in the County Development Plan?**
4.2	Are there any other High Amenity Landscape considerations?
5	Size for Notification to Local Authority
5.1	Is the area greater than 25 ha?
6	Other Environmental Considerations
6.1	Specify

2.1.2 Proposed Replanting Lands

Three potential areas have been identified, and any replanting associated with the Croagh Wind Farm will take place at these lands or similarly Technically Approved lands. The potential sites have been assessed as part of the Afforestation Approval – Form 1 process described above and have obtained Technical Approval for Afforestation from the Forest Service. The list of Technically Approved lands

assessed in this report is presented in Table 2.2. Site location maps and further details on each site are provided in Sections 2.1.2 to 2.1.4 below.

Table 2-2 Proposed Replanting Locations

Location No.	Property Name	Location	Proposed Replanting Area (Hectares)
1	Stranamart	Co. Cavan	12.57ha
2	Brackloon	Co. Roscommon	7.2ha
3	Ballard	Co. Wicklow	39.56ha
Total Area Available			**59.33ha**

2.1.2.1 Forestry Replacement Area 1: Stranamart, Co. Cavan

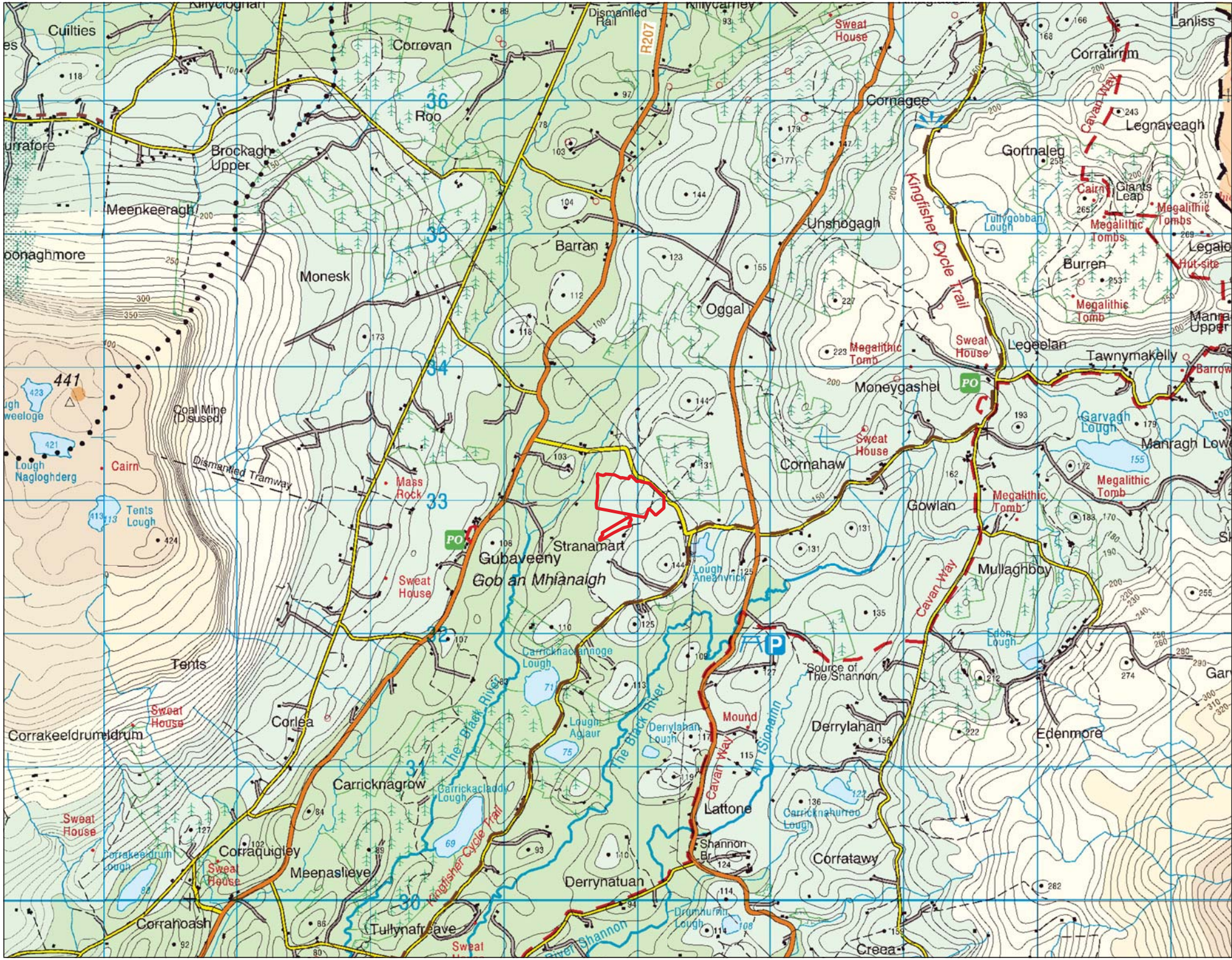
This replacement area is located in the townland of Stranamart, Co. Cavan, approximately 6.3km southwest of the town of Blacklion. This area has already been planted. Prior to afforestation, this replacement area comprised several small fields located within a rural setting The site location and aerial view are presented in Figure 2.1 and 2.2. The site is accessed via an existing track directly off a local road which connects to both the R207 and R206.The Technical Approval area for afforestation at Stranamart measures 12.57 hectares in total. The current land use is commercial forestry. The Cuilcagh - Anierin Uplands SAC/pNHA is located to the east and the Bolebrack Mountain SAC is 2.2km to the west.

2.1.2.2 Forestry Replacement Area 2: Brackloon, Roscommon

This replanting area is in the townland of Brackloon, Shankill, Co. Roscommon. The replanting site is located approximately 3.7km east of the village of Ballinagare and 8km west of the town of Elphin. The site location and aerial view are presented in Figure 2.3 and 2.4. The site will be accessed off local unnamed road which bounds the site to the east. The Technical Approval area for afforestation Brackloon measures 7.2 hectares in total. The current land use is pastoral farming. Existing Coillte forestry can be found immediately to the north and west and further to south and east.

2.1.2.3 Forestry Replacement Area 3: Ballard, Co. Wicklow

This replanting area is in the townland of Ballard in Co. Wicklow, approximately 1.3km west of the village of Ballinaclash and approximately 4km southwest of the Rathdrum town. Avondale Forest is located 3.5km to the east. The site location and aerial view are presented in Figure 2.5 and 2.6. The site is accessed via a track directly off a local unnamed road which runs along the southern boundary. The Technical Approval area for afforestation measures 39.56 hectares in total. Existing Coillte forestry can be found immediately to the south, and to the west and east.


Map Legend
Stranamart Forestry
Replacement Site Location
Stranamart
Gubaveeny
Gob an Mhianaigh
Coal Mine (Disused)
Dismantled Tramway
Mass Rock
Sweat House
Cairn
Tents Lough
Lough Nagloghderg
Meenkeeragh
Brockagh Upper
Monesk
Barran
Oggal
Unshogagh
Cornagee
Corratirrim
Lanliss
Legnaveagh
Gortnaleg
Giants Leap
Megalithic Tombs
Hut-site
Burren
Megalithic Tomb
Legeelan
Tawnymakelly
Moneygashel
Cornahaw
Gowlan
Mullaghboy
Garvagh Lough
Manragh Lower
Manragh Upper
Barrow
Tullygobban Lough
Kingfisher Cycle Trail
Cavan Way
R207
Dismantled Rail
Lough Aneanvrick
Carricknacannoge Lough
Source of The Shannon
Edon Lough
Derrylahan
Edenmore
Mound
Lough Aglaur
Derrylahan Lough
The Black River
Carrickaclaudy Lough
Carricknagrow
Lattone
Carricknahurroo Lough
Shannon Br
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Derrynatuan
Drumhurrin Lough
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Corraquigley
Meenasleive
Corrahoash
Corrakeeldrumeldrum
Corrakeeldrum Lough
Corlea
Tents
Creea
River Shannon
Ordnance Survey Ireland Licence No. AR 0021820© Ordnance Survey Ireland/Government of Ireland
Drawing Title
Site Location: Stranamart
Project Title
180511 - Croagh Wind Farm EIAR
Drawn By
Daire O'Shaughnessy
Checked By
Eoin McCarthy
Project No.
180511
Drawing No.
Fig 2.1
Scale
1:25,000
Date
15.06.20
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Map Legend

Stranamart Forestry Replacement Site Location

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Drawing Title

Site Location: Stranamart

Project Title	180511 - Croagh Wind Farm EIAR
Drawn By: Daire O'Shaughnessy	Checked By: Eoin McCarthy
Project No.: 180511	Drawing No.: Fig 2.2
Scale: 1:5,000	Date: 15.06.20

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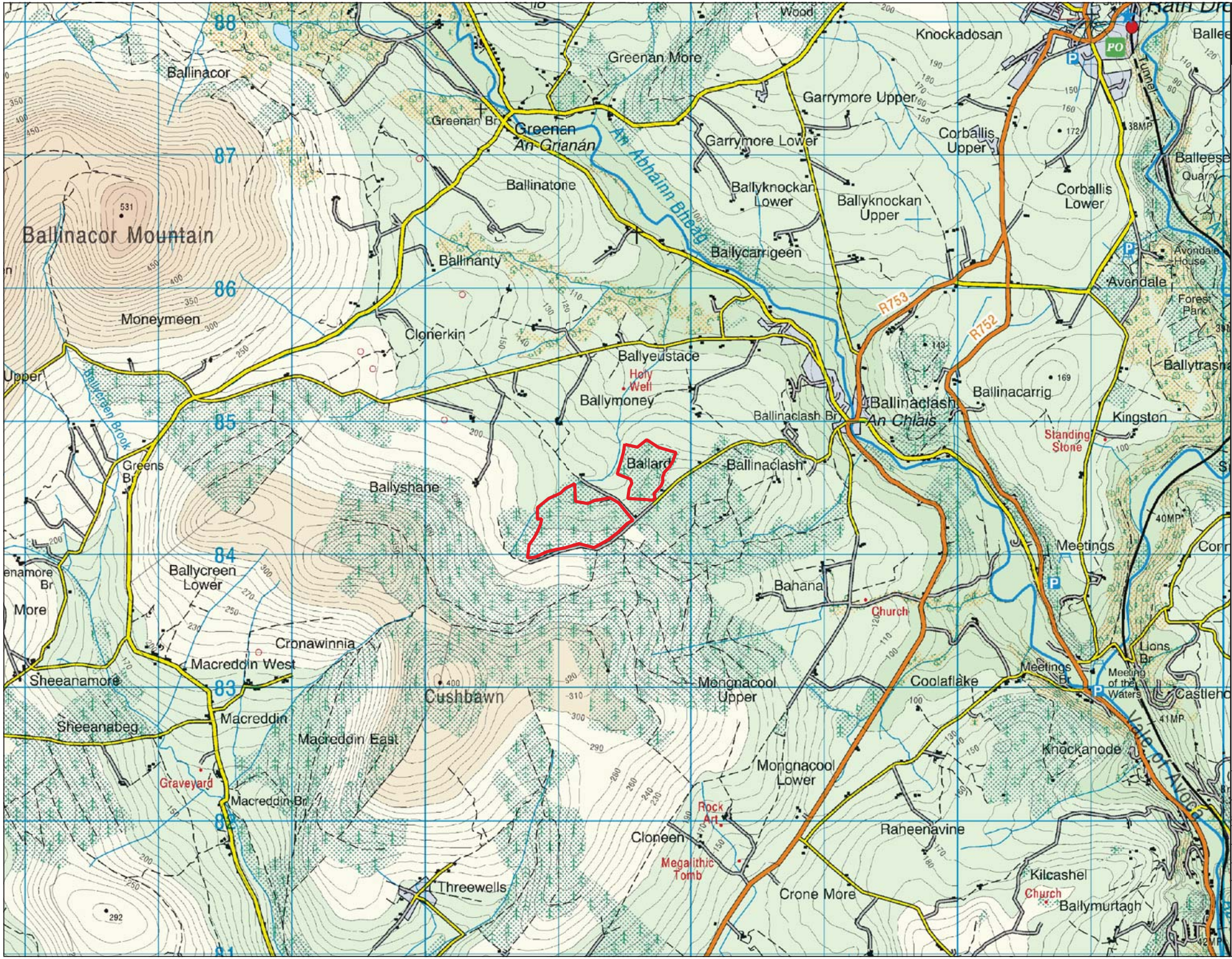
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Map Legend

Ballard Site Boundary

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Drawing Title

Site Boundary: Ballard

Project Title	180511 - Croagh Wind Farm EIAR
Drawn By: Daire O'Shaughnessy	Checked By: Eoin McCarthy
Project No.: 180511	Drawing No.: Fig 2.5
Scale: 1:5,000	Date: 15.06.20

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2.2 Proposed Afforestation Techniques

2.2.1 Forest Service Best Practice

Afforestation and subsequent harvesting will conform to current best practice Forest Service policies, strategic guidance documents as well as Coillte produced guidance documents, including the specific guidelines listed below, to ensure that newly planted trees remain viable and afforestation provides minimal potential impacts to the receiving environment.

- 'Land Types for Afforestation' [2016]
- 'Environmental Requirements for Afforestation' [2016]
- 'Forest Operations & Water Protection Guidelines' (2009)
- 'Methodology for Clear Felling Harvesting Operations' (2009)
- 'Forestry and Water Quality Guidelines' (2000)
- 'Forestry and the Landscape Guidelines' (2000)
- 'Forestry and Archaeology Guidelines' (2000)
- 'Forestry Biodiversity Guidelines' (2000)
- 'Forestry Protection Guidelines' (2002)
- 'Forestry Harvesting and Environmental Guidelines' (2000)

Planting will be carried out in accordance with the 'Forestry Schemes Manual' (Forest Service, 2011), which provides guidance in relation to ground cultivation, stocking and spacing, plant handling, planting dates, fertiliser application, fencing, fire, and weed control. Certain specific silvicultural and environmental conditions are also set out in the Forest Service Technical Approvals for each site, which will be adhered.

2.2.1.1 Planting

Planting will be by hand. The main forms of planting, as described in the Forestry Schemes Manual, are set out as follows.

Slit Planting

A spade is used to make a vertical slit in the ground. The trees roots are carefully positioned in the slit to ensure that roots are equally spaced in the vertical slit created. The slit is closed and firmed up ensuring the tree is vertical and upright. It is important to ensure that roots are not bent over which can lead to poor development, e.g. J root. This form of planting can be suitable for ribbons, mounds and ripped ground.

Angle Notch

A spade is used to cut a T or L-shaped slit in the ground. The spade is used to lift the slit and the trees roots placed underneath to ensure good root distribution without causing damage. The slit is closed and firmed up to ensure that stem is left vertical and upright.

Pit Planting

A spade is used to dig a hole and the trees roots placed in the centre. Soil is placed around the tree and firmed in, ensuring that it is upright and straight. This form of planting can be used in sensitive sites where no ground preparation has taken place. It may also be appropriate for steep slopes where other types of preparation may lead to sediment run off. The Technical Approvals for the proposed replanting lands include the species approved for afforestation.

2.2.1.2 Drainage

Drainage and sediment control at each site will conform to Forest Service best practice as detailed in the Forestry and Water Quality Guidelines and the Forests & Water Achieving Objectives under Ireland's River Basin Management Plan 2018-2021 . Appropriate drainage designs will include collector drains, interceptor drains and cut-off drains. A description of each drain type, as per the Forestry Schemes Manual, is set out below. Figure 2.7 presents a schematic diagram of each drain type.

Collector Drains

Collector drains collect water from mound drains, plough furrows, mole drains, etc., and discharge via sediment traps and/or an interceptor drain. Collector drains are excavated to a depth not greater than 10-15 cm below the depth of mound drains. Where collector drains must be extended into erodible material, 'mini' silt traps are placed appropriately by deepening the drains in places.

Interceptor Drains

Interceptor drains are constructed along the edges of aquatic buffer zones, i.e. areas where forest operations are curtailed, and which are managed for environmental protection and enhancement. Interceptor drains collect the discharge from the drainage sub-catchment and allow it to overflow into the buffer zone. In most cases, slope will allow for drainage channels to taper out or be connected to an interceptor drain rather than enter a buffer zone. However, on flat sites, or those with low slopes, it will be necessary to connect drains into the aquatic zone. This may be done only where it will not result in sediment or any pollutants entering the aquatic zone.

Cut off Drains

Cut off drains are constructed immediately up slope of a site and are designed to direct water away from the site.

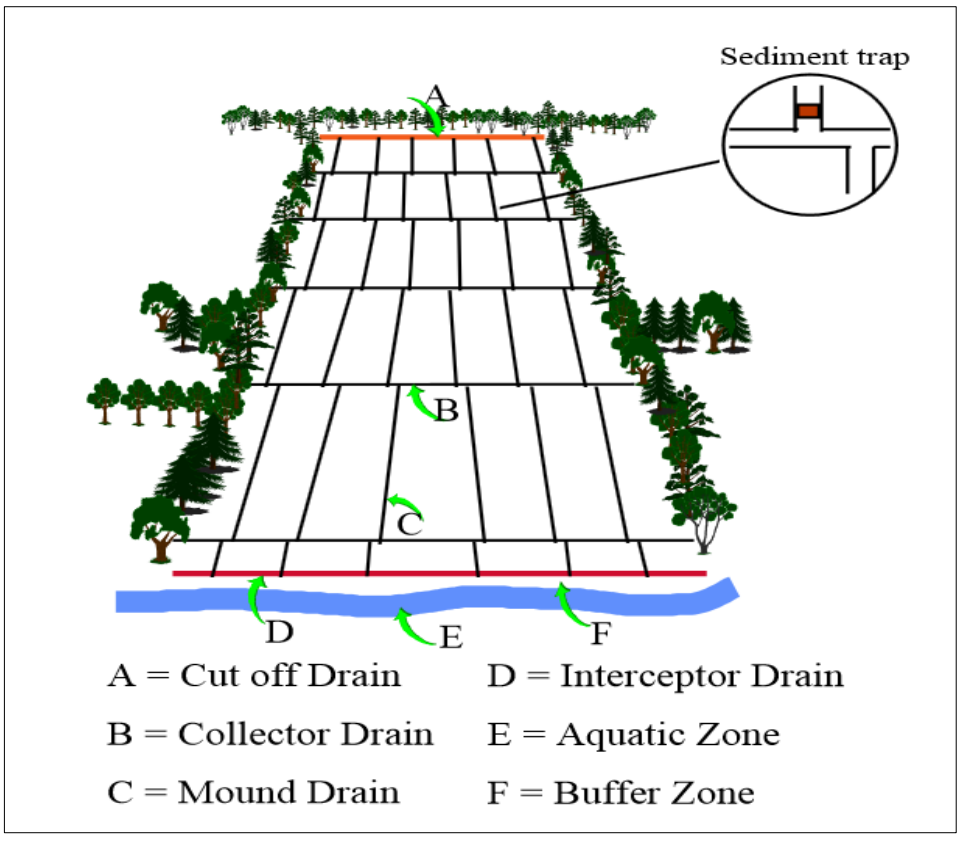


Figure 2-1 Standard Forestry Drainage (Forestry Schemes Manual, Forest Service, 2011)

3. PLANNING POLICY AND PLANNING HISTORY

This section contains relevant National and Local policies regarding forestry. This includes reference to several National forestry policy documents, the National Climate Change Strategy, as well as County Development Plans for Cavan, Roscommon and Wicklow.
This section of the report also addresses the planning history within and in the vicinity of the proposed replanting lands.

3.1 Planning Policy

3.1.1 National Policy

National Policy includes Forest Policy as well as policy on climate change. Forestry policy in Ireland is overseen by the Forest Policy Section of the Department of Agriculture, Food and the Marine (DAFM). At a European and International level, the Forest Policy Section is responsible for the transposition of EU Directives and Regulations into Irish Law as well as representing the Forest Service at a European Level. On a National Level, the policy Section deals with issues relating to climate change, carbon sequestration, wood energy, forestry and the environment, legislative framework and liaison with stakeholders which includes other Government agencies.

National Policy is aimed towards increasing Ireland's forest cover in a sustainable manner. As part of the Department's policy to ensure compatibility between forestry development and the protection of the environment, the Forest Service is implementing Sustainable Forest Management (SFM) with a view to ensuring that all timber produced in Ireland is derived from sustainably managed forests. This work is in accordance with Ireland's commitment to the six pan-European criteria for SFM adopted at the Third Ministerial Conference on the Protection of Forests in Europe, Lisbon, 1998. The implementation of SFM within Ireland is supported by the Irish National Forest Standard, the Code of Best Forest Practice and a suite of environmental guidelines (relating to water quality, landscape, archaeology, biodiversity and harvesting) as well as the work of the Forestry Inspectorate and the ongoing review of Irish forest legislation. These environmental guidelines are referred to in Section 3.1.1.4 below.

3.1.1.1 Forests, Products and People: Ireland's Forest Policy – A Renewed Vision

The Forests, Products and People document, published in 2014 by the Department of Agriculture, Food and the Marine, sets out the strategic goals and recommendations of the Forest Policy Review Group. The Strategic goal is to:

"*Develop an internationally competitive and sustainable forest sector that provides a full range of economic, environmental and social benefits to society and which accords with the Forest Europe definition of sustainable development.*"

The report notes the increasing economic, environmental and social role of forestry in Ireland, stating that forestry accounts for 10.8% of the land area of the country, which is low in comparison with other European countries. The strong forest growth rates found in Ireland when compared to other European countries is also noted. The role of forestry in rural development and diversification as well as rural employment is also recognised.

The document notes also the contribution of forests to mitigation of climate change through carbon sequestration which is referred to in the National Climate Change Strategy (see Section 3.1 below) and

notes that Irish forests will sequester approximately 4.8 million tonnes of C02 in 2020. This document's afforestation policy therefore supports Ireland's efforts to reach the greenhouse gas emission reduction targets as well as reducing dependence on fossil fuels.

The role of the forest resource in contributing to the renewable energy policy goals such as achieving a percentage of power generation by co-firing with biomass, as well as biomass in power generation is also noted. The report notes that the contribution of forestry to achieving renewable energy targets is dependent on the scale and accessibility of the resource, and that a continuation of afforestation in order to maintain a sustainable level supply of small roundwood would result in confidence for investment in Combined Heat and Power and other wood energy mechanisms.

Some recommended relevant policies and actions include:

- Expansion of the Forest Resource: To increase the forest area in accordance with sustainable forest management (SFM) principles, in order to support a long term sustainable roundwood supply of 7 to 8 million cubic metres per annum. This policy aims to increase afforestation to 15,000 hectares.
- Management of the Resource: To ensure that the sustainable management of the forest resource in accordance with best practice thereby ensuring its capacity to provide the full range of timber and other benefits.
- Environment and Public Goods: To ensure that afforestation, management of existing forests and development of the forest sector are undertaken in a manner that enhances their contribution to the environment and the capacity to provide public goods and services.

3.1.1.2 Forestry Programme 2014-2020

The Forestry Programme was submitted by the Department of Agriculture, Food and the Marine in accordance with EU Guidelines on State aid for agriculture and forestry in rural areas 2014-2020 and represents Ireland's proposals for 100% State aid funding for a new forestry programme 2014-2020. These measures are consistent with the document 'Forests, products and people; Ireland's forest policy – a renewed vision' as referred to in Section 3.1.1 above.

This document contains several responses to the actions and policies identified in the above document, and these include an Afforestation scheme - this is the main response to the policy entitled '*Expansion of the forest resource'*.

An identification of needs was carried out by the Department of Agriculture, Food and the Marine (DAFM) in relation to forestry, and these needs are as follows:

- *Increase, on a permanent basis, Ireland's forest cover to capture carbon, produce wood and help mitigation;*
- *Increase and sustain the production of forest-based biomass to meet renewable energy targets;*
- *Support forest holders to actively manage their plantations;*
- *Optimise the environmental and social benefits of new and existing forests.*

Several measures are proposed to meet these needs, and the most relevant of these refers to the first measure, which is aimed at increasing Ireland's forest cover (at approximately 10.7% which is well below the EU average of 38%. The aim is to increase forest cover to 18% by the mid-century. The second need, that to increase forest-based biomass in order to meet the stated targets for renewable energy by 2020.

3.1.1.3 Project Ireland 2040- National Planning Framework

Agricultural diversification and alternative landuses are necessary in order to maintain and create jobs in rural Ireland where low quality land presents challenges for sustainable development and economic growth. Afforestation is recognised as an alternative landuse which creates rural employment and drives the national economy. The direct and indirect contribution of the forestry sector to the economy has been calculated at €2.3 billion annually. Afforestation play an important role reaching national CO_2 target emissions "*through carbon sequestration in forests and the provision of renewable fuels and raw materials. Irish forestry is a major carbon sink and afforestation is the most significant mitigation option that is available to Ireland's land use sector".* In order to facilitate this further, the annual target for afforestation by 2020 is 8,290 hectares, an increase in over 2,000 hectares over the past three years.

Table 3-1 Project Ireland 2040 NPF Objectives which relate to forestry

National Policy Objective 23	Facilitate the development of the rural economy through supporting a sustainable and economically efficient agricultural and food sector, together with forestry, fishing and aquaculture, energy and extractive industries, the bio-economy and diversification into alternative on-farm and off-farm activities, while at the same time noting the importance of maintaining and protecting the natural landscape and built heritage which are vital to rural tourism.

3.1.1.4 National Climate Change Strategy 2007-2020

The National Climate Change Strategy notes that forest residues and thinnings are recognised as a major biomass resource alongside dedicated energy crops and farm wastes. It also notes that the Department of Agriculture run several schemes to encourage afforestation (Afforestation Grant Scheme) and early harvesting (Forest Roading Scheme), as well as schemes aimed at encouraging the growth of biomass crops such as miscanthus and willow. Such schemes are complimented by the RETROFIT 3 scheme, which aims to create a demand for the biomass by encouraging the bioenergy industry.

3.1.2 Local Policy

3.1.2.1 Cavan County Development Plan 2014-2020

The Cavan County Development Plan (CDP) sets out the counties plans and objectives regarding strategic landuse and is reviewed every six years. The current adopted plan illustrates the county's vision for continuous, sustainable development for the period 2014 to 2020.

The CDP recognises the National Spatial Strategy (NSS) classification of Cavan as located within the 'Border Region', one of the Eight Regions established for the Republic of Ireland. The 'Border Region' comprises Donegal, Louth, Sligo, Monaghan, Leitrim and Cavan. The NSS further divides the Border Region into three subcategories with Cavan falling under the classification of 'Rural Areas with strong Potential for Diversification'. These areas have the potential for rural diversification based around a possible mix of activities including forestry. The Cavan CDP considers enterprises such as forestry a means to provide employment and maintain populations in rural areas.

The CDP supports the diversification and sustainable development of appropriate lands to forestry subject to appropriate location selection in order to prevent potential impacts on the environment, landscape, visual amenity etc., all of which can be minimised through careful planning. The CDP is careful to point out that new access points for, and additional traffic generated by, afforestation developments should be avoided in order to prevent potential impacts on National Roads with over 60kmh speed limits.

Policies and objectives related to forestry and rural enterprise can be found in Table 3.2.

Table 3-2 Policies and Objectives of the Cavan CDP which relate to forestry

EDP5	Encourages the sustainable development of rural enterprises within the County.
EDP11	To encourage the development of a well-managed sustainable forestry sector, which is planted, managed and harvested in accordance with the 'Forest Service Guidelines for Landscape, Forest Harvesting and Environmental, Archaeology, Biodiversity and Water Quality.'
EDP12	To encourage forestry and forestry related development, as a means of diversifying from traditional farming activity.
EDP13	To promote forestry development of appropriate scale and character whilst ensuring that the development does not have a negative visual impact on the countryside or cause pollution or degradation to wildlife habitats, natural waters or areas of ecological importance.
EDP14	To encourage the provision of public access to forests for walking routes, recreational areas and other similar facilities.
EDP15	To retain existing right of way through forest lands.
ED013	To promote the growth of rural enterprises whilst ensuring the protection of the environment and our natural assets. Individual projects shall be accessed on a case by case basis in line with best practice and in compliance with all sections of this plan.
ED014	To promote the diversification of the rural economy and the growth of rural indigenous industry, such as farming, forestry and tourism, while safeguarding the environment and the role of the rural area as an asset.
EDO27	To promote and support the Forest Service in the preparation and adoption of the 'Indicative Forestry Strategy for County Cavan,' in order to plan sustainable forestry development.
EDO28	To investigate, with Coillte, the potential to provide forest and countryside walks on lands in state ownership in County Cavan and in the promotion of a high level of environmental quality/protection.
EDO29	To promote the planting of native deciduous trees and mixed forestry.
EDO30	To resist forestry proposals which would unduly impact on protected views, sensitive upland areas, lands of wildlife interest and in the upper reaches of salmonid rivers which would affect biodiversity.
EDO31	That existing Rights of Way and established walking routes are identified prior to any new planting and are maintained as Rights of Way/Walking Route.
EDO32	To ensure forestry and forestry type development adheres to the 'Forestry and Water Quality Guidelines,' issued by the Forest Service, DAFF.

3.1.2.2 Roscommon County Development Plan 2014-2020

The Roscommon CDP states that the council acts as a consultee rather than an assessor in relation to forestry development and adhere to the 'Code of Best Forestry Practice – Ireland (2000)'. The council recognise the benefits of forestry as a method of: boosting the rural economy, encouraging population growth and agricultural diversity, and assisting in Irelands goal of reaching CO_2 target emissions. It is also recognised as a recreational use and therefore the council encourages forestry development. However, any such afforestation proposals must be appropriate in scale and nature with the surrounding environment to the location, comply with the following:

- *"landscapes of scenic value are not unduly eroded.*
- *areas with environmental and archaeological protections are safeguarded.*
- *access from forestry development onto public roads for the purposes of thinning and felling do not compromise traffic safety"*

Roscommon County Council (RCC) requests a mixture of broadleaf and conifer species to be planted where possible in order to support flora and fauna species and to encourage rich biodiversity in the forestry landscape. A planting free zone of 30m along public roads should be observed. Reference should be made to the document Code of Best Forestry Practice – Ireland (2000), published by the Forest Service, Department of the Marine and Natural Resources.

Policies and objectives in the Roscommon CDP which relate to forestry can be found in Table 3-3 below.

Table 3-3 Policies and objectives in Roscommon CDP which relate to forestry

Policy 188	RCC shall facilitate forestation in suitable locations in co-operation with the Forest Service and Coillte Teoranta and in accordance with sustainable Forest Management guidelines including; • Forestry and Landscape Guidelines in order to enhance the overall landscape, involving shape, scale, diversity, visual force and unity • Forestry and Water Quality Guidelines including recommendations in relation to sensitive water catchments, cultivation, drainage, fertilizing and storage, the use of chemicals, herbicides and fuels, road making, bridges and culverts and harvesting Forestry and Archaeology Guidelines designed to ensure that Ireland's rich heritage of archaeological sites and artifacts are not damaged by forest operations • Forest Biodiversity Guidelines to recognize the importance of the maintenance and enhancement of forest biodiversity and implement the objectives in a forestry context of the National Biodiversity Plan such as structural diversity, retained habitats and open spaces, the retention of deadwood, the control of troublesome species and the use of conservation of native species • Forest Harvesting and Environmental Guidelines to ensure that all forest harvesting operations, including felling, extraction, road and site restoration, are environmentally sustainable
Policy 189	Facilitate forestation in appropriate locations, in co-operation with Coillte Teoranta and the Forest Service and in line with National policy and the Roscommon LCA (S 3.6 of the LCA Report 2007), while ensuring the no pollution or injury is caused to natural waters, wildlife habitats or conservation areas
Policy 190	Discourage forestry development in proposed/candidate/adopted SAC's, NHA'S and SPA's, in designated Sensitive Rural Landscapes and in water quality

	sensitive areas
Policy 191	Promote appropriate forestry related industries and rural tourism.
Policy 192	Prevent excessive forestation that would negatively impact on rural communities i.e. forestry development should be appropriate to the surrounding area in terms of nature and scale and should not allow that residential development becomes isolated when plantations mature
Policy 193	Promote mixed species forestry and selective rather than clear felling
Policy 194	The Council will co-operate with Coillte Teoranta, the Forest Service and private landowners in promoting greater public access and recreational use of Forests in the County
Policy 195	Have regard to the Bio-energy Action Plan for Ireland 2007, to the Department of Agriculture and Food Best Practice Manuals and to the LCA when considering significant planting of bio energy crops
Policy 196	RCC shall support the development of the bio energy industry over the Plan period.

3.1.2.3 Wicklow County Development Plan 2016-2022

The Wicklow County Development Plan (CDP) outlines the economic, social, cultural, and environmental aims and objectives of the council to ensure proper planning and sustainable development until 2022 and beyond. Please see Table 3.4 for details.

3.1.2.3.1 *Wicklow Indicative Forestry Strategy 2002*

County Wicklow has a long history of forest management establishing Irelands first forestry training centre in Avondale in 1905. Since then, a strong tradition of forest management has sustained throughout the county. Wicklow County Council developed the 'Wicklow Indicative Forestry Strategy' in 2002 to assist planners in the assessment of afforestation proposals. The Strategy also establishes Areas Preferred to Afforestation and Areas Sensitive to Afforestation.

Table 3-4 Forestry Objectives and Policies of Wicklow County Council.

Strategic Objective	To promote state and private afforestation, to a scale and in a manner, which maximises its contribution to the County's economic and social wellbeing on a sustainable basis and which is compatible with the protection of the environment.
FTY1	To facilitate afforestation in appropriate locations, in accordance with the 'Wicklow Indicative Forestry Strategy' (Wicklow County Council, 2002), and in co-operation with forestry operators and the Forest Service. The Wicklow Indicative Forestry Strategy was produced by the Council in 2002, in consultation with the Forest Service. The strategy is intended to be a tool of assistance to planners in dealing with proposals for forestry applications. The strategy includes a list of areas that are preferred for afforestation and a list of areas where afforestation would be inappropriate by virtue of landscape, soil type, settlement or environmental grounds. The strategy also includes a series of objectives which are intended to guide planning decisions. The Council will have particular regard

	to developments that are 13 Farm shops refer to premises primarily for the sale of produce originating from the farm holding or the local area. Chapter 5 | Economic Development Wicklow County Development Plan 2016-2022 located in the areas included in 'Table 3: Areas Sensitive to Afforestation', and as per the Strategy, should be consulted on all forestry grant applications in these areas
FTY2	To promote afforestation in co-operation with relevant agencies, including the Forest Service (Department of Agriculture, Food and the Marine) and forestry operators and to ensure that afforestation is undertaken in a manner that is consistent with the principle of 'sustainable forest management'. The Council will only permit development that complies with the following: › The development is compatible with the protection of the environment, and does not cause pollution or degradation of wildlife habitats, natural waters or areas of ecological importance; › the development does not have a negative visual impact on the scenic quality of the countryside, and is of an appropriate nature and scale to the surrounding area; › the development is not detrimental to archaeological or other historic/heritage features; and, › the Council will permit forestry development where it is considered that the roads infrastructure (in terms of design, width, surfacing etc.), which is to serve the development, can accommodate the proposed development. No development will be permitted that will result in damage to roads infrastructure or undue nuisance to other road users. The Council may apply a special financial levy to certain developments for works that are required to be undertaken to the road network.
FTY3	To promote the use of forests for appropriate recreation purposes and to facilitate the development of appropriate recreation facilities at suitable locations. The recreational use of forests will only be permitted where it can be demonstrated that the recreational use is compatible with the other forest objectives, functions and values of the forest, such as timber production, sensitive habitats and important archaeology. Developments will only be permitted that are acceptable in terms of other planning considerations, including the provision of acceptable infrastructure such as roads, car parking, water and sewerage infrastructure.
FTY4	To promote County Wicklow as a 'centre of excellence' in the forestry research and management field. The Council will facilitate the development of forestry research / interpretative centres, at appropriate locations.
FTY5	To promote the use of native hardwood species using seed of native provenance where possible in afforestation schemes. The use of native species or a broadleaf / conifer mixture and age class diversity can enhance the visual impact and biodiversity of forests.
FTY6	To encourage the development of farm forestry as a means of promoting rural diversity and strengthening the rural economy.
FTY7	To encourage the development of forestry for timber biomass which can be used as a renewable energy source.

3.1.3 Forest Service Guidelines

The Environmental Requirements for Afforestation, released in December 2016, incorporate more recent developments in relation to environmental regulation, research and changes in forest practices, and consolidate into one single coherent document those measures and safeguards relating to afforestation which were previously contained within the following Forest Service Environmental 'Guidelines': Forestry & Water Quality Guidelines, Forestry & Archaeology Guidelines, Forestry & the Landscape Guidelines and Forest Biodiversity Guidelines. The use of the word 'requirements' in the title was selected over 'guidelines', in order to underline the mandatory nature of the measures therein.

The overall aim of the Environmental Requirements for Afforestation is to ensure that the establishment of forests is carried out in a way that is compatible with the protection and enhancement of the environment, regarding water quality, biodiversity, archaeology, landscape and other environmental receptors. In relation to water, the focus is on reducing and eliminating sources of pollution and preventing the creation of pathways to receiving waters. The Requirements provide an enhanced 'baseline' level of protection regarding afforestation and water, with the water setback representing an important feature. They will also support the Plan for Forestry & Freshwater Pearl Mussel in Ireland, by providing an enhanced baseline level of protection regarding afforestation and water.

The Environmental Requirements for Afforestation are set out in three stages that reflect the project development process, i.e. pre-application design, site works, and ongoing site management. While some overlap exists, these three stages reflect the typical sequence of activities undertaken by an Applicant and her / his Registered Forester, and the corresponding sequence of mandatory environmental measures that apply, throughout afforestation up until the end of the premium period (or 15 years, for non-grant aided forests).

3.1.4 Planning History

A planning history search was carried out for the proposed replanting lands and the lands in their immediate vicinity. This entailed reference to the Planning Application search facility and maps on the website of each relevant Planning Authority, i.e. Cavan County Council, Roscommon County Council and Wicklow County Council. The planning history searches found that planning applications in the vicinity of the proposed replanting lands comprise one-off houses or agricultural buildings. No projects or plans of similar scale and type within proximity to the replanting site were identified that would be incompatible with the proposed replanting or give rise to significant cumulative impacts.

4. IMPACT ASSESSMENT METHODOLOGY

The impacts associated with afforestation at the potential replanting land are assessed in Sections 5 to 12 of this document under the following key environmental headings:

- Biodiversity
- Land, Soils and Geology
- Hydrology and Hydrogeology
- Landscape
- Cultural Heritage
- Air, Climate and Noise
- Population & Human Health
- Material Assets

Each site is addressed separately under the key environmental headings, and described in terms of Baseline Environment, Impact Assessment, Proposed Mitigation Measures and Residual Impacts. The findings of the assessment are presented in Sections 5 to 12 of this report.

Impacts are described in terms of quality, significance, duration and type, where possible. The classification of impacts in this report uses the standard best-practice terms provided in the Environmental Protection Agency document, "Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports' in August 2017 (an update for the 'Guidelines on the Information to be contained in Environmental Impact Statements' (2002). Table 1.1 (page 1-6) of this EIAR presents a copy of the EPA glossary of terms.

Appropriate mitigation measures are presented where relevant to reduce, remedy or eliminate potential impacts. Residual impacts are also presented following any impact for which mitigation measures are prescribed.

5. BIODIVERSITY

This section of the report includes accurate descriptions of the baseline ecological environment of the forestry replacement lands, which is based on an appropriate level of survey work that was carried out in accordance with the most appropriate guidelines and methodologies. The assessment then completes a thorough assessment of the impacts of the proposed afforestation on biodiversity. Where likely ecologically significant effects are identified, measures are prescribed to avoid or minimise or compensate for such effects associated with afforestation, at the following locations:

5.1 Establishing the Zone of Influence

As described in the CIEEM, 2018 *Guidelines for Ecological Impact Assessment in The UK and Ireland*, *'the 'zone of influence' for a project is the area over which ecological features may be affected by biophysical changes as a result of the proposed project and associated activities'*. The zone of influence will vary with different ecological features, depending on their sensitivities to an environmental change. This may extend beyond the project site, for example where there are ecological or hydrological links beyond the site boundaries.

The assessment of the site began with a desk study of available published data on sites designated for nature conservation, other ecologically sensitive sites, habitats and species of interest near the proposed development. A review of OSI mapping, online environmental web-mappers and ortho-photography was also undertaken. The baseline information obtained from the desk study was the first stage in defining a zone of influence of the proposed development.

The zone of likely influence for the proposed development varied depending on the ecological receptors identified on site. In the assessment, effects on habitats and species within the site were considered and also the potential for the proposed development to affect habitats and species outside the site.

5.2 Methodology

5.3 Field Surveys

Ecological site visits were undertaken to the subject sites between 2016 and 2019. Habitats were identified in accordance with the Heritage Council's *'Guide to Habitats in Ireland'* (Fossitt, 2000). 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).

The multi-disciplinary walkover surveys was designed to detect the presence, or likely presence, of a range of protected habitats and species. Incidental sighting/observations of birds and additional fauna were noted during the site visits. Surveys were undertaken in accordance best practice guidance (TII, 2008: *Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes*). During the multi-disciplinary ecological walkover surveys the potential for the study area to support protected mammals listed in the Wildlife Acts, 1976–2019, such as pine marten, red squirrel, Irish hare, pygmy shrew, Irish stoat etc. was assessed.

During the multi-disciplinary walkover surveys, a search for non-native invasive species was undertaken. The survey focused on the identification of invasive species listed under the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 (As Amended) (S.I. 477 of 2015).

Features within the sites were visually assessed for potential as bat roosting habitat using a protocol set out in the Bat Conservation Trust (BCT) Bat Surveys for Professional Ecologists: good practice Guidelines (3rd edn.) (Collins, J (ed.), 2016). Table 4.1 of the BCT Guidelines identifies a grading protocol for assessing structures, trees and commuting/foraging habitat for bats. The protocol is divided into four Suitability Categories: High, Moderate, Low and Negligible.

Seasonal factors that affect distribution patterns and habits of species were taken into account when conducting the surveys. The potential of the sites to support certain populations (in particular those of conservation importance that may not have been recorded during the field survey due to their seasonal absence or nocturnal/cryptic habits) was assessed. All habitats were readily identifiable and it is considered that a comprehensive and accurate assessment of the habitats was achieved.

5.3.1 Desk Study

The following sections detail the results of the searches of published material that were consulted as part of the desk study. These included the Site Synopses of relevant designated sites as compiled by the National Parks and Wildlife Service (NPWS) of the Department of Culture Heritage, and the Gaeltacht (CHG) bird and plant distribution atlases and other research publications.

5.3.1.1 Designated Sites

5.3.1.1.1 *European Sites*

The Habitats Directive (together with the Birds Directive) forms the cornerstone of Europe's nature conservation policy. It is built around two pillars: the Natura 2000 network of protected sites and the strict system of species protection. In total, the Habitats Directive protects over 1,000 animal and plant species and over 200 'habitat types' (e.g. special types of forests, meadows, wetlands, etc.), which are of European importance.

With the introduction of the EU Habitats Directive (92/43/EEC) and Birds Directive (79/409/EEC) which were transposed into Irish law as S.I. No. 94/1997 *European Communities (Birds and Natural Habitats) Regulations* 1997, the European Union formally recognised the significance of protecting rare and endangered species of flora and fauna, and also, more importantly, their habitats. The 1997 Regulations and their amendments were subsequently revised and consolidated in S.I. No. 477/2011- *European Communities (Birds and Natural Habitats) Regulations* 2011. This legislation requires the establishment and conservation of a network of sites of particular conservation value that are to be termed 'European Sites'. This includes Special Areas of Conservation and Special Protection Areas, as described below.

Special Areas of Conservation

Articles 3 – 9 of the EU Habitats Directive (92/43/EEC) provide the EU legislative framework of protecting rare and endangered species of flora and fauna, and habitats. Annex I of the Directive lists habitat types whose conservation requires the designation of Special Areas of Conservation (SAC). Priority habitats, such as Turloughs, which are in danger of disappearing within the EU territory are also listed in Annex I. Annex II of the Directive lists animal and plant species (e.g. Marsh Fritillary, Atlantic Salmon, and Killarney Fern) whose conservation also requires the designation of SAC. Annex IV lists animal and plant species in need of strict protection such as Lesser Horseshoe Bat and Otter, and Annex V lists animal and plant species whose taking in the wild and exploitation may be subject to management measures. In Ireland, species listed under Annex V include Irish Hare, Common Frog and Pine Marten.

Species can be listed in more than one Annex, as is the case with Otter and Lesser Horseshoe Bat which are listed on both Annex II and Annex IV.

Special Protection Areas

Council Directive 79/409/EEC of 2 April 1976 on the conservation of wild birds (Birds Directive) has been substantially amended several times. In the interests of clarity and rationality the said Directive was codified in 2009 and is now cited as Directive 2009/147/EC. The Directive instructs Member States to take measures to maintain populations of all bird species naturally occurring in the wild state in the EU (Article 2). Such measures may include the maintenance and/or re-establishment of habitats in order to sustain these bird populations (Article 3).

A subset of bird species have been identified in the Directive and are listed in Annex I as requiring special conservation measures in relation to their habitats. These species have been listed on account of inter alia: their risk of extinction; vulnerability to specific changes in their habitat; and/or due to their relatively small population size or restricted distribution. Special Protection Areas (SPAs) are to be identified and classified for these Annex I listed species and for regularly occurring migratory species, paying particular attention to the protection of wetlands (Article 4).

5.3.1.1.2 *Nationally Designated Sites*

Natural Heritage Areas (NHAs) and Proposed Natural Heritage Areas (pNHAs) are heritage sites that were designated for the protection of flora, fauna, habitats and geological sites under the Wildlife (Amendment) Act 2000. These sites do not form part of the Natura 2000 network.

5.3.2 Methodology for Assessment of Impacts and Effects

5.3.2.1 Identification of Target Receptors and Key Ecological Receptors

The methodology for assessment followed a precautionary screening approach with regard to the identification of Key Ecological Receptors (KERs). Following a comprehensive desk study, site visits were undertaken, "Target receptors" likely to occur in the zone of influence of the development were identified. The target receptors included habitats and species that were protected under the following legislation:

- Annexes of the EU Habitats Directive
- Qualifying Interests (QI) of Special Areas of Conservation (SAC) within the likely zone of impact.
- Species protected under the Wildlife Acts 1976-2019
- Species protected under the Flora Protection Order 2015

5.3.2.2 Determining Importance of Ecological Receptors

The importance of the ecological features identified within the study area was determined with reference to a defined geographical context. This was undertaken following a methodology that is set out in Chapter 3 of the '*Guidelines for Assessment of Ecological Impacts of National Roads Schemes*' (NRA, 2009). These guidelines set out the context for the determination of value on a geographic basis with a hierarchy assigned in relation to the importance of any particular receptor. The guidelines provide a basis for determination of whether any particular receptor is of importance on the following scales:

- International
- National
- County
- Local Importance (Higher Value)
- Local Importance (Lower Value)

The Guidelines clearly set out the criteria by which each geographic level of importance can be assigned. Locally Important (lower value) receptors contain habitats and species that are widespread and of low ecological significance and of any importance only in the local area. Internationally Important sites are either designated for conservation as part of the Natura 2000 Network (SAC or SPA) or provide the best examples of habitats or internationally important populations of protected flora and fauna. Specific criteria for assigning each of the other levels of importance are set out in the guidelines and have been followed in this assessment. Where appropriate, the geographic frame of reference set out above was adapted to suit local circumstances. In addition, and where appropriate, the conservation status of habitats and species is considered when determining the significance of ecological receptors.

Any ecological receptors that are determined to be of National or International, County or Local importance (Higher Value) following the criteria set out in NRA (2009) are considered to be Key Ecological Receptors (KERs) for the purposes of ecological impact assessment if there is a pathway for effects thereon. Any receptors that are determined to be of Local Importance (Lower Value) are not considered to be Key Ecological Receptors.

5.3.2.3 Characterisation of Impacts and Effects

The proposed development will result in a number of impacts. The ecological effects of these impacts are characterised as per the CIEEM '*Guidelines for Ecological Impact Assessment in the UK and Ireland*' (2018). These guidelines are the industry standard for the completion of Ecological Impact Assessment in the UK and Ireland. This chapter has also been prepared in accordance with the corresponding EPA guidance (EPA 2017). The headings under which the impacts are characterised follow those listed in the guidance document and are applied where relevant. A summary of the impact characteristics considered in the assessment is provided below:

- **Positive or Negative.** Assessment of whether the proposed development results in a positive or negative effect on the ecological receptor.
- **Extent.** Description of the spatial area over which the effect has the potential to occur.
- **Magnitude** Refers to size, amount, intensity and volume. It should be quantified if possible and expressed in absolute or relative terms e.g. the amount of habitat lost, percentage change to habitat area, percentage decline in a species population.
- **Duration** is defined in relation to ecological characteristics (such as the lifecycle of a species) as well as human timeframes. For example, five years, which might seem short-term in the human context or that of other long-lived species, would span at least five generations of some invertebrate species.
- **Frequency and Timing.** This relates to the number of times that an impact occurs and its frequency. A small-scale impact can have a significant effect if it is repeated on numerous occasions over a long period.
- **Reversibility.** This is a consideration of whether an effect is reversible within a 'reasonable' timescale. What is considered to be a reasonable timescale can vary between receptors and is justified where appropriate in the impact assessment section of this report.

5.3.2.4 Determining the Significance of Effects

The ecological significance of the effects of the proposed development are determined following the precautionary principle and in accordance with the methodology set out in Section 5 of CIEEM (2018).

For the purpose of Ecological Impact Assessment (EcIA), 'significant effect' is an effect that either supports or undermines biodiversity conservation objectives for 'important ecological features' or for biodiversity in general. Conservation objectives may be specific (e.g. for a designated site) or broad (e.g. national/local nature conservation policy) or more wide-ranging (enhancement of biodiversity). Effects can be considered significant at a wide range of scales from international to local (CIEEM, 2018).

When determining significance, consideration is given to whether:

- Any processes or key characteristics of key ecological receptors will be removed or changed
- There will be an effect on the nature, extent, structure and function of important ecological features
- There is an effect on the average population size and viability of ecologically important species.
- There is an effect on the conservation status of important ecological habitats and species.

The EPA draft *Guidelines on information to be included in Environmental Impact Assessment Reports* (EPA, 2017) and the *Guidelines for assessment of Ecological Impacts of National Road Schemes*, (NRA, 2009) were also considered when determining significance and the assessment is in accordance with those guidelines.

The terminology used in the determination of significance follows the suggested language set out in the Draft EPA Guidelines (2017) as shown in

Table 5.1.

Table 5.1 Criteria for determining significance of effect, based on (EPA, 2017) guidelines

Effect Magnitude	Definition
No change	No discernible change in the ecology of the affected feature.
Imperceptible effect	An effect capable of measurement but without noticeable consequences.
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight effect	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate effect	An effect that alters the character of the environment that is consistent with existing and emerging trends.
Significant effect	An effect which, by its character, its magnitude, duration or intensity alters a sensitive aspect of the environment.
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
Profound effect	An effect which obliterates sensitive characteristics.

As per TII (NRA, 2009) and CIEEM (2018) best practice guidelines, the following key elements should also be examined when determining the significance of effects:

- The likely effects on 'integrity' should be used as a measure to determine whether an impact on a site is likely to be significant (NRA, 2009).
- A 'significant effect' is an effect that either supports or undermines biodiversity conservation objectives (CIEEM, 2018).

Integrity

In the context of EcIA, 'integrity' refers to the coherence of the ecological structure and function, across the entirety of a site, that enables it to sustain all of the ecological resources for which it has been valued (NRA, 2009). Impacts resulting in adverse changes to the nature, extent, structure and function of component habitats and effects on the average population size and viability of component species, would affect the integrity of a site, if it changes the condition of the ecosystem to unfavourable.

Conservation status

An impact on the conservation status of a habitat or species is considered to be significant if it will result in a change in conservation status. According to CIEEM (2018) guidelines the definition for conservation status in relation to habitats and species are as follows:

- Habitats – conservation status is determined by the sum of the influences acting on the habitat that may affect its extent, structure and functions as well as its distribution and its typical species within a given geographical area
- Species – conservation status is determined by the sum of influences acting on the species concerned that may affect its abundance and distribution within a given geographical area.

As defined in the EU Habitats Directive 92/43/EEC, the conservation of a habitat is favourable when:

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

The conservation of a species is 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
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future
- There is and will probably continue to be, a sufficiently large habitat to maintain its population on a long-term basis.

According to the NRA/CIEEM methodology, if it is determined that the integrity and/or conservation status of an ecological feature will be impacted on, then the level of significance of that impact is related to the geographical scale at which the impact will occur (i.e. local, county, national, international).

5.3.2.5 Incorporation of Mitigation

Sections 5.4, 5.5 and 5.6 of this document assesses the potential effects of the proposed development to ensure that all effects on Key Ecological Receptors (KERs) are adequately addressed. Where significant effects on Key Ecological Receptors are predicted, mitigation is incorporated into the assessment to address such impacts. The implemented mitigation measures avoid or reduce or offset potential significant residual effects, post mitigation.

5.3.2.6 Limitations

The information provided in this assessment accurately and comprehensively describes the baseline ecological environment following dedicated ecological surveys; provides an accurate prediction of the likely ecological effects of the proposed development; prescribes best practice and mitigation as necessary; and, describes the residual ecological impacts.

The specialist studies, analysis and reporting have been undertaken in accordance with the appropriate guidelines.

The habitats and species on the site were readily identifiable and comprehensive assessments were made during the field visits. No significant limitations in the scope, scale or context of the assessment have been identified.

5.4 Forestry replacement lands - Site 1: Stranamart, Co. Cavan

The proposed forestry replacement lands at Stranamart, Co. Cavan have been assessed as part of the Afforestation Approval – Form 1 process described above and has obtained Technical Approval for Afforestation from the Forest Service. The site location is presented in Figure 2.1.

5.4.1 Desk Study

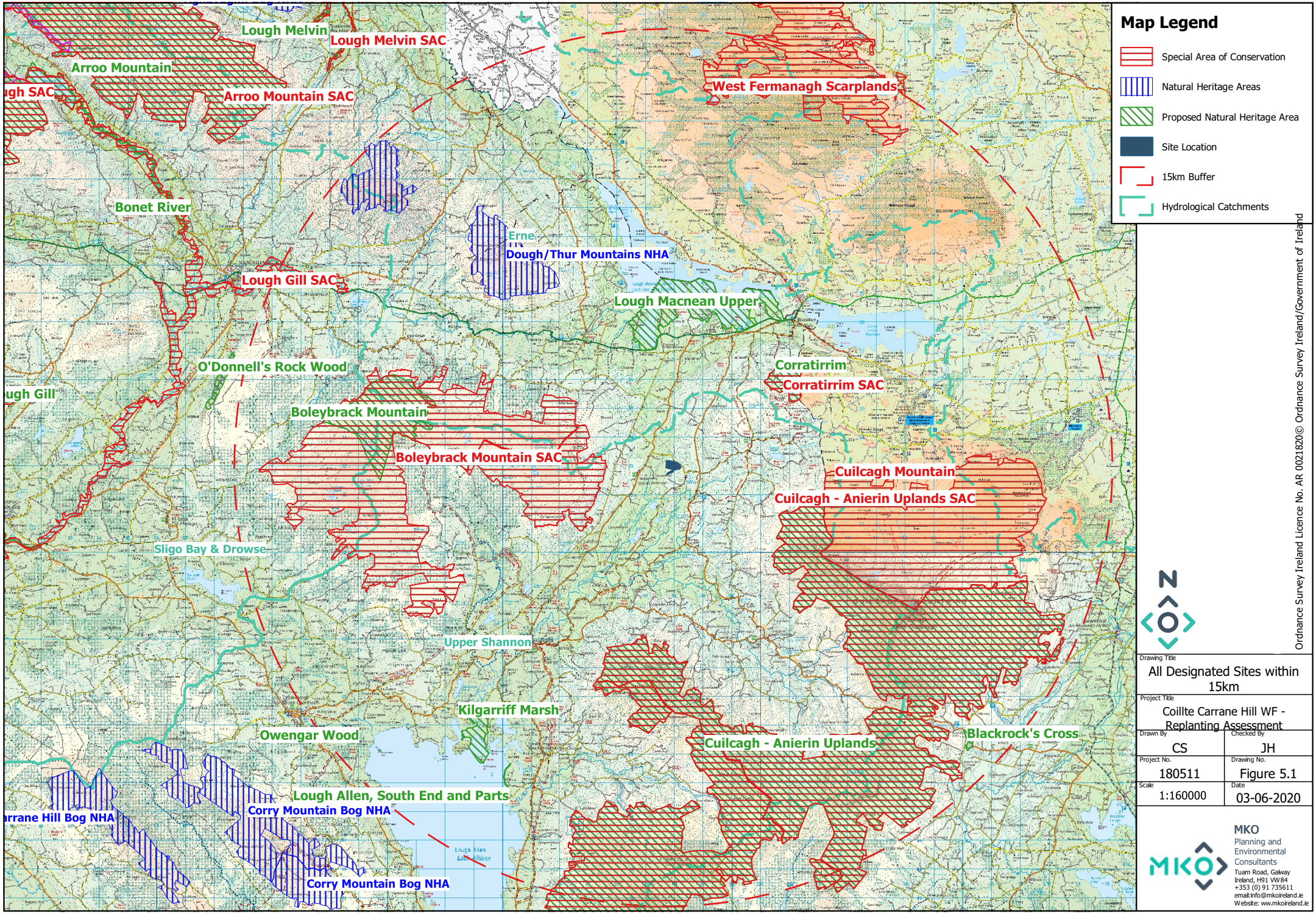
The following sections detail the results of the searches of published material that were consulted as part of the desk study for the Stranamart site.

5.4.1.1 Identification of the Designated Sites Likely Zone of Influence of the Project

Using the Geographic Information System (GIS) software QGIS Version 3.4 designated sites within a within a 15-kilometre radius of the proposed afforestation site were identified. Sites outside 15km were considered but no potential for impact was identified. The European designated sites are listed below in Table 5.2. Special Areas of Conservation (SACs) and Special Protection Areas for birds (SPAs) are designated under the EU Habitats Directive and EU Birds Directive, respectively, and are collectively known as 'European Sites'. The potential for significant effects on the integrity of European Sites is fully assessed in the AA Screening Report that accompanies this report, see Appendix 2. As per EPA draft Guidance 2017, *"a biodiversity section of an EIAR, should not repeat the detailed assessment of potential effects on European sites"* contained in a Screening for Appropriate Assessment but should *"incorporate their key findings as available and appropriate"*. Section 5.4.1.1 of this report provides a summary of the key assessment findings with regard to European Designated Sites. All designated sites are displayed in Figure 3.1 of the accompanying AASR and Figure 5.1 of this document. EU designated sites are listed in Table 5.2.

Natural Heritage Areas (NHAs) are designated under Section 18 the Wildlife (Amendment) Act 2000 and their management and protection is provided for by this legislation and planning policy. The potential for effects on these designated sites is fully considered in this assessment.

Proposed Natural Heritage Areas (pNHAs) were designated on a non-statutory basis in 1995 but have not since been statutorily proposed or designated. However, the potential for effects on these designated sites is fully considered in this EcIA. Nationally designated sites are listed in Table 5.3. All designated sites are displayed in Figure 5.1.



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Drawing Title: All Designated Sites within 15km

Project Title: Coillte Carrane Hill WF - Replanting Assessment

Drawn By	Checked By
CS	JH
Project No.	Drawing No.
180511	Figure 5.1
Scale	Date
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Table 5.2 Identification of EU designated sites within the Likely Zone of Impact

European Sites and distance from proposed development	Likely Zone of Impact Determination
Special Area of Conservation (SAC)	
Boleybrack Mountain SAC (002032) **Distance:** 2.0km	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this SAC and therefore no potential for indirect effects on the SAC exists as a result of the proposed small scale works. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**
Cuilcagh - Anierin Uplands SAC (000584) **Distance:** 3.8km	There will be no direct effects as the project footprint is located entirely outside the designated site. Cuilcagh - Anierin Uplands SAC is located approximately 3.8km south-east of the proposed afforestation site and are buffered by a variety of habitats. Although the sites are located within the same hydrological catchment, no hydrological connectivity exists between the proposed development and the European designated site. Impacts on all of the listed QI habitats and species can be ruled out due to the distance from the proposed small scale afforestation and the absence of a complete source-pathway-receptor chain for impact. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**
Corratirrim SAC (000979) **Distance:** 4.1km	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no connectivity between this European site designated for terrestrial habitats and the proposed afforestation works in a separate hydrological sub-catchment. No pathway for indirect effects was identified. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**
Cuilcagh Mountain SAC [UK0016603] **Distance:** 5.0km	There will be no direct effects as the project footprint is located entirely outside the designated site. Cuilcagh Mountain SAC is located approximately 5km east of the proposed afforestation site and is buffered by a variety of habitats. Although the sites are located within the same hydrological catchment, no hydrological connectivity exists between the proposed development and the European designated site. Impacts on all of the listed QI habitats and species can be ruled out due to the distance from the proposed small scale works area and the absence of a complete source-pathway-receptor chain for impact. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**

European Sites and distance from proposed development	Likely Zone of Impact Determination
Special Area of Conservation (SAC)	
Lough Gill SAC (001976) **Distance:** 12.5km	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the site and the European Designated Site. The SAC is located in a separate surface water catchment to the proposed small-scale afforestation site. Therefore, no pathway for indirect effects was identified. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**
West Fermanagh Scarplands SAC [UK0030300] **Distance:** 12.5km	There will be no direct effects as the project footprint is located entirely outside the designated site. This European site is located in a separate hydrological catchment to the proposed small scale afforestation works. No pathway for indirect effects was identified. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**
Special Protection Area (SPA)	
There are no SPA's within 15km of these forestry replacement lands.	

Table 5.3 Identification of Nationally Designated sites within the Likely Zone of Impact

Designated Sites and distance from proposed development	Features of Interest	Likely Zone of Impact Determination
Natural Heritage Area (NHA)		
Dough/Thur Mountains NHA (002384) **Distance:** 7.1km	› Peatlands [4]	There will be no direct effects as the project footprint is located entirely outside the designated site. No hydrological connectivity exists between the proposed development and the designated site. This site is located in a separate hydrological catchment to the proposed afforestation works. No pathway for indirect effects was identified. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Proposed Natural Heritage Area (pNHA)		
Cuilcagh - Anierin Uplands (000584)	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated

Designated Sites and distance from proposed development	Features of Interest	Likely Zone of Impact Determination
Distance: 3.8km		site. Cuilcagh Mountain pNHA is located approximately 5km east of the proposed afforestation site and is buffered by a variety of habitats. Although the sites are located within the same hydrological catchment, no hydrological connectivity exists between the proposed development and the European designated site. Impacts on all of the listed QI habitats and species can be ruled out due to the distance from the proposed small scale afforestation area and the absence of a complete source-pathway-receptor chain for impact. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Lough Macnean Upper (000986) **Distance:** 3.9km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. No hydrological connectivity exists between the proposed development and the designated site. This site is located in a separate hydrological catchment to the proposed afforestation works. No pathway for indirect effects was identified. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Corratirrim (000979) **Distance:** 4.1km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. No hydrological connectivity exists between the proposed development and the designated site. This site is located in a separate hydrological sub-catchment to the proposed afforestation works. No pathway for indirect effects was identified. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Boleybrack Mountain (002032) **Distance:** 8.2km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. Boleybrack Mountain pNHA is located approximately 8.2km west of the proposed afforestation site and is buffered by a variety of habitats. Although the sites are located within the same hydrological catchment, no hydrological

Designated Sites and distance from proposed development	Features of Interest	Likely Zone of Impact Determination
		connectivity exists between the proposed development and the Natural Heritage designated site. Impacts on all of the site can be ruled out due to the distance from the proposed small scale afforestation area and the absence of a complete source-pathway-receptor chain for impact. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**
Kilgarriff Marsh (000426) **Distance:** 10.2km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. The proposed afforestation site has potential surface water connectivity in excess of 15.9km downstream with Kilgarriff Marsh pNHA via a drainage ditch that flows along the eastern boundary of the site, which discharges to the Black (Cavan) River >530m downstream. This river provides connectivity downstream with this Natural Heritage Area. Given the nature and small scale of the proposed planting and the distance of the pNHA downstream, no pathway for indirect effects on this coastal Nationally designated pNHA was identified. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Lough Allen, South End and Parts (000427) **Distance:** 11.4km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. The proposed afforestation site has potential surface water connectivity in excess of 18km downstream with Lough Allen, South End and Parts pNHA via a drainage ditch that flows along the eastern boundary of the site, which discharges to the Black (Cavan) River >530m downstream. This river provides connectivity downstream with Lough Allen and this Natural heritage area. Given the nature and small scale of the proposed afforestation and the distance of the pNHA downstream, no pathway for indirect effects on this coastal nationally designated pNHA was identified. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Blackrock's Cross (000976) **Distance:** 13.4km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site.

Designated Sites and distance from proposed development	Features of Interest	Likely Zone of Impact Determination
		No hydrological connectivity exists between the proposed development and the designated site. This site is located in a separate hydrological catchment to the proposed afforestation works. No pathway for indirect effects was identified. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Owengar Wood (001419) **Distance:** 14.8km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. No hydrological connectivity exists between the proposed afforestation site and the nationally designated site, located in a separate hydrological sub-catchment to the proposed afforestation works. No pathway for indirect effects was identified. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**

5.4.1.2 New Flora Atlas

A search was made in the New Atlas of the British & Irish Flora (Preston et al, 2002) to investigate whether any rare or unusual plant species listed under Annex II of the EU Habitats Directive, Ireland Red List no 10 Vascular Plants (Wyse et.al 2016) or the Flora (Protection) Order, 2015 had been recorded in the relevant 10km square in which the study site is situated (H03).

Small-white orchid *(Pseudorchis albida)* and globe-flower *(Trollius europaeus)* protected under the Flora (Protection) Order, 1999 (as amended 2015) and listed on the Irish Red List (Vulnerable) has been previously recorded within the hectad.

Small-white orchid *(Pseudorchis albida)* is also listed on the Irish Red List (Vulnerable). Chaffweed (*Anagallis minima),* frog orchid (*Coeloglossum viride),* six-stamened waterwort (*Elatine hexandra),* dwarf Spurge(*Euphorbia exigua*), field gentian(*Gentianella campestris*), globe-flower(*Trollius europaeus)*and green field-speedwell(*Veronica agrestis*) listed on the Irish Red List (Near threatened) have also been previously recorded within the hectad.

5.4.1.3 Biodiversity Ireland Database

A search of the National Biodiversity Data Centre (NBDC) database was conducted with a focus on records of protected fauna recorded from hectad H03. The results of the database search (excluding birds) are provided below in Table 5.4 and the results for bird species recorded within the hectad are provided in Table 5.5. Table 5.6 includes records of non-native invasive species listed under the Third Schedule of the European Communities Regulations 2011 (S.I. 477 of 2015).

Table 5.4 NBDC records for species of conservation interest within 10km Grid Square H03 [excluding birds]

Common Name	Scientific Name	Designation
Brown long-eared bat	*Plecotus auritus*	HD Annex IV, WA
Common frog	*Rana temporaria*	HD Annex V, WA
Daubenton's bat	*Myotis daubentonii*	HD Annex IV, WA
Eurasian badger	*Meles meles*	WA
Eurasian red squirrel	*Sciurus vulgaris*	WA
European otter	*Lutra lutra*	HD Annex II & IV, WA
Freshwater white-clawed crayfish	*Austropotamobius pallipes*	HD Annex II & V, WA
Killarney Fern	*Trichomanes speciosum*	HD Annex II & IV
Lesser noctule	*Nyctalus leisleri*	HD Annex IV, WA
Natterer's Bat	*Myotis nattereri*	HD Annex IV, WA
Marsh Fritillary	*Euphydryas aurinia*	HD Annex II
Pine marten	*Martes martes*	HD Annex V, WA
Pipistrelle	*Pipistrellus pipistrellus sensu*	HD Annex IV, WA

	lato	
Soprano Pipistrelle	*Pipistrellus pygmaeus*	HD Annex IV, WA
West European hedgehog	*Erinaceus europaeus*	WA

WA = Wildlife Acts (1976-2019), HD Annex II, III, IV and V = EU Habitats Directive.

Table 5.5 NBDC records for bird species of conservation interest within 10km Grid Square H03

Common Name	Scientific Name	Designation
Black-headed gull	*Larus ridibundus*	BoCCI Red List, WA
Common kingfisher	*Alcedo atthis*	BD Annex I, WA
Common pochard	*Aythya ferina*	BoCCI Red List, WA
Corn crake	*Crex crex*	BD Annex I, BoCCI Red List, WA
Eurasian curlew	*Numenius arquata*	BoCCI Red List, WA
Eurasian Wigeon	*Anas penelope*	BoCCI Red List, WA
Eurasian woodcock	*Scolopax rusticola*	BoCCI Red List, WA
European golden plover	*Pluvialis apricaria*	BD Annex I, BoCCI Red List, WA
Grey wagtail	*Motacilla cinerea*	BoCCI Red List, WA
Hen harrier	*Circus cyaneus*	BD Annex I, WA
Meadow pipit	*Anthus pratensis*	BoCCI Red List, WA
Red grouse	*Lagopus lagopus*	BoCCI Red List, WA
Whooper swan	*Cygnus cygnus*	BD Annex I, WA
Yellowhammer	*Emberiza citrinella*	BoCCI Red List, WA

WA = Wildlife Acts (1976-2019), BoCCI Red List = Birds of Conservation Concern Red List; BD Annex I = EU Birds Directive Annex I.

Table 5.6 NBDC records for invasive species in hectad H03

Common Name	Scientific Name
Brown Rat	*Rattus norvegicus*
Canadian Waterweed	*Elodea Canadensis*
Eastern Grey Squirrel	*Sciurus carolinensis*
Fallow Deer	*Dama dama*
Indian Balsam	*Impatiens glandulifera*

Japanese Knotweed	*Fallopia japonica*
Nuttall's Waterweed	*Elodea nuttallii*
Rhododendron	*Rhododendron ponticum*
Roach	*Rutilus rutilus*
Salmonberry	*Rubus spectabilis*

5.4.1.4 Water Quality

The proposed afforestation site is located within the Shannon Upper Catchment. A drainage ditch flows along the eastern boundary of the site has potential surface water connectivity with the Black (Cavan) River >530m downstream. There are no other watercourses within or adjacent to these forestry replacement lands. The Water Framework Directive (WFD) ground waterbody risk score for the site, within the 'Glenarde Dowra' region has been assessed as 'Good'.

5.4.1.5 Freshwater Pearl Mussel Sensitive Areas

The site is not located within a freshwater pearl mussel (*Margaritifera margaritifera)* sensitive area. The site has no connectivity to any freshwater pearl mussel sensitive areas.

5.4.1.6 Conclusions of the Desktop Study

The afforestation site is not located within any site designated for nature conservation. The mammal species recorded within the relevant hectad have widespread range and distributions and are likely to be recorded frequently throughout Ireland. A number of rare and protected flora and fauna have been recorded from the hectad in which the proposed development is located.

5.4.2 Habitats Present

The site at Stanamart consists of ringfenced planted forestry classified as ***conifer plantation (WD4)***. A ***drainage ditch (FW4)*** exists along the eastern boundary of the site.

5.4.3 Significance of Habitats

The Ecological evaluation within this section follows a methodology that is set out in Chapter 3 of the 'Guidelines for Assessment of Ecological Impacts of National Roads Schemes' (NRA, 2009).

The conifer plantation and drainage ditches that are present within the site, given their highly modified nature, are of Local Importance (*Lower Value*) as they contain areas which are of some local importance for wildlife. However, these habitats are common in the wider landscape and are not of ecological impact assessment

5.4.3.1 Do Nothing' Impact

The site has received Technical Approval from the Forest Service as described above and was afforested per the provisions of the approval.

5.4.3.2 Loss of Floral Habitat

The replacement lands at Stranamart have been afforested, no further floral loss is anticipated. No significant effects are anticipated.

5.4.3.3 Loss of Faunal Habitat

No further faunal loss is anticipated at the planted site. It is likely that the ring-fenced conifer plantation will limit faunal access on-site however deer and some faunal species are likely to forage and habituate the site.

5.4.3.4 Impacts During Operational Phase (i.e. Harvesting/ Planting)

Afforestation and subsequent harvesting will conform to current best practice Forest Service regulations, policies and strategic guidance documents as well as Coillte produced guidance documents, including the specific guidelines listed below, to ensure that newly planted trees remain viable and afforestation results in minimal potential impacts to the receiving environment.

- 'Land Types for Afforestation' [2016]
- 'Environmental Requirements for Afforestation' [2016]
- 'Forest Operations & Water Protection Guidelines' (2009)
- 'Methodology for Clear Felling Harvesting Operations' (2009)
- 'Forestry and Water Quality Guidelines' (2000)
- 'Forestry and the Landscape Guidelines' (2000)
- 'Forestry and Archeology Guidelines' (2000)
- 'Forestry Biodiversity Guidelines' (2000)
- 'Forestry Protection Guidelines' (2002)
- 'Forestry Harvesting and Environmental Guidelines' (2000)

Following afforestation, subsequent forestry related activities will be subject to a separate consent process (i.e. from the Forest Service). All such activities will be undertaken in accordance with the above guidance documents. No potential for significant effect has been identified.

5.4.3.5 Impact on Designated Sites

The site was subject to Article 6(3) Appropriate Assessment Screening as part of the technical approval process and an Appropriate Assessment Screening Report has also been prepared, see Appendix 1 of this report.

Potential indirect impacts on European Designated sites (SACs and SPAs) are fully assessed within a separate Appropriate Assessment Screening Report (AASR), see Appendix 2. The AASR concludes that:

> *It is concluded 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 replacement land, individually or in combination with other plans and projects, will not have a significant effect on any European Site.*
>
> *The replacement lands have Technical Approval from the Forest Service and will be undertaken accordingly. This approval is conditional to all associated works being undertaken in accordance with Forest Service requirements. The impacts associated with this afforestation have been classified overall as a neutral impact. As such, when considered in combination with the other land uses in the area, and considering that the forestry guidelines are designed to minimise and prevent impacts to habitats that are outside the site, cumulative impacts on sensitive ecological receptors are not anticipated.*

The impact on nationally designated sites was assessed as per Table 5.2 above and there was no Natural Heritage Areas (NHA) or proposed Natural Heritage Areas (pNHAs) identified within the Zone of Likely Impact. All forestry activities will be undertaken in accordance with industry guidance and best practice. No potential for significant effect was identified based on the nature and scale of the works and separation in distance from the designated site.

5.4.3.6 Cumulative Impacts

The proposed afforestation has Technical Approval from the Forest Service and will be undertaken accordingly. This approval is conditional to all associated works being undertaken in accordance with Forest Service requirements. The impacts associated with this afforestation have been classified overall as a neutral impact. As such, when considered in combination with the other land uses in the area, and considering that the forestry guidelines are designed to minimise and prevent impacts to habitats that are outside the site, cumulative impacts on sensitive ecological receptors are not anticipated.

5.5 Forestry replacement lands - Site 2: Brackloon, Co. Roscommon

The proposed forestry replacement land at Brackloon, Co. Roscommon has been assessed as part of the Afforestation Approval – Form 1 process described above and has obtained Technical Approval for Afforestation from the Forest Service. The site location is presented in Figure 2.3.

5.5.1 Desk Study

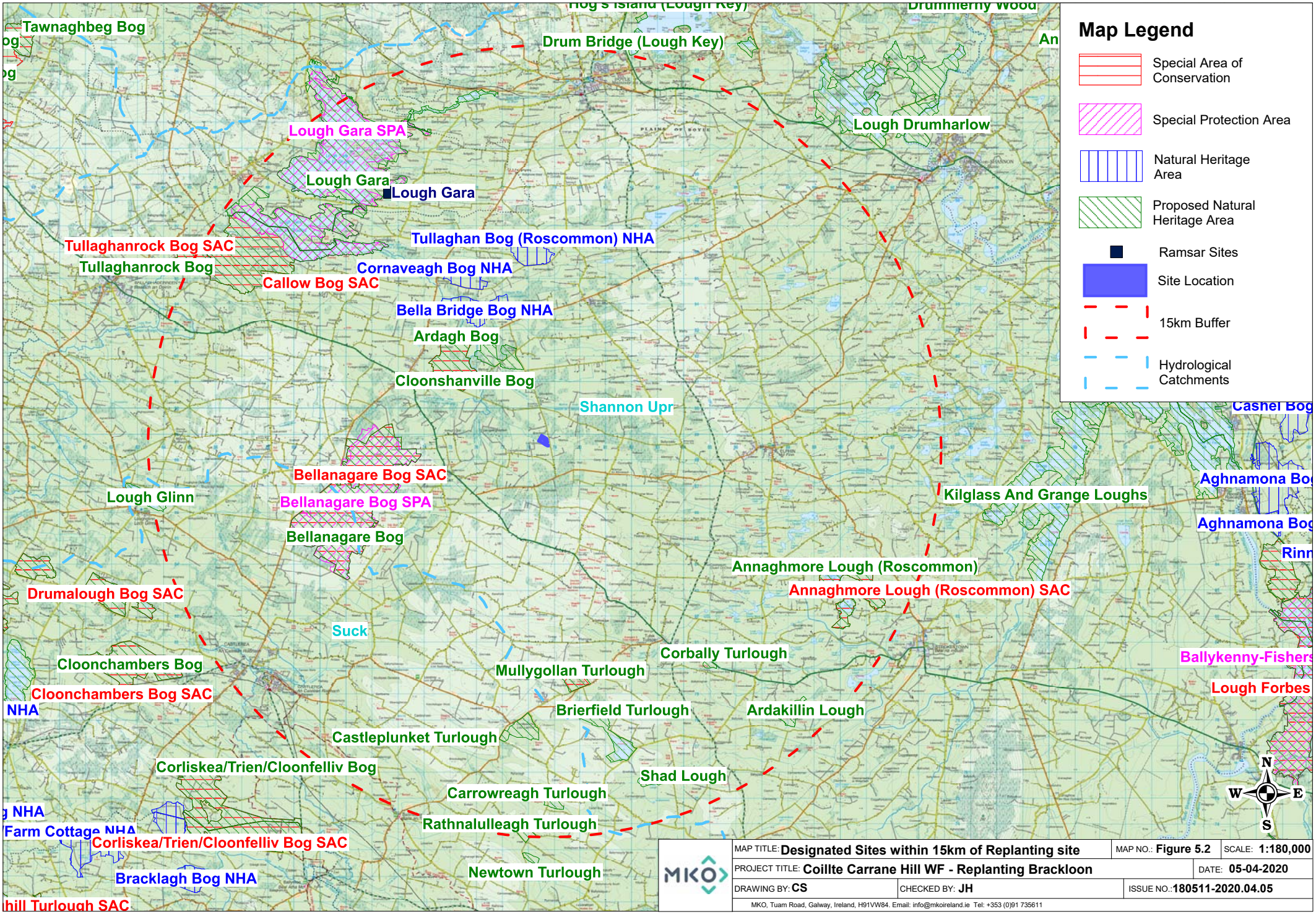
The following sections detail the results of the searches of published material that were consulted as part of the desk study for the Brackloon site.

5.5.1.1 Identification of the Designated Sites Likely Zone of Influence of the Project

Using the Geographic Information System (GIS) software QGIS Version 3.4 designated sites within a within a 15-kilometre radius of the proposed afforestation site were identified. Sites outside 15km were considered but no potential for impact was identified. The European designated sites are listed below in Table 5.7. Special Areas of Conservation (SACs) and Special Protection Areas for birds (SPAs) are designated under the EU Habitats Directive and EU Birds Directive, respectively, and are collectively known as 'European Sites'. The potential for significant effects on the integrity of European Sites is fully assessed in the AA Screening Report that accompanies this application, see Appendix 2. As per EPA draft Guidance 2017, *"a biodiversity section of an EIAR, should not repeat the detailed assessment of potential effects on European sites"* contained in a Screening for Appropriate Assessment but should *"incorporate their key findings as available and appropriate"*. Section 5.5.1.1 of this document provides a summary of the key assessment findings with regard to European Designated Sites. All designated sites are displayed in Figure 3.1 of the accompanying AASR and Figure 5.2 of this report.

Natural Heritage Areas (NHAs) are designated under Section 18 the Wildlife (Amendment) Act 2000 and their management and protection is provided for by this legislation and planning policy. The potential for effects on these designated sites is fully considered in this assessment.

Proposed Natural Heritage Areas (pNHAs) were designated on a non-statutory basis in 1995 but have not since been statutorily proposed or designated. However, the potential for effects on these designated sites is fully considered in this EcIA. Nationally designated sites are listed in Table 5.8.



MAP TITLE: **Designated Sites within 15km of Replanting site**		MAP NO.: **Figure 5.2**	SCALE: **1:180,000**
PROJECT TITLE: **Coillte Carrane Hill WF - Replanting Brackloon**			DATE: **05-04-2020**
DRAWING BY: **CS**	CHECKED BY: **JH**		ISSUE NO.: **180511-2020.04.05**

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Table 5.7 Identification of Designated sites within the Likely Zone of Impact

European Sites and distance from proposed development	Likely Zone of Impact Determination
Special Areas of Conservation (SAC)	
Cloonshanville Bog SAC (000614) **Distance:** 3.3km (4.1km hydrological distance)	There will be no direct effects as the project footprint is located entirely outside the designated site. The proposed afforestation site has surface water connectivity >4.1km downstream with Cloonshanville Bog SAC via a stream, running adjacent along the southern boundary of the site. However, given distance downstream of the terrestrial nature of the habitats for which the SAC has been designated, as well as the nature and small scale of the proposed planting, as permitted in the technical approval document, there is no potential for indirect effects on the SAC. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**
Bellanagare Bog SAC (000592) **Distance:** 3.3km	There will be no direct effects as the project footprint is located entirely outside the designated site. No hydrological connectivity has been identified between the proposed afforestation site designated for terrestrial habitats and this European site. Due to the lack of connectivity between the small-scale forestry replacement lands and the European Site, no pathway for indirect effect between the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Mullygollan Turlough SAC [000612] **Distance:** 3.4km	There will be no direct effects as the project footprint is located entirely outside the designated site. Mullygollan Turlough SAC is located approximately 3.4km south-east of the proposed afforestation site and is buffered by agricultural, forestry, bog and scrub habitats. No hydrological connectivity exists between the proposed development and the designated site. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Callow Bog SAC (000595) **Distance:** 3.6km	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this European site designated for terrestrial habitats, located in a separate hydrological sub-catchment. Therefore, no pathway for indirect effect between the proposal and the designated site exists.

European Sites and distance from proposed development	Likely Zone of Impact Determination
Special Areas of Conservation (SAC)	
	No pathway for effect was identified and the site is not within the Likely Zone of Impact.
Annaghmore Lough (Roscommon) SAC [001626] **Distance:** 4.6km	There will be no direct effects as the project footprint is located entirely outside the designated site. This SAC is located in a separate hydrological catchment to the proposed small-scale afforestation works and there is no connectivity between the afforestation site and the SAC. Impacts on the listed Qualifying Interests can be ruled out due to the distance from the proposed works area and the absence of a complete source-pathway-receptor chain for impact. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Tullaghanrock Bog SAC (002354) **Distance:** 4.6km	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this European site designated for terrestrial habitats, located in a separate hydrological sub-catchment. Therefore, no pathway for indirect effect between the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Special Protection Area (SPA)	
Bellanagare Bog SPA [004105] **Distance:** 4.6km	There will be no direct effects as the project footprint is located entirely outside the designated site. Bellanagare Bog SPA is located approximately 4.6km south-west of the proposed afforestation site and is buffered by agricultural, forestry and peatland habitats. No significant supporting habitat for SCI species within the site and that given the absence of habitat and distance from the SPA no potential for indirect effects as a result of disturbance exist. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Lough Gara SPA [004048] **Distance:** 9.4km (12.9km hydrological distance)	There will be no direct effects as the project footprint is located entirely outside the designated site. The proposed afforestation site has surface water connectivity >12.9km downstream with Lough Gara SPA via a stream, running adjacent along the southern boundary of the site. However, given

European Sites and distance from proposed development	Likely Zone of Impact Determination
Special Areas of Conservation (SAC)	
	the distance downstream of the wetland species and nature and small scale of the forestry replacement lands, as permitted in the technical approval document, there is no potential for indirect effects on the SPA. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**

Table 5.8 Identification of nationally Designated sites within the Likely Zone of Impact

Designated Sites and distance from proposed development	Features of Interest	Likely Zone of Impact Determination
Natural Heritage Area (NHA)		
Bella Bridge Bog NHA (000591) **Distance:** 4.6km	› Peatlands [4]	There will be no direct effects as the project footprint is located entirely outside the designated site. The proposed afforestation site has surface water connectivity >7.6km downstream with Bella Bridge Bog NHA via a stream, running adjacent along the southern boundary of the site. However, given distance downstream and nature and small scale of the forestry replacement lands, as permitted in the technical approval document, there is no potential for indirect effects on the NHA. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**
Cornaveagh Bog NHA (000603) **Distance:** 6.1km	› Peatlands [4]	There will be no direct effects as the project footprint is located entirely outside the designated site. Cornaveagh Bog NHA is located approximately 6.1km north-west of the proposed afforestation site and is buffered by agricultural, forestry andpeatland habitats. Although the sites are located within the same hydrological catchment, no hydrological connectivity exists between the proposed development. This designated site is designated for terrestrial habitats. No pathway for indirect effect between the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Tullaghan Bog (Roscommon) NHA (001652) **Distance:** 6.6km	› Peatlands [4]	There will be no direct effects as the project footprint is located entirely outside the designated site. Tullaghan Bog (Roscommon) NHA is located approximately 6.6km north of the proposed afforestation

Designated Sites and distance from proposed development	Features of Interest	Likely Zone of Impact Determination
		site and is buffered by agricultural, forestry and peatland habitats. Although the sites are located within the same hydrological catchment, no hydrological connectivity exists between the proposed development. This designated site is designated for terrestrial habitats. No pathway for indirect effect between the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Proposed Natural Heritage Area (pNHA)		
Ardagh Bog [001222] **Distance:** 2.7km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. The proposed afforestation site has surface water connectivity >5.4km downstream with Ardagh Bog pNHA via a stream, running adjacent along the southern boundary of the site. However, given distance downstream and nature and small scale of the forestry replacement lands, as permitted in the technical approval document, there is no potential for indirect effects on the pNHA. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**
Cloonshanville Bog [000614] **Distance:** 3.3km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. The proposed afforestation site has surface water connectivity >4.1km downstream with Cloonshanville Bog pNHA via a stream, running adjacent along the southern boundary of the site. However, given distance downstream of the site, nature and small scale of the forestry replacement lands as permitted in the technical approval document there is no potential for indirect effects on the pNHA. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**
Bellanagare Bog [000592] **Distance:** 4.6km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. Bellanagare Bog pNHA is located approximately 4.6km south-west of the proposed afforestation site and is buffered by agricultural, forestry and peatland habitats. Although the sites are located within the same hydrological catchment, no hydrological connectivity exists between the proposed development. This designated site is designated for terrestrial habitats. No pathway for indirect effect between

Designated Sites and distance from proposed development	Features of Interest	Likely Zone of Impact Determination
		the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Mullygollan Turlough [000612] **Distance:** 8.8km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this nationally designated site, located in a separate hydrological catchment. Therefore, no pathway for indirect effect between the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Lough Gara [000587] **Distance:** 9.4km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. The proposed afforestation site has surface water connectivity >12.9km downstream with Lough Gara pNHA via a stream, running adjacent along the southern boundary of the site. However, given the distance downstream and nature and small scale of the forestry replacement lands as permitted in the technical approval document there is no potential for indirect effects on the pNHA. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Brierfield Turlough [000594] **Distance:** 10.1km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this natural heritage area, located in a separate hydrological catchment. Therefore, no pathway for indirect effect between the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Corbally Turlough [001627] **Distance:** 10.2km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this nationally designated site, located in a separate hydrological catchment. Therefore, no pathway for indirect effect between the proposal and the designated site exists.

Designated Sites and distance from proposed development	Features of Interest	Likely Zone of Impact Determination
		No pathway for effect was identified and the site is not within the Likely Zone of Impact.
Castleplunket Turlough [0000598] **Distance:** 10.2km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this nationally designated site, located in a separate hydrological catchment. Therefore, no pathway for indirect effect between the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Annaghmore Lough (Roscommon) [001626] **Distance:** 11.4km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this nationally designated site, located in a separate hydrological catchment. Therefore, no pathway for indirect effect between the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Ardakillin Lough [001617] **Distance:** 13.0km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this nationally designated site, located in a separate hydrological catchment. Therefore, no pathway for indirect effect between the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Carrowreagh Turlough [001624] **Distance:** 13.1km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this nationally designated site, located in a separate hydrological catchment. Therefore, no pathway for indirect effect between the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**

Designated Sites and distance from proposed development	Features of Interest	Likely Zone of Impact Determination
Shad Lough [001648] **Distance:** 13.1km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this natural heritage area, located in a separate hydrological catchment. Therefore, no pathway for indirect effect between the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Lough Glinn [001644] **Distance:** 14.1km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this natural heritage area located in a separate hydrological sub-catchment. Therefore, no pathway for indirect effect between the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Tullaghanrock Bog [002013] **Distance:** 14.4	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this proposed natural heritage area located in a separate hydrological sub-catchment. Therefore, no pathway for indirect effect between the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Rathnalulleagh Turlough [000613] **Distance:** 14.5km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this natural heritage area located in a separate hydrological catchment. Therefore, no pathway for indirect effect between the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Drum Bridge (Lough Key)	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site.

Designated Sites and distance from proposed development	Features of Interest	Likely Zone of Impact Determination
[001631] **Distance:** 15.0km		There is no hydrological connectivity between the proposed afforestation site and this natural heritage area located in a separate hydrological sub-catchment. Therefore, no pathway for indirect effect between the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**

5.5.1.2 New Flora Atlas

A search was made in the New Atlas of the British & Irish Flora (Preston et al, 2002) to investigate whether any rare or unusual plant species listed under Annex I of the EU Habitats Directive had been recorded in the relevant 10km squares in which the study site is situated (M78), during the 1987-1999 atlas survey. Smooth brome *(Bromus racemosus)* – Red Listed Species – (Near Threatened); was the only rare species that have been previously recorded within hectad N78. No species were recorded within the 10km hectad designated under the Flora Protection Order.

5.5.1.3 National Biodiversity Data Centre Notable Records

A search of the National Biodiversity Data Centre (NBDC) website was conducted with a focus on records of protected fauna recorded from hectad M78. The results of the database search (excluding birds) are provided below in

Table 5.9 and the results for bird species recorded within the hectad are provided in

Table 5.10. Table 5.11 includes records of non-native invasive species listed under the Third Schedule of the European Communities Regulations 2011 (S.I. 477 of 2015).

Table 5.9 Notable species that occur within 10km Grid Square M78 [excluding birds]

Common Name	Latin name	Designation
Common Frog	*Rana temporaria*	WA, HD Annex V
Eurasian Badger	*Meles meles*	WA
Eurasian Red Squirrel	*Sciurus vulgaris*	WA
European Otter	*Lutra lutra*	HD Annex II and IV, WA
Freshwater White-clawed Crayfish	*Austropotamobius pallipes*	HD Annex II and V
Lesser Noctule	*Nyctalus leisleri*	HD Annex IV, WA
Marsh Fritillary	*Euphydryas aurinia*	HD Annex II
Natterer's Bat	*Myotis nattereri*	HD Annex IV, WA
Pipistrelle	*Pipistrellus pipistrellus sensu lato*	HD Annex IV, WA

Soprano Pipistrelle	*Pipistrellus pygmaeus*	HD Annex IV, WA
West European Hedgehog	*Erinaceus europaeus*	WA

WA = Wildlife Acts (1976-2019), HD Annex II, III, IV and V = EU Habitats Directive.

Table 5.10 Notable bird species that occur within 10km Grid Square M78

Common Name	Latin name	Designation
Barn Owl	*Tyto alba*	BoCCI Red List, WA
Black-headed Gull	*Larus ridibundus*	BoCCI Red List, WA
Common Kingfisher	*Alcedo atthis*	BD Annex I, WA
Corn Crake	*Crex crex*	BD Annex I, BoCCI Red List, WA
Eurasian Curlew	*Numenius arquata*	BoCCI Red List, WA
Eurasian Woodcock	*Scolopax rusticola*	BoCCI Red List, WA
European Golden Plover	*Pluvialis apricaria*	BD Annex I, BoCCI Red List, WA
Grey Wagtail	*Motacilla cinerea*	BoCCI Red List, WA
Hen Harrier	*Circus cyaneus*	BD Annex I, WA
Lapwing	*Vanellus vanellus*	BoCCI Red List, WA
Meadow Pipit	*Anthus pratensis*	BoCCI Red List, WA
Red Grouse	*Lagopus lagopus*	BoCCI Red List, WA
Whinchat	*Saxicola rubetra*	BoCCI Red List, WA
Whooper Swan	*Cygnus cygnus*	BD Annex I, WA
Yellowhammer	*Emberiza citrinella*	BoCCI Red List, WA

WA = Wildlife Acts (1976-2019), BoCCI Red List = Birds of Conservation Concern Red List; BD Annex I = EU Birds Directive Annex I.

Table 5.11 NBDC records for invasive species in hectad M78

Common Name	Scientific Name
American Mink	*Mustela vison*
Japanese Knotweed	*Fallopia japonica*

5.5.1.4 Water Quality

The proposed afforestation site is located within the Upper Shannon Catchment and the Breedoge Sub catchment. A stream, runs adjacent along the southern boundary of the site, flowing in a north westerly direction and discharging to the Owennaforeesha River, approximately 2.3km downstream of the site.

There are two EPA water quality monitoring stations downstream of the site along Owennaforeesha River; one approximately 2.8km down-stream of the site at the 100 m u/s Breedoge confl station on the

Owennaforeesha River (Station code: RS26O040200). This monitoring station was most recently surveyed in 2011 and had a Q value of 3, indicating that water quality is poor.

The second water quality monitoring station located approximately 3km downstream of the afforestation site on the Owennaforeesha River at the Breedoge - Br 2 km E.S.E. of Frenchpark station (Station code: RS26B090100). This monitoring station was most recently surveyed in 2005 and had a Q value of 3, indicating that water quality was poor.

The Water Framework Directive (WFD) river waterbody risk score for the Owennaforeesha River has been assessed as 'At Risk' for the section of the watercourse flowing along the southern site boundary. The WFD River Waterbody status for the period 2013 - 2018 classifies the stream to the south of the site and the downstream Owennaforeesha River waterbody status as 'Poor'.

5.5.1.5 Freshwater Pearl Mussel Sensitive Areas

The site is not located within a Pearl Mussel (*Margaritifera margaritifera*) sensitive area. The site has no connectivity to any freshwater pearl mussel sensitive areas.

5.5.1.6 Conclusions of the Desktop Study

The afforestation site is not located within any site designated for nature conservation. The proposed afforestation site has surface water connectivity >4.1km downstream with Cloonshanville Bog SAC and approximately >12.9km downstream with Lough Gara SPA [004048]. However, given distance downstream, nature and small scale of the forestry replacement lands, as permitted in the technical approval document, there is no potential for indirect effects on the designated sites. The mammal species recorded within the relevant hectad have widespread range and distributions and are likely to be recorded frequently throughout Ireland. A number of rare and protected flora and fauna have been recorded from the hectad in which the proposed development is located. The field surveys will identify if any of the identified habitats, flora or fauna or additional ecological receptors occur within the study area.

5.5.2 Habitats Present

The site is largely dominated by an ***improved agricultural grassland/wet grassland (GA1/GS4)*** mosaic with field boundaries demarcated by ***hedgerows(WL1)*** (Plate 5.1). This grassland habitat is extensively dominated by rushes (*Juncus* spp.). Other species recorded include cock's-foot (*Dactylus glomerata*), perennial ryegrass (*Lolium perenne*), spear thistle *(Circium vulgare),* flag iris (*Iris pseudacorus),* ivy (Hedera helix) and bramble (*Rubus fructicosus* agg.). The ***hedgerows (WL1)*** are dominated by willow *(Salix* spp.), hawthorn (Crataegus monogyna) and bramble.

A stream categorised as ***eroding/upland river (FW1)***, Plate 5.2, runs adjacent along the southern boundary of the site, flowing in a north westerly direction and discharging to the Owennaforeesha River, approximately 2.3km downstream of the site.



Plate 5.1 Improved agricultural grassland/wet grassland (GA1/GS4) mosaic with field boundaries demarcated by hedgerows (WL1)



Plate 5.2 Stream categorised as eroding/upland river (FW1) adjacent along the southern boundary of the site

5.5.2.1 Invasive Species

No invasive species listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations, 2011 were recorded within the site boundary during the site visit.

5.5.2.2 Significance of Habitats

Ecological evaluation within this section follows a methodology that is set out in Chapter 3 of the 'Guidelines for Assessment of Ecological Impacts of National Roads Schemes' (NRA, 2009).

No habitats which correspond to those that are listed in the EU Habitats Directive were identified during the site visit. The grassland habitats that are present within the site, given their highly modified nature, are of *Local Importance (Lower Value)* as they contain areas which are of some local importance for wildlife. Hedgerows and eroding/upland river habitats were assigned a significance of *Local Importance (Higher Value)* as these habitats have a higher level of biodiversity within the context of the local environment, and in the case of the hedgerows and watercourses provide cover and commuting corridor links between habitats of higher ecological value.

5.5.3 Fauna in the Existing Environment

Birds

Records of birds seen and heard on the forestry replacement site were taken. Common passerines were recorded incidentally within the site. No birds listed on Annex I of the EU Birds Directive were recorded during the field survey. The site provided habitat for a range of common and widespread species but not of significance for rare or protected bird species. Given the lack of significant habitat for rare or protected bird species, there is no requirement for further bird surveys at the site.

Terrestrial Mammals

No evidence of badger was recorded during the site visit and no other protected mammal species or evidence of such species were recorded within the site boundaries.

No species listed under Annex II of the Habitats Directive were recorded during the site visit.

Otter

A comprehensive search for otter was undertaken along a 10m riparian buffer of the stream adjacent to the southern site boundary (NRA, 2008 and Reid, et al 2013). No otter resting or breeding sites and no evidence of otter was recorded within the development site, however, the watercourse along the site boundary is likely to be utilised by commuting and foraging otter.

Bats

There are no structures within the site which may provide suitable roosting habitat for bats. A large open landscape structure dominates the site and though linear features may be used by foraging and commuting bats, overall, the site is considered to have low suitability for bat species.

5.5.3.1 Significance of Fauna

No evidence of Annex listed species, or other species of conservation concern were recorded within the site boundaries.

Bird species recorded within the site boundaries are common generally and assigned a value of **Local Importance (Lower Value):** The forestry replacement site provides some limited foraging, commuting

and nesting habitats for these and other common bird species in general. Similar habitat is widespread in the locality.

5.5.4 Impact Assessment

5.5.4.1 Do Nothing' Impact

Were the site to remain unplanted the management on site would likely remain as it is presently i.e. wet agricultural grassland grazed by livestock. However, given that the site has received Technical Approval from the Forest Service as described above it will be afforested per the provisions of the approval at a later date.

5.5.4.2 Impacts During the Site Preparation and Planting Phase

5.5.4.2.1 *Loss of Floral Habitat*

Long-Term Neutral Impact

The development will result in the loss of wet agricultural grassland habitat assigned local importance (lower value). This habitat type is common in a local, national and international context and their loss will constitute a neutral impact.

The loss of these habitats is not considered significant.

All hedgerows of *Local Importance (Higher Value)* within the site will be retained.

Mitigation

Despite the fact that the loss of habitats on the forestry replacement site is not a significant ecological effect, all works will be carried out in accordance with the relevant Forest Service requirements, including 'Forestry Biodiversity Guidelines' (2000)'. All hedgerows will be retained and appropriate set-back applied as per the Forest Service document 'Environmental Requirements for Afforestation (2016)'. The Technical Approval document specifies the area that should contain suitable broadleaf and conifer species. This management would allow for the retention of some of the Local Value (Higher Importance) habitats.

Residual Impact

The replacement of grassland habitat with coniferous and broadleaf forestry is considered to be a Long-Term Neutral Impact. No significant effects are anticipated.

5.5.4.2.2 *Loss of Faunal Habitat*

Long Term Neutral Impact

The proposed planting site is not of high value or importance as a faunal habitat, being dominated mostly by wet agricultural grassland and limited cover or shelter for faunal species in bramble and hedgerow habitats. It is likely that the proposed planting of forestry will result in some loss of foraging for small mammals, along with local bird species. Grassland habitat is widespread in the local area and this loss is considered to be negligible.

The proposed development site does not provide significant foraging or roosting habitat for protected bird species given the highly managed/modified nature of habitats on site, dominated by wet agricultural grassland. Given the lack of significant bird assemblages recorded within or adjacent to the

site, significant impacts as a result of disturbance or displacement are not anticipated on bird species at any geographic scale.

Hedgerows provide bat commuting and foraging habitat, there will be no loss of hedgerow or trees as part of the proposal and therefore no impacts on bat commuting and foraging habitat.

The afforestation, in particular that of broadleaf species will result in the creation of cover and nesting habitat for a range of bird species, resulting in an overall Long-Term Neutral Impact.

Mitigation / Best Practice

- All works will be carried out in accordance with the relevant Forest Service requirements, including 'Forestry Biodiversity Guidelines' (2000)'.
- All hedgerows and existing treelines will be retained and appropriate set-back applied as per the Forest Service document '*Environmental Requirements for Afforestation (2016)*'.
- Vegetation clearance will be carried out in line with the Wildlife Acts

Residual Impact.

- No significant effects on faunal habitat as a result of the proposed afforestation is anticipated.

5.5.4.2.3 *Water Pollution*

Short-Term Slight Negative Impact

Following a precautionary approach, in the absence of best practice and design, there is potential for water pollution to occur through discharge to the adjacent stream and therefore potential localised water pollution effects in the form of release of suspended solids, siltation and erosion as a result of the proposed afforestation.

Mitigation/Best Practice

Best practice methods related to water incorporated into the forestry management and mitigation measures have been derived from:

- Forestry Commission (2004): Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh;
- Coillte (2009): Forest Operations & Water Protection Guidelines;
- Forest Service (Draft): Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures; and,
- Forest Service (2000): Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.
- Forest Service (2016) Environmental Requirements for Afforestation. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.
- Forest Service (2016) Land Types for Afforestation. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.

Measures which will reduce the risk of entrainment of suspended solids and nutrient release in surface watercourses comprise best practice methods which will be applied at the forestry replacement lands. These include:

- Machine combinations will be chosen which are most suitable for ground conditions at the time of excavation and felling, and which will minimise surrounding soils disturbance;
- Where possible, existing drains will not be disturbed during drainage works;

- Drains and sediment traps will be installed during ground preparation and felling. Collector drains will be excavated at an acute angle to the contour (~0.3%-3% gradient), to minimise flow velocities. Main drains to take the discharge from collector drains will include water drops and rock armour, as required, where there are steep gradients, and should avoid being placed at right angles to the contour;
- Drains and silt traps will be maintained throughout all planting works, ensuring that they are clear of sediment build-up and are not severely eroded. Correct drain alignment, spacing and depth will ensure that erosion and sediment build-up are minimised and controlled;
- Apply a 5 metre wide (minimum) uncultivated and unplanted water setback along relevant watercourses (as defined in Circular 12/2017) located within or adjoining the site. This setback is to remain undisturbed during establishment and throughout the forest rotation. Apply and maintain as per details set out in Tables 5 and 6 of the Environmental Requirements for Afforestation (DAFM, 2016).
- Adhere to all water protection measures relating to cultivation, herbicide application, the location of onsite storage depots and the disposal of waste, set out in the Environmental Requirements for Afforestation (DAFM, 2016).
- There will be no woody weed removal within 20 m of a drainage ditch.

Buffer Zones

There is a requirement in the Forest Service Code of Practice and in the FSC Certification Standard for the installation of buffer zones adjacent to aquatic zones at planting stage. Minimum buffer zone widths recommended in the Forest Service (2000) guidance document "Forestry and Water Quality Guidelines" are shown in Table 5.12.

Table 5.12 Minimum Buffer Zone Widths (Forest Service, 2000)

Average slope leading to the aquatic zone		Buffer zone width on either side of the aquatic zone	Buffer zone width for highly erodible soils
Moderate	(0 – 15%)	10 m	15 m
Steep	(15 – 30%)	15 m	20 m
Very steep	(>30%)	20 m	25 m

Residual Impact.

- No significant impacts on water quality as a result of the proposed afforestation are anticipated.

5.5.4.3 Impacts During Operational Phase (i.e. Harvesting/ Afforestation)

There will be no significant indirect or direct impacts on the biodiversity, ground water or designated sites once the site has been afforested.

Residual Impact

No residual impacts are anticipated associated with the proposed afforestation site during the planted phase.

5.5.4.4 Impact on Designated Sites

Potential indirect impacts on European Designated sites (SACs and SPAs) are fully assessed within a separate Appropriate Assessment Screening Report (AASR), see Appendix 2. The AASR concludes that:

> *It is concluded 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 replanting replacement land, individually or in combination with other plans and projects, will not have a significant effect on any European Site.*
>
> *The proposed afforestation has Technical Approval from the Forest Service and will be undertaken accordingly. This approval is conditional to all associated works being undertaken in accordance with Forest Service requirements. The impacts associated with this afforestation have been classified overall as a neutral impact. As such, when considered in combination with the other land uses in the area, and considering that the forestry guidelines are designed to minimise and prevent impacts to habitats that are outside the site, cumulative impacts on sensitive ecological receptors are not anticipated.*

The impact on nationally designated sites was assessed as per Table 5.8 above and there was no Natural Heritage Areas (NHA) or proposed Natural Heritage Areas (pNHAs) identified within the Zone of Likely Impact. All forestry activities will be undertaken in accordance with industry guidance and best practice. No potential for significant effect was identified based on the nature and scale of the works and separation in distance from the designated site.

5.5.4.5 Cumulative Impacts

The proposed afforestation has Technical Approval from the Forest Service and will be undertaken accordingly. This approval is conditional to all associated works being undertaken in accordance with Forest Service requirements. The impacts associated with this afforestation have been classified overall as a neutral impact. As such, when considered in-combination with the other land uses in the area, and considering that the forestry guidelines are designed to minimise and prevent impacts to habitats that are outside the site, cumulative impacts on sensitive ecological receptors are not anticipated.

5.6 Forestry replacement lands - Site 3: Ballard, Co. Wicklow

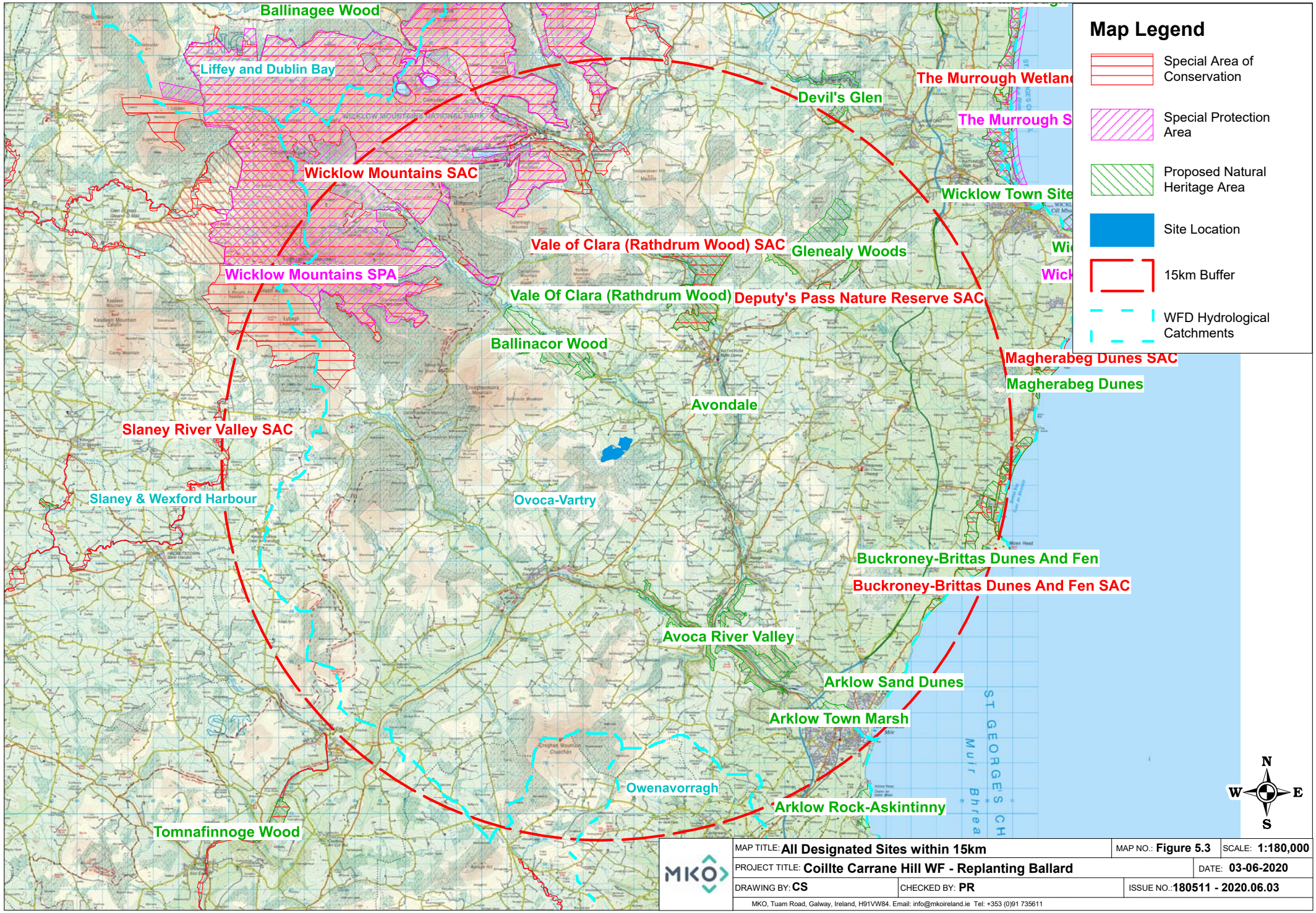
The proposed forestry replacement land at Ballard, Co. Wicklow has been assessed as part of the Afforestation Approval – Form 1 process described above and has obtained Technical Approval for Afforestation from the Forest Service. The site location is presented in Figure 2.5.

5.6.1 Desk Study

The following sections detail the results of the searches of published material that were consulted as part of the desk study for the Ballard site.

5.6.1.1 Identification of the Designated Sites Likely Zone of Influence of the Project

Using the Geographic Information System (GIS) software QGIS Version 3.4 designated sites within a within a 15-kilometre radius of the proposed afforestation site were identified. Sites outside 15km were considered but no potential for impact was identified. The European designated sites are listed below in Table 5.13. Special Areas of Conservation (SACs) and Special Protection Areas for birds (SPAs) are



MAP TITLE: **All Designated Sites within 15km**		MAP NO.: **Figure 5.3**	SCALE: **1:180,000**
PROJECT TITLE: **Coillte Carrane Hill WF - Replanting Ballard**			DATE: **03-06-2020**
DRAWING BY: **CS**	CHECKED BY: **PR**		ISSUE NO.: **180511 - 2020.06.03**

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designated under the EU Habitats Directive and EU Birds Directive, respectively, and are collectively known as 'European Sites'. The potential for significant effects on the integrity of European Sites is fully assessed in the AA Screening Report that accompanies this application, see Appendix 3. As per EPA draft Guidance 2017, *"a biodiversity section of an EIAR, should not repeat the detailed assessment of potential effects on European sites"* contained in a Screening for Appropriate Assessment but should *"incorporate their key findings as available and appropriate"*. Section 5.6.1.1 of this document provides a summary of the key assessment findings with regard to European Designated Sites. All designated sites are displayed in Figure 3.1of the accompanying AASR and Figure 5.3 of this report.

Natural Heritage Areas (NHAs) are designated under Section 18 the Wildlife (Amendment) Act 2000 and their management and protection is provided for by this legislation and planning policy. The potential for effects on these designated sites is fully considered in this assessment.

Proposed Natural Heritage Areas (pNHAs) were designated on a non-statutory basis in 1995 but have not since been statutorily proposed or designated. However, the potential for effects on these designated sites is fully considered in this EcIA. Nationally designated sites are listed in Table 5.14.

Table 5.13 Identification of Designated sites within the Likely zone of Impact

European Sites and distance from proposed development	Likely Zone of Impact Determination
Vale of Clara (Rathdrum Wood) SAC (000733) **Distance:** 4.7km	There will be no direct effects as the project footprint is located entirely outside the designated site. This European site is designated for terrestrial habitats and is located in a separate hydrological sub-catchment to the proposed afforestation works. No pathway for indirect effect between the proposal and the designated site exists. No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.
Wicklow Mountains SAC (002122) **Distance:** 7.8km	There will be no direct effects as the project footprint is located entirely outside the designated site. Wicklow Mountains SAC is located approximately 7.8km north-west of the proposed afforestation site and are buffered by agricultural, forestry, peatland and scrub habitats. Although the sites are located within the same hydrological catchment, no hydrological connectivity exists between the proposed development and the designated site. No pathway for effect was identified and the site is not within the Likely Zone of Impact.
Deputy's Pass Nature Reserve SAC (000717) **Distance:** 9.0km	There will be no direct effects as the project footprint is located entirely outside the designated site. This European site is designated for terrestrial habitats. There is no connectivity between the forestry replacement lands and the SAC. Therefore, no pathways for indirect effects were identified. No pathway for effect was identified and the site is not within the Likely Zone of Impact.
Buckroney-Brittas Dunes and Fen	There will be no direct effects as the project footprint is located entirely

European Sites and distance from proposed development	Likely Zone of Impact Determination
SAC (000729) **Distance:** 13.4km	outside the designated site. This European site is located in a separate hydrological sub-catchment to the proposed afforestation works. Given the nature and small scale of the forestry replacement lands and the distance between the works and the SAC, no pathways for indirect effects via surface water were identified. No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.
Slaney River Valley SAC (000781) **Distance:** 14.7km	There will be no direct effects as the project footprint is located entirely outside the designated site. This European site is located in a separate hydrological catchment to the proposed afforestation works. Given the nature and small scale of the forestry replacement lands and the distance between the works and the SAC, no pathways for indirect effects via surface water were identified or any significant impacts on any QI's. No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.
Special Protection Areas (SPAs)	
Wicklow Mountains SPA (004040) **Distance:** 7.8km	There will be no direct effects as the project footprint is located entirely outside the designated site. The proposed afforestation site is located outside of the core foraging range of Merlin (5km core range) and Peregrine (2km core range) (SHN 2016). The site does not support significant suitable habitat for the SCI species for which the SPA is designated. Therefore, potential for indirect effects as a result of disturbance can be ruled out. No pathway for effect was identified and the site is not within the Likely Zone of Impact.

Table 5.14 Identification of nationally designated sites within the Likely Zone of Impact

Designated Sites and distance from proposed development	Features of Interest	Likely Zone of Impact Determination
Natural Heritage Area (NHA)		
There are no NHA's within 15km of the proposed afforestation site		
Proposed Natural Heritage Area (pNHA)		
Ballinacor Wood [001749] **Distance:** 2.7 km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. Ballinacor Wood pNHA is located approximately 2.7km

Designated Sites and distance from proposed development	Features of Interest	Likely Zone of Impact Determination
		north-west of the proposed afforestation site and are buffered by predominantly agricultural and forestry, habitats. Although the sites are located within the same hydrological catchment, no hydrological connectivity exists between the proposed development and the designated site. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Avondale [002093] Distance: 3.9km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. Avondale pNHA is located approximately 3.9km east of the proposed afforestation site and are buffered by predominantly agricultural and forestry habitats. Although the sites are located within the same hydrological catchment, no hydrological connectivity exists between the proposed development and the designated site. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Vale of Clara (Rathdrum Wood) [000733] **Distance:** 4.7 km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this natural heritage site, located in a separate hydrological sub-catchment. Therefore, no pathway for indirect effect between the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Avoca River Valley **Distance**: 4.9km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. The proposed afforestation site has surface water connectivity in excess of 11.8km downstream with Avoca River Valley pNHA via Ballyeustace stream which discharges into the Avonbeg River. However, given distance downstream and nature and small scale of the forestry replacement lands as permitted in the technical approval document there is no potential for indirect effects on this pNHA. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**
Glenealy Woods **Distance:** 8.8km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed

Designated Sites and distance from proposed development	Features of Interest	Likely Zone of Impact Determination
		afforestation site and this natural heritage area, located in a separate hydrological sub-catchment. Therefore, no pathway for indirect effect between the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Arklow Town Marsh **Distance:** 12.6km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. The proposed afforestation site has surface water connectivity in excess of 20.3km downstream with Arklow Town Marsh pNHA via Ballyeustace stream which discharges into the Avonbeg River which joins the Avoca River further downstream. However, given distance downstream and nature and small scale of the forestry replacement lands as permitted in the technical approval document there is no potential for indirect effects on this pNHA. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**
Buckroney-Brittas Dunes And Fen (000729) **Distance:** 13.4km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this natural heritage site, located in a separate hydrological sub-catchment. Therefore, no pathway for indirect effect between the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Arklow Sand Dunes **Distance:** 13.8km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this coastal natural heritage site, located in a separate hydrological sub-catchment. Therefore, no pathway for indirect effect between the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**
Devil's Glen **Distance:** 14.7km	› N/A	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this natural heritage area, located in a

Designated Sites and distance from proposed development	Features of Interest	Likely Zone of Impact Determination
		separate hydrological sub-catchment. Therefore, no pathway for indirect effect between the proposal and the designated site exists. **No pathway for effect was identified and the site is not within the Likely Zone of Impact.**

5.6.1.2 New Flora Atlas

A search was made in the New Atlas of the British & Irish Flora (Preston et al, 2002) to investigate whether any rare or unusual plant species listed under Annex II of the EU Habitats Directive, Ireland Red List no 10 Vascular Plants (Wyse et.al 2016) or the Flora (Protection) Order, 2015 had been recorded in the relevant 10km square in which the study site is situated (T18), during the 1987-1999 atlas survey. Lanceolate spleenwort *(Asplenium obovatum),* sword-leaved helleborine*(Cephalanthera longifolia)* and heath cudweed*(Gnaphalium sylvaticum)*protected under the Flora (Protection) Order, 1999 (as amended 2015) have been previously recorded within the hectad. Oak fern (*Gymnocarpium dryopteris)* and shepherd's-needle *(Scandix pecten-veneris)* protected as Red Listed (Regionally Extinct) species have been previously recorded within the hectad T18 in which the proposed afforestation site lies. Green-Winged Orchid *(Orchis morio),* lanceolate spleenwort *(Asplenium obovatum)* and sword-leaved helleborine (*Cephalanthera longifolia)* protected as Red List (Vulnerable) were also recorded within hectad T18. Common moonwort *(Botrychium lunaria),* dwarf spurge *(Euphorbia exigua),* large flowered hemp nettle *(Galeopsis speciosa),* corn marigold *(Chrysanthemum segetum),* bog orchid *(Hammarbya paludosa),* greater broomrape*(Orobanche rapum-genistae)* and common wintergreen*(Pyrola minor)* protected as Red listed (Near threatened) species have also been previously recorded within the hectad T18 in which the proposed afforestation site lies.

5.6.1.3 National Biodiversity Data Centre Notable Records

A search of the National Biodiversity Data Centre (NBDC) website was conducted with a focus on records of protected fauna recorded from hectad T18. The results of the database search (excluding birds) are provided below in Table 5.15 and the results for bird species recorded within the hectad are provided in

Table 5.16. Table 5.17 includes records of non-native invasive species listed under the Third Schedule of the European Communities Regulations 2011 (S.I. 477 of 2015).

Table 5.15 Notable species that occur within 10km Grid Square T18 [excluding birds]

Common Name	Scientific Name	Designation
Brown long-eared bat	*Plecotus auritus*	HD Annex IV, WA
Common frog	*Rana temporaria*	HD Annex V, WA
Daubenton's bat	*Myotis daubentonii*	HD Annex IV, WA
Eurasian badger	*Meles meles*	WA
Eurasian red squirrel	*Sciurus vulgaris*	WA
European otter	*Lutra lutra*	HD Annex II & IV, WA
Irish Hare	*Lepus timidus subsp. Hibernicus*	WA
Irish Stoat	*Mustela erminea subsp. Hibernica*	WA
Lesser noctule	*Nyctalus leisleri*	HD Annex IV, WA
Marsh fritillary	*Euphydryas aurinia*	HD Annex II

Pine marten	*Martes martes*	HD Annex V, WA
Pipistrelle	*Pipistrellus pipistrellus sensu lato*	HD Annex IV, WA
Soprano pipistrelle	*Pipistrellus pygmaeus*	HD Annex IV, WA
West European Hedgehog	*Erinaceus europaeus*	WA
Whiskered bat	*Myotic mystacinus*	HD Annex IV, WA

WA = Wildlife Acts (1976-2019), HD Annex II, III, IV and V = EU Habitats Directive.

Table 5.16 Notable bird species that occur within 10km Grid Square T18

Common Name	Scientific Name	Designation
Barn owl	*Tyto alba*	BoCCI Red List, WA
Black-headed gull	*Larus ridibundus*	BoCCI Red List, WA
Common kingfisher	*Alcedo atthis*	BD Annex I, WA
Corn crake	*Crex crex*	BD Annex I, BoCCI Red List, WA
Eurasian curlew	*Numenius arquata*	BoCCI Red List, WA
Eurasian woodcock	*Scolopax rusticola*	BoCCI Red List, WA
Grey partridge	*Perdix perdix*	BoCCI Red List, WA
Grey wagtail	*Motacilla cinerea*	BoCCI Red List, WA
Hen harrier	*Circus cyaneus*	BD Annex I, WA
Herring gull	*Larus argentatus*	BoCCI Red List, WA
Meadow pipit	*Anthus pratensis*	BoCCI Red List, WA
Merlin	*Falco columbarius*	BD Annex I, WA
Northern lapwing	*Vanellus vanellus*	BoCCI Red List, WA
Peregrine falcon	*Falco peregrinus*	BD Annex I, WA
Red grouse	*Lagopus lagopus*	BoCCI Red List, WA
Yellowhammer	*Emberiza citronella*	BoCCI Red List, WA

BoCCI Red List = Birds of Conservation Concern Red List; BD Annex I = EU Birds Directive Annex I, WA = Wildlife Acts (1976-2019).

Table 5.17 NBDC records for invasive species in hectad T18

Common Name	Scientific Name
American Mink	*Mustela vison*
Brown rat	*Rattus norvegicus*
Chinese Muntjac	*Muntiacus reevesi*
Eastern Grey Squirrel	*Sciurus carolinensis*
Fallow deer	*Dama dama*
Greylag goose	*Anser anser*
Himalayan knotweed	*Persicaria wallichii*
Rhododendron	*Rhododendron ponticum*
Salmonberry	*Rubus spectabilis*
Sitka deer	*Cervus Nippon*
Three-cornered garlic	*Allium triquetrum*

5.6.1.4 Water Quality

The proposed afforestation site is located within the Avoca-Vartry Catchment. The Ballyeustace stream, a tributary of the Avonbeg River flows along the site to the north-west draining in a north easterly direction.

There is no EPA water quality monitoring station downstream from the Ballyeustace stream to provide a River Water Quality assessment score. There is a monitoring station downstream of the site along Avonbeg River approximately 3.7km downstream of the site. The latest Q value from this monitoring station Avonbeg - Ballinaclash Bridge River Station from 1990 was '5' – 'High' Q ValueStatus. The Water Framework Directive (WFD) river waterbody status for the Ballyeustace stream has been assessed as 'Good'. The Ground waterbody WFD Status 2013-2018 for the area in which the forestry replacement lands, and wider surrounding area, is 'Good'.

5.6.1.5 Freshwater Pearl Mussel Sensitive Areas

The site is not located within a freshwater pearl mussel (*Margaritifera margaritifera*) sensitive area. The site has no connectivity to any freshwater pearl mussel sensitive areas.

5.6.1.6 Conclusions of the Desktop Study

The afforestation site is not located within any site designated for nature conservation. The site has downstream connectivity with Avoca River Valley pNHA >11.8km downstream and Arklow Town Marsh pNHA approximately 20.3km downstream. However, given distance downstream, nature and small scale of the works (afforestation only) as permitted in the technical approval document there is no potential for indirect effects on the natural heritage area.

The mammal species recorded within the relevant hectad have widespread range and distributions and are likely to be recorded frequently throughout Ireland. A number of rare and protected flora and fauna have been recorded from the hectad in which the proposed development is located.

5.6.2 Habitats Present

The proposed afforestation site was visited on the 29th October 2018. The dominant habitats at the site were ***Scrub (WS2).*** In the western block, the scrub formed a habitat mosaic with ***Dry-humid acid grassland (GS3).*** Pockets of ***Dense bracken (HD1***) occurs throughout the site, mostly adjoining disused tracks which are classified as ***Recolonising bare ground (ED3).*** The site boundaries are a combination of ***Hedgerow (WL1)*** habitat and ***Treeline (WL2).*** Both the eastern and western extent of the Ballard site each features a small area of ***Immature woodland (WS2),*** consisting of birch (*Betula* sp.). The western extent of the Ballard site features a small area of ***Mixed broadleaved conifer woodland (WD2), Conifer plantation (WD4)*** and ***Wet grassland (GS4).***

The only evidence of drainage at the Ballard site existed as shallow drills created during a previous planting operation. These were widely spaced and sloped towards the Ballyeustace Stream classified as ***Depositing/lowland river (FW2***). The stream flows along the north–western and northern boundary of the western compartment and along the northern boundary of the eastern compartment. The sides of this stream are well vegetated by willows (*Salix sp.)* and birch (*Betula* sp.). The shallow drains were dry at the time of the survey and had floral cover of terrestrial plants.



Plate 5.3 Typical character of the replacement lands at Ballard (Photo: Malachy Walsh & Partners).

5.6.2.1 Significance of Habitats

Ecological evaluation within this section follows a methodology that is set out in Chapter 3 of the 'Guidelines for Assessment of Ecological Impacts of National Roads Schemes' (NRA, 2009).

No habitats which correspond to those that are listed in the EU Habitats Directive were identified during the site visit. Treelines, hedgerows, woodland habitats and the lowland/depositing river habitats were assigned a significance of Local Importance (Higher Value) as these habitats have a higher level of biodiversity within the context of the local environment, and provide cover and commuting corridor links between habitats of higher ecological value.

The grassland habitats, scrub and bare ground within the site is of Local Importance (Lower Value) as it contains areas which are of some local importance for wildlife.

5.6.3 Fauna in the Existing Environment

Non-volant mammals

A comprehensive search of the site for mammals was undertaken. Evidence of badger (a subsidiary sett) and sitka deer was seen while onsite as well as droppings were identified within the development boundary.

Bats

There are no structures within the site which may provide suitable roosting habitat for bats. Treelines, hedgerows, woodland habitat and the stream habitat within and around the site are likely to be utilised by commuting and foraging bat species.

Birds

Bird species recorded within the site included jay *(Garrulus glandarius)*, snipe (*Gallinago gallinago*), buzzard (*Buteo buteo),* kestrel (*Falco tinnunculus*) and stonechat *(Saxicola torquata).* The site provided habitat for a range of common and widespread species but not of significance for rare or protected bird species. Given the lack of significant habitat for rare or protected bird species, there is no requirement for further bird surveys at the site.

5.6.3.1 Significance of Fauna

No evidence of Annex listed species were recorded within the site boundaries. Evidence of badger was observed from a single subsidiary sett entrance identified within the site boundary.

The watercourse along the site boundaries is likely to be utilised by commuting and foraging otter. Otter is listed on Annex II and IV of the EU Habitats Directive and is protected under the Irish Wildlife Act. No suitable habitat for other species of conservation concern was identified within the proposed afforestation site.

No Annex I listed bird species and no bird species associated with any SPA were recorded during the site visit. Bird species recorded within the site were common species. The forestry replacement site provides some foraging and nesting habitats for these and other common bird species in general.

5.6.4 Impact Assessment

5.6.4.1 Do Nothing' Impact

Were the site to remain unplanted the management on site would likely remain as it is presently i.e. Scrub habitat mosaic with Dry-humid acid grassland, wet grassland with some dense bracken accumulations, woodland habitats with the river running along the site boundary. However, given that the site has received Technical Approval from the Forest Service as described above it will be afforested per the provisions of the approval at a later date.

5.6.4.2 Impacts During the Site Preparation and Planting Phase

5.6.4.2.1 *Loss of Floral Habitat*

Long-Term Neutral Impact

The proposed afforestation will result in the loss of wet agricultural grassland, dense bracken habitats, scrub, bare ground and some dry-humid acid grassland assigned Local importance (lower value). These habitats are common in the wider landscape and the loss of these habitats is not considered to be significant.

The treelines, hedgerows and woodland habitats within the site will be retained.

The impacted habitats are not considered to be of ecological sensitivity and their loss will constitute a neutral impact when compared with the coniferous forestry to be planted. The loss of these habitats is not considered significant.

Mitigation

Despite the fact that the loss of habitats on the forestry replacement site is not a significant ecological effect, all works will be carried out in accordance with the relevant Forest Service requirements, including 'Forestry Biodiversity Guidelines' (2000)'. All hedgerows and existing treelines will be retained and appropriate set-back applied as per the Forest Service document 'Environmental Requirements for Afforestation (2016)'. The Technical Approval document specifies the area that should contain a suitable broadleaf and conifer species. This management would allow for the retention of the Local Value (Higher Importance) habitats.

Residual Impact

The replacement of these grassland habitats, scrub and bracken with forestry is considered to be a Long Term Neutral Impact. No significant effects are anticipated.

5.6.4.2.2 *Loss of Faunal Habitat*

Long Term Neutral Impact

The proposed planting site is not of high value or importance as a faunal habitat, being dominated mostly by wet agricultural grassland, dense bracken habitats, scrub, bare ground and some dry-humid acid grassland assigned Local importance (lower value). It is likely that the proposed planting of forestry will result in some loss of foraging habitat for deer. These habitats are common in the wider landscape and the loss of these habitats is not considered to be significant.

Evidence of badger was observed from a single subsidiary sett entrance identified within the site boundary. A pre-planting commencement site visit should be conducted by a qualified ecologist to determine if the sett is occupied. If it established that the sett is active a badger sett closure licence should be applied for from NPWS, to temporarily close the sett during planting in order to avoid any potential impact on badger. Following the completion of the afforestation/planting, the sett will be reopened. Loss would therefore be short-term in nature. All affected badger setts should be clearly marked, and the extent of bounds prohibited for vehicles clearly marked by fencing and signage. As per the NRA (2006) '*guidelines for the treatment of badgers prior to the construction of national road schemes*', 'light work, such as digging by hand or scrub clearance should not take place within 10m of sett entrances,' however this work should not be undertaken during the breeding season (December to June inclusive).

The proposed development site does not provide significant foraging or roosting habitat for protected bird species given the highly managed/modified nature of habitats on site, dominated by agricultural

wet grassland. Given the lack of significant bird assemblages recorded within or adjacent to the site, significant impacts as a result of disturbance or displacement are not anticipated on bird species at any geographic scale.

Treelines, hedgerow and woodland habitat provide bat commuting and foraging habitat and there will be no loss of hedgerow or trees as part of the proposal and therefore no impacts on bat commuting and foraging habitat.

The afforestation, in particular that of broadleaf species will result in the creation of cover and nesting habitat for a range of bird species, resulting in an overall Long-Term Neutral Impact.

Mitigation / Best Practice

- Afforestation will be preceded by an ecological survey to identify if badger occupy the site by an appropriately qualified and experienced ecologist. If badger are found to occupy the site, consultation with the National Parks and Wildlife Service (NPWS) will be required,
- Any works undertaken within 50 metres of any identified badger sett will be undertaken under licence from the National Parks and Wildlife Service (NPWS). All such works will follow best practice measures described in the NRA (2006) '*guidelines for the treatment of badgers prior to the construction of national road schemes*',
- Where works are undertaken within 30 metres of a badger sett, site preparation works will be supervised by an appropriately qualified ecologist as per NRA (2006) guidelines.
- All works will be carried out in accordance with the relevant Forest Service requirements, including '*Forestry Biodiversity Guidelines*' (2000)'.
- All hedgerows, existing treelines and mixed broadleaf woodland will be retained and appropriate set-back applied as per the Forest Service document '*Environmental Requirements for Afforestation (2016)*'.
- Vegetation clearance will be carried out in line with the Wildlife Act.

Residual Impact.

- No significant effects on faunal habitat as a result of the proposed afforestation is anticipated.

5.6.4.2.3 *Water Pollution*

Short-Term Slight Negative Impact

Following a precautionary approach, in the absence of best practice and design, there is potential for water pollution to occur through discharge to the Ballyeustace stream along the site's northern and north-western boundaries and therefore potential localised water pollution effects in the form of release of suspended solids, siltation and erosion as a result of the proposed afforestation.

Mitigation

Best Practice

Best practice methods related to water incorporated into the forestry management and mitigation measures have been derived from:

- Forestry Commission (2004): Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh;
- Coillte (2009): Forest Operations & Water Protection Guidelines;

- Forest Service (Draft): Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures; and,
- Forest Service (2000): Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.
- Forest Service (2016) Environmental Requirements for Afforestation. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.
- Forest Service (2016) Land Types for Afforestation. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.

Measures which will reduce the risk of entrainment of suspended solids and nutrient release in surface watercourses comprise best practice methods which will be applied at the forestry replacement lands. These include:

- Machine combinations will be chosen which are most suitable for ground conditions at the time of excavation and felling, and which will minimise surrounding soils disturbance;
- Where possible, existing drains will not be disturbed during drainage works;
- Drains and sediment traps will be installed during ground preparation and felling. Collector drains will be excavated at an acute angle to the contour (~0.3%-3% gradient), to minimise flow velocities. Main drains to take the discharge from collector drains will include water drops and rock armour, as required, where there are steep gradients, and should avoid being placed at right angles to the contour;
- Drains and silt traps will be maintained throughout all planting works, ensuring that they are clear of sediment build-up and are not severely eroded. Correct drain alignment, spacing and depth will ensure that erosion and sediment build-up are minimised and controlled;
- Apply a 5 metre wide (minimum) uncultivated and unplanted water setback along relevant watercourses (as defined in Circular 12/2017) located within or adjoining the site. This setback is to remain undisturbed during establishment and throughout the forest rotation. Apply and maintain as per details set out in Tables 5 and 6 of the Environmental Requirements for Afforestation (DAFM, 2016).
- Adhere to all water protection measures relating to cultivation, herbicide application, the location of onsite storage depots and the disposal of waste, set out in the Environmental Requirements for Afforestation (DAFM, 2016).
- There will be no woody weed removal within 20 m of a drainage ditch.

Buffer Zones

There is a requirement in the Forest Service Code of Practice and in the FSC Certification Standard for the installation of buffer zones adjacent to aquatic zones at planting stage. Minimum buffer zone widths recommended in the Forest Service (2000) guidance document "Forestry and Water Quality Guidelines" are shown in Table 5.18.

Table 5.18 Minimum Buffer Zone Widths (Forest Service, 2000)

Average slope leading to the aquatic zone		Buffer zone width on either side of the aquatic zone	Buffer zone width for highly erodible soils
Moderate	(0 – 15%)	10 m	15 m
Steep	(15 – 30%)	15 m	20 m
Very steep	(>30%)	20 m	25 m

Residual Impact

No impacts on water quality are anticipated as a result of any element of the proposed afforestation.

5.6.4.3 Impacts During Operational Phase (i.e. Harvesting/ Afforestation)

There will be no significant indirect or direct impacts on the biodiversity, surface or ground water. In addition, no potential for impact on designated sites was identified once the site has been afforested.

Residual Impact

No residual impacts are anticipated associated with the proposed afforestation while planted.

5.6.4.4 Impact on Designated Sites

Potential indirect impacts on European Designated sites (SACs and SPAs) are fully assessed within a separate Appropriate Assessment Screening Report (AASR), see Appendix 3. The AASR report concludes that:

> *It is concluded 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 forestry replacement land, individually or in combination with other plans and projects, will not have a significant effect on any European Site.*
>
> *The proposed afforestation has Technical Approval from the Forest Service and will be undertaken accordingly. This approval is conditional to all associated works being undertaken in accordance with Forest Service requirements. The impacts associated with this afforestation have been classified overall as a neutral impact. As such, when considered in-combination with the other land uses in the area, and considering that the forestry guidelines are designed to minimise and prevent impacts to habitats that are outside the site, cumulative impacts on sensitive ecological receptors are not anticipated.*

The impact on nationally designated sites was assessed as per Table 5.15 above and there was no Natural Heritage Areas (NHA) or proposed Natural Heritage Areas (pNHAs) identified within the Zone of Likely Impact. All forestry activities will be undertaken in accordance with industry guidance and best practice. No potential for significant effect was identified based on the nature and scale of the works and separation in distance from the designated site.

5.6.4.5 Cumulative Impacts

The proposed afforestation has Technical Approval from the Forest Service and will be undertaken accordingly. This approval is conditional to all associated works being undertaken in accordance with Forest Service requirements. The impacts associated with this afforestation have been classified overall as a neutral impact. As such, when considered in-combination with the other land uses in the area, and considering that the forestry guidelines are designed to minimise and prevent impacts to habitats that are outside the site, cumulative impacts on sensitive ecological receptors are not anticipated.

6. SOILS AND GEOLOGY

6.1 Introduction

This section of the report provides baseline information on the environmental setting of the approved forestry replacement sites in terms of soils and geology and assesses the potential impacts that the activity may have on these. Where required, appropriate mitigation measures to limit any identified significant impacts to soils and geology are recommended.

6.2 Desk Study

This desk study involved collecting all relevant geological data for each site and its surrounding area. This included consultation of the following:

- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland - National Draft Bedrock Aquifer map;
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Geological Survey of Ireland (GSI, 2003);
- Geological Survey of Ireland – 1:25,000 Field Mapping Sheets; and,
- General Soil Map of Ireland 2nd edition (www.epa.ie).

6.2.1 Impact Assessment Methodology

Using information from the desk study, an estimation of the importance of the soil and geological environment within the study area is assessed using the criteria set out in Table 6.1 (NRA, 2005).

Table 6-1 Estimation of Importance of Soil and Geology Criteria (NRA, 2005)

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale.	Geological feature rare on a regional or national scale (NHA). Large existing quarry or pit. Proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and/or soft organic soil underlying site is significant on a local scale.	Contaminated soil on site with previous heavy industrial usage. Large recent landfill site for mixed wastes Geological feature of high value on a local scale (County Geological Site). Well drained and/or highly fertility soils. Moderately sized existing quarry or pit Marginally economic extractable mineral resource.

Medium	Attribute has a medium quality, significance or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and/or soft organic soil underlying site is moderate on a local scale.	Contaminated soil on site with previous light industrial usage. Small recent landfill site for mixed Wastes. Moderately drained and/or moderate fertility soils. Small existing quarry or pit. Sub-economic extractable mineral Resource.
Low	Attribute has a low quality, significance or value on a local scale. Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying site is small on a local scale.	Large historical and/or recent site for construction and demolition wastes. Small historical and/or recent landfill site for construction and demolition wastes. Poorly drained and/or low fertility soils. Uneconomically extractable mineral Resource.

The statutory criteria (EPA, 2017, EPA, 2002 and EPA, 2003) for the assessment of impacts require that likely impacts are described with respect to their extent, magnitude, complexity, probability, duration, frequency, reversibility and transfrontier nature (if applicable). The descriptors used in this environmental impact assessment are those set out in EPA (2017) Glossary of Impacts as shown in Section 1 of the EIAR which accompanied the application. In addition, the two impact characteristics proximity and probability are described for each impact and these are defined in Table 6.2.

In order to provide an understanding of this descriptive system in terms of the geological/hydrological environment, elements of this system of description of impacts are related to examples of potential impacts on the hydrology and morphology of the existing environment, as listed in Table 6.3.

Table 6-2 Additional Impact Characteristics

Impact Characteristic	Degree/ Nature	Description
Proximity	Direct	An impact which occurs within the area of the proposed project, as a direct result of the proposed project.
	Indirect	An impact which is caused by the interaction of effects, or by off-site developments.
Probability	Low	A low likelihood of occurrence of the impact.
	Medium	A medium likelihood of occurrence of the impact.
	High	A high likelihood of occurrence of the impact.

Table 6-3 Impact descriptors related to the receiving environment

Impact Characteristics		Potential Hydrological Impacts
Quality	Significance	
Negative only	Profound	Widespread permanent impact on: - The extent or morphology of a SAC. - Regionally important aquifers. - Extents of floodplains. Mitigation measures are unlikely to remove such impacts.
Positive or Negative	Significant	Local or widespread time dependent impacts on: -The extent or morphology of a SAC / ecologically important area. -A regionally important hydrogeological feature (or widespread effects to minor hydrogeological features). -Extent of floodplains. Widespread permanent impacts on the extent or morphology of an NHA/ecologically important area, Mitigation measures (to design) will reduce but not completely remove the impact – residual impacts will occur.
Positive or Negative	Moderate	Local time dependent impacts on: - The extent or morphology of a SAC / NHA / ecologically important area. - A minor hydrogeological feature. - Extent of floodplains. Mitigation measures can mitigate the impact OR residual impacts occur, but these are consistent with existing or emerging trends
Positive, Negative or Neutral	Slight	Local perceptible time dependent impacts not requiring mitigation.
Neutral	Imperceptible	No impacts, or impacts which are beneath levels of perception, within normal bounds of variation, or within the bounds of measurement or forecasting error.

6.3 Proposed Replanting Lands

6.3.1 Replanting Area 1: Stranamart, Co. Cavan

6.3.1.1 Geology and Subsoils

Information on the main geological formations and subsoils underlying replanting area 1 Stranamart, Co. Cavan.

Table 6-4 Information on geology and subsoil under site in Stranamart, Co. Cavan.

Site	Geological Formation	Subsoil Type
Stranamart	› Pale orthoquartzitic sandstone	› Shales and sandstones till (Namurian) › Cutover peat

Much of the site at Stranamart is underlain with Pale orthoquartzitic sandstone, described as ah omogenous, thick bedded, medium-grained, orthoquartzitic, brown coloured sandstone with minor amounts of shale. The subsoil comprises Shales and sandstones till (Namurian) with pockets of cutover peat to the east and south. The immediate area surrounding the site is underlain with similar subsoils to the site; however, further to the east and west, vast areas of blanket peat can be found.

6.3.1.2 Geological Resource Importance

The bedrock at the site is classified as having a "moderate potential" for construction purposes. There is no record of mining in the area.

The peat deposits at the site are classified as "low" importance. Is not designated in this area, is poorly drained and extensive in the surrounding landscape. Refer to Table 6.1 for criteria.

6.3.1.3 Geological Heritage and Designated Sites

There are no recorded Geological Heritage sites, historical landslides, mineral deposit sites or mining sites (current or historic) within the proposed development area.

6.3.1.4 Potential Impacts

6.3.1.4.1 *Likely and Significant Impacts and Associated Mitigation Measures*

The likely impacts of the proposed development and mitigation measures that will be put in place to eliminate or reduce them are described below.

Construction of Drains and Planting of Trees

There will be some minor disturbance of soils, associated with the construction of drains through the site. Planting of trees will be carried out by hand using the slit planting method, so soil disturbance from this will be insignificant. There are no likely impacts of this afforestation on the underlying geology.

Site Roads & Tracks Construction

Forestry felling would typically occur within 0.5km of access points (roads & tracks) to the main forest body. Due to the small size of this site, additional access tracks or roads will not be required. This site is located adjacent to an existing road network which will not require upgrading or alteration.

6.3.1.5 Mitigation Measures

Planting of trees will be carried out by hand. Any drains will be generally shallow and will be constructed in accordance with the forestry service best practice guidelines described in detail in Section 2. Soils will remain in situ at the site and will not be removed offsite.

6.3.2 Operational Phase

There will be no significant indirect or direct impacts on soils and geology once the site has been afforested.

6.3.2.1.1 *Residual Impact*

There will be no impacts on soils and geology associated with the proposed afforestation.

6.3.2.1.2 *Significance of the Effects*

Based on the above, there will be no significant effects on soils and geology at this site.

6.3.3 Replanting Area 2: Brackloon, Co. Roscommon

6.3.3.1 Geology and Subsoils

Information on the main geological formations and subsoils underlying replanting area 2, Brackloon, Co. Roscommon.

Table 6-5 Information on geology and subsoil under site in Brackloon Co. Roscommon.

Site	Geological Formation	Subsoil Type
› Brackloon	› Dark fine-grained limestone & shale	› Till derived from mixed Devonian and Carboniferous rock › Cutover peat

The site at Brackloon is underlain with dark fine-grained limestone & shale with a sandstone till (Devonian/ Carboniferous) subsoil covering most of the site. A strip of cutover peat subsoil can be found along the southern boundary. To the east and further south, the same subsoils can be found, while to the north, west and immediate south, basin peat can be found.

6.3.3.2 Geological Resource Importance

The limestone & shale bedrock at the site is classified as “Medium” importance. The bedrock is used on a “sub-economic” local scale for construction purposes. The bedrock at the site has not been used in the past for this purpose.

6.3.3.3 Geological Heritage and Designated Sites

There are no recorded Geological Heritage sites, mineral deposit sites or mining sites (current or historic) within the proposed development area.

6.3.3.4 Potential Impacts

6.3.3.4.1 *'Do-Nothing' Scenario*

The lands have been Technically Approved and will be afforested should the Croagh Wind Farm proceed or not. If the land was not replanted, the current landuse would continue at the site.

6.3.3.4.2 *Likely and Significant Impacts and Associated Mitigation Measures*

The likely impacts of the proposed development and mitigation measures that will be put in place to eliminate or reduce them are described below.

Construction of Drains and Planting of Trees

There will be some minor disturbance of soils, associated with the construction of drains through the site. Planting of trees will be carried out by hand using the slit planting method, so soil disturbance from this will be insignificant. There are no likely impacts of this afforestation on the underlying geology.

Site Roads & Tracks Construction

Forestry felling would typically occur within 0.5km of access points (roads & tracks) to the main forest body. Due to the small size of this site, additional access tracks or roads will not be required. This site is located adjacent to an existing road network which will not require upgrading or alteration.

6.3.3.4.3 *Mitigation Measures*

Planting of trees will be carried out by hand. Any drains will be generally shallow and will be constructed in accordance with the forestry service best practice guidelines described in detail in Section 2. Soils will remain in situ at the site and will not be removed offsite.

6.3.4 Operational Phase

There will be no significant indirect or direct impacts on soils and geology once the site has been afforested.

6.3.5 Residual Impact

There will be no impacts on soils and geology associated with the proposed afforestation.

6.3.5.1.1 *Significance of the Effects*

Based on the above, there will be no significant effects on soils and geology at this site.

6.3.6 Replanting Area 3: Ballard, Co. Wicklow

6.3.6.1 Geology and Subsoils

Information on the main geological formations and subsoils underlying replanting area 3, Ballard, Co. Wicklow.

Table 6-6 Information on geology and subsoil under site in Ballard, Co. Wicklow.

Site	Geological Formation	Subsoil Type
› Ballard	› Dark grey semi-pelitic, psammitic schist	› Sandstone and shale till

The site at Ballard is underlain with dark grey semi-pelitic, psammitic schist, with the subsoil being composed of sandstone and shale till. The surrounding area comprises the same with a small pocket of sandstone and shale sands and gravels to the north of the site.

6.3.6.2 Geological Resource Importance

The schist bedrock at the site is classified as "Medium" importance. The bedrock is used on a "sub-economic" local scale for construction purposes. The bedrock at the site has not been used in the past for this purpose.

6.3.6.3 Geological Heritage and Designated Sites

There are no recorded Geological Heritage sites, mineral deposit sites or mining sites (current or historic) within the proposed development area.

6.3.6.4 Potential Impacts

6.3.6.4.1 *'Do-Nothing' Scenario*

The lands have been Technically Approved and will be afforested should the Croagh Wind Farm proceed or not. If the land was not replanted, the current land use would continue at the site.

6.3.6.4.2 *Likely and Significant Impacts and Associated Mitigation Measures*

The likely impacts of the proposed development and mitigation measures that will be put in place to eliminate or reduce them are described below.

Construction of Drains and Planting of Trees

There will be some minor disturbance of soils, associated with the construction of drains through the site. Planting of trees will be carried out by hand using the slit planting method, so soil disturbance from this will be insignificant. There are no likely impacts of this afforestation on the underlying geology.

Site Roads & Tracks Construction

Forestry felling would typically occur within 0.5km of access points (roads & tracks) to the main forest body ('Forest Roads Scheme'. Forest Service, 2012). Due to the small size of this site, additional access

tracks or roads will not be required. This site is located adjacent an existing road network with existing entrances, which will not require alteration.

6.3.6.4.3 *Mitigation Measures*

Planting of trees will be carried out by hand. Any drains will be generally shallow and will be constructed in accordance with the forestry service best practice guidelines described in detail in Section 2. Soils will remain in situ at the site and will not be removed offsite.

6.3.7 Operational Phase

There will be no significant indirect or direct impacts on soils and geology once the site has been afforested.

6.3.7.1.1 *Residual Impact*

There will be no impacts on soils and geology associated with the proposed afforestation.

6.3.7.1.2 *Significance of the Effects*

Based on the above, there will be no significant effects on soils and geology at this site.

7. HYDROLOGY AND HYDROGEOLOGY

7.1 Introduction

7.1.1 Background and Objectives

The objective of the hydrology and hydrogeology assessment is to:

- Produce a baseline study of the existing water environment (surface and groundwater) in the area of the site locations;
- Identify likely positive and negative impacts of the proposed development on surface and groundwater during all phases of the development; and,
- Identify mitigation measures to avoid, remediate or reduce significant negative impacts.

This section of the report provides baseline information on the environmental setting of the approved afforestation sites in terms of hydrology and hydrogeology and discusses the potential impacts that the activity may have on it. Where required, appropriate mitigation measures to limit any identified significant impacts to site hydrology and hydrogeology are recommended.

7.1.2 Methodology

7.1.2.1 Desk Study

A desk study of the site and the surrounding areas involved collecting the relevant geological, hydrological, hydrogeological and meteorological data for the area. This included consultation with the following:

- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland - National Draft Bedrock Aquifer map;
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie);
- Water Framework Directive "Catchments" Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Geological Survey of Ireland (GSI, 2003);
- OPW Indicative Flood Maps (www.floodmaps.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).

7.1.2.2 Impact Assessment Methodology

Please refer to Chapter 1 of the EIAR for details on the impact assessment methodology (EPA, 2017, 2002 & 2003). In addition to the above methodology, the sensitivity of the water environment receptors was assessed on completion of the desk study. Levels of sensitivity which are defined in Table 7.1 are then used to assess the potential effect that the proposed development may have on them.

Table 7-1 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

7.2 Proposed Drainage

The proposed replanting land will be drained in accordance with the Forestry Guidelines. Forestry plantations are generally drained by a network of mound drains which typically run perpendicular to the topographic contours of the site and feed into collector drains, which discharge to interceptor drains down-gradient of the plantation.

Mound drains are generally spaced approximately every 15m. Interceptor drains are generally located up-gradient (cut-off drains) and down-gradient of forestry plantations. A schematic of a typical standard forestry drainage network and one which is representative of the proposed site drainage network is shown in Figure 2.7 of this report.

7.3 Replanting Area 1: Stranamart, Co. Cavan.

7.3.1 Baseline Environment and Local Hydrology

Ground level elevations at the replanting site range from 93m OD (meters above Ordnance Datum) in the northwest to 120m OD in the northeast.

There are no watercourses within or adjacent to the Stranamart site.

7.3.1.1 Regional Hydrology

The site is located within the Shannon [Upper]_SC_010 subcatchment., which in turn is located in the Upper Shannon Catchment IE_26A. The status of the replanting site and the subcatchment overall is 'Good' condition. The River Waterbodies Risk of the subcatchment area is 'Not at Risk'.

7.3.1.2 Water Balance

While the process of afforestation may result in a slight alteration in the water runoff of the site, the small size of the site (0.13km^2) when compared with the Upper Shannon 26A catchment (604.47 km^2) means that any potential impacts this may have would be insignificant. The afforestation will lead to an imperceptible reduction in the runoff volumes in the longer term as the trees mature.

7.3.1.3 Flood Risk Identification

OPW's indicative river and coastal flood map (www.floodmaps.ie), CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie), Department of Environment, Community and Local Government on-line planning mapping (www.myplan.ie) were consulted to identify those areas as being at risk of flooding.

No records or risks associated with flooding were identified in the published data sets.

7.3.1.4 Surface Water Hydrochemistry

The underlying sandstone bedrock (in part) and the sandstone derived till subsoil and peat would have slightly acidic groundwater characteristics which would have some effect on surface water chemistry, specifically during dry periods when baseflow is likely to be more prevalent.

7.3.1.5 Hydrogeology

The underlying bedrock at the site is mapped as Pale orthoquartzitic sandstone with a Shales and sandstones till (Namurian) subsoil and areas of cutover peat (refer to Section 6 – Soils & Geology). The GSI has classified the bedrock formation here as a Locally Important Aquifer - Bedrock which is Generally Moderately Productive (Lm).

7.3.1.6 Groundwater Vulnerability

The vulnerability rating of the aquifer for the majority of the site is categorised as ''High' (H) with areas of 'Extreme' (E) and 'Rock at or near Surface or Karst' (X) to the south.

7.3.1.7 Surface Water Body Status

The EU Water Framework Directive aims to protect, enhance and restore all waters with aim to achieve at least good status by 2021.

Under the first cycle of the Water Framework Directive Local surface water Body status reports were available for download from www.wfdireland.ie. Local surface water body (1st and 2nd cycle) information is available for viewing from www.catchments.ie.

There are no watercourses within or adjacent to the study site.

7.3.1.8 Groundwater Body Status

Under the first cycle of the Water Framework Directive Local Groundwater Body status reports were available for download from www.wfdireland.ie. and information related to the 1st and 2nd cycles of the WFD is available at www.catchments.ie.

The site is located in the Glenade Dowra IEGBNI_SH_G_264 Ground Water Body (GWB) which has a status of 'Good' in the 2013-2018 assessment cycle and 'Not at Risk'.

7.3.1.9 Designated Sites and Habitats

Designated sites include National Heritage Areas (NHAs), Proposed National Heritage Areas (pNHAs) Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). The proposed site is not located within any designated conservation-site. Designated sites in proximity to the proposed development site are described Section 5 Biodiversity.

7.3.1.10 Water Resources

There are no borehole wells within or adjacent to the site. The nearest borehole G-19-2965 is 1.53km south of the site however, there is no information on the GSI website regarding it function, or year of construction.

7.3.1.11 Receptor Sensitivity

As afforestation is a near-surface construction activity, impacts on groundwater are largely negligible and surface water is generally the main sensitive receptor assessed during impact assessments. The primary risk to groundwater at the site is from nutrients associated with fertilisers.

As there are no surface water bodies within or near the site, there is no risk to waterbody pollution by surface run off in the area.

7.3.2 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 natural drainage features. The second method involves collecting any drainage waters from planted areas within the site that might carry silt or sediment, and nutrients, using cut off drains to control direct discharge into streams.

As there are no surface water bodies within or near the site, there is no risk to waterbody pollution by surface run off in the area, therefore drainage management is not required.

7.3.3 Potential Impacts

The potential impacts of the proposed development and mitigation measures that will be put in place to eliminate or reduce them are set out below.

7.3.3.1 'Do-Nothing' Scenario

The lands have been Technically Approved and will be afforested should the Croagh Wind Farm proceed or not. If the land was not replanted, the current land use would continue at the site.

7.3.3.2 Planting Phase

7.3.3.2.1 *Excavation of Forestry Drains and Planting*

Pathways: Drainage and surface water discharge routes.

Receptors: Surface waters and associated dependent ecosystems.

Potential Impacts: Indirect, negative, slight, short term low probability impact.

Shallow forestry drains will be constructed using an excavator throughout the site to a similar drainage pattern as Figure 2.7 and will discharge into the adjacent watercourse.

Potential impacts during drain construction occur mainly from:

- Exposure of soil and subsoils due to excavation, vehicle tracking, and skidding resulting in a source of suspended sediment which can become entrained in surface water runoff and enter drains; and,
- Nutrient release.

7.3.3.2.2 *Harvesting Operations*

Pathways: Drainage and surface water discharge routes.

Receptors: Surface waters and associated dependant ecosystems.

Potential Impacts: Indirect, negative, moderate, short term, medium probability impact.

Potential impacts during tree felling occur mainly from:

- Exposure of soil and subsoils due to vehicle tracking, and skidding or forwarding extraction methods resulting in a source of suspended sediment which can become entrained in surface water runoff;
- Release of sediment attached to timber in stacking areas; and,
- Nutrient release.

7.3.3.2.3 *Site Access*

Forestry felling would typically occur within 0.5km of access points (roads & tracks) to the main forest body. Due to the small size of this site, additional access tracks or roads will not be required. This site is located adjacent an existing road network with which will not require upgrading or alteration.

7.3.3.2.4 *Proposed Mitigation Measures*

Best practice methods related to water incorporated into the forestry management and mitigation measures have been derived from:

- Forestry Commission (2004): Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh;
- Coillte (2009): Forest Operations & Water Protection Guidelines;
- Forest Service (Draft): Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures; and,
- Forest Service (2000): Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.
- Forest Service (2016) Environmental Requirements for Afforestation. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.
- Forest Service (2016) Land Types for Afforestation. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.

Mitigation measures which will reduce the risk of entrainment of suspended solids and nutrient release in surface watercourses comprise best practice methods which are set out as follows:

- Machine combinations will be chosen which are most suitable for ground conditions at the time of excavation and felling, and which will minimise surrounding soils disturbance;
- Where possible, existing drains will not be disturbed during drainage works;
- Drains and sediment traps will be installed during ground preparation and felling. Collector drains will be excavated at an acute angle to the contour (~0.3%-3% gradient), to minimise flow velocities. Main drains to take the discharge from collector drains will include water drops and rock armour, as required, where there are steep gradients, and should avoid being placed at right angles to the contour; and,
- Drains and silt traps will be maintained throughout all planting works, ensuring that they are clear of sediment build-up and are not severely eroded. Correct drain alignment, spacing and depth will ensure that erosion and sediment build-up are minimised and controlled.

Buffer Zones

There is a requirement in the Forest Service Code of Practice, Environmental Requirements for Afforestation document and in the FSC Certification Standard for the installation of buffer zones adjacent to aquatic zones at planting stage. Minimum buffer zone widths recommended in the Forest Service (2000) guidance document "Forestry and Water Quality Guidelines" are shown in Table 7.2.

Table 7-2 Minimum Buffer Zone Widths (Forest Service, 2000)

Average slope leading to the aquatic zone		Buffer zone width on either side of the aquatic zone	Buffer zone width for highly erodible soils
Moderate	(0 – 15%)	10 m	15 m
Steep	(15 – 30%)	15 m	20 m
Very steep	(>30%)	20 m	25 m

There are no surface waterbodies within or adjacent to the site. The closest is a watercourse IE_SH_26S020300 which is 113m west of the site, Therefore, the above buffer zones are not required.

7.3.3.2.5 *Residual Impact*

Indirect, imperceptible, short term, low probability impact.

7.3.3.3 Potential Release of Hydrocarbons during drainage works

Pathway: Groundwater flow paths and site drainage network.

Receptor: Groundwater and surface water.

Potential Impact: Indirect, negative, not significant, temporary, low probability impact to surface water quality.

Indirect, negative, not significant, temporary, medium probability impact to local groundwater quality.

The replanting will be carried out by hand, but it may be necessary to employ one excavator to create shallow drainage channels prior to planting. There is the potential for minor leaks from the excavator.

7.3.3.3.1 *Proposed Mitigation Measures*

Mitigation measures proposed to avoid release of hydrocarbons at the site are as follows:

- Maintenance will not be carried out on site.
- Fuels will not be stored on site.
- The plant used will be regularly inspected for leaks and fitness for purpose;

7.3.3.3.2 *Residual Impact*

Indirect, not significant, imperceptible, short term, low probability impact.

7.3.3.4 Potential Hydrological Impacts on Designated Sites

The proposed afforestation site is located within the Upper Shannon catchment. There will however be no direct discharges from the site and the hydrological regime locally will not be altered by the afforestation due to its small scale.

Pathway: Surface water flow paths.

Receptor: Down-gradient water quality & designated sites.

Potential Impact: Indirect, negative, imperceptible, short term, low probability impact.

7.3.3.4.1 *Impact Assessment & Proposed Mitigation Measures*

The proposed mitigation measures which will include buffer zones and drainage control measures (*i.e.* cut off drains, tapered drains before buffer zones) will ensure that the quality of runoff from proposed development areas will be very high. The proposed development site is located in Shannon Upper catchment. There could potentially be an "*imperceptible, short term, low probability impact*" on local streams and rivers but this would be very localised and over a very short time period (*i.e.* hours).

7.3.3.4.2 *Residual Impact*

No residual impacts.

7.3.4 Operational Phase

There will be no significant direct or indirect effects on groundwater and surface water during the operational phase.

7.3.4.1.1 *Residual Impact*

No residual impacts.

7.4 Replanting Area 2: Brackloon, Co. Roscommon

7.4.1 Baseline Environment and Local Hydrology

Ground level elevations at the replanting site range between 74–79m OD.

There are no rivers or streams located within the site; however, drainage channels run through the site and a large drain flows in a northwest direction along the southern boundary and discharges into the Owennaforeesha Stream. The latter confluences with Carricknabraher Stream to form the Breedoge

River which discharges into the Lough Gara SPA/pNHA 9.5km northwest of the site. The drain is under OPW control and maintenance and part of an Arterial Drainage Scheme.

7.4.1.1 Water Balance

While the process of afforestation may result in a slight alteration in the water runoff of the site, the small size of the site (0.0.72 km^2) when compared with the Upper Shannon catchment (674.13km^2) means that any potential impacts this may have would be insignificant. The afforestation will lead to an imperceptible reduction in the runoff volumes in the longer term as the trees mature.

7.4.1.2 Regional Hydrology

The site is located within the Upper Shannon Catchment IE_26B and forms part of the Breedoge subcatchment_SC_010. The subcatchment here has an overall status of 'Poor' condition due to urban pressures as approximately half of the surrounding dwellings are not connected to the wastewater treatment works resulting in discharges to surface water drains. Sediment impacts from peat and forestry on the Breedoge_010 subcatchment are part of the ongoing WFD 2018 – 2021 river basin management plan.

7.4.1.3 Flood Risk Identification

OPW's indicative river and coastal flood map (www.floodmaps.ie), CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie), Department of Environment, Community and Local Government on-line planning mapping (www.myplan.ie) were consulted to identify those areas as being at risk of flooding.

No records or risks associated with flooding were identified in the published data sets. The nearest flood event was recorded in 2005 at Kinclare, Co. Roscommon, approximately 2.17km east of the replanting site.

7.4.1.4 Surface Water Hydrochemistry

Slightly high pH values of surface waters would be typical of poorly drained mineral soil found on site. In addition, the underlying limestone and shale bedrock would have slightly alkaline groundwater characteristics which would have some effect on surface water chemistry, specifically during dry periods when baseflow is likely to be more prevalent.

7.4.1.5 Hydrogeology

The underlying bedrock at the site is mapped as being dark fine-grained limestone and shale (refer to Section 6 – Soils & Geology). The GSI has classified the bedrock formation here as 'Rkc' Regionally Important Aquifer – Karstified.

7.4.1.6 Groundwater Vulnerability

The vulnerability rating of the aquifer within the site is 'Low'. The surrounding area is also categorised as 'Low' with the exception of a small area approximately 300 to the southwest of where the vulnerability ranges from 'Moderate' to 'Extreme'.

7.4.1.7 Surface Water Body Status

The EU Water Framework Directive aims to protect, enhance and restore all waters with aim to achieve at least good status by 2021.

Under the first cycle of the Water Framework Directive Local surface water Body status reports were available for download from www.wfdireland.ie. Local surface water body (1st and 2nd cycle) information is available for viewing from www.catchments.ie.

As stated above, a drain runs along the southern boundary of the site and flows into the Breedoge River which has a status of 'Poor' since 2010 as some surrounding dwellings are not connected to the wastewater treatment works resulting in discharges to surface water drains. The Breedoge_010 subcatchment is 'At Risk'. Sediment impacts from peat and forestry on the Breedoge_010 subcatchment are part of the ongoing WFD 2018 – 2021 river basin management plan.

7.4.1.8 Groundwater Body Status

Under the first cycle of the Water Framework Directive Local Groundwater Body status reports were available for download from www.wfdireland.ie. And information related to the 1st and 2nd cycles of the WFD is available at www.catchments.ie.

The proposed afforestation site lies on the Carrick on Shannon Groundwater Body IE_SH_G_048 (GWB) as classified during the 2013-2018 assessment cycle. This GWB has an overall status of 'Good' but a projection of 'At Risk' due to potential groundwater contribution of phosphate from agriculture.

7.4.1.9 Designated Sites and Habitats

Designated sites include National Heritage Areas (NHAs), Proposed National Heritage Areas (pNHAs) Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). The proposed forestry development site is not located within any designated conservation-site. Designated sites in proximity to the proposed development site are described Section 5 Biodiversity.

7.4.1.10 Water Resources

There are no borehole wells within or adjacent to the site. The nearest well (GSI name: 1727NWW047) is located 0.54km southwest of the proposed replanting area and was constructed in 1899 for agricultural purposes.

7.4.1.11 Receptor Sensitivity

As afforestation is a near-surface construction activity, impacts on groundwater are largely negligible and surface water is generally the main sensitive receptor assessed during impact assessments. The primary risk to groundwater at the site is from nutrients associated with fertilisers.

Based on criteria set out in Table 7.1 groundwater at the site can be classed as Sensitive to pollution because the bedrock is classified 'Rkc' Regionally Important Aquifer – Karstified.

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 afforested areas of the site will be of a high quality and will therefore not impact on the quality of downstream surface water bodies.

7.4.2 Proposed Site Drainage

The site will be drained in accordance with the Forestry Guidelines. Forestry plantations are generally drained by a network of mound drains which typically run perpendicular to the topographic contours of the site and feed into collector drains, which discharge to interceptor drains down-gradient of the plantation.

Mound drains are generally spaced approximately every 15m. As illustrated in Figure 2.7, Interceptor drains are generally located up-gradient (cut-off drains) and down-gradient of forestry plantations. A schematic of a typical standard forestry drainage network and one which is representative of the proposed site drainage network is shown above as Figure 2.7.

7.4.3 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 natural drainage features. The second method involves collecting any drainage waters from planted areas within the site that might carry silt or sediment, and nutrients, using cut off drains to control direct discharge into streams.

7.4.4 Potential Impacts

The potential impacts of the proposed development and mitigation measures that will be put in place to eliminate or reduce them are set out below.

7.4.4.1 'Do-Nothing' Scenario

The lands have been Technically Approved and will be afforested should the Croagh Wind Farm proceed or not. If the land was not replanted, the current land use would continue at the site.

7.4.4.1.1 *Excavation of Forestry Drains and Planting*

Pathways: Drainage and surface water discharge routes.
Receptors: Surface waters and associated dependent ecosystems.
Potential Impacts: Indirect, negative, slight, short term, medium probability impact.

Shallow forestry drains will be constructed using an excavator throughout the site to a similar drainage pattern as Figure 2.7. There are no surface water courses on or adjacent the site and so the drains will ultimately discharge to the existing offsite field drain networks.

Potential impacts during drain construction occur mainly from:

- Exposure of soil and subsoils due to excavation, vehicle tracking, and skidding resulting in a source of suspended sediment which can become entrained in surface water runoff and enter drains; and,

Nutrient release.

7.4.4.1.2 *Harvesting Operations*

Pathways: Drainage and surface water discharge routes.

Receptors: Surface waters and associated dependant ecosystems.

Potential Impacts: Indirect, negative, moderate, short term, medium probability impact.

Potential impacts during tree felling occur mainly from:

- Exposure of soil and subsoils due to vehicle tracking, and skidding or forwarding extraction methods resulting in a source of suspended sediment which can become entrained in surface water runoff;
- Release of sediment attached to timber in stacking areas; and,
- Nutrient release.

7.4.4.1.3 *Site Access*

Forestry felling would typically occur within 0.5km of access points (roads & tracks) to the main forest body. Due to the small size of this site, additional access tracks or roads will not be required. This site is located adjacent an existing road network with which will not require upgrading or alteration.

7.4.4.2 Proposed Mitigation Measures

Best practice methods related to water incorporated into the forestry management and mitigation measures have been derived from:

- Forest Service (2016) Environmental Requirements for Afforestation
- Forestry Commission (2004): Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh;
- Coillte (2009): Forest Operations & Water Protection Guidelines;
- Forest Service (Draft): Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures

Mitigation measures which will reduce the risk of entrainment of suspended solids and nutrient release in surface watercourses comprise best practice methods which are set out as follows:

- Machine combinations will be chosen which are most suitable for ground conditions at the time of excavation and felling, and which will minimise surrounding soils disturbance;
- Where possible, existing drains will not be disturbed during drainage works;
- Drains and sediment traps will be installed during ground preparation and felling. Collector drains will be excavated at an acute angle to the contour (~0.3%-3% gradient), to minimise flow velocities. Main drains to take the discharge from collector drains will include water drops and rock armour, as required, where there are steep gradients, and should avoid being placed at right angles to the contour; and,
- Drains and silt traps will be maintained throughout all planting works, ensuring that they are clear of sediment build-up and are not severely eroded. Correct drain alignment, spacing and depth will ensure that erosion and sediment build-up are minimised and controlled.

Buffer Zones

There is a requirement in the Forest Service Code of Practice and in the FSC Certification Standard for the installation of buffer zones adjacent to aquatic zones at planting stage. Minimum buffer zone widths recommended in the Forest Service (2000) guidance document *"Forestry and Water Quality Guidelines"* are shown in Table 7.3.

Table 7-3 Minimum Buffer Zone Widths (Forest Service, 2000)

Average slope leading to the aquatic zone		Buffer zone width on either side of the aquatic zone	Buffer zone width for highly erodible soils
Moderate	(0 – 15%)	10 m	15 m
Steep	(15 – 30%)	15 m	20 m
Very steep	(>30%)	20 m	25 m

7.4.4.2.2 *Residual Impact*

Indirect, slight, short term, low probability impact.

7.4.4.3 Potential Release of Hydrocarbons during drainage works

Pathway: Groundwater flow paths and site drainage network.

Receptor: Groundwater and surface water.

Potential Impact: Indirect, negative, slight, temporary, medium probability impact to surface water quality.

Indirect, negative, slight, temporary, medium probability impact to local groundwater quality.

The replanting will be carried out by hand, but it may be necessary to employ one excavator to create shallow drainage channels prior to planting. There is the potential for minor leaks from the excavator.

7.4.4.3.1 *Proposed Mitigation Measures*

Mitigation measures proposed to avoid release of hydrocarbons at the site are as follows:

- Maintenance will not be carried out on site.
- Fuels will not be stored on site.
- The plant used will be regularly inspected for leaks and fitness for purpose

7.4.4.3.2 *Residual Impact*

Indirect, negative, imperceptible, short term, low probability impact.

7.4.4.4 Potential Hydrological Impacts on Designated Sites

The proposed afforestation site is located within the upper Shannon 26B catchment. There will however be no direct discharges from the site and the hydrological regime locally will not be altered by the afforestation due to its small scale.

Pathway: Surface water flow paths.

Receptor: Down-gradient water quality & designated sites.

Potential Impact: Indirect, negative, imperceptible, short term, low probability impact.

7.4.4.4.1 *Impact Assessment & Proposed Mitigation Measures*

The proposed mitigation measures which will include buffer zones and drainage control measures (*i.e.* cut off drains, tapered drains before buffer zones) will ensure that the quality of runoff from proposed development areas will be very high. The proposed development site is located in the Upper Shannon catchment. There could potentially be an "*imperceptible, short term, low probability impact*" on local streams and rivers but this would be very localised and over a very short time period (*i.e.* hours).

7.4.4.4.2 *Residual Impact*

No residual impacts.

7.4.5 Operational Phase

There will be no significant indirect or direct impacts on hydrology and hydrogeology once the site has been afforested.

7.4.5.1.1 *Residual Impact*

No residual impacts.

7.5 Replanting Site 3: Ballard, Co. Wicklow.

7.5.1 Baseline Environment and Local Hydrology

Ground level elevations at the replanting site range from 158m to 219m OD.

There are no drains, rivers or streams located within the site; however, the Ballyeustace Stream flows in a northeast direction approximately 50m north of the northern boundary.

7.5.1.1 Water Balance

While the process of afforestation may result in a slight alteration in the water runoff of the site, the small size of the site (0.396 km^2) when compared with the Avoca-Vartry catchment (1234.19 km^2) means that any potential impacts this may have would be insignificant. The afforestation will lead to an imperceptible reduction in the runoff volumes in the longer term as the trees mature.

7.5.1.2 Regional Hydrology

The site is located in the Avoca-Vartry Catchment IE_10 and forms part of the Avonbeg_SC_010 subcatchment. The subcatchment here has an overall status of 'At Risk' condition due to acidification.

7.5.1.3 Flood Risk Identification

OPW's indicative river and coastal flood map (www.floodmaps.ie), CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie), Department of Environment, Community and Local Government on-line planning mapping (www.myplan.ie) were consulted to identify those areas as being at risk of flooding.

No records or risks associated with flooding were identified in the published data sets.

7.5.1.4 Surface Water Hydrochemistry

Slightly high pH values of surface waters would be typical of poorly drained mineral soil found on site. In addition, the sandstone and till derived subsoils would have slightly acidic groundwater characteristics which would have some effect on surface water chemistry, specifically during dry periods when baseflow is likely to be more prevalent. As stated above, the WFD status for the Avonbeg_010 is 'Poor' due to acidification.

7.5.1.5 Hydrogeology

The underlying bedrock at the site is mapped as dark grey semi-pelitic, psammitic schist (refer to Section 6 – Soils & Geology). The GSI has classified the bedrock formation here as a Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones.

7.5.1.6 Groundwater Vulnerability

The vulnerability rating of the aquifer within the site is categorised as 'High' due to the presence of bedrock relatively close to the surface. To the south and west of the site and in pockets to the north, the groundwater vulnerability is categorised as 'Extreme' (E) and 'Rock near surface or karst' (X) which is likely to be as a result of the presence of bedrock at or within 1 to 3 metres of the surface.

7.5.1.7 Surface Water Body Status

The EU Water Framework Directive aims to protect, enhance and restore all waters with aim to achieve at least good status by 2021.

Under the first cycle of the Water Framework Directive Local surface water Body status reports were available for download from www.wfdireland.ie. Local surface water body (1st and 2nd cycle) information is available for viewing from www.catchments.ie.

The Ballyeustace Stream IE_EA_10A040800 flows in a northeast direction, 50m north of the replanting site's northern boundary before it confluences with the Avonbeg River IE_EA_10A040800 and is deemed to be of 'Good' status but 'at risk' in the 2010-2015 assessment cycle of the Water Framework Directive.

7.5.1.8 Groundwater Body Status

Under the first cycle of the Water Framework Directive Local Groundwater Body status reports were available for download from www.wfdireland.ie. and information related to the 1st and 2nd cycles of the WFD is available at www.catchments.ie.

The proposed afforestation site lies on the Wicklow IE_EA_G_076 (GWB) and was classified during the 2013-2018 assessment cycle as having a 'Good' overall ground water status with a projection status of in 'Review'.

7.5.1.9 Designated Sites and Habitats

Designated sites include National Heritage Areas (NHAs), Proposed National Heritage Areas (pNHAs) Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). The proposed forestry development site is not located within any designated conservation-site. Designated sites in proximity to the proposed development site are described Section 5 Biodiversity.

7.5.1.10 Water Resources

There are no borehole wells within the site. The nearest borehole wells (GSI name- 2917NEW038; and 2917NEW054) can be found at a minimum distance of 0.1km east of the site and were constructed in 1969/1970 for domestic use. The exact location of these wells cannot be determined from the online database.

7.5.1.11 Receptor Sensitivity

As afforestation is a near-surface construction activity, impacts on groundwater are largely negligible and surface water is generally the main sensitive receptor assessed during impact assessments. The primary risk to groundwater at the site is from nutrients associated with fertilisers.

Based on criteria set out in Table 7.1 groundwater at the site can be classed as sensitive to pollution because the dark grey semi-pelitic psammitic schist bedrock is classified as a locally important Aquifer.

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 afforested areas of the site will be of a high quality and will therefore not impact on the quality of downstream surface water bodies.

7.5.1.12 Proposed Site Drainage

The site will be drained in accordance with the Forestry Guidelines. Forestry plantations are generally drained by a network of mound drains which typically run perpendicular to the topographic contours of the site and feed into collector drains, which discharge to interceptor drains down-gradient of the plantation.

Mound drains are generally spaced approximately every 15m. As illustrated in Figure 2.7, Interceptor drains are generally located up-gradient (cut-off drains) and down-gradient of forestry plantations. A schematic of a typical standard forestry drainage network and one which is representative of the proposed site drainage network is shown above as Figure 2.7.

7.5.1.13 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 natural drainage features. The second method involves collecting any drainage waters from planted areas within the site that might carry silt or sediment, and nutrients, using cut off drains to control direct discharge into streams.

7.5.2 Potential Impacts

The potential impacts of the proposed development and mitigation measures that will be put in place to eliminate or reduce them are set out below.

7.5.2.1 'Do-Nothing' Scenario

The lands have been Technically Approved and will be afforested should the Croagh Wind Farm proceed or not If the land was not replanted, the current land use would continue at the site.

7.5.2.1.1 *Excavation of Forestry Drains and Planting*

Pathways: Drainage and surface water discharge routes.

Receptors: Surface waters and associated dependent ecosystems.

Potential Impacts: Indirect, negative, slight, short term, medium probability impact.

Shallow forestry drains will be constructed using an excavator throughout the site to a similar drainage pattern as Figure 2.7. There are no surface water courses on or adjacent the site and so the drains will ultimately discharge to the existing offsite field drain networks.

Potential impacts during drain construction occur mainly from:

- Exposure of soil and subsoils due to excavation, vehicle tracking, and skidding resulting in a source of suspended sediment which can become entrained in surface water runoff and enter drains; and,
- Nutrient release.

7.5.2.1.2 *Harvesting Operations*

Pathways: Drainage and surface water discharge routes.

Receptors: Surface waters and associated dependant ecosystems.

Potential Impacts: Indirect, negative, moderate, short term, medium probability impact.

Potential impacts during tree felling occur mainly from:

- Exposure of soil and subsoils due to vehicle tracking, and skidding or forwarding extraction methods resulting in a source of suspended sediment which can become entrained in surface water runoff;
- Release of sediment attached to timber in stacking areas; and,
- Nutrient release.

7.5.2.1.3 *Site Access*

Forestry felling would typically occur within 0.5km of access points (roads & tracks) to the main forest body. Due to the small size of this site, additional access tracks or roads will not be required. This site is located adjacent an existing road network with which will not require upgrading or alteration.

7.5.2.2 Proposed Mitigation Measures

Best practice methods related to water incorporated into the forestry management and mitigation measures have been derived from:

- Forest Service (2016) Environmental Requirements for Afforestation
- Forestry Commission (2004): Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh;
- Coillte (2009): Forest Operations & Water Protection Guidelines;
- Forest Service (Draft): Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures

Mitigation measures which will reduce the risk of entrainment of suspended solids and nutrient release in surface watercourses comprise best practice methods which are set out as follows:

- Machine combinations will be chosen which are most suitable for ground conditions at the time of excavation and felling, and which will minimise surrounding soils disturbance;
- Where possible, existing drains will not be disturbed during drainage works;
- Drains and sediment traps will be installed during ground preparation and felling. Collector drains will be excavated at an acute angle to the contour (~0.3%-3% gradient), to minimise flow velocities. Main drains to take the discharge from collector drains will include water drops and rock armour, as required, where there are steep gradients, and should avoid being placed at right angles to the contour; and,
- Drains and silt traps will be maintained throughout all planting works, ensuring that they are clear of sediment build-up and are not severely eroded. Correct drain alignment, spacing and depth will ensure that erosion and sediment build-up are minimised and controlled.

Buffer Zones

There is a requirement in the Forest Service Code of Practice and in the FSC Certification Standard for the installation of buffer zones adjacent to aquatic zones at planting stage. Minimum buffer zone widths recommended in the Forest Service (2000) guidance document "Forestry and Water Quality Guidelines" are shown in Table 7.4.

Table 7-4 Minimum Buffer Zone Widths (Forest Service, 2000)

Average slope leading to the aquatic zone		Buffer zone width on either side of the aquatic zone	Buffer zone width for highly erodible soils
Moderate	(0 – 15%)	10 m	15 m
Steep	(15 – 30%)	15 m	20 m
Very steep	(>30%)	20 m	25 m

7.5.2.2.2 *Residual Impact*

Indirect, slight, short term, low probability impact.

7.5.2.3 Potential Release of Hydrocarbons during drainage works

Pathway: Groundwater flow paths and site drainage network.

Receptor: Groundwater and surface water.

Potential Impact: Indirect, negative, slight, temporary, medium probability impact to surface water quality.

Indirect, negative, slight, temporary, medium probability impact to local groundwater quality.

The replanting will be carried out by hand, but it may be necessary to employ one excavator to create shallow drainage channels prior to planting. There is the potential for minor leaks from the excavator.

7.5.2.3.1 *Proposed Mitigation Measures*

Mitigation measures proposed to avoid release of hydrocarbons at the site are as follows:

- Maintenance will not be carried out on site.
- Fuels will not be stored on site.

- The plant used will be regularly inspected for leaks and fitness for purpose;

7.5.2.3.2 *Residual Impact*

Indirect, negative, imperceptible, short term, low probability impact.

7.5.2.4 Potential Hydrological Impacts on Designated Sites

The proposed afforestation site is located within the Mal Bay catchment. There will however be no direct discharges from the site and the hydrological regime locally will not be altered by the afforestation due to its small scale.

Pathway: Surface water flow paths.

Receptor: Down-gradient water quality & designated sites.

Potential Impact: Indirect, negative, imperceptible, short term, low probability impact.

7.5.2.4.1 *Impact Assessment & Proposed Mitigation Measures*

The proposed mitigation measures which will include buffer zones and drainage control measures (*i.e.* cut off drains, tapered drains before buffer zones) will ensure that the quality of runoff from proposed development areas will be very high. The proposed development site is located in Avoca-Vartry catchment. There could potentially be an "*imperceptible, short term, low probability impact*" on local streams and rivers but this would be very localised and over a very short time period (*i.e.* hours).

7.5.2.4.2 *Residual Impact*

No residual impacts.

7.5.3 Operational Phase

There will be no significant indirect or direct impacts on hydrology and hydrogeology once the site has been afforested.

7.5.3.1.1 *Residual Impact*

No residual impact.

8. LANDSCAPE AND VISUAL

8.1 Introduction

This section of the report addresses the landscape and visual impacts of the proposed replanting areas at Stranamart, Co. Cavan, Brackloon, Co. Roscommon and Ballard, Co. Wicklow.
It includes a description of the relevant County Council landscape policy for each site and describes the sites' landscape values and sensitivity. The landscape of each area is described in terms of its character, which includes a description of landform and landcover. An impact assessment of the proposed replanting is then undertaken. Documents consulted include:

- 'Landscape and Landscape Assessment: Consultation Draft of Guidelines for Planning Authorities' (Department of the Environment and Local Government 2000)
- 'Guidelines for Landscape and Visual Impact Assessment' (The Landscape Institute/Institute of Environmental Management & Assessment, 2013)
- 'Environmental Requirements for Afforestation (Forest Service, 2016)
- Forestry and the Landscape Guidelines' (Forest Service, 2000)

In order to carry out this assessment, a desk study was undertaken which identified relevant policies and guidelines, both at national and local level. This includes policies on forestry, landscape and landscape character, designated landscapes, and scenic routes. Maps and aerial images of the replanting site were also studied.

8.2 Landscape Policy Context

This section of the report refers to policies of the relevant County Council Development Plans as well as to the Forest Service Landscape Guidelines.

8.2.1 Cavan County Development Plan 2014-2020

8.2.1.1 Forestry Policy and Objectives

Section 3: 'Economic Development' of the Cavan County Development Plan deals with policies and objectives relating to forestry. This section outlines the vision for sustainable economic activity within the county and emphasises the benefit of forestry as a manner of diversifying agriculture and enterprise and boosting population levels in rural areas and acknowledges its benefit in the protection of the environment. The policies are listed in Chapter 3.

8.2.1.2 Landscape Policy and Objectives

This section of the report refers to the Cavan County Development Plan 2014 – 2020 and the Landscape Character Assessment of County Cavan, as well as to the Environmental Requirements for Afforestation document. Cavan County Council has not prepared a Landscape Character Assessment. The Border Region Planning Guidelines (BRPG) 2010-2022 which, along with the National Spatial Strategy, shapes the Cavan CDP, supports the preparation and implementation of a Regional Character Assessment and Strategy by Local Authorities and supports the enhancement of landscape in the region.

8.2.1.3 Landscape Character Assessment of County Cavan

The replanting site is located within the Cavan Rural Area Type classed as a 'Structurally Weak Area'. There are five Landscape Character Areas with the proposed replanting are located within the 'No. 1

Cuilcagh-Anierin Uplands of West Cavan'. The Cavan High Value Landscape Area 'Uplands Areas in West Cavan' is located to the north and south of the replanting site. Cavan County Council endeavour to maintain the scenic and recreation value of these areas by restricting adverse uses and negative visual impacts.

8.2.1.4 Heritage Landscapes

The Cavan Heritage Plan is currently under review. The CDP has identified various sites of heritage value within the county. The aim of the CDP is to restrict incompatible development in order to protect the amenity, scientific and historical value of these areas. The nearest heritage landscape is the Cuilcagh Mountain Geological Heritage Site to the east of the site which comprises the Marble Arch Caves Global Geopark. It incorporates the Marble Arch Caves. While no landscape assessment has been undertaken for the area, the CDP follows the guidelines set out in the Planning and Development Act 2000 (as amended), the Heritage Act 1995 and the Wildlife Amendment Act 2000 which mandates the council to conserve the county's Geological Heritage.

8.2.1.5 Scenic Routes

There are three Scenic Routes (SR) in the county and are included in Appendix 4 Map 10 of the Cavan CDP. The Dowra to Blacklion Scenic Route (Kingfisher Cycle Trail) runs northeast to southwest approximately 400m east of the site, along the R206. There are no Scenic Views within the surrounding landscape.

The aims and objectives of the CDP in relation to scenic routes and views are as follows:

- **NHEO30** *"To regulate development that would seriously obstruct and detract from views of high scenic value from designated Scenic Routes. Development will be restricted where it is likely to cause irreconcilable damage to the exceptional scenic value.*
- ***NHEO31*** *"To maintain and protect the natural landscapes visual character which is recognised to be of an exceptional high amenity value. These upland landscapes of west Cavan are open and exposed, unenclosed and vulnerable to insensitive development. These scenic routes are considered to be part of the County's amenity resources."*

8.2.2 Forestry and the Landscape Guidelines

There are four 'Forest Parks and Other Parks' within the county. Appendix 20 of the CDP outlines the Draft Indicative Forest Strategy (IFS) for the county. The aim of the IFS is to "*provide high-level, national guidance in relation to the suitability of land for afforestation".* The Strategy is a GIS based system which identifies areas most suitable for planting primarily on the basis of environmental considerations and soil-productivity. Guidance within the Strategy also details the economic and amenity value of forestry as an alternative farm income and boost to tourism. It also recognises the benefit of afforestation in climate change mitigation.

According to the IFS forestry suitability map, the replanting site is located within a Category 2 area: "Suitable for certain types of forest development". Please see Table 8.1 below for details.

Table 8-1 Description of Policy Categories, Environmental Designations and the Process associated with each Policy Category

Policy Category	Description	Environmental Designations	Application Process
Category 2 "Suitable for certain types of forest development"	Areas where at least one environmental designation (such as a fisheries sensitive areas) exist. For more details on the consultation system associated with specific environmental designations see Appendix 1.	› Acid sensitive areas. › Areas sensitive for fisheries. › Catchment areas of local authority water schemes. › REPs areas. › Archaeological sites or monuments › Areas of moderate landscape sensitivity.	Process as for "Suitable for a range of forest types" and, in addition: consultation with relevant authority (such as Regional Fisheries Boards, National Parks and Wildlife Service, Local Authority).

The replanting site has been granted Technical Approval for afforestation. The Technical Approval document includes as a condition that all guidelines (which includes the Forest Service landscape guidelines) will apply to afforestation at the site.

8.3 Baseline Environment

8.3.1 Landscape Character

The topography, vegetation and anthropological features on the land surface in an area combine to set limits on the amount of the landscape that can be seen at any one time. These physical restrictions form individual areas or units, known as physical units, whose character can be defined by aspect, slope, scale and size. A physical unit is generally delineated by topographical boundaries and is defined by landform and landcover.

The replanting site is located on elevated but relatively flat land within an elevation range of 90–120 m OD. The replanting site is immediately adjacent to areas of existing conifer plantation to the south and northeast. The physical unit of the replanting site is defined by the R207 to the west and R206 to the east. The 'Cuilcagh - Anierin Uplands LCA' are further to the east and the Bolebrack Mountains SAC are further to the west.

The proposed replanting area which has been given technical approval is 12.57ha. This represents a roughly one third of the existing forestry immediately adjacent to the site (c. 30ha). In the wider landscape, there are larger tracts of forestry, measuring over 300 ha.

The replanting area is located c. 40m southwest of the nearest residential dwelling which is located across the R206 and screened from the site by existing high growing boundary vegetation along the R206. The replanting site comprises several small fields whose boundaries will be retained on the site where possible. A second house is located just under 300m east of the site and is screened from the site by mature tree-lined boundaries within its own curtilage and existing forestry.

8.3.2 Landscape Sensitivity

The sensitivity of a landscape to development and therefore to change varies according to its character and to the importance that is attached to any combination of landscape values. The sensitivity of a landscape is derived from consideration of designations such as Special Protection Areas (SPAs), Special Areas of Conservation (SACs), Natural Heritage Areas (NHAs) and National Parks, from information such as tourist maps, guidebooks and brochures, and from the evaluation of indicators such as uniqueness, popularity, distinctiveness, and quality of the elements of the area.

A desktop assessment of landscape sensitivity in the vicinity of the replanting site was carried out. The methodology for this assessment was based on that set out in the Department of the Environment and Local Government (DoEHLG) guidance document *'Landscape and Landscape Assessment – Consultation Draft of Guidelines for Planning Authorities'* (2000). This document recommends an assessment of landscape sensitivity based on an evaluation of individual features, such as the quality, integrity, etc. The results of the assessment are presented in Table 8.2.

Table 8-2 Stranamart Landscape Sensitivity

Feature	Description
Quality	The quality of the landscape in this area can be described as modified due to agriculture and forestry plantations.
Integrity	The current development site has been modified by the interaction of man with the environment.
Distinctiveness	There are no distinctive features on the site.
Popularity	A sense of popularity is created where landscape features are widely recognised or appreciated. There are no popular features on the replanting site.
Rarity	The site is not located within a designated ecological area. The closest Natura 2000 site, i.e. Special Area of Conservation (SAC) or Special Protection Area (SPA), is the Boleybrack Mountain SAC is over 3km west of the site.
Cultural Meaning	A sense of cultural meaning arises where a site or features within a site are deemed to explain, represent or inspire cultural values. There are no archaeological monuments close to the site and none within the site.
Sense of Public Ownership & Social Importance	A sense of public ownership arises due to ease of accessibility, visibility or a widely shared meaning. The site is owned by the applicant and has no special social importance.

The replanting site is therefore considered to be of a low sensitivity.

8.3.2.1 Landscape Context and Site Visibility

Views of coniferous forestry are a feature of the immediate and wider area with views of the Cuilcagh-Anierin Uplands and Bolebrack Mountains in the distance. Views from the site are dominated by existing conifer plantation, the Bolebrack Mountains and the Cuilcagh-Anierin Uplands.

8.3.3 Potential Impacts

8.3.3.1 'Do-Nothing' Scenario

In the 'Do Nothing' scenario, the subject site would be afforested in any case, as per Technical Approval that has been issued for the site. If the land was not replanted, the current land use would continue at the site.

8.3.4 Site Preparation and Planting Phase

8.3.4.1 Impacts on Landscape Character –Temporary Imperceptible Neutral Impact

The planting of forestry will entail site works in terms of woody weed clearance and construction of forestry drains and will use the angle notch planting method described in Section 2.2.1.1 above. These activities will have a temporary imperceptible neutral impact on the landscape character, which is that of a rural working landscape with a mixture of agricultural and forestry land uses. A neutral impact is a change which does not affect the quality of the environment (EPA, 2017). The site clearance and replanting activities will assimilate well into the receiving environment, and are therefore classed as an imperceptible impact, i.e. an impact capable of measurement but without noticeable consequences.

8.3.4.2 Impacts on Visual Amenity - Long Term Imperceptible Neutral Impact

The proposed replanting is to be carried out in an area where there are already existing conifer plantations among agricultural fields, and therefore the proposed replanting is not introducing a new land use but conforming to an established one. The predicted residual visual impact of the proposed replanting is Long Term, Imperceptible Neutral Impact.

8.3.5 Operational Phase

8.3.5.1 Impacts on Landscape Character – Long Term Imperceptible Neutral Impact

The proposed replanting is to be carried out in an area where there are already existing conifer plantations among agricultural fields, and therefore the proposed replanting is not introducing a new land use but conforming to an established one and contributing to the patchwork of forestry plantations with open land. The predicted residual visual impact of the proposed replanting is Long Term, Imperceptible Neutral Impact.

8.3.5.2 Impacts on Visual Amenity - Long Term Imperceptible Neutral Impact

The proposed replanting is to be carried out in an area where there are already existing conifer plantations among agricultural fields, and therefore the proposed replanting is not introducing a new land use but conforming to an established one and contributing to the patchwork of forestry plantations with open land. Felling will be carried out in accordance with the Environmental Requirements for Afforestation. The predicted residual visual impact of the proposed replanting is Long Term, Imperceptible Neutral Impact.

8.3.6 Proposed Mitigation Measures

The forestry drains are to be mound drains where deemed necessary along contours, or at most at a 30% acute angle to the contours, as outlined in the Conditions in the Technical Approval Document. Mitigation measures for the construction of the drainage and planting methods have been included as indicated in the Technical Document, and as a mitigation measure the planting method will be pit planting and mound drains constructed.

8.3.7 Residual Impacts

Following mitigation, the Residual Impact on Landscape Character will be Long Term Imperceptible Neutral Impact while the Residual Impact on Visual Amenity will be Long Term Imperceptible Neutral Impact.

8.3.8 Cumulative Impacts

Cumulative impacts are described as additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments or actions that occurred in the past, present or are likely to occur in the foreseeable future. The cumulative impact assessment is based on the planning history search carried out as described in Section 3.1.4 and the existing landuses. The cumulative impact arising from the proposed replanting in conjunction with other developments and the existing forestry plantations in the immediate vicinity and future development is assessed as Long Term, Imperceptible Neutral Impact. The cumulative impact of the replanting site is assessed as Long Term Imperceptible Neutral Impact in conjunction with the existing and future forestry developments in the vicinity.

8.3.9 Roscommon County Development Plan 2014-2020

8.3.9.1 Forestry Policy and Objectives

Section 9: 'Development Management Guidelines and Standards' of the Roscommon County Development Plan deals with policies and objectives relating to forestry. The planning authority acts as a consultee rather than an assessor in relation to forestry. Policies in the Roscommon CDP relating to forestry can be found in Chapter 3 Table 3.2.

8.3.9.2 Landscape Policy and Objectives

This section of the report refers to the Roscommon County Development Plan (CDP) 2014-2020 and the Landscape Character Assessment of the county, as well as to the Environmental Requirements for Afforestation document.

8.3.10 Landscape Character Assessment of Co. Roscommon

Section 11 of the Roscommon CDP comprises the Landscape Character Assessment of the county. The aim of the assessment is to provide technical background for the local planning authority to formulate a set of Landscape Objectives and Policy Recommendations for the county. The objectives and policies aim to strike a balance between boosting rural economic diversity, job creation and tackling climate change with landscape suitability and environmental sensitivity. Particular emphasis is laid on the following development types when assessing landscape sensitivity:

- Housing (including housing in existing settlements as well as single rural dwellings relating to the guidance set out in the Sustainable Rural Housing Guidelines for Planning Authorities);
- Quarries;
- Wind farms;
- Afforestation; and
- Rural buildings and alternative enterprise proposals (an increase of farm buildings is anticipated as a result of the recent EU Nitrates Directive).

The main sensitivities and areas of concern when assessing the above developments are:

- The conservation and enhancement of the landscape diversity, character and quality of the County; Protection of sensitive areas from development that would detract from or be injurious to the amenity of the area;
- Provision for development and change that would benefit the economy of the county including the rural economy while protecting and enhancing the landscape;
- Identification of suitable 'working' landscapes where there is potential to accommodate development.
- The landscape objectives and policy recommendations focus on the following five specific development types:
- Heritage Landscapes

8.3.10.1 Scenic Routes

There are a total of 9 existing and proposed Scenic Routes and a total 25 existing and proposed Scenic Views within the county and can be found in Appendix 1 of the Landscape Character Assessment of the CDP. The need to preserve scenic routes and views are highlighted throughout the CDP and are taken into consideration, along with sites of special value and immediate and long-distance views, when processing all types of development within the county.

8.3.11 Forestry and the Landscape Guidelines

As of 2011, almost 21,000ha (8.7%) of forestry has been planted within the county, with 13,000 if this on private land and 8,000ha in public ownership. The grant-driven Forest Environment Protection Scheme (FEPS) maintains public interest in this type of agricultural diversification. The Landscape Assessment of the CDP follows the national guidelines produced by the Department of Agriculture and outlined in Chapter 3 Table 3.2 to ensure that sustainable Forest Management is implemented throughout the county.

8.4 Baseline Environment

8.4.1 Landscape Character

The topography, vegetation and anthropological features on the land surface in an area combine to set limits on the amount of the landscape that can be seen at any one time. These physical restrictions form individual areas or units, known as physical units, whose character can be defined by aspect, slope, scale and size. A physical unit is generally delineated by topographical boundaries and is defined by landform and landcover.

The landscape character of Roscommon varies from greatly in form and cover and therefore it is recommended that proposed afforestation sites consider the surrounding landscape and the suitably for that particular type of development in the area. There are 4 distinct landscape character types:

- Rolling moorland, represented in County Roscommon by the Landscape Character Type of Hills and Uplands and Bogland.
- Rolling fertile farmland, represented by Wet Farmland, Dry Farmland, River Corridors.
- Drumlins represented by Drumlin Lakelands.
- Mountain and farmland complex, including Bog and Farmland Complex.

The site is located in LCA No. 20: Breedoge Bogland Basin which comprises varying landcover; wet and dry grassland complexes with low hedgerows of hawthorn and willow in the east, raised bog and reclaimed raised bog in the centre with birch and willow woodland and drier grassland in the northwest. The physical unit of the replanting site is defined by the drainage channel to its southern boundary, a local unnamed road to its east and areas of forestry to the west and north.

Forces of change in this LCA are listed as:

- "*afforestation of bogland,*
- *encroachment of rural housing into bogland fringes and overlooking Lough Gara*
- *increased marginalisation of farmland particularly to the east."*

The LPA recommends an alternative for rural enterprise in the LCA where bogland dominates.

8.4.2 Landcover on the site

The proposed replanting area which has been given technical approval is 7.2 ha. This represents a relatively small area of cover considering the existing 500ha+ of forestry plantation located within the immediate and surrounding environs.

The proposed replanting adjacent to the curtilage of the nearest residential dwelling. Field boundaries are not always prominent; however, the boundaries of the replanting site follow the existing field patterns. Although the internal field boundaries of the site are not always obvious, they will be retained on the site where possible.

8.4.3 Landscape Sensitivity

The sensitivity of a landscape to development and therefore to change varies according to its character and to the importance that is attached to any combination of landscape values. The sensitivity of a landscape is derived from consideration of designations such as Special Protection Areas (SPAs), Special Areas of Conservation (SACs), Natural Heritage Areas (NHAs) and National Parks, from information such as tourist maps, guidebooks and brochures, and from the evaluation of indicators such as uniqueness, popularity, distinctiveness, and quality of the elements of the area.

A desktop assessment of landscape sensitivity in the vicinity of the replanting site was carried out. The methodology for this assessment was based on that set out in the Department of the Environment and Local Government (DoEHLG) guidance document *'Landscape and Landscape Assessment – Consultation Draft of Guidelines for Planning Authorities'* (2000). This document recommends an assessment of landscape sensitivity based on an evaluation of individual features, such as the quality, integrity, etc. The results of the assessment are presented in Table 8.4.

Table 8-3 Brackloon Site: Landscape Sensitivity

Feature	Description
Quality	The quality of the landscape in this area can be described as modified due to agriculture and forestry plantations.
Integrity	The current development site has been modified by the interaction of man with the environment.
Distinctiveness	There are no distinctive features on the site.
Popularity	A sense of popularity is created where landscape features are widely recognised or appreciated. There are no popular features on the replanting site.
Rarity	There are no Natura 2000 sites within the vicinity of the site
Cultural Meaning	A sense of cultural meaning arises where a site or features within a site are deemed to explain, represent or inspire cultural values. There are no archaeological monuments close to the site and none within the site.
Sense of Public Ownership & Social Importance	A sense of public ownership arises due to ease of accessibility, visibility or a widely shared meaning. The site is owned by the applicant and has no special social importance.

The replanting site is therefore considered to be of Low landscape sensitivity.

8.4.3.1 Landscape Context and Site Visibility

Views towards the site would be westward from the local unnamed road that runs adjacent to the eastern boundary. Views from the west and north are partially blocked from existing forestry. Views of the site will be indiscernible due to the existing blocks of forestry.

8.4.4 Potential Impacts

8.4.4.1 'Do-Nothing' Scenario

In the 'Do Nothing' scenario, the subject site would be afforested in any case, as per Technical Approval that has been issued for the site. If the land was not replanted, the current land use would continue at the site.

8.4.4.2 Site Preparation and Planting Phase

8.4.4.2.1 *Impacts on Landscape Character –Temporary Imperceptible Neutral Impact*

The planting of forestry will entail site works in terms of woody weed clearance and construction of forestry drains using methods described in Section 2.2.1.1 above. These activities will have a temporary imperceptible neutral impact on the landscape character, which is that of a rural working landscape with a mixture of agricultural and forestry land uses. A neutral impact is a change which does not affect the quality of the environment (EPA, 2017). The site clearance and replanting activities will assimilate well into the receiving environment, and are therefore classed as an imperceptible impact, i.e. an impact capable of measurement but without noticeable consequences.

8.4.4.2.2 *Impacts on Visual Amenity - Long Term Imperceptible Neutral Impact*

The proposed replanting is to be carried out in an area where there are already existing conifer plantations among agricultural fields, and therefore the proposed replanting is not introducing a new land use but conforming to an established one. The predicted residual visual impact of the proposed replanting is Long Term, Imperceptible Neutral Impact.

8.4.5 Operational Phase

8.4.5.1 Impacts on Landscape Character – Long Term Imperceptible Neutral Impact

The proposed replanting is to be carried out in an area where there are already existing conifer plantations among agricultural fields, and therefore the proposed replanting is not introducing a new land use but conforming to an established one and contributing to the patchwork of forestry plantations with open land. The predicted residual visual impact of the proposed replanting is Long Term, Imperceptible Neutral Impact.

8.4.5.2 Impacts on Visual Amenity - Long Term Imperceptible Neutral Impact

The proposed replanting is to be carried out in an area where there are already existing conifer plantations among agricultural fields, and therefore the proposed replanting is not introducing a new land use but conforming to an established one and contributing to the patchwork of forestry plantations

with open land. Felling will be carried out in accordance with the Environmental Requirements for Afforestation. The predicted residual visual impact of the proposed replanting is Long Term, Imperceptible Neutral Impact.

8.4.6 Proposed Mitigation Measures

Mitigation measures for the construction of the drainage and planting methods have been included in the Technical Approval document. The planting method will be as per Section 2 above and mound drains will be constructed. The proposed replanting will be carried out in line with the recommendations of the Forestry and the Landscape Guidelines.

8.4.7 Residual Impacts

Following mitigation, the Residual Impact on Landscape Character will be Long Term Imperceptible Neutral Impact while the Residual Impact on Visual Amenity will be Long Term Imperceptible Neutral Impact.

8.4.8 Cumulative Impacts

Cumulative impacts are described as additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments or actions that occurred in the past, present or are likely to occur in the foreseeable future. The cumulative impact assessment is based on the planning history search carried out as described in Section 3.1.4 and the existing landuses. The cumulative impact arising from the proposed replanting in conjunction with the existing forestry plantations in the immediate vicinity and future development is assessed as Long Term, Imperceptible Neutral Impact. The cumulative impact of the replanting site is assessed as Long Term Imperceptible Neutral Impact in conjunction with the existing and future forestry developments in the vicinity.

8.5 Wicklow County Development Plan 2016-2022

8.5.1.1 Forestry Policy and Objectives

Wicklow County Council developed the 'Wicklow Indicative Forestry Strategy' in 2002 to assist planners in the assessment of afforestation proposals. The Strategy also establishes Areas Preferred to Afforestation and Areas Sensitive to Afforestation. Policies relating to forestry can be found in Chapter 3 and Table 3.3.

8.5.1.2 Landscape Policy and Objectives

This section of the report refers to the Wicklow County Development Plan 2016-2022, and the Landscape Character Assessment of County Wicklow as well as to the Environmental Requirements for Afforestation document. Section 10 of the Wicklow CDP discusses Natural Heritage and Landscape.

Wicklow is described as the 'Garden County' due to its attractive scenic quality and varying topography of rolling hills, forests, lakes, mountains and beaches. Enhancement and conservation of the natural environment while adapting to and tackling climate change is paramount for the local authority. The Natural Heritage Strategy is listed below:

- To conserve and enhance biodiversity in recognition of the many ecosystem services provided to society;
- to promote an integrated approach to landscape planning and management in order to protect the County's unique landscape character;
- to conserve and enhance the County's geological heritage;

- to avoid negative impacts upon the natural environment and promote appropriate enhancement of the natural environment as an integral part of any development; and to support the actions in the County Wicklow Heritage Plan which seek to enhance the understanding, appreciation and protection of Wicklow's biodiversity including the County Wicklow Biodiversity Action Plan.

The Strategy is based on policy and guidelines established in the EU Directives on Habitats, Birds, Water Framework and groundwater as well as the nation Planning and Development Act 2000 (as amended).

Table 8-4: Wicklow's Landscape Objectives

Objective	
NH49	All development proposals shall have regard to the County landscape classification hierarchy in particular the key landscape features and characteristics identified in the Wicklow Landscape Assessment (set in Volume 3 of this plan) and the 'Key Development Considerations' set out for each landscape area set out in Section 5 of the Wicklow Landscape Assessment
NH50	Any application for permission in the AONB which may have the potential to significantly adversely impact the landscape area shall be accompanied by a Landscape / Visual Impact Assessment, which shall include, inter alia, an evaluation of visibility and prominence of the proposed development in its immediate environs and in the wider landscape, a series of photos or photomontages of the site / development from clearly identified vantage points, an evaluation of impacts on any listed views / prospects and an assessment of vegetation / land cover type in the area (with particular regard to commercial forestry plantations which may be felled thus altering character / visibility). The Assessment shall demonstrate that landscape impacts have been anticipated and avoided to a level consistent with the sensitivity of the landscape and the nature of the designation.
NH51	To resist development that would significantly or unnecessarily alter the natural landscape and topography, including land infilling / reclamation projects or projects involving significant landscape remodelling, unless it can be demonstrated that the development would enhance the landscape and / or not give rise to adverse impacts

8.5.2 Landscape Character Assessment of County Wicklow

Wicklow contains many different landscape types and 15 distinctive landscape categories which fall within 6 hierarchies have been identified for the county. The replanting site is located within LCA 1(a) 'Mountain Uplands' which falls within the Mountain and Laksehsore AONB., It is described as "Upland areas, the Wicklow Mountains National Park and the Poulaphouca Reservoir" and holds a category 'High' landscape sensitivity. This LCA is described as "*mountainous with U-shaped valleys, lakes and glacial topography"* with land generally above 300m+. The replanting site ranges in elevation from 158m to 219m OD.

All proposals within this area must consider impacts upon the visual amenity, listed views and prospects of the uplands AONB, the various heritage assets within the area and the National Park. Proposals must also maintain the favourable conservation status of existing natural habitats including Natura Sites and Annex I-Habitats and Annex II-Animal and Plant species within this LCA.

8.5.2.1 Heritage Landscapes

Heritage Landscapes are those areas within the County where sensitive environmental resources – scenic, ecological and historic, are located. The site is not located within or near a Heritage Landscape.

8.5.2.2 Scenic Routes

Proposed developments within the Mountain Uplands must "*ensure developments on steep slopes (i.e. 10%) will not be conspicuous or have a disproportionate or dominating visual impact on the surrounding environment as seen from relevant scenic routes and settlements.*" The replanting site is not located near a scenic route.

8.5.3 Forestry and the Landscape Guidelines

Wicklow County Council released an Indicative Forestry Strategy in 2002 to assist planners in the assessment of afforestation proposals. The Strategy also establishes Areas Preferred to Afforestation and Areas Sensitive to Afforestation. Policies and objectives can be found in Table 3.4.

8.6 Baseline Environment

8.6.1 Landscape Character

The topography, vegetation and anthropological features on the land surface in an area combine to set limits on the amount of the landscape that can be seen at any one time. These physical restrictions form individual areas or units, known as physical units, whose character can be defined by aspect, slope, scale and size. A physical unit is generally delineated by topographical boundaries and is defined by landform and landcover.

The replanting site comprises two land parcels with the western parcel totalling 39.56ha with an elevation range of 158m to 219m OD. The physical unit of the replanting site is defined by large areas of forestry to the south and west and the Ballyeustace Stream to the north. Agricultural fields can be found to the east. As the replanting site occupies 39.56ha, it represents a relatively small area compared with the existing 615ha+ of forestry within the immediate environs.

The proposed replanting area is located adjacent to the curtilage of the nearest dwelling. Field boundaries are not always prominent; however, the boundaries of the replanting site follow the existing field patterns. Although the internal field boundaries of the site are not always obvious, they will be retained on the site where possible.

8.6.2 Landscape Sensitivity

The sensitivity of a landscape to development and therefore to change varies according to its character and to the importance that is attached to any combination of landscape values. The sensitivity of a landscape is derived from consideration of designations such as Special Protection Areas (SPAs), Special Areas of Conservation (SACs), Natural Heritage Areas (NHAs) and National Parks, from information such as tourist maps, guidebooks and brochures, and from the evaluation of indicators such as uniqueness, popularity, distinctiveness, and quality of the elements of the area.

A desktop assessment of landscape sensitivity in the vicinity of the replanting site was carried out. The methodology for this assessment was based on that set out in the Department of the Environment and Local Government (DoEHLG) guidance document *'Landscape and Landscape Assessment – Consultation Draft of Guidelines for Planning Authorities'* (2000). This document recommends an

assessment of landscape sensitivity based on an evaluation of individual features, such as the quality, integrity, etc. The results of the assessment are presented in Table 8.5.

Table 8-5 Ballard Site: Landscape Sensitivity

Feature	Description
Quality	The quality of the landscape in this area can be described as modified due to agriculture and forestry plantations.
Integrity	The current development site has been modified by the interaction of man with the environment.
Distinctiveness	There are no distinctive features on the site.
Popularity	A sense of popularity is created where landscape features are widely recognised or appreciated. There are no popular features on the replanting site.
Rarity	There are no Natura 2000 sites within the vicinity of the site
Cultural Meaning	A sense of cultural meaning arises where a site or features within a site are deemed to explain, represent or inspire cultural values. National Monuments Service Record No WI034-006 Enclosure is located within the northern parcel of the replanting site. A 50m buffer zone has been placed around this recorded monument. It is not visible at ground level. It is only included in the 6" Historical Map (1829-41). It is not included in the 25" (1897-1913) or the Cassini (1940s).
Sense of Public Ownership & Social Importance	A sense of public ownership arises due to ease of accessibility, visibility or a widely shared meaning. The site is privately owned and has no special social importance.

The replanting site is therefore considered to be of Medium landscape sensitivity.

8.6.2.1 Landscape Context and Site Visibility

Views towards the site would be downwards from the Wicklow Mountains to the north upwards from the east. Views from the west and south are impeded by large tracts of forestry plantation. As the additional replanting matures, it will be indistinguishable from the surrounding forestry.

8.6.3 Potential Impacts

8.6.3.1 'Do-Nothing' Scenario

In the 'Do Nothing' scenario, the subject site would be afforested in any case, as per Technical Approval that has been issued for the site. If the land was not replanted, the current land use would continue at the site.

8.6.4 Site Preparation and Planting Phase

8.6.4.1 Impacts on Landscape Character –Temporary Imperceptible Neutral Impact

The planting of forestry will entail site works in terms of woody weed clearance and construction of forestry drains and will use methods described in Section 2.2.1.1 above. These activities will have a temporary neutral impact on the landscape character, which is that of a rural working landscape with a mixture of agricultural and forestry land uses. A neutral impact is a change which does not affect the quality of the environment (EPA, 2017). The site clearance and replanting activities will assimilate well into the receiving environment, and are therefore classed as an imperceptible impact, i.e. an impact capable of measurement but without noticeable consequences.

8.6.4.2 Impacts on Visual Amenity - Long Term Imperceptible Neutral Impact

The proposed replanting is to be carried out in an area where there are already existing conifer plantations among agricultural fields, and therefore the proposed replanting is not introducing a new land use but conforming to an established one. The predicted residual visual impact of the proposed replanting is Long Term, Imperceptible Neutral Impact.

8.6.5 Operational Phase

8.6.5.1 Impacts on Landscape Character – Long Term Imperceptible Neutral Impact

The proposed replanting is to be carried out in an area where there are already existing conifer plantations among agricultural fields, and therefore the proposed replanting is not introducing a new land use but conforming to an established one and contributing to the patchwork of forestry plantations with open land. The predicted residual visual impact of the proposed replanting is Long Term, Imperceptible Neutral Impact.

8.6.5.2 Impacts on Visual Amenity - Long Term Imperceptible Neutral Impact

The proposed replanting is to be carried out in an area where there are already existing conifer plantations among agricultural fields, and therefore the proposed replanting is not introducing a new land use but conforming to an established one and contributing to the patchwork of forestry plantations with open land. Felling will be carried out in accordance with the Environmental Requirements for Afforestation. The predicted residual visual impact of the proposed replanting is Long Term, Imperceptible Neutral Impact.

8.6.6 Proposed Mitigation Measures

The forestry drains are to be mound drains where deemed necessary along contours, or at most at a 30% acute angle to the contours, as outlined in the Conditions in the Technical Approval Document. Mitigation measures for the construction of the drainage and planting methods have been included as indicated in the Technical Document, and as a mitigation measure the planting method will be pit planting and mound drains constructed.

The 100m buffer zone (zone of notification) around recorded monument WI034-006 will be maintained and no ground disturbance will occur in this area. Elsewhere, there will be some minor disturbance of soils associated with the construction of drains through the site. Planting of trees will be carried out by hand using the slit planting method, so soil disturbance from this will be insignificant.

8.6.7 Residual Impacts

Following mitigation, the Residual Impact on Landscape Character will be Long Term Imperceptible Neutral Impact while the Residual Impact on Visual Amenity will be Long Term Imperceptible Neutral Impact.

8.6.8 Cumulative Impacts

Cumulative impacts are described as additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments or actions that occurred in the past, present or are likely to occur in the foreseeable future. The cumulative impact assessment is based on

the planning history search carried out as described in Section 3.1.4 and the existing landuses. The cumulative impact arising from the proposed replanting in conjunction with the existing forestry plantations in the immediate vicinity and future development is assessed as Long Term, Imperceptible Neutral Impact. The cumulative impact of the replanting site is assessed as Long Term Imperceptible Neutral Impact in conjunction with the existing and future forestry developments in the vicinity.

9. CULTURAL HERITAGE

9.1 Introduction

This section presents the results of an archaeological and cultural heritage impact assessment for the proposed afforestation of the proposed replanting areas.

The purpose of this section is to assess the potential impacts of the afforestation on the surrounding archaeological, architectural and cultural heritage landscape. An assessment of potential impacts is presented, and a number of mitigation measures are recommended where appropriate.

9.2 Methodology

A desk-based study of the proposed replanting areas was undertaken in order to assess the archaeological, architectural and cultural heritage potential of the area and to identify constraints or features of archaeological/cultural heritage significance within or adjacent to the sites. Each of the proposed sites have been Technically Approved for afforestation which will be completed in accordance with the *'Forestry and Archaeology Guidelines' (2000) (the Guidelines).* The guidelines provide specific mitigation measures to be employed for afforestation which will minimise potential impacts on this resource.

9.2.1 Statutory Context

9.2.1.1 Current Legislation

Archaeological monuments are safeguarded through national and international policy, which is designed to secure the protection of the cultural heritage resource. This is undertaken in accordance with the provisions of the European Convention on the Protection of the Archaeological Heritage (Valletta Convention). This was ratified by Ireland in 1997. Both the National Monuments Acts 1930 to 2004 and relevant provisions of the Cultural Institutions Act 1997 are the primary means of ensuring protection of archaeological monuments, the latter of which includes all man-made structures of whatever form or date. There are a number of provisions under the National Monuments Acts which ensure protection of the archaeological resource:

- It is recorded in the Record of Monuments and Places (RMP).
- It is registered in the Register of Historic Monuments (RHM).
- It is a national monument subject to a preservation order (or temporary preservation order).
- It is a national monument in the ownership or guardianship of the Minister for Culture, Heritage and the Gaeltacht or a Local Authority.

The Record of Monuments and Places (RMP) was established under Section 12 (1) of the National Monuments (Amendment) Act 1994 and consists of a list of known archaeological monuments and accompanying maps. The Record of Monuments and Places affords some protection to the monuments entered therein. Section 12 (3) of the 1994 Amendment Act states that any person proposing to carry out work at or in relation to a recorded monument must give notice in writing to the Minister (Environment, Heritage and Local Government) and shall not commence the work for a period of two months after having given the notice. All proposed works, therefore, within or around any archaeological monument are subject to statutory protection and legislation (National Monuments Acts 1930-2004).

Under the Heritage Act (1995) architectural heritage is defined to include *'all structures, buildings, traditional and designed, and groups of buildings including street-scapes and urban vistas, which are of*

historical, archaeological, artistic, engineering, scientific, social or technical interest, together with their setting, attendant grounds, fixtures, fittings and contents...'. A heritage building is also defined to include *'any building, or part thereof, which is of significance because of its intrinsic architectural or artistic quality or its setting or because of its association with the commercial, cultural, economic, industrial, military, political, social or religious history of the place where it is situated or of the country or generally'*.

9.2.1.2 Granada Convention

The Council of Europe, in Article 2 of the 1985 Convention for the Protection of the Architectural Heritage of Europe (Granada Convention), states that *'for the purpose of precise identification of the monuments, groups of structures and sites to be protected, each member State will undertake to maintain inventories of that architectural heritage'*. The Granada Convention emphasizes the importance of inventories in underpinning conservation policies.

The National Inventory of Architectural Heritage (NIAH) was established in 1990 to fulfill Ireland's obligations under the Granada Convention, through the establishment and maintenance of a central record, documenting and evaluating the architectural heritage of Ireland. Article 1 of the Granada Convention establishes the parameters of this work by defining *'architectural heritage'* under three broad categories of Monument, Groups of Buildings, and Sites:

- **Monument**: all buildings and structures of conspicuous historical, archaeological, artistic, scientific, social or technical interest, including their fixtures and fittings;
- **Group of buildings**: homogeneous groups of urban or rural buildings conspicuous for their historical, archaeological, artistic, scientific, social or technical interest, which are sufficiently coherent to form topographically definable units;
- **Sites**: the combined works of man and nature, being areas, which are partially built upon and sufficiently distinctive and homogenous to be topographically definable, and are of conspicuous historical, archaeological, artistic, scientific, social or technical interest.

The Council of Europe's definition of architectural heritage allows for the inclusion of structures, groups of structures and sites which are of significance in their own right, or which are of significance in their local context and environment. The NIAH believes it is important to consider the architectural heritage as encompassing a wide variety of structures and sites as diverse as post boxes, grand country houses, mill complexes and vernacular farmhouses.

9.2.2 Desktop Assessment

A primary cartographic source and base-line data for the archaeological assessment was the consultation of the Sites and Monuments Record (SMR) and Record of Monuments and Places (RMP) through the electronic database of recorded monuments which may be accessed at www.archaeology.ie. All known recorded archaeological monuments are indicated on 6-inch Ordnance Survey (OS) maps and are listed in this record.

The following sources were consulted for this assessment report:

- Electronic database of recorded monuments (www.archaeology.ie)
- Aerial photographs (copyright of Ordnance Survey Ireland (OSI.ie)

9.2.2.1 Recorded Monuments and Places

The Sites and Monuments Record (SMR) and Record of Monuments and Places (RMP) is a record of all known recorded archaeological monuments. The SMR/RMP is not a complete record of all monuments as newly discovered sites may not appear in the list or accompanying maps. In conjunction

with the consultation of the SMR and RMP, the electronic database of recorded monuments which may be accessed at www.archaeology.ie was consulted.

9.2.2.2 Aerial Photograph Analysis

Aerial photographs of the sites were examined, and no previously unrecorded archaeological features could be seen. Sources included Bing, Google Maps and Ordnance Survey of Ireland.

9.2.3 Archaeology

Archaeological heritage is a non-renewable resource. The overall objective of this assessment of impacts of the proposed development is to ensure that where a potential impact has been identified, that it can be mitigated against to ensure that the archaeological heritage will be available for future generations. The potential impacts on the recorded archaeological heritage are assessed here.

Potential impact is assessed based on the impact classification terminology outlined in Table 5.1 of this Report, with the significance of impacts being defined as either imperceptible, slight, moderate, significant or profound, or if no impact is predicted to occur, 'No Impact'.

9.2.4 Potential Impacts

Potential afforestation impacts include direct destruction of recorded and unrecorded sites and indirect impacts on archaeological potential of nearby sites.

9.3 Replanting Area 1: Stranamart, Co. Cavan

9.3.1 Existing Environment

9.3.1.1 Recorded Monuments within the Study Area

The Electronic database of recorded monuments (www.archaeology.ie) was used to compile a list of known sites which occur in the vicinity of the site. There are no recorded archaeological features on or in the vicinity of the study site.

The nearest Recorded Monuments and Place (RMP) is a cairn- unclassified CV02429, located approximately 760m north of the site in the townland of Stranamart. Currently the information for this record has not been uploaded to the national monuments database. Aerial photography indicates there are little surface remains of this asset. Intervisibility between this low-lying asset and the site are not possible due to the screening effect of intervening vegetation from field boundaries and along roads.

9.3.1.2 Record of Protected Structures

There are no Protected Structures (RPS) located within or adjacent to the replanting area. The nearest RPS, St Felim's Roman Catholic Church - Reg. No. 40400401 is located 2.5km east of the site. Intervisibility between the chapel and the site are not possible due to the screening effect of intervening vegetation from field boundaries and along roads, and large tracts of forestry

9.3.1.3 Potential Impacts

9.3.1.4 'Do-Nothing' Scenario

The lands have been Technically Approved and will be afforested should the Croagh Wind Farm proceed or not. If the land was not replanted, the current land use would continue at the site.

9.3.1.5 Potential Direct Impacts on the Archaeological Heritage

Direct Impact refers to a 'physical impact' on a monument. The afforestation will require some minor earthmoving activities such as drainage and the provision of access tracks. Harvesting will require tree felling. There are no recorded monuments on the site and therefore there will be no direct impacts.

9.3.1.6 Potential Indirect Impacts on the Archaeological Heritage

Potential indirect impacts may arise where a monument or area of archaeological potential is situated in relatively proximity to a proposed development but is not directly (physically) affected by the development. In such cases the impact on the setting of the monument or views to and from it are assessed.

There are no recorded monuments in the vicinity of the site with the nearest RMP and RPS located approximately 760m north and 2.5km east of the site, respectively. Intervisibility between these assets and the proposed replanting areas are heavily impeded by intervening vegetation of field boundaries along roads and existing tracts of forestry. Furthermore, the small area to be replanted will be indistinguishable from the existing forestry in the immediate and surrounding environs. Therefore, indirect impacts are considered to be imperceptible.

9.3.1.7 Cumulative Impacts

As stated above, the small area to be replanted will be indistinguishable from the existing forestry in the immediate and surrounding environs. Therefore, cumulative impacts on heritage assets are considered to be imperceptible. Additionally, there are no proposed developments of a similar scale or nature located in the vicinity of the site that would give rise to cumulative impacts in conjunction with the proposed replanting on features of cultural heritage significance. The cumulative impact of the replanting site is assessed as Long Term Imperceptible Neutral Impact in conjunction with the existing and future forestry developments in the vicinity.

9.3.2 Operational Phase

There will be no significant indirect or direct impacts on cultural heritage once the site has been afforested.

9.3.2.1.1 *Residual Impact*

No residual impacts.

9.4 Replanting Area 2: Brackloon, Co. Roscommon

9.4.1 Existing Environment

9.4.1.1 Recorded Monuments within the Study Area

There are no recorded archaeological features on or in the vicinity of the study site. The Electronic database of recorded monuments (www.archaeology.ie) was used to compile a list of known sites which occur in the vicinity of the site.

The nearest recorded features are a ringfort, located approximately 1km to the north-east of the site.

9.4.2 Potential Impacts

9.4.2.1 'Do-Nothing' Scenario

The lands have been Technically Approved and will be afforested should the Croagh Wind Farm proceed or not. If the land was not replanted, the current land use would continue at the site.

9.4.2.2 Potential Direct Impacts on the Archaeological Heritage

Direct Impact refers to a 'physical impact' on a monument. The afforestation will require some minor earthmoving activities such as drainage and the provision of access tracks. Harvesting will require tree felling.

There are no recorded monuments on the site and therefore there will be no direct impacts.

9.4.2.3 Potential Indirect Impacts on the Archaeological Heritage

Potential indirect impacts may arise where a monument or area of archaeological potential is situated in relatively proximity to a proposed development but is not directly (physically) affected by the development. In such cases the impact on the setting of the monument or views to and from it are assessed.

The nearest RMP comprises a group of 4 records: two possible Bullaun Stones ROO15-054002 & ROO15-054003, an enclosure R0015-054001 and a redundant record R00150-54004. The RMPs are located 400m to the southeast of the replanting site. A 50m Zone of Notification remains around the RMP cluster.

Enclosure R0015-054001

The enclosure comprises a natural hillock (44m north-south, 33m east-west, H 1.8–2.5m) with an earthen bank (W 3m, internal H 0.2m, external H 1.3m-1.4m) and scarp and fosse; the latter recut by a drain. Mature trees are growing on the hillock.

Bullaun Stones ROO15-054002

Both 'possible' bullaun stones have not been found to date. Therefore, there are no indirect impacts on these assets.

Penitential Station ROO15-054003

The Penitential Station is described within the RMP as a "*on an oval hillock ... [...] ...slab resting on some small stones and surrounded by a drystone wall. A broken slab surrounded by and partly overlain by a collapsed drystone wall...mature deciduous trees grow at the edge of the hill and one at the summit has a small shrine with a statue. Two possible bullaun stones ROO15-054002 (Gannon 1972) could not be found. Stations were performed here on Garland Sunday (MacNeill 1962, 631-2)*". The western boundary of the RMP features on both the 6" OS historical Map (1829-1841) and the 25" historical Map (1897-1913) as the Mullenduff townland, Kilcolgah parish and Frenchpark Barony boundary.

Redundant record R00150-54004

This RMP is known as St. Patricks Bed and was initially thought to have been a megalithic tomb. It has since been determined to be a natural hillock. Thus, the record is redundant.

The 25" map shows that a private lane was constructed along its southern boundary and a drain was inserted into the fosse of an earthen bank which was constructed around the base of the hillock; both compromising the setting of the heritage asset. The site is no longer used for penitential ceremonies, is not accessible to the public and is currently used for grazing cattle. The 'possible' bullaun stones have never been located and record R00150-54004 is redundant. Intervisibility between these RMPs and the replanting site is possible; however, the proposed replanting area is considered small in comparison with existing forestry plantation in the area. Therefore, the replanted site will be indistinguishable from the surrounding forestry. Hence, indirect impacts on this RMP cluster is considered to be imperceptible.

9.4.2.4 Cumulative Impacts

There will be no cumulative impact associated with the afforestation of the site as there are no features close to the site. A planning history search of applications in the vicinity of the proposed replanting lands has also been carried out, as described in Section 3.1.4 of this report. There are no developments of a similar scale and nature located in the vicinity of the site that would give rise to cumulative impacts in conjunction with the proposed replanting on features of cultural heritage significance. The cumulative impact of the replanting site is assessed as Long Term Imperceptible Neutral Impact in conjunction with the existing and future forestry developments in the vicinity.

9.4.3 Operational Phase

There will be no significant indirect or direct impacts on cultural heritage once the site has been afforested.

9.4.3.1.1 *Residual Impact*

No residual impacts.

9.5 Replanting Area 3: Ballard, Co. Wicklow

9.5.1 Existing Environment

9.5.1.1 Recorded Monuments within the Study Area

There are no recorded archaeological features on or in the vicinity of the study site. The Electronic database of recorded monuments (www.archaeology.ie) was used to compile a list of known sites which occur in the vicinity of the site.

The nearest recorded features are a ringfort, located approximately 1km to the north-east of the site.

9.5.2 Potential Impacts

9.5.2.1 'Do-Nothing' Scenario

The lands have been Technically Approved and will be afforested should the Croagh Wind Farm proceed or not. If the land was not replanted, the current land use would continue at the site.

9.5.2.2 Potential Direct Impacts on the Archaeological Heritage

Direct Impact refers to a 'physical impact' on a monument. The afforestation will require some minor earthmoving activities such as drainage and the provision of access tracks. Harvesting will require tree felling.

There is one RMP Enclosure WI034-006 located within the eastern parcel of the replanting site. It is described within the RMP as "situated on a gentle NW-facing slope. Circular enclosure (dims. C. 40m x 35m) marked only on the 1838 OS 6" map. Not visible at ground level". A 100m zone of notification (buffer) is placed around this RMP.

The zone of notification will be maintained during the planting phase. Planting of trees outside of this zone will be carried out by hand using the methods described in Section 2.2.1.1 above. Drains will be constructed in accordance with the Forestry Service Best Practice Guidelines described in detail in Section 2.

9.5.2.3 Potential Indirect Impacts on the Archaeological Heritage

Potential indirect impacts may arise where a monument or area of archaeological potential is situated in relative proximity to a proposed development but is not directly (physically) affected by the development. In such cases the impact on the setting of the monument or views to and from it are assessed.

There are a further three RMPs (WI035-001, WI035-003 and WI035-002) recorded as enclosures and mounds located within 500m of the replanting site. However, all RMPs are located within existing forestry land with one (WI035-002) bisected by a local road. All are not visible at surface level or recorded as in 'poor condition'. The setting and intervisibility of all RMPs have been heavily compromised by existing forestry and roads. Therefore, impacts on all RMPs are considered not significant.

9.5.2.4 Cumulative Impacts

There will be no cumulative impact associated with the afforestation of the site as there are no features close to the site. A planning history search of applications in the vicinity of the proposed replanting lands has also been carried out, as described in Section 3.1.4 of this report. There are no developments of a similar scale and nature located in the vicinity of the site that would give rise to cumulative impacts in conjunction with the proposed replanting on features of cultural heritage significance. The cumulative impact of the replanting site is assessed as Long Term Imperceptible Neutral Impact in conjunction with the existing and future forestry developments in the vicinity.

9.5.3 Operational Phase

There will be no significant indirect or direct impacts on cultural heritage once the site has been afforested.

9.5.3.1.1 *Residual Impact*

No residual impacts.

10. AIR, CLIMATE AND NOISE

10.1 AIR

10.1.1 Background

The primary land-uses within and in the vicinity of the 3 no. site locations comprises agriculture and forestry. Due to the non-industrial nature of afforestation and the general character of the surrounding environment, air quality sampling was deemed to be unnecessary for this study. It is expected that air quality in the existing environment is good, since there are no major sources of air pollution (e.g. heavy industry) in the vicinity of the sites.

The growth of forestry has no direct atmospheric emissions. Some minor indirect emissions associated with site preparation, planting and harvesting include vehicular and dust emissions.

10.1.2 Air Quality Standards

In 1996, the Air Quality Framework Directive (96/62/EC) was published. This Directive was transposed into Irish law by the Environmental Protection Agency Act 1992 (Ambient Air Quality Assessment and Management) Regulations 1999. The Directive was followed by four Daughter Directives, which set out limit values for specific pollutants:

- The first Daughter Directive (1999/30/EC) deals with sulphur dioxide, oxides of nitrogen, particulate matter and lead.
- The second Daughter Directive (2000/69/EC) addresses carbon monoxide and benzene. The first two Daughter Directives were transposed into Irish law by the Air Quality Standards Regulations 2002 (SI No. 271 of 2002).
- A third Daughter Directive, Council Directive (2002/3/EC) relating to ozone was published in 2002 and was transposed into Irish law by the Ozone in Ambient Air Regulations 2004 (SI No. 53 of 2004).
- The fourth Daughter Directive, published in 2007, deals with polyaromatic hydrocarbons (PAHs), arsenic, nickel, cadmium and mercury in ambient air.

The Air Quality Framework Directive and the first three Daughter Directives have been replaced by the Clean Air for Europe (CAFE) Directive (Directive 2008/50/EC on ambient air quality), which encompasses the following elements:

- The merging of most of the existing legislation into a single Directive (except for the Fourth Daughter Directive) with no change to existing air quality objectives.
- New air quality objectives for PM2.5 (fine particles) including the limit value and exposure concentration reduction target.
- The possibility to discount natural sources of pollution when assessing compliance against limit values.
- The possibility for time extensions of three years (for particulate matter PM10) or up to five years (nitrogen dioxide, benzene) for complying with limit values, based on conditions and the assessment by the European Commission.

Table 10.1 below sets out the limit values of the CAFE Directive, as derived from the Air Quality Framework Daughter Directives. Limit values are presented in micrograms per cubic metre ($\mu g/m^3$) and parts per billion (ppb). The notation PM_{10} is used to describe particulate matter or particles of ten micrometres or less in aerodynamic diameter. $PM_{2.5}$ represents particles measuring less than 2.5 micrometres in aerodynamic diameter.

Table 10-1 Limit values of Directive 2008/50/EC, 1999/30/EC and 2000/69/EC (Source: EPA)

Pollutant	Limit Value Objective	Averaging Period	Limit Value (µg/m^3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
Sulphur dioxide (SO_2)	Protection of Human Health	1 hour	350	132	Not to be exceeded more than 24 times in a calendar year	1st Jan 2005
Sulphur dioxide (SO_2)	Protection of human health	24 hours	125	47	Not to be exceeded more than 3 times in a calendar year	1st Jan 2005
Sulphur dioxide (SO_2)	Protection of vegetation	Calendar year	20	7.5	Annual mean	19th Jul 2001
Sulphur dioxide (SO_2)	Protection of vegetation	1st Oct to 31st Mar	20	7.5	Winter mean	19th Jul 2001
Nitrogen dioxide (NO_2)	Protection of human health	1 hour	200	105	Not to be exceeded more than 18 times in a calendar year	1st Jan 2010
Nitrogen dioxide (NO_2)	Protection of human health	Calendar year	40	21	Annual mean	1st Jan 2010
Nitrogen monoxide (NO) and nitrogen dioxide (NO_2)	Protection of ecosystems	Calendar year	30	16	Annual mean	19th Jul 2001
Particulate matter 10 (PM_{10})	Protection of human health	24 hours	50	-	Not to be exceeded more than 35 times in a calendar year	1st Jan 2005
Particulate matter 2.5 ($PM_{2.5}$)	Protection of human health	Calendar year	40	-	Annual mean	1st Jan 2005
Particulate matter 2.5 ($PM_{2.5}$) Stage 1	Protection of human health	Calendar year	25	-	Annual mean	1st Jan 2015

Particulate matter 2.5 ($PM_{2.5}$) Stage 2	Protection of human health	Calendar year	20	-	Annual mean	1st Jan 2020
Lead (Pb)	Protection of human health	Calendar year	0.5	-	Annual mean	1st Jan 2005
Carbon Monoxide (CO)	Protection of human health	8 hours	10,000	8,620	-	1st Jan 2005
Benzene (C_6H_6)	Protection of human health	Calendar Year	5	1.5	-	1st Jan 2010

The Ozone Directive 2002/3/EC is different from Directive 2008/50/EC in that it sets target values and long-term objectives for ozone rather than limit values. Table 10.2 presents the limit and target values for ozone.

Table 10-2 Target values for Ozone Defined in Directive 2008/50/EC

Objective	Parameter	Target Value for 2010	Target Value for 2020
Protection of human health	Maximum daily 8 hour mean	120 mg/m^3 not to be exceeded more than 25 days per calendar year averaged over 3 years	120 mg/m^3
Protection of vegetation	AOT_{40} calculated from 1-hour values from May to July	18,000 $mg/m^3.h$ averaged over 5 years	6,000 $mg/m^3.h$
Information Threshold	1-hour average	180 mg/m^3	-
Alert Threshold	1-hour average	240 mg/m^3	-

AOT_{40} is a measure of the overall exposure of plants to ozone. It is the sum of the excess hourly concentrations greater than 80 $\mu g/m^3$ and is expressed as $\mu g/m^3$ hours.

10.1.2.1 Air Quality Zones

The Environmental Protection Agency (EPA) has designated four Air Quality Zones for Ireland:

- Zone A: Dublin City and environs
- Zone B: Cork City and environs
- Zone C: 16 urban areas with population greater than 15,000
- Zone D: Remainder of the country.

These zones were defined to meet the criteria for air quality monitoring, assessment and management described in the Framework Directive and Daughter Directives. The 3 sites for afforestation lie within Zone D, which represents rural areas located away from large population centres.

10.2 Replanting Area 1: Stranamart, Co. Cavan

10.2.1 Potential Impacts on Air Quality

10.2.1.1 'Do-Nothing' Impact

The lands have been Technically Approved and will be afforested should the Croagh Wind Farm proceed or not. If these lands are not afforested, the landuse at the site will continue and potential for the reduction in $C0_2$ emissions will be lost.

10.2.1.2 Planting Phase

10.2.1.2.1 *Short-term Imperceptible Negative Impact*

Some minor emissions associated with the use of an excavator for site drainage works are expected. This potential impact will not be significant and will be restricted to the duration of the drainage works.

10.2.1.3 Mitigation

All construction machinery will be maintained in good operational order while on-site, minimising any emissions that are likely to arise.

10.2.1.4 Operational Phase

10.2.1.4.1 *Long Term Slight Positive Impact*

The growth of trees will result in the fixation of atmospheric carbon, and the production of oxygen.

10.2.1.5 Residual Effects

On balance there will be positive effects on air associated with the proposed afforestation.

10.2.2 Potential Impacts from Dust

10.2.2.1 Planting Phase

10.2.2.1.1 *Short-term Imperceptible Negative Impact*

Potential dust emission sources include the working of an excavator. This potential impact will not be significant and will be restricted to the duration of the drainage works.

10.2.2.2 Mitigation

Areas of excavation will be kept to a minimum, and all works will be carried out in accordance with the Forestry Service Best Practice Guidelines described in detail in Section 2.

10.2.2.3 Operational Phase

There will be no significant indirect or direct impacts from dust the site has been afforested.

10.2.2.4 Residual Effects

On balance there will be positive impacts on air associated with the proposed afforestation.

10.3 Replanting Area 2: Brackloon, Co. Roscommon

10.3.1 Potential Impacts on Air Quality

10.3.1.1 'Do-Nothing' Impact

The lands have been Technically Approved and will be afforested should the Croagh Wind Farm proceed or not. If these lands are not afforested, the landuse at the site will continue and potential for the reduction in C02 emissions will be lost.

10.3.1.2 Planting Phase

10.3.1.3 Short-term Imperceptible Negative Impact

Some minor emissions associated with the use of an excavator for site drainage works are expected. This potential impact will not be significant and will be restricted to the duration of the drainage works.

10.3.1.4 Mitigation

All construction machinery will be maintained in good operational order while on-site, minimising any emissions that are likely to arise.

10.3.1.5 Operational Phase

10.3.1.5.1 *Long Term Slight Positive Impact*

The growth of trees will result in the fixation of atmospheric carbon, and the production of oxygen.

10.3.1.6 Residual Effects

On balance there will be positive effects on air associated with the proposed afforestation.

10.3.2 Potential Impacts from Dust

10.3.2.1 Replanting Phase

10.3.2.1.1 *Short-term Imperceptible Negative Impact*

Potential dust emission sources include the working of an excavator. This potential impact will not be significant and will be restricted to the duration of the drainage works.

10.3.2.2 Mitigation

Areas of excavation will be kept to a minimum, and all works will be carried out in accordance with the Forestry Service Best Practice Guidelines described in detail in Section 2.

10.3.2.3 Operational Phase

There will be no significant indirect or direct impacts from dust the site has been afforested.

10.3.2.4 Residual Effects

On balance there will be positive impacts on air associated with the proposed afforestation.

10.4 Replanting Area 3: Ballard, Co. Wicklow

10.4.1 Potential Impacts on Air Quality

10.4.1.1 'Do-Nothing' Impact

The lands have been Technically Approved and will be afforested should the Croagh Wind Farm proceed or not. If these lands are not afforested, the landuse at the site will continue and potential for the reduction in C02 emissions will be lost.

10.4.1.2 Planting Phase

10.4.1.2.1 *Short-term Imperceptible Negative Impact*

Some minor emissions associated with the use of an excavator for site drainage works are expected. This potential impact will not be significant and will be restricted to the duration of the drainage works.

10.4.1.3 Mitigation

All construction machinery will be maintained in good operational order while on-site, minimising any emissions that are likely to arise.

10.4.1.4 Operational Phase

10.4.1.4.1 *Long Term Slight Positive Impact*

The growth of trees will result in the fixation of atmospheric carbon, and the production of oxygen.

10.4.1.5 Residual Effects

On balance there will be positive effects on air associated with the proposed afforestation.

10.4.2 Potential Impacts from Dust

10.4.2.1 Planting Phase

10.4.2.1.1 *Short-term Imperceptible Negative Impact*

Potential dust emission sources include the working of an excavator. This potential impact will not be significant and will be restricted to the duration of the drainage works.

10.4.2.2 Mitigation

Areas of excavation will be kept to a minimum, and all works will be carried out in accordance with the Forestry Service Best Practice Guidelines described in detail in Section 2.

10.4.2.3 Operational Phase

There will be no significant indirect or direct impacts from dust the site has been afforested.

10.4.2.4 Residual Effects

On balance there will be positive impacts on air associated with the proposed afforestation.

10.5 Climate

10.5.1 Climate Change and Greenhouse Gases

Although climate change is thought to be a natural process, the rate at which the climate is changing has been accelerated rapidly by human activities. Climate change is one of the most challenging global issues facing us today and is primarily the result of increased levels of greenhouse gases in the atmosphere. These greenhouse gases come primarily from the combustion of fossil fuels in energy use. Changing climate patterns are thought to increase the frequency of extreme weather conditions such as storms, floods and droughts. In addition, warmer weather trends can place pressure on animals and plants that cannot adapt to a rapidly changing environment. Moving away from our reliance on coal, oil and other fossil fuel-driven power plants is essential to reduce emissions of greenhouse gases and combat climate change.

10.5.2 International Policy

10.5.2.1 United Nations Framework Convention on Climate Change

In 1992, countries joined an international treaty, the United Nations Framework Convention on Climate Change (UNFCCC), as a framework for international efforts to combat the challenge posed by climate change. The UNFCCC seeks to limit average global temperature increases and the resulting climate change. In addition, the UNFCCC seeks to cope with impacts that are already inevitable. It recognises that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. The framework set no binding limits on greenhouse gas emissions for individual countries and contains no enforcement mechanisms. Instead, the framework outlines how specific international treaties (called "protocols" or "Agreements") may be negotiated to set binding limits on greenhouse gases.

Ireland is a Party to the Kyoto Protocol, which is a protocol to the UNFCCC. The Kyoto Protocol is an international agreement that sets limitations and reduction targets for greenhouse gases for developed countries. It came into effect in 2005, as a result of which, emission reduction targets agreed by developed countries, including Ireland, are now binding. Further details on Ireland's obligations under the Kyoto Protocol are presented below.

10.5.2.2 Kyoto Protocol Targets

Under the Kyoto Protocol, the EU agreed to achieve a significant reduction in total greenhouse gas emissions of 8% below 1990 levels in the period 2008 to 2012. Ireland's contribution to the EU commitment for the period 2008 – 2012 was to limit its greenhouse gas emissions to no more than 13% above 1990 levels.

10.5.2.3 Doha Amendment to the Kyoto Protocol

In Doha, Qatar, on 8th December 2012, the "Doha Amendment to the Kyoto Protocol" was adopted. The amendment includes:

- New commitments for Annex I Parties to the Kyoto Protocol who agreed to take on commitments in a second commitment period from 1 January 2013 to 31 December 2020;
- A revised list of greenhouse gases (GHG) to be reported on by Parties in the second commitment period; and
- Amendments to several articles of the Kyoto Protocol which specifically referenced issues pertaining to the first commitment period and which needed to be updated for the second commitment period.

During the first commitment period, 37 industrialised countries and the European Community committed to reduce GHG emissions to an average of 5% below 1990 levels. During the second commitment period, Parties committed to reduce GHG emissions by at least 18% below 1990 levels in the eight-year period from 2013 to 2020. The composition of Parties in the second commitment period is different from the first; however, Ireland and the EU signed up to both the first and second commitment periods.

Under the protocol, countries must meet their targets primarily through national measures, although market-based mechanisms (such as international emissions trading) can also be utilised.

10.5.2.4 COP21 Paris Agreement

COP21 was the 21st session of the Conference of the Parties (COP) to the UNFCCC. Every year since 1995, the COP has gathered the 196 Parties (195 countries and the European Union) that have ratified the Convention in a different country, to evaluate its implementation and negotiate new commitments. COP21 was organised by the United Nations in Paris and held from 30thNovember to 12th December 2015.

COP21 closed on 12th December 2015 with the adoption of the first international climate agreement (concluded by 195 countries and applicable to all). The 12-page text, made up of a preamble and 29 articles, provides for a limitation of the global average temperature rise to well below 2°C above pre-industrial levels and to limit the increase to 1.5°C. It is flexible and takes into account the needs and capacities of each country. It is balanced as regards adaptation and mitigation, and durable, with a periodical ratcheting-up of ambitions. Ireland formally ratified the agreement on the 27th October 2016, and it entered into force on the 4th November 2016.

10.5.2.5 COP25 Climate Change Conference

The 25th United Nations Climate Change conference COP25 was held in Madrid and ran from December 2nd to December 13th, 2019. While largely regarded as an unsuccessful conference, the European Union launched its most ambitious plan, 'The European Green New Deal' which aims to lower CO_2 emissions to zero by 2050. The deal includes proposals to reduce emissions from the transport, agriculture and energy sectors and will affect the technology chemicals, textiles, cement and steel industries. Measures such as fines and pay-outs by member states who rely on coal power will be in place to encourage the switch to renewable clean energies such as wind. The Commission will present draft laws for the new deal to the EU in January of 2020 and if accepted will likely be implemented in 2021. Decisions regarding the global carbon market were postponed until the next Climate Conference (COP26) which will be held in Glasgow in November 2020.

10.6 Replanting Area 1: Stranamart, Co. Cavan.

County Cavan has a temperate oceanic climate, resulting in mild winters and cool summers. The Met Éireann weather station at Finner Camp, Co. Donegal is the nearest weather and climate monitoring station to the site, located approximately 33.8 km northwest of the site. This station was installed in 2010 and replaced an existing weather station which had taken measurements since April 1996. There is no long-term meteorological data available from this station. The nearest station with 30-year data is recorded Clones over the 30-year period from 1978-2007 and is shown in Table 10.3 while mean monthly data collected at the Finner met station for the years 2017- 2020 to date can be found in Table 10.4.

The wettest month on average monitored at the Clones station from the period 1978-2007 was October with an average monthly rainfall of 102.7mm. The wettest month monitored at Finner from 2017 to April 2020 was also October with an average rainfall of 136.8mm. The warmest month detected at the Clones monitoring site was July with an average daily temperature of 15.3°C. The warmest month detected at Finner was also July with an average daily temperature of 15.1°C.

Table 10-3 Data from Met Éireann Weather Station, Clones, Co. Monaghan 1979 to 2007

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
TEMPERATURE (degrees Celsius)													
mean daily max	7.2	7.8	9.7	12.1	15.1	17.4	19.2	18.8	16.6	13.1	9.8	7.6	12.9
mean daily min	1.6	1.6	3.0	4.2	6.5	9.5	11.4	11.1	9.2	6.6	3.9	2.3	5.9
mean temperature	4.4	4.7	6.4	8.1	10.8	13.4	15.3	15.0	12.9	9.9	6.8	5.0	9.4
absolute max.	14.8	16.3	16.9	21.5	25.9	29.3	30.5	28.3	25.3	20.1	16.9	14.8	30.5
min. maximum	-3.8	-0.4	2.3	0.0	0.0	10.1	10.7	11.3	10.7	6.2	1.6	-5.7	-5.7
max. minimum	12.0	11.3	11.0	12.1	13.4	16.9	18.7	18.0	17.1	15.4	12.7	12.6	18.7
absolute min.	-12.4	-7.3	-6.8	-3.8	-3.7	1.6	4.6	3.5	0.2	-4.5	-5.4	-11.0	-12.4
RELATIVE HUMIDITY (%)													
mean at 0900UTC	89.9	88.7	86.6	81.8	77.4	78.8	81.7	84.6	87.3	89.3	90.8	90.9	85.7
mean at 1500UTC	83.3	77.3	72.9	67.5	66.5	68.7	69.6	71.2	72.8	77.3	82.5	85.9	74.6
SUNSHINE (Hours)													
mean daily duration	1.5	2.2	3.0	4.6	5.6	4.6	4.4	4.2	3.6	2.8	1.8	1.2	3.3
greatest daily duration	7.5	9.8	11.0	13.1	15.5	16.0	15.2	14.4	12.0	9.6	8.5	6.9	16.0
mean num. of days with no sun	12.1	8.3	6.0	3.8	2.2	2.6	2.2	2.8	4.0	6.9	10.3	13.2	74.3
RAINFALL (mm)													

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
mean monthly total	87.6	71.0	84.0	61.6	63.4	70.9	70.8	88.7	76.2	102.7	85.1	98.4	960.4
greatest daily total	30.0	26.9	34.0	23.5	37.7	38.1	50.3	74.6	27.1	43.8	33.1	31.9	74.6
mean num. of days with >= 0.2mm	20	17	20	16	16	17	18	18	18	20	19	19	218
mean num. of days with >= 1.0mm	15	12	15	12	12	12	13	13	13	15	14	15	161
mean num. of days with >= 5.0mm	6	5	6	4	4	5	4	5	5	7	6	7	64
WIND (knots)													
mean monthly speed	9.2	9.4	9.4	7.9	7.2	6.7	6.3	6.3	7.0	7.8	8.2	8.7	7.8
max. gust	70	81	69	61	53	50	53	49	57	62	60	72	61.4
max. mean 10-minute speed	46	51	41	34	35	31	30	29	37	37	35	44	37.5
mean num. of days with gales	0.6	0.4	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.4	2.2
WEATHER (Mean No. of Days With:)													
snow or sleet	4.9	4.7	3.8	1.1	0.3	0.0	0.0	0.0	0.0	0.0	0.6	2.6	18.0
snow lying at 0900UTC	2.8	1.1	0.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.2	6.2
Hail	0.8	1.6	2.8	2.3	1.3	0.1	0.1	0.0	0.1	0.6	0.4	0.8	10.8
Thunder	0.1	0.1	0.1	0.1	0.8	1.0	0.5	0.8	0.1	0.1	0.0	0.1	3.8
Fog	3.7	3.6	2.1	2.2	1.5	1.3	1.6	2.9	4.0	3.5	4.0	4.4	34.8

Table 10-4 Monthly values from Met Eireann Weather Station, Finner Camp, Co. Donegal from Jan 2017 to April 2020

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
TOTAL RAINFALL (millimetres)													
2020 (to date)	91.0	263.2	101.3	9.0									464.5
2019	91.6	72.2	194.2	43.6	73.9	94.6	95.7	188.1	106.8	136.4	81.9	143.6	1322.6
2018	219.7	77.5	52.7	84.0	51.5	47.7	84.0	150.9	79.8	85.5	88.9	123.9	1146.1
2017	54.4	63.4	140.6	25.7	69.9	63.0	105.1	163.7	147.8	141.3	125.9	121.4	1222.
Mean	**130.4**	**95.4**	**103.8**	**75.9**	**77.2**	**72.3**	**91.0**	**105.7**	**102.4**	**136.8**	**128.6**	**130.6**	**1249.9**
MEAN TEMPERATURE (degrees Celsius)													
2020	7.0	5.7	6.2	9.4									6.6
2019	6.1	8.3	7.4	9.4	10.6	12.6	15.7	15.4	13.5	9.5	6.2	6.5	10.1
2018													
2017	6.6	6.5	8.1	9.2	12.4	13.7	14.4	14.3	12.4	11.6	7.4	6.4	10.3
Mean	**5.1**	**5.3**	**6.8**	**8.3**	**10.9**	**13.3**	**15.1**	**14.8**	**13.1**	**10.3**	**7.6**	**5.5**	**9.7**
Global Solar Radiation in Joules/cm2 for FINNER													
2020	6723	11790	25833	8565									52911
2019	5327	11581	23137	36446	52142	51699	51680	38828	29753	17508	7864	5396	331361
2018	5771	14374	24839	38305	55249	62758	51170	38331	24744	16581	8337	4349	344808

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
2017	6465	10381	26417	33449	57451	44685	48853	42815	25654	12833	7448	4553	321004
Mean	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
POTENTIAL EVAPORTRANSPIRATION (millimetres)													
2020	20.6	24.4	36.6	14.2									95.8
2019	15.4	26.9	37.4	57.9	74.3	78.6	82.7	65.5	46.3	28.2	13.0	14.7	540.9
2018	16.5	21.0	33.5	52.7	84.5	99.1	84.4	59.7	44.6	32.8	18.2	15.0	562.0
2017	19.5	24.4	41.5	53.5	88.9	76.3	80.5	67.3	45.2	30.8	20.4	14.5	562.8
Mean	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
EVAPORATION (millimetres)													
2020	25.8	36.8	54.6	20.8									138.0
2019	19.9	35.0	56.6	84.5	108.3	115.4	118.5	94.2	66.4	38.7	17.4	18.2	773.1
2018	22.8	29.5	49.8	79.2	120.7	139.2	117.3	87.2	63.1	43.9	22.5	18.5	793.7
2017	25.1	32.8	59.4	79.1	126.2	111.0	114.6	97.5	63.7	41.6	25.4	18.3	794.7
Mean	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
DEGREE DAYS BELOW 15.5 DEGREE CELSIUS													

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
2020	264	286	287	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2019	292	202	252	188	158	102	36	34	71	187	278	279	2079
2018	316	320	334	213	114	57	42	55	107	164	230	235	2188
2017	275	251	230	190	114	68	57	53	97	124	243	281	1985

10.6.1 Potential Impacts

10.6.1.1 Planting Phase

10.6.1.1.1 *Short Term Imperceptible Negative Impact*

The use of machinery during the drainage works will result in the emission of greenhouse gases. Operations such as the transport of materials are typical examples of machinery use. This impact is considered to be imperceptible only, given the insignificant quantity of greenhouse gases that will be emitted. Planting will be carried out by hand.

10.6.1.2 Proposed Mitigation Measures

Planting of trees will be carried out by hand using the methods described in Section 2.3.2 above. Any drains will be constructed in accordance with the Forestry Service Best Practice Guidelines described in detail in Section 2.

10.6.2 Operational Phase

10.6.2.1 Long Term Slight Positive Impact

The growth of forestry allows for the fixation of atmospheric carbon as it grows.

10.6.3 Residual Impacts

On balance there will be positive impacts on air and climate associated with the proposed afforestation

10.6.4 Replanting Area 2: Brackloon, Co. Roscommon.

County Roscommon has a temperate oceanic climate, resulting in mild winters and cool summers. The Met Éireann weather station at the Bord na Móna site at Mount Dillon is the nearest weather and climate monitoring station to the site, located approximately 25.4 km southeast of the site. This met station was established in 2003; hence, historical data at this station is not available. The nearest met station to the site which portrays historical data is Claremorris. Meteorological data recorded at Claremorris over the 30-year period from 1971–2000 is shown in Table 10.5 overleaf while data from 2017-2020 to date from the Mount Dillon weather station can be found in Table 10.6.

The wettest month recorded at Claremorris across the 1971–2000 timeframe was December with an average rainfall of 129.6mm and the warmest month recorded was July with an average temperature of 15°C. At Mount Dillon, the wettest month recorded during the 2017-2020 timeframe was October with an average rainfall of 111.8mm. The warmest month was July with an average temperature of 15.3°C. and April is usually the driest.

10.6.5 Potential Impacts

10.6.5.1 Planting Phase

10.6.5.1.1 *Short Term Imperceptible Negative Impact*

The use of machinery during the drainage works will result in the emission of greenhouse gases. Operations such as the transport of materials are typical examples of machinery use. This impact is

considered to be imperceptible only, given the insignificant quantity of greenhouse gases that will be emitted. Planting will be carried out by hand.

10.6.6 Proposed Mitigation Measures

Planting of trees will be carried out by hand using the methods described in Section 2.3.2 above. Any drains will be constructed in accordance with the Forestry Service Best Practice Guidelines described in detail in Section 2.

10.6.6.1 Operational Phase

10.6.6.1.1 *Long Term Slight Positive Impact*

The growth of forestry allows for the fixation of atmospheric carbon as it grows.

10.6.7 Residual Impacts

10.6.8 On balance there will be positive impacts on air and climate associated with the proposed afforestation.

Table 10-5 Data from Met Éireann Weather Station, Claremorris, Co. Mayo 1971-2000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
TEMPERATURE (degrees Celsius)													
mean daily max	7.5	8.1	9.8	12.1	14.9	17.0	18.9	18.7	16.4	13.1	9.9	8.1	12.9
mean daily min	1.7	1.8	2.9	3.9	6.1	8.8	11.0	10.6	8.6	6.4	3.5	2.5	5.7
mean temperature	4.6	4.9	6.3	8.0	10.5	12.9	15.0	14.7	12.5	9.8	6.7	5.3	9.3
absolute max.	13.3	13.6	16.2	22.3	25.4	29.8	30.5	28.0	25.1	19.9	15.9	14.3	30.5
min. maximum	-2.9	0.1	0.0	5.0	6.1	11.2	11.7	12.2	10.5	6.8	1.3	-1.5	-2.9
max. minimum	11.3	10.9	10.4	11.3	14.2	15.3	17.0	16.7	16.7	15.6	12.5	12.1	17.0
absolute min.	-11.7	-9.1	-8.0	-5.5	-3.1	0.7	0.6	2.6	-1.2	-4.3	-5.3	-12.9	-12.9
mean num. of days with air frost	8.7	7.3	5.2	3.3	0.8	0.0	0.0	0.0	0.1	1.2	5.3	7.6	39.5
mean num. of days with ground frost	**15**	**14**	**12**	**10**	**5**	**0**	**0**	**0**	**2**	**5**	**12**	**14**	**89**
mean 5cm soil	3.2	3.1	4.5	7.3	10.9	14.1	15.5	14.6	12.0	8.9	5.3	4.2	8.6
mean 10cm soil	3.5	3.4	4.7	7.0	10.3	13.5	15.0	14.3	12.0	9.3	5.8	4.5	8.6
mean 20cm soil	4.2	4.2	5.5	7.7	10.7	13.8	15.3	15.0	13.0	10.3	6.9	5.3	9.3
RELATIVE HUMIDITY (%)													
mean at 0900UTC	90.7	90.3	88.7	82.5	79.3	80.4	83.6	86.2	88.1	91.6	91.2	91.0	87.0

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
mean at 1500UTC	85.6	79.8	75.7	67.9	68.0	71.1	73.2	73.4	74.7	80.2	84.4	88.1	76.8
SUNSHINE (Hours)													
mean daily duration	1.3	1.9	2.6	4.3	5.0	4.4	3.7	3.8	3.2	2.4	1.7	0.9	2.9
greatest daily duration	7.9	9.3	10.8	13.4	15.1	15.8	14.8	13.7	11.4	9.3	8.6	6.7	15.8
mean num. of days with no sun	9.5	7.3	5.7	2.8	2.0	2.2	2.2	2.1	3.4	5.0	8.1	10.8	61.1
RAINFALL (mm)													
mean monthly total	127.9	102.1	101.6	63.7	68.1	64.5	70.1	95.7	94.3	128.2	127.7	129.6	1173.6
greatest daily total	31.5	107.0	26.8	34.0	51.3	38.0	42.2	49.7	41.0	46.7	54.9	41.2	107.0
mean num. of days with >= 0.2mm	21	18	21	16	16	15	17	18	18	21	21	22	224
mean num. of days with >= 1.0mm	18	15	17	12	12	11	12	13	14	17	18	17	176
mean num. of days with >= 5.0mm	9	7	7	4	4	4	4	6	5	8	8	9	75
WIND (knots)													
mean monthly speed	10.2	10.3	10.2	8.7	8.1	7.7	7.2	6.8	7.7	8.7	8.9	9.7	8.7
max. gust	96	85	74	74	62	51	66	78	58	70	67	81	96
max. mean 10-minute speed	59	48	45	41	41	34	39	32	37	46	40	52	59
mean num. of days with gales	1.4	0.9	0.7	0.1	0.1	0.0	0.0	0.0	0.1	0.3	0.4	0.8	4.8

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
WEATHER (Mean No. of Days With:)													
snow or sleet	5.7	4.4	3.8	1.6	0.2	0.0	0.0	0.0	0.0	0.1	1.2	3.1	20.0
snow lying at 0900UTC	2.3	0.7	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.7	4.6
Hail	4.4	3.2	5.4	3.2	1.6	0.4	0.1	0.0	0.7	0.8	2.6	2.7	25.2
Thunder	0.3	0.1	0.2	0.2	0.4	0.7	0.7	0.2	0.2	0.2	0.3	0.5	4.0
Fog	3.4	2.3	1.6	1.8	1.2	1.4	2.0	3.2	3.3	3.2	2.6	3.4	29.5

Table 10-6 Monthly data collected at Mount Dillon 20167 2020 to date

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
TOTAL RAINFALL (millimetres)													
2020	100.7	225.3	80.6	7.2									413.8
2019	51.7	56.8	158.2	80.1	43.9	113.7	63.5	200.8	130.8	85.6	99.6	96.3	1181.0
2018	176.6	62.5	62.9	69.5	61.4	82.2	42.2	105.1	50.5	42.3	97.5	111.9	964.6
2017	31.9	84.5	103.3	15.9	63.8	72.9	94.0	102.8	104.9	107.9	85.3	128.4	995.6
Mean	**105.0**	**77.7**	**88.2**	**66.6**	**70.5**	**74.2**	**73.1**	**88.3**	**79.4**	**111.8**	**102.4**	**109.8**	**1047.1**
MEAN TEMPERATURE (degrees Celsius)													
2020	5.7	5.4	6.0	9.1									6.0
2019	5.7	7.0	7.0	8.8	10.6	12.8	16.1	15.4	12.6	8.6	5.5	5.5	9.7
2018	4.7	3.4	4.3	8.4	12.1	15.5	15.8	14.6	11.4	9.2	6.8	7.3	9.5
2017	5.6	5.8	7.8	8.8	11.8	14.0	14.5	14.0	11.9	10.7	6.4	5.3	9.7
Mean	**4.7**	**5.0**	**6.5**	**8.3**	**10.9**	**13.5**	**15.3**	**14.8**	**12.7**	**9.6**	**6.9**	**5.0**	**9.4**
MEAN 10CM SOIL TEMPERATURE AT 0900 UTC													
2020	5.5	5.4	6.2	n/a									5.7
2019	6.9	6.4	7.5	9.0	11.7	13.5	15.9	15.6	13.6	9.8	6.6	5.6	10.2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
2018	4.7	4.3	5.2	8.6	12.4	16.3	17.0	16.1	12.9	10.4	7.4	7.0	10.2
2017	5.8	6.1	7.5	9.8	13.0	15.1	16.0	15.7	13.5	11.6	8.0	5.7	10.7
Mean	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
GLOBAL SOLAR RADIATION IN JOULES/cm^2													
2020	6697	12510	27776	9787									56770
2019	6099	12282	23256	32863	50018	49058	49347	38822	29860	18311	8347	5789	324052
2018	7199	15035	23757	33533	52484	59724	47260	37188	26158	17054	8108	4223	331723
2017	7101	10458	26263	32305	57915	49056	45609	38797	27791	13020	8445	n/a	316760
Mean	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
POTENTIAL EVAPORTRANSPIRATION (millimetres)													
2020	9.9	16.7	32.4	14.0									73.0
2019	10.7	18.8	32.3	49.6	74.4	78.2	85.6	64.3	41.9	23.1	9.2	7.2	495.3
2018	9.5	15.8	29.9	48.9	79.8	98.0	84.1	61.3	39.4	24.5	12.1	9.3	512.6
2017	9.6	15.5	35.5	48.4	84.6	79.2	74.8	60.9	40.6	21.3	9.9	n/a	480.3
Mean	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
EVAPORATION (millimetres)	0.1	0.1	0.1	0.1	0.8	1.0	0.5	0.8	0.1	0.1	0.0	0.1	3.8

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
2020	13.4	24.1	47.7	19.9									105.1
2019	14.2	25.3	46.8	71.0	103.9	109.1	115.6	88.3	58.8	32.2	12.6	9.2	687.0
2018	12.6	22.4	44.2	70.0	111.2	132.3	112.5	83.7	54.7	33.4	16.0	11.9	704.9
2017	12.8	22.1	50.9	68.5	119.0	111.6	102.9	84.2	56.9	29.5	13.4	n/a	671.8
Mean	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
DEGREE DAYS BELOW 15.5 DEGREE CELSIUS													
2020	303	292	295	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2019	305	237	263	210	163	108	42	48	105	214	299	309	2301
2018	334	339	346	216	135	65	51	69	134	199	260	256	2403
2017	308	271	240	202	140	71	64	73	117	151	274	316	2227

10.6.9 Replanting Area 3: Ballard, Co. Wicklow

County Wicklow has a temperate oceanic climate, resulting in mild winters and cool summers. The Met Éireann weather station at Teagasc, Oakpark, Co. Carlow is the nearest weather and climate monitoring station to the site, located approximately 42 km west of the site. Meteorological data was manually recorded at this station and no data prior to 2016 is available. Data collected at Casement aerodrome in Co. Dublin from 1981–2010, the nearest met station with historical data can be found in Table 10.7 while data collected at Oakpark from 2017 –2020 to date can be found in Table 10.8.

The wettest month recorded at Casement Aerodrome during the period 1981–2010 was October with an average rainfall of 128.2mm. The wettest month recorded at Oakpark in the period 2017–2020 was also October with an average rainfall of 92.6mm. The warmest month recorded was July with an average temperature of 15˚C at Casement Aerodrome and 15.6˚C at Oakpark.

10.6.10 Potential Impacts

10.6.10.1 Planting Phase

10.6.10.1.1 *Short Term Imperceptible Negative Impact*

The use of machinery during the drainage works will result in the emission of greenhouse gases. Operations such as the transport of materials are typical examples of machinery use. This impact is considered to be imperceptible only, given the insignificant quantity of greenhouse gases that will be emitted. Planting will be carried out by hand.

10.6.10.2 Proposed Mitigation Measures

Planting of trees will be carried out by hand using the methods described in Section 2.3.2 above. Any drains will be constructed in accordance with the Forestry Service Best Practice Guidelines described in detail in Section 2.

10.6.10.3 Operational Phase

10.6.10.3.1 *Long Term Slight Positive Impact*

The growth of forestry allows for the fixation of atmospheric carbon as it grows.

10.6.10.4 Residual Impacts

10.6.11 On balance there will be positive impacts on air and climate associated with the proposed afforestation

Table 10-7 Data from Met Éireann Weather Station, Casement Aerodrome, Co. Dublin 1981-2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
TEMPERATURE (degrees Celsius)													
mean daily max	8.0	8.2	10.2	12.4	15.2	17.9	19.8	19.5	17.1	13.6	10.2	8.3	13.4
mean daily min	2.1	2.0	3.3	4.1	6.6	9.4	11.5	11.3	9.5	7.0	4.2	2.4	6.1
mean temperature	5.1	5.1	6.8	8.2	10.9	13.6	15.7	15.4	13.3	10.3	7.2	5.4	9.7
absolute max.	15.2	15.9	17.3	22.7	24.9	27.6	31.0	29.5	25.4	21.3	17.7	14.8	31.0
min. maximum	-3.0	-0.7	2.3	4.5	7.1	10.2	10.6	11.7	10.8	5.2	-3.1	-4.7	-4.7
max. minimum	11.3	13.0	11.5	12.6	13.8	17.2	18.1	18.3	17.8	16.4	13.8	12.7	18.3
absolute min.	-12.4	-8.0	-9.0	-5.5	-2.4	0.4	4.6	2.2	0.2	-4.1	-9.1	-15.7	-15.7
mean num. of days with air frost	7.5	7.7	4.6	3.4	0.8	0.0	0.0	0.0	0.0	1.3	4.3	7.6	37.2
mean num. of days with ground frost	14.0	14.0	11.0	11.0	4.0	0.0	0.0	0.0	1.0	4.0	9.0	14.0	82.0
mean 5cm soil	3.7	3.6	5.3	8.4	12.6	15.7	17.1	16.0	12.8	9.2	6.0	4.2	9.6
mean 10cm soil	3.9	3.8	5.2	7.6	11.4	14.6	16.2	15.3	12.6	9.2	6.2	4.4	9.2
mean 20cm soil	4.6	4.5	5.9	8.1	11.5	14.5	16.3	15.8	13.4	10.1	7.1	5.1	9.7
RELATIVE HUMIDITY (%)													
mean at 0900UTC	87.2	86.7	84.5	80.1	77.4	77.7	79.7	82.2	84.5	86.3	88.9	88.4	83.6

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
mean at 1500UTC	82.2	76.7	71.8	67.7	67.3	67.9	68.9	69.0	71.8	76.6	81.6	84.1	73.8
SUNSHINE (Hours)													
mean daily duration	1.7	2.5	3.3	5.1	6.0	5.3	4.9	4.8	4.1	3.3	2.2	1.5	3.7
greatest daily duration	8.1	9.2	10.9	13.2	15.4	16.0	15.5	14.4	12.3	10.1	8.5	6.9	16.0
mean no. of days with no sun	8.9	5.8	4.4	2.5	1.8	2.1	1.6	1.1	2.4	4.5	7.0	9.9	52.0
RAINFALL (mm)													
mean monthly total	63.8	48.5	50.7	51.9	59.1	62.5	54.2	72.3	60.3	81.6	73.7	75.7	754.2
greatest daily total	30.0	32.2	31.1	38.7	29.8	97.5	33.7	89.3	51.1	50.1	82.0	46.8	97.5
mean num. of days with >= 0.2mm	17	14	16	14	15	14	15	16	14	16	16	16	183
mean num. of days with >= 1.0mm	12	10	11	10	11	10	10	11	10	12	11	12	130
mean num. of days with >= 5.0mm	4	3	3	3	3	3	3	4	4	4	4	5	43
WIND (knots)													
mean monthly speed	13.6	12.9	12.4	9.8	9.1	8.6	8.8	9.0	9.6	11.1	11.6	12.3	10.7
max. gust	80	78	71	59	63	51	58	55	59	65	66	82	82
max. mean 10-minute speed	57	54	47	43	43	36	39	36	38	44	46	57	57
mean num. of days with gales	4.5	3.2	2.1	0.6	0.4	0.1	0.1	0.2	0.3	1.2	1.9	3.5	18.1

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
WEATHER (Mean No. of Days With:)													
snow or sleet	4.1	3.9	2.5	1.1	0.1	0.0	0.0	0.0	0.0	0.0	0.5	2.3	14.6
snow lying at 0900UTC	1.8	1.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0	4.1
Hail	1.0	1.5	2.7	2.4	1.5	0.2	0.2	0.1	0.2	0.2	0.7	0.6	11.3
Thunder	0.1	0.1	0.3	0.4	1.1	1.0	1.0	1.2	0.6	0.4	0.1	0.1	6.3
Fog	1.8	1.9	1.6	1.6	1.5	1.2	1.1	2.0	2.8	2.0	2.1	2.4	22.1

Table 10-8 Met data collected at Oakpark Co. Carlow 2017–2020

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
TOTAL RAINFALL (millimetres)													
2020	61.4	172.8	51.8	11.9									297.9
2019	30.9	36.8	122.9	72.5	14.1	55.0	42.6	86.4	116.7	102.3	117.2	68.0	865.4
2018	108.1	38.7	98.1	73.0	24.3	5.2	42.5	39.8	53.7	58.3	160.5	119.3	821.5
2017	36.3	57.8	66.6	15.8	81.8	91.0	52.7	62.3	92.5	62.9	52.8	84.2	756.7
Mean	**80.4**	**57.3**	**63.4**	**55.9**	**59.8**	**60.8**	**58.7**	**71.9**	**69.6**	**92.9**	**85.9**	**83.6**	**840.2**
MEAN TEMPERATURE (degrees Celsius)													
2020	5.9	6.0	6.6	9.3									6.4
2019	5.9	7.5	7.4	8.9	11.0	13.0	16.7	16.2	13.7	9.4	6.3	5.9	10.2
2018	5.4	3.6	4.8	9.0	12.5	16.4	17.8	16.0	12.8	10.0	8.1	8.4	10.4
2017	6.0	6.5	8.3	9.0	12.4	15.0	15.7	15.0	13.0	11.5	6.7	5.6	10.4
Mean	**5.1**	**5.6**	**6.9**	**8.4**	**11.0**	**13.7**	**15.6**	**15.3**	**13.2**	**10.1**	**7.2**	**5.5**	**9.8**
MEAN 10CM SOIL TEMPERATURE AT 0900 UTC													
2020	4.7	4.4	5.1	8.3									5.0
2019	5.3	5.5	6.3	8.8	12.8	14.8	17.7	16.1	13.8	8.8	5.7	4.6	10.0

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
2018	4.0	2.5	4.1	8.8	13.4	18.6	19.4	16.3	12.7	9.4	6.8	6.9	10.3
2017	4.9	5.1	7.0	9.7	13.8	16.4	16.7	15.3	12.8	10.9	6.4	4.5	10.3
Mean	**3.7**	**3.7**	**5.4**	**8.1**	**12.0**	**15.5**	**16.9**	**15.9**	**13.0**	**9.3**	**6.0**	**4.2**	**9.5**
GLOBAL SOLAR RADIATION IN JOULES/cm^2													
2020	8431	15487	31358	10558									65834
2019	7642	14822	29254	35333	52217	52607	53970	44104	32306	19242	8423	6290	356210
2018	8391	15960	23667	38598	56893	65358	57086	40751	32665	19493	7581	4932	371375
2017	7224	11187	27159	34762	55979	52967	52622	39969	30597	14765	10430	6224	343885
Mean	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
POTENTIAL EVAPORTRANSPIRATION (millimetres)													
2020	12.1	23.2	40.7	14.9									90.9
2019	12.6	20.6	37.5	52.0	76.6	82.3	94.1	77.3	51.3	25.9	11.2	11.1	552.5
2018	13.5	17.0	29.8	52.3	84.7	110.7	107.9	74.5	50.7	27.4	13.4	11.6	593.5
2017	11.5	17.9	35.4	50.0	80.7	86.5	87.7	68.2	45.8	25.9	10.3	9.4	529.3
Mean	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
EVAPORATION (millimetres)	0.1	0.1	0.1	0.1	0.8	1.0	0.5	0.8	0.1	0.1	0.0	0.1	3.8

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
2020	15.9	33.6	59.5	21.4									130.4
2019	16.5	28.8	55.5	74.6	107.4	115.4	127.0	106.0	70.1	35.8	15.3	14.1	766.5
2018	17.5	24.3	43.7	77.3	119.3	148.6	142.2	100.2	70.0	37.6	17.9	14.8	813.4
2017	15.3	25.4	51.7	71.0	114.0	121.5	120.1	93.3	64.2	35.5	13.9	11.9	737.8
Mean	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
DEGREE DAYS BELOW 15.5 DEGREE CELSIUS													
2020	298	274	276	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2019	299	225	252	206	148	97	30	38	78	190	277	N/A	N/A
2018	312	334	333	199	117	47	26	46	101	175	222	221	2134
2017	293	253	223	194	116	54	44	52	92	129	N/A	307	N/

10.7 Noise

10.7.1 Replanting Area 1: Stranamart, Co. Cavan

The nearest sensitive location to the afforestation site is the residential dwellings located 40m north of the replanting site across the R206. A second residential dwelling is located just under 300m east of the site. Both dwellings are screened from the site by mature boundary vegetation.

In general, the existing noise climate is typical of a rural agricultural location. There are existing forestry plantations located in the vicinity of the site, along with a small number of agricultural yards.

10.7.2 Likely and Significant Impacts and Associated Mitigation Measures

10.7.2.1 Do-Nothing' Scenario

The land has been Technically Approved and will be afforested should the proposed Croagh Wind Farm proceed or not. If the land was not replanted, the current land use would continue at the site.

10.7.3 Planting Phase

10.7.3.1 Negative Imperceptible Short-term Impact

There will potentially be an increase in noise levels in the vicinity of the proposed development site during the planting phase, as a result of the use of an excavator for drainage works. These impacts will be short-term in duration and are not considered potentially significant. The noise levels will be similar to the existing agricultural machinery in use in the vicinity of the lands which is a working rural environment. Noise at any given noise sensitive location will be variable throughout the works, depending on the distance from the excavator to the receiving properties.

10.7.3.2 Mitigation

Best practice measures for noise control will be adhered to onsite during the planting phase of the afforestation in order to mitigate the potentially imperceptible short-term negative impact associated with this phase of the development. The measures include:

- Noise will be controlled by prescribing that all work will be restricted to the specified working hours. Any work carried out outside of these hours shall be restricted to activities that will not generate noise of a level that may cause a nuisance.
- The excavator used on the site shall be well maintained and will comply with E.U. and Irish legislation in relation to noise emissions. The timing of on- and off-site movements of plant near occupied properties will be controlled.

10.7.4 Operational Phase

10.7.4.1 Negative Slight Short-term Impact

There will be an intermittent increase in noise levels in the vicinity of the proposed development site during the operational phase, as a result of the use of machinery for timber harvesting works. These impacts will be short-term in duration. Noise at any given noise sensitive location will be variable

throughout the harvesting works, depending on the distance from the machinery to the receiving properties.

10.7.4.2 Mitigation

Best practice measures for noise control will be adhered to onsite during the timber harvesting at the proposed afforestation site in order to mitigate the slight short-term negative impact associated with this phase of the development. The measures include:

- Harvesting noise will be controlled by prescribing that all construction work will be restricted to the specified working hours. Any work carried out outside of these hours shall be restricted to activities that will not generate noise of a level that may cause a nuisance.
- The machinery used on the site shall be well maintained and will comply with E.U. and Irish legislation in relation to noise emissions. The timing of on- and off-site movements of plant near occupied properties will be controlled.

10.7.4.3 Residual Impacts

Potential residual impacts will be imperceptible and temporary in nature and not dissimilar to the existing noise sources of a working rural environment.

10.8 Replanting Area 2: Brackloon, Co. Roscommon

The eastern side of the replanting site at Brackloon extends around three sites of the curtilage of the nearest sensitive location to the afforestation site. The nearest dwelling to the western, northern and southern sides is located approx. 250m to the southwest of the replanting site. In general, the existing noise climate is typical of a rural agricultural location. There are existing forestry plantations located in the vicinity of the site, along with a small number of agricultural yards.

10.8.1 Likely and Significant Impacts and Associated Mitigation Measures

10.8.1.1 'Do-Nothing' Scenario

The land has been Technically Approved and will be afforested should the proposed Croagh Wind Farm proceed or not If the land was not replanted, the current land use would continue at the site.

10.8.1.2 Planting Phase

10.8.1.3 Negative Imperceptible Short-term Impact

There will potentially be an increase in noise levels in the vicinity of the proposed development site during the planting phase, as a result of the use of an excavator for drainage works. These impacts will be short-term in duration and are not considered potentially significant. The noise levels will be similar to the existing agricultural machinery in use in the vicinity of the lands which is a working rural environment. Noise at any given noise sensitive location will be variable throughout the works, depending on the distance from the excavator to the receiving properties.

Mitigation

Best practice measures for noise control will be adhered to onsite during the planting phase of the afforestation in order to mitigate the potentially imperceptible short-term negative impact associated with this phase of the development. The measures include:

- Noise will be controlled by prescribing that all work will be restricted to the specified working hours. Any work carried out outside of these hours shall be restricted to activities that will not generate noise of a level that may cause a nuisance.
- The excavator used on the site shall be well maintained and will comply with E.U. and Irish legislation in relation to noise emissions. The timing of on- and off-site movements of plant near occupied properties will be controlled.

10.8.2 Operational Phase

10.8.2.1 Negative Slight Short-term Impact

There will be an intermittent increase in noise levels in the vicinity of the proposed development site during the operational phase, as a result of the use of machinery for timber harvesting works. These impacts will be short-term in duration. Noise at any given noise sensitive location will be variable throughout the harvesting works, depending on the distance from the machinery to the receiving properties.

Mitigation

Best practice measures for noise control will be adhered to onsite during the timber harvesting at the proposed afforestation site in order to mitigate the slight short-term negative impact associated with this phase of the development. The measures include:

- Harvesting noise will be controlled by prescribing that all construction work will be restricted to the specified working hours. Any work carried out outside of these hours shall be restricted to activities that will not generate noise of a level that may cause a nuisance.
- The machinery used on the site shall be well maintained and will comply with E.U. and Irish legislation in relation to noise emissions. The timing of on- and off-site movements of plant near occupied properties will be controlled.

Residual Impacts

Potential residual impacts will be imperceptible and temporary in nature and not dissimilar to the existing noise sources of a working rural environment.

10.9 Replanting Area 3: Ballard, Co. Wicklow

There are two residential dwellings located adjacent to the replanting site with a further two more dwellings located within 100m.In general, the existing noise climate is typical of a rural agricultural location. There are existing forestry plantations located in the vicinity of the site, along with a small number of agricultural yards.

10.9.1 Likely and Significant Impacts and Associated Mitigation Measures

10.9.1.1 'Do-Nothing' Scenario

The land has been Technically Approved and will be afforested should the proposed Croagh Wind Farm proceed or not. If the land was not replanted, the current land use would continue at the site.

10.9.2 Planting Phase

10.9.2.1 Negative Imperceptible Short-term Impact

There will potentially be an increase in noise levels in the vicinity of the proposed development site during the planting phase, as a result of the use of an excavator for drainage works. These impacts will be short-term in duration and are not considered potentially significant. The noise levels will be similar to the existing agricultural machinery in use in the vicinity of the lands which is a working rural environment. Noise at any given noise sensitive location will be variable throughout the works, depending on the distance from the excavator to the receiving properties.

Mitigation

Best practice measures for noise control will be adhered to onsite during the planting phase of the afforestation in order to mitigate the potentially imperceptible short-term negative impact associated with this phase of the development. The measures include:

- Noise will be controlled by prescribing that all work will be restricted to the specified working hours. Any work carried out outside of these hours shall be restricted to activities that will not generate noise of a level that may cause a nuisance.
- The excavator used on the site shall be well maintained and will comply with E.U. and Irish legislation in relation to noise emissions. The timing of on- and off-site movements of plant near occupied properties will be controlled.

10.9.3 Operational Phase

10.9.3.1 Negative Slight Short-term Impact

There will be an intermittent increase in noise levels in the vicinity of the proposed development site during the operational phase, as a result of the use of machinery for timber harvesting works. These impacts will be short-term in duration. Noise at any given noise sensitive location will be variable throughout the harvesting works, depending on the distance from the machinery to the receiving properties.

Mitigation

Best practice measures for noise control will be adhered to onsite during the timber harvesting at the proposed afforestation site in order to mitigate the slight short-term negative impact associated with this phase of the development. The measures include:

- Harvesting noise will be controlled by prescribing that all construction work will be restricted to the specified working hours. Any work carried out outside of these hours shall be restricted to activities that will not generate noise of a level that may cause a nuisance.

- The machinery used on the site shall be well maintained and will comply with E.U. and Irish legislation in relation to noise emissions. The timing of on- and off-site movements of plant near occupied properties will be controlled.

Residual Impacts

Potential residual impacts will be imperceptible and temporary in nature and not dissimilar to the existing noise sources of a working rural environment.

11. POPULATION AND HEALTH

This section of the report describes the potential impacts of the proposed afforestation on Population & Human Health and has been completed in accordance with the guidance set out by the Environmental Protection Agency in 'Draft Guidelines on the Information to be contained in Environmental Impact Statements (EPA, 2017).

One of the principal concerns in the development process is that people, as individuals or communities, should experience no diminution in their quality of life from the direct or indirect impacts arising from the construction and operation of a development. The key issues examined in this section of the document include population, employment, health and safety, land-use, residential amenity, community facilities and services, and tourism.

11.1 Replanting Area 1: Stranamart, Cavan

11.1.1 Baseline Environment

11.1.1.1 Population

The proposed replanting land Stranamart is located approximately 6.3km southeast of the nearest town of Blacklion, within the District Electoral Division (DED) of Killinagh / Teebane. Population data for the Killinagh / Teebane DED has been sourced from the results of the Census of Ireland 2016 (the most recent Census for which detailed data are yet available), as provided on the Central Statistics Office website, www.cso.ie. Population data for the DED and Co. Cavan are presented in Table 11.1.

Table 11-1 Population 2011-2016 (Source: CSO)

Area	Population		% Population Change
	2011	2016	2016-2011
Killinagh / Teebane DED	154	137	-11.03%
Co. Cavan	73,183	76,176	+4.09%

The population of Killinagh / Teebane DED recorded during the 2016 Census was 137 persons. The population density of the DED at this time was 0.25 persons per square kilometre, based on a total DED area of 33.8 km^2. This is significantly lower than the population density of County Cavan as a whole during the 2016 Census, which equates to 39.43 persons per square kilometre, based on the County area of 1,932km^2.

The population of Killinagh / Teebane DED declined by 11.03% between the 2011 and 2016 Censuses. The rate of population change within the DED between these Censuses is different to the average rate of population growth within the County as a whole, which had a growth of 4.09% in the same time.

There were 67 households recorded within the DED during the 2016 Census. The proposed replanting site is located adjacent to local unnamed road which connects to the R205 to the west of the site and R206 to the east. The overall level of residential development within a kilometre of this site is low, with intermittent houses located along the local road network.

11.1.1.2 Employment

Employment in the area is likely to be based primarily on agriculture, with various small commercial activities in the area.

11.1.1.3 Land-use

The current land-use on the proposed replanting area is agriculture. This site is located within a rural, working landscape in which agriculture and forestry form the primary land-uses. The site is bordered to the south by existing coniferous forestry with further forestry to the northeast, west and south in the wider environs.

11.1.1.4 Community Facilities and Amenities

The nearest schools and community facilities to the proposed planting site are located in Blacklion, approximately 6.3km north of the site.

The nearest designated amenity route to the replanting site is the Dowra to Blacklion Scenic Route (Kingfisher Cycle Trail) which runs northeast to southwest approximately 400m east of the site, along the R206. This amenity route bypasses large areas of existing coniferous forestry.

11.1.1.5 Tourism

Ireland is divided into seven tourism regions. The northwest Region, in which the site of the replanting site is located, comprises Counties Cavan, Donegal, Leitrim, Monaghan and Sligo.

The nearest tourist attraction to the replanting area is the Cavan Burren Park which is located in Blacklion. The park comprises 5 walking trails through forestry which also contains various prehistoric monuments such as cairns, wedge tombs and rock art. The Park is located 3.9km northeast of the replanting site north of the Cuilcagh Mountains.

11.1.2 Impact Assessment and Proposed Mitigation Measures

11.1.2.1 'Do-Nothing' Scenario

The lands have been Technically Approved and will be afforested should the Croagh Wind Farm proceed or not. If the land was not replanted, the current land use would continue at the site.

11.1.2.2 Operational Phase

11.1.2.2.1 *Population*

Afforestation of the replanting site will have no impact on population trends or population density in the vicinity of the site.

11.1.2.2.2 *Employment*

The preparation and planting of the proposed replanting lands will provide short-term employment for three people; one person to operate an excavator for installation of drainage features, and two people to plant the site by hand.

In the longer-term, maintenance and felling of the site will provide part-term employment for two people.

11.1.2.2.3 Health and Safety

Health and safety in forestry is the concern of all those involved, including forest owners, managers, supervisors, operators, recreational users and trespassers *('Code of Best Forest Practice'*, Forest Service, 2000). Forest practice must ensure that operations do not endanger workers and others. In the absence of the correct health and safety measures, forestry-related activities have the potential to have a significant negative effect on the health and safety of workers and members of the public, on and in the vicinity of the site.

The Forest Service's *'Code of Best Forest Practice'* states that the Safety, Health and Welfare at Work Act 1989 and the Safety, Health and Welfare at Work (General Application) Regulations 1993 place responsibilities on all involved in work activities and set out a basis for managing health and safety in all workplaces. Forest owners have legal responsibilities to ensure that the workplace and all articles and substances situated there are safe and free from health risk. This involves informing contractors of potential hazards, work agreements and monitoring. Employers, self-employed and employees all have clear responsibility to ensure safe working practices for themselves and others.

All Forest Service guidelines and Health and Safety legislation will be adhered to during all forestry-related activities at the proposed replanting lands. The residual potential for a significant negative impact on worker and public health and safety is therefore reduced to minimal.

11.1.2.2.4 Land-use

Afforestation of the replanting site will result in a long-term change in use of the site, from agriculture to forestry. This change in land-use is in keeping with the character of the surrounding landscape, as forestry is already an established land-use in the area. The impact of the change in land-use is therefore neutral, i.e. a change which does not affect the quality of the environment.

11.1.2.2.5 Residential Amenity

Planting at the site will have a short-term, slight negative impact on the residential amenity of dwellings dotted along the local road to the east and north of the site as a result of the of site activity/disturbance during the replanting phase. In the longer term, nearby views from these houses will be restricted by forestry. However, existing nearby views include areas of forestry immediately south, southeast and northeast of the replanting site while distant views also contain large tracts of existing forestry. Therefore, the additional forestry attributed by the replanting site will be visually indistinguishable from the existing surrounding forestry.

11.1.2.2.6 Community Facilities and Amenities

There are no community facilities or amenities located on or in the immediate vicinity of the proposed replanting lands. No walks pass through the site, and there will be no impact to community amenities within the area. All appropriate health and safety measures, including signage, will be adopted at the site to ensure the safety of workers and the general public.

11.1.2.2.7 Tourism

Afforestation of the proposed replanting lands will have no impact on tourism. There are no tourist facilities or attractions located at the replanting lands. Views west from the Dowra to Blacklion Scenic Route (Kingfisher Cycle Trail) which runs northeast to southwest 400m east of the site currently comprises vase areas of existing forestry. Forestry is an established land-use in this area, and a common feature in the landscape.

11.1.2.3 Significance of the Effects

Based on the above, there will be no significant effects, on human beings, population or health, associated with afforestation the at this site.

11.2 Replanting Area 2: Brackloon, Co. Roscommon

11.2.1 Baseline Environment

11.2.1.1 Population

The proposed replanting land at Brackloon is located approximately 3.81km northeast of the nearest village of Ballinagare. The towns of Frenchpark and Elphin are located 5.58km and 7.2km from the site respectively. The replanting site is located within the District Electoral Division (DED) of Lisgarve/Mantua. Population data for the Lisgarve/Mantua DED has been sourced from the results of the Census of Ireland 2016 (the most recent Census for which detailed data are yet available), as provided on the Central Statistics Office website, www.cso.ie. Population data for Lisgarve/Mantua DED and Co. Roscommon are presented in Table 11.2.

Table 11-2 Population 2011-2016 (Source: CSO)

Area	Population		% Population Change
	2011	2016	2016-2011
Lisgarve/Mantua DED	237	226	-4.6%
Co. Roscommon	64,065	64,544	+0.75%

The population of the Lisgarve/Mantua DED recorded during the 2016 Census was 266 persons. The population density of the DED at this time was 8.26 persons per square kilometre, based on a total DED area of 32.2 km^2. This is much lower than the population density of County Roscommon as a whole during the 2016 Census, which equates to 25.331 persons per square kilometre, based on the County area of 2,548km^2.

The population of the Lisgarve/Mantua DED declined by 4.6% between the 2011 and 2016 Censuses. The rate of population change within the DED between these Censuses is different to the average rate of population growth within the County as a whole, which had a growth of 0.75% in the same time.

The number of households recorded within the DED during the 2016 Census was 105 households. The proposed replanting site is located adjacent to a local road. The overall level of residential development within a kilometre of this site is low, with intermittent houses located along the local road network. The nearest dwelling to the proposed replanting site is adjacent to site.

11.2.1.2 Employment

Employment in the area is likely to be based primarily on agriculture, with various small commercial activities in the area.

11.2.1.3 Land-use

The current land-use on the proposed replanting area is agriculture. This site is located within a rural, working landscape in which agriculture and forestry form the primary land-uses. The site is bordered

to the south by existing coniferous forestry with further forestry to the northeast, west and south in the wider environs.

11.2.1.4 Community Facilities and Amenities

The nearest schools and community facilities to the proposed planting site are located in the town of Frenchpark, approximately 5.58km west of the site.

The nearest designated walking route to the replanting site is the Miner's Way & Historical Trail which runs through Counties Roscommon, Sligo and Leitrim. It is located 13.1km to the north of the replanting site and comprises a 118km loop route that beings and terminates in Arigna, Co. Roscommon. The walking route passes through large areas of existing coniferous forestry.

11.2.1.5 Tourism

Ireland is divided into seven tourism regions. The West Region, in which the site of the replanting site is located, comprises Counties Galway, Mayo and Roscommon.

The nearest tourist attractions to the replanting area is the Elphin Windmill approximately 7.68km east of the site and Cruachan Ai Heritage site 9m southeast of the site.

There are no scenic views or routes located near the replanting site.

11.2.2 Impact Assessment and Proposed Mitigation Measures

11.2.2.1 'Do-Nothing' Scenario

The lands have been Technically Approved and will be afforested should the Croagh Wind Farm proceed or not. If the land was not replanted, the current land use would continue at the site.

11.2.2.1.1 *Population*

Afforestation of the replanting site will have no impact on population trends or population density in the vicinity of the site.

11.2.2.1.2 *Employment*

The preparation and planting of the proposed replanting lands will provide short-term employment for three people; one person to operate an excavator for installation of drainage features, and two people to plant the site by hand.

In the longer-term, maintenance and felling of the site will provide part-term employment for two people.

11.2.2.1.3 *Health and Safety*

Health and safety in forestry is the concern of all those involved, including forest owners, managers, supervisors, operators, recreational users and trespassers *('Code of Best Forest Practice'*, Forest Service, 2000). Forest practice must ensure that operations do not endanger workers and others. In the absence of the correct health and safety measures, forestry-related activities have the potential to have a significant negative effect on the health and safety of workers and members of the public, on and in the vicinity of the site.

The Forest Service's *'Code of Best Forest Practice'* states that the Safety, Health and Welfare at Work Act 1989 and the Safety, Health and Welfare at Work (General Application) Regulations 1993 place responsibilities on all involved in work activities and set out a basis for managing health and safety in all workplaces. Forest owners have legal responsibilities to ensure that the workplace and all articles and substances situated there are safe and free from health risk. This involves informing contractors of potential hazards, work agreements and monitoring. Employers, self-employed and employees all have clear responsibility to ensure safe working practices for themselves and others.

All Forest Service guidelines and Health and Safety legislation will be adhered to during all forestry-related activities at the proposed replanting lands. The residual potential for a significant negative impact on worker and public health and safety is therefore reduced to minimal.

11.2.2.1.4 *Land-use*

Afforestation of the replanting site will result in a long-term change in use of the site, from agriculture to forestry. This change in land-use is in keeping with the character of the surrounding landscape, as forestry is already an established land-use in the area. The impact of the change in land-use is therefore neutral, i.e. a change which does not affect the quality of the environment.

11.2.2.1.5 *Residential Amenity*

Planting at the site will have a short-term, slight negative impact on the residential amenity of the dwelling located adjacent to the site and dwellings in the wider environs. This impact will be the result of the visual impact of site activity/disturbance. Views from these houses toward the replanting site are currently restricted by forestry. In the long term, as the replanting site matures, it will be indistinguishable from the surrounding large areas of forestry. Views west, north and south from the dwelling located adjacent to the replanting site will be shortened by the additional planting in the long term. However, existing views in these directions from this dwelling comprises large areas of forestry.

It is a requirement of the Technical Approval for the site that the owners of the house adjacent to the site will be consulted in advance of planting in order to resolve any concerns they may have prior to works being carried out.

11.2.2.1.6 *Community Facilities and Amenities*

There are no community facilities or amenities located on or in the immediate vicinity of the proposed replanting lands. No walks pass directly through the site, and there will be no impact to this or any other community amenities within the area. All appropriate health and safety measures, including signage, will be adopted at the site to ensure the safety of workers and the general public.

11.2.2.1.7 *Tourism*

Afforestation of the proposed replanting lands will have no impact on tourism. There are no tourist facilities or attractions located at the replanting lands or within the vicinity of the site. Forestry is a well-established land-use in this area; along with bogland, it is a common and dominating feature dominating of the landscape.

11.2.2.2 Significance of the Effects

Based on the above, there will be no significant effects, on human beings, population or health, associated with afforestation the at this site.

11.3 Replanting Area 3: Ballard, Co. Wicklow

11.3.1 Baseline Environment

11.3.1.1 Population

The proposed replanting land at Ballard is located approximately 1.3km west of Ballinaclash village. The replanting site is located within the District Electoral Division (DED) of Ballinaclash. Population data for the Ballinaclash DED has been sourced from the results of the Census of Ireland 2016 (the most recent Census for which detailed data are yet available), as provided on the Central Statistics Office website, www.cso.ie. Population data for Ballinaclash DED and Co. Wicklow are presented in Table 11.3.

Table 11-3 Population 2011-2016 (Source: CSO)

Area	Population		% Population Change
	2011	2016	2016-2011
Ballinaclash DED	636	633	-0.47%
Co. Wicklow	136,640	142,425	+4.2%

The population of the Ballinaclash DED recorded during the 2016 Census was 633 persons. The population density of the DED at this time was 32.131 persons per km^2, based on a total DED area of 19.7 km^2. This is much lower than the population density of County Wicklow as a whole during the 2016 Census, which equates to 70.26 persons per km^2, based on the County area of 2,027km^2.

The population of the Ballinaclash DED declined by 0.47% between the 2011 and 2016 Censuses. The rate of population change within the DED between these Censuses is different to the average rate of population growth within the County as a whole, which had a growth of 4.2% in the same time.

The number of households recorded within the DED during the 2016 Census was 254 households. The proposed replanting site is located adjacent to a local road. The overall level of residential development within a kilometre of this site is low, with intermittent houses located along the local road network. The nearest dwelling to the proposed replanting site is adjacent to site.

11.3.1.2 Employment

Employment in the area is likely to be based primarily on agriculture, with various small commercial activities in the area.

11.3.1.3 Land-use

The current land-use on the proposed replanting area is agriculture. This site is located within a rural, working landscape in which agriculture and forestry form the primary land-uses. To the south, west and small areas to the north comprise existing forestry. with further forestry in the wider environs.

11.3.1.4 Community Facilities and Amenities

The nearest schools and community facilities to the proposed planting site are located in the town of Rathdrum, approximately 4.2km northeast of the site.

The nearest designated walking route to the replanting site is Wicklow Way which is a 131km route that begins in Dublin's Marlay Park, crosses the Wicklow Mountains and terminates in Clonegal, Co. Carlow. The walking route passes through large areas of existing coniferous forestry.

11.3.1.5 Tourism

Ireland is divided into seven tourism regions. The East Coast & Midlands Region, in which the site of the replanting site is located, comprises Kildare, Laois, Longford, Louth, Offaly, Meath, Westmeath and Wicklow. The nearest tourist attraction is the Avoca Mines which is located 4.58km southeast of the replanting area.

There are no scenic views or routes located near the replanting site.

11.4 Impact Assessment and Proposed Mitigation Measures

11.4.1.1 'Do-Nothing' Scenario

The lands have been Technically Approved and will be afforested should the Croagh Wind Farm proceed or not. If the land was not replanted, the current land use would continue at the site.

11.4.1.1.1 *Population*

Afforestation of the replanting site will have no impact on population trends or population density in the vicinity of the site.

11.4.1.1.2 *Employment*

The preparation and planting of the proposed replanting lands will provide short-term employment for three people; one person to operate an excavator for installation of drainage features, and two people to plant the site by hand.

In the longer-term, maintenance and felling of the site will provide part-term employment for two people.

11.4.1.1.3 *Health and Safety*

Health and safety in forestry is the concern of all those involved, including forest owners, managers, supervisors, operators, recreational users and trespassers *('Code of Best Forest Practice'*, Forest Service, 2000). Forest practice must ensure that operations do not endanger workers and others. In the absence of the correct health and safety measures, forestry-related activities have the potential to have a significant negative effect on the health and safety of workers and members of the public, on and in the vicinity of the site.

The Forest Service's *'Code of Best Forest Practice'* states that the Safety, Health and Welfare at Work Act 1989 and the Safety, Health and Welfare at Work (General Application) Regulations 1993 place responsibilities on all involved in work activities and set out a basis for managing health and safety in all workplaces. Forest owners have legal responsibilities to ensure that the workplace and all articles and substances situated there are safe and free from health risk. This involves informing contractors of potential hazards, work agreements and monitoring. Employers, self-employed and employees all have clear responsibility to ensure safe working practices for themselves and others.

All Forest Service guidelines and Health and Safety legislation will be adhered to during all forestry-related activities at the proposed replanting lands. The residual potential for a significant negative impact on worker and public health and safety is therefore reduced to minimal.

11.4.1.1.4 *Land-use*

Afforestation of the replanting site will result in a long-term change in use of the site, from agriculture to forestry. This change in land-use is in keeping with the character of the surrounding landscape, as forestry is already an established land-use in the area. The impact of the change in land-use is therefore neutral, i.e. a change which does not affect the quality of the environment.

11.4.1.1.5 *Residential Amenity*

Planting at the site will have a short-term, slight negative impact on the residential amenity of the dwelling located adjacent to the site and dwellings in the wider environs. This impact will be the result of the visual impact of site activity/disturbance. Views from these houses toward the replanting site are currently restricted by forestry. In the long term, as the replanting site matures, it will be indistinguishable from the surrounding large areas of forestry. Views west, north and south from the closest dwellings will be shortened by the additional planting in the long term as existing views in these directions from this dwelling comprises large areas of forestry. Views eastwards toward the village of Ballinaclash will contain a new landuse type in the form of forestry. However, the existing mature fields boundaries and vast areas of forestry to the north, south and west will help assimilate this new landuse into the surrounding environs. Furthermore, it is a requirement of the Technical Approval for the site that the owners of the house adjacent to the site will be consulted in advance of planting in order to resolve any concerns they may have prior to works being carried out.

11.4.1.1.6 *Community Facilities and Amenities*

There are no community facilities or amenities located on or in the immediate vicinity of the proposed replanting lands. No walks pass directly through the site, and there will be no impact to this or any other community amenities within the area. All appropriate health and safety measures, including signage, will be adopted at the site to ensure the safety of workers and the general public.

11.4.1.1.7 *Tourism*

Afforestation of the proposed replanting lands will have no impact on tourism as forestry is a well-established land-use of the landscape. There are no tourist facilities or attractions located at the replanting lands or within the vicinity of the site. The recorded Record of Monuments and Places within and adjacent to the site are not visible on the ground, are inaccessible and in poor condition.

11.4.1.2 Significance of the Effects

Based on the above, there will be no significant effects, on human beings, population or health, associated with afforestation the at this site.

12. MATERIAL ASSETS

Material Assets are resources that are valued and intrinsic to specific places. Economic assets of natural heritage include non-renewable resources such as minerals or soils, and renewable resources such as wind and water. These assets are dealt with in Sections 6, 7 and 8 of this report. Cultural assets are discussed in Section 9. Transportation infrastructure and land-use practices, which are economic assets of human origin, are discussed in this section of the report.

12.1 Replanting Area 1: Stranamart, Co. Cavan

12.1.1 Do-Nothing' Scenario

The lands have been Technically Approved and will be afforested should the Croagh Wind Farm proceed or not. If the land was not replanted, the current land use would continue at the site.

12.1.2 Planting Phase

12.1.2.1 Transportation

Traffic movements associated with the preparation and planting of the site will be minimal. Preparation of the site will require the use of an excavator for drainage, and travel to the site by the driver. Planting of the site will be by hand and will be carried out by one to two people over a two-week period approximately.

Forestry felling would typically occur within 0.5km of access points (roads & tracks) to the main forest body. Due to the small size of this site, additional access tracks or roads will not be required. This site is located adjacent an existing road network with which will not require upgrading or alteration.

12.1.2.2 Land-Use

Land-use on the site will change from pastoral agriculture to coniferous forestry. Forestry, like agriculture, is an extractive industry, i.e. it produces a raw material which is then processed to add value.

12.1.3 Operational Phase

12.1.3.1 Transportation

Traffic movements associated with the operation of the site will be minimal and will comprise maintenance workers only in Light Goods Vehicles.

12.1.3.2 Land-Use

Land-use on the site will change from pastoral agriculture to coniferous forestry. The use of the proposed replanting lands for coniferous forestry will have a positive effect on the economic assets of the site.

12.1.4 Significance of the Effects

Based on the above, there will be no significant effects on traffic associated with afforestation at this site.

12.2 Replanting Area 2: Brackloon, Co. Roscommon

12.2.1 Do-Nothing' Scenario

The lands have been Technically Approved and will be afforested should the Croagh Wind Farm proceed or not. If the land was not replanted, the current land use would continue at the site.

12.2.2 Transportation

Traffic movements associated with the preparation and planting of the site will be minimal. Preparation of the site will require the use of an excavator for drainage, and travel to the site by the driver. Planting of the site will be by hand and will be carried out by one to two people over a two-week period approximately.

Forestry felling would typically occur within 0.5km of access points (roads & tracks) to the main forest body. Due to the small size of this site, additional access tracks or roads will not be required. This site is located adjacent an existing road network with which will not require upgrading or alteration.

12.2.2.1 Land-Use

Land-use on the site will change from pastoral agriculture to coniferous forestry. Forestry, like agriculture, is an extractive industry, i.e. it produces a raw material which is then processed to add value.

12.2.3 Operational Phase

12.2.3.1 Transportation

Traffic movements associated with the operation of the site will be minimal and will comprise maintenance workers only in Light Goods Vehicles.

12.2.3.2 Land-Use

Land-use on the site will change from pastoral agriculture to coniferous forestry. The use of the proposed replanting lands for coniferous forestry will have a positive effect on the economic assets of the site.

12.3 Replanting Area 3: Ballard, Co. Wicklow

12.3.1 Do-Nothing' Scenario

The lands have been Technically Approved and will be afforested should the Croagh Wind Farm proceed or not. If the land was not replanted, the current land use would continue at the site.

12.3.2 Transportation

Traffic movements associated with the preparation and planting of the site will be minimal. Preparation of the site will require the use of an excavator for drainage, and travel to the site by the driver. Planting of the site will be by hand and will be carried out by one to two people over a two-week period approximately.

Forestry felling would typically occur within 0.5km of access points (roads & tracks) to the main forest body. Due to the small size of this site, additional access tracks or roads will not be required. This site is located adjacent an existing road network with which will not require upgrading or alteration.

12.3.2.1 Land-Use

Land-use on the site will change from pastoral agriculture to coniferous forestry. Forestry, like agriculture, is an extractive industry, i.e. it produces a raw material which is then processed to add value.

12.3.3 Operational Phase

12.3.3.1 Transportation

Traffic movements associated with the operation of the site will be minimal and will comprise maintenance workers only in Light Goods Vehicles.

12.3.3.2 Land-Use

Land-use on the site will change from pastoral agriculture to coniferous forestry. The use of the proposed replanting lands for coniferous forestry will have a positive effect on the economic assets of the site.

APPENDIX 1

APPROPRIATE ASSESSMENT SCREENING REPORT – STRANAMAR,T CO. CAVAN

Article 6 (3) Appropriate Assessment Screening Report

Assessment of Forestry Replacement Lands for Croagh Wind Farm at Stranamart, Co. Cavan

DOCUMENT DETAILS

Client:	**Coillte Teoranta**
Project Title:	**Assessment of Forestry Replacement Lands for Croagh Wind Farm at Stranamart, Co. Cavan**
Project Number:	**180511**
Document Title:	**Appropriate Assessment Screening Report**
Document File Name:	**AASR F–2020.07.06 -180511**
Prepared By:	**MKO** **Tuam Road** **Galway** **Ireland** **H91 VW84**

Planning and Environmental Consultants

Rev	Status	Date	Author(s)	Approved By
01	Draft	24/06/2020	CS	

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1. INTRODUCTION

1.1 Background

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 the proposed replacement area is in the townland of Stranamart in Co. Cavan.

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). 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 assessment in this report is based on a desk study was undertaken during 2020. It specifically assesses 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 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, 2001) and 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 (DoEHLG, 2010).

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.*

1.2 Appropriate Assessment

1.2.1 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 provision of section 177U of the Planning & Development Act 2010 as amended.

Statement of Authority

This report has been prepared by Claire Stephens (B.Sc. Env.) of MKO. Claire is an experienced ecologist with over 2 years' professional ecological consultancy experience. The report has been reviewed by David McNicholas (B.Sc., M.Sc., MCIEEM) who has over 9 years' professional ecological consultancy experience and is a full member of the Chartered Institute of Ecology and Environmental Management.

[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

2. DESCRIPTION OF THE PROPOSED DEVELOPMENT

2.1 Site Location

The replacement area is located within the townland of Stranamart, Co. Cavan (Grid Reference: E 203907 N 333027). This replacement area comprising several small fields is located within a rural setting between the R207 to the west and the R206 to the east, in County Cavan. The nearest town is Blacklion approximately 6.3km to the northeast. The site is accessed via an existing track directly off a local road which connects to both the R207 and R206.The Technical Approval area for afforestation at Stranamart measures 12.57 hectares in total. A site location map is provided in Figure 2.1.

2.2 Characteristics of the Proposed Development

2.2.1 Description of the project

This report provides a description of the proposed replacement land and an assessment of the potential impacts including cumulative impacts associated with afforestation at Stranamart, Co. Cavan

Construction of the proposed Croagh Wind Farm will require felling of 54.2 hectares of forestry. The site of 12.57ha at Stranamart, Co. Cavan was identified as a potential forestry replacement area. The proposed replacement land has been assessed as part of the Afforestation Approval – Form 1 process described above and has obtained Technical Approval for Afforestation from the Forest Service. If these replacement lands become unavailable, other similarly approved replant lands will be identified for replacement should the proposed wind farm be developed.

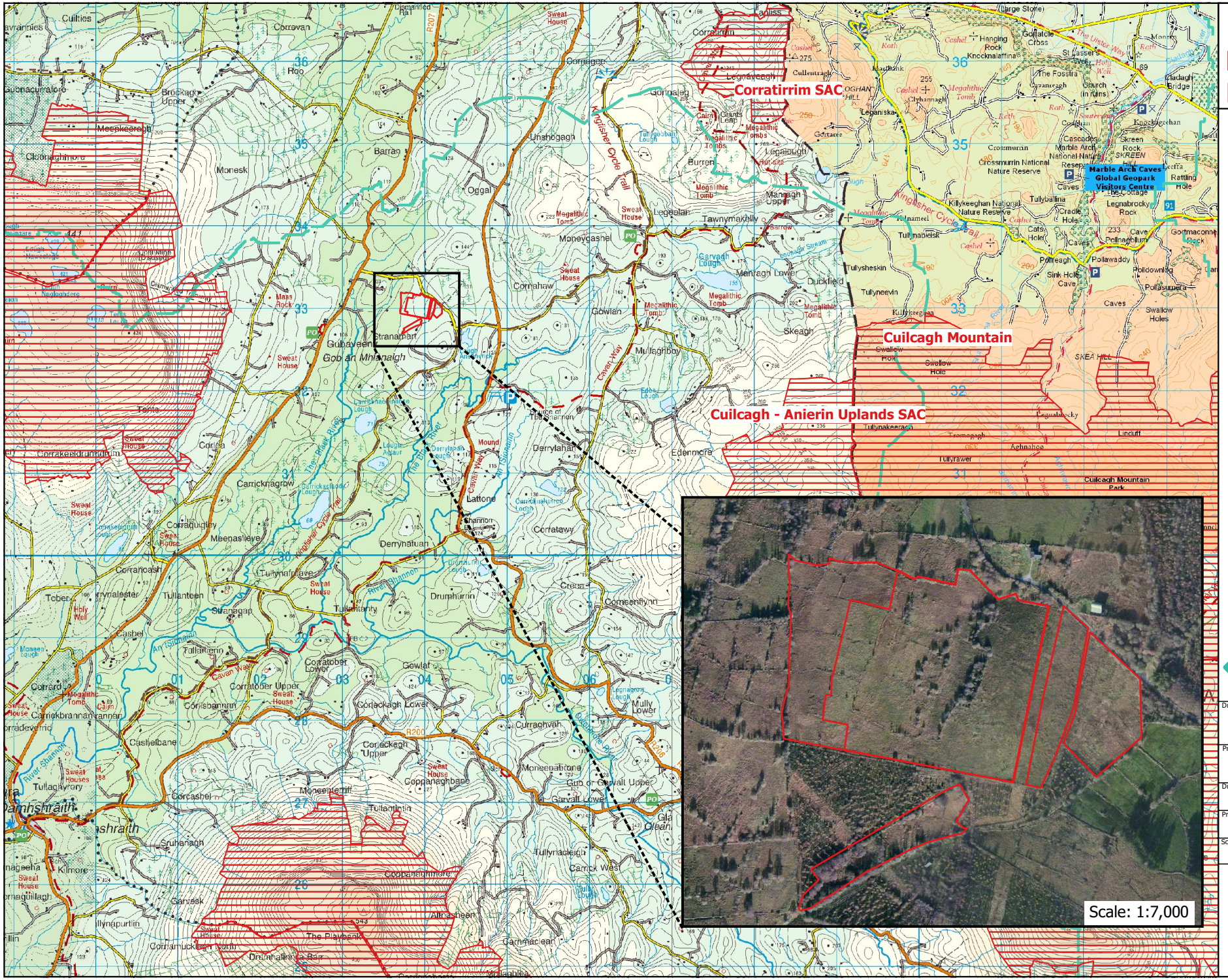
2.3 Description of the Baseline Ecological Environment

The site at Stanamart consists of ringfenced planted forestry classified as ***conifer plantation (WD4)***. A ***drainage ditch (FW4)*** exists along the eastern boundary of the site.

2.3.1 Significance of Habitats

The Ecological evaluation within this section follows a methodology that is set out in Chapter 3 of the 'Guidelines for Assessment of Ecological Impacts of National Roads Schemes' (NRA, 2009).

The conifer plantation and drainage ditches that are present within the site, given their highly modified nature, are of Local Importance (*Lower Value*) as they contain areas which are of some local importance for wildlife. However, these habitats are common in the wider landscape and are not of ecological Impact Assessment



Map Legend

- Site Boundary
- Special Area of Conservation

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Drawing Title

Site Location - Stranamart

Project Title	Coillte Carrane Hill WF - Replanting Assessment
Drawn By: CS	Checked By: JH
Project No.: 180511	Drawing No.: Figure 2.1
Scale: 1:60000	Date: 20-04-2020

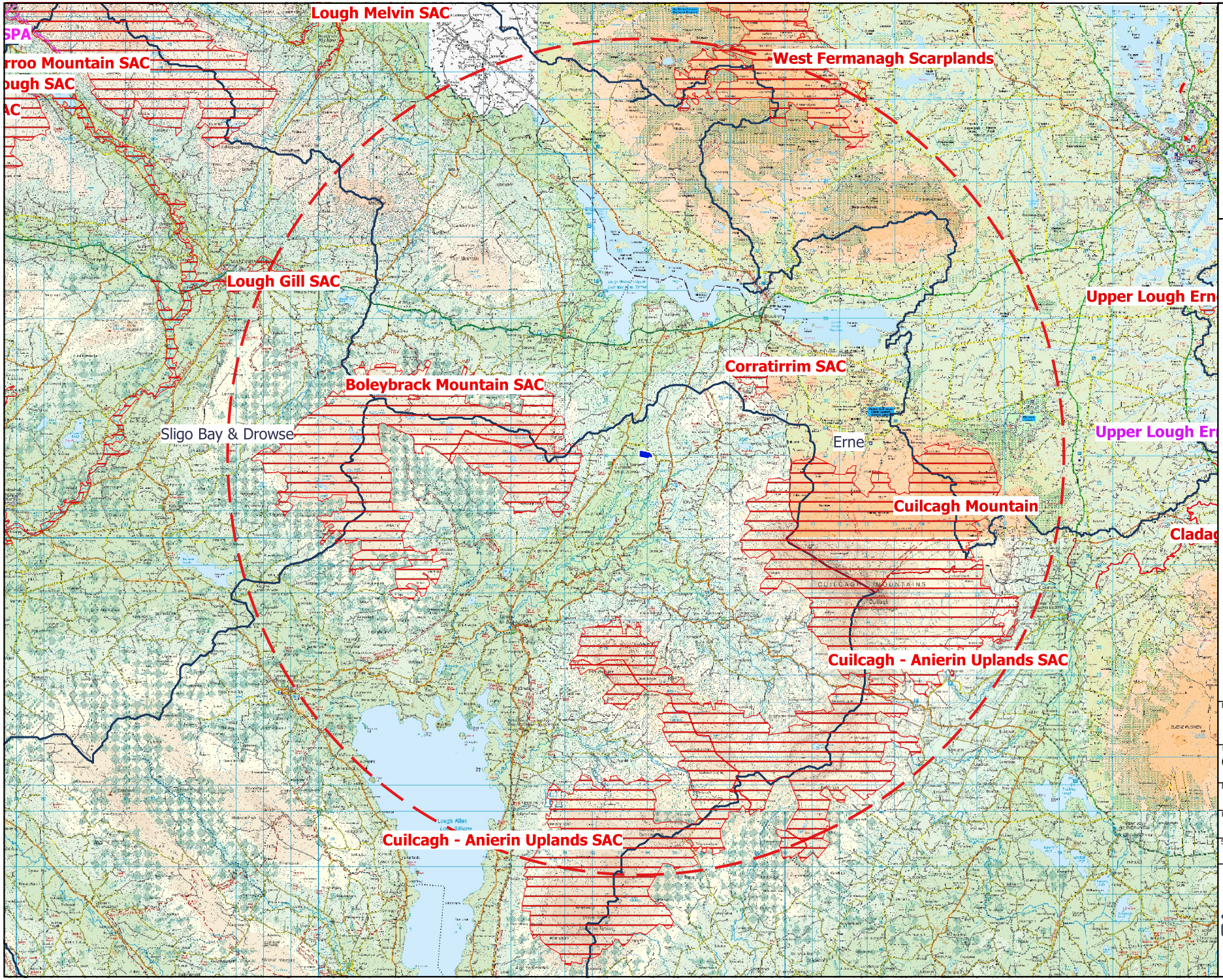
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3. IDENTIFICATION OF RELEVANT EUROPEAN SITES

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 24/06/2020. The datasets were utilized 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, no potential connectivity with sites located at a distance of over 15km from the proposed development 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.
- In relation to Special Protection Areas, in the absence of any specific European or Irish guidance in relation to such sites, the Scottish Natural Heritage (SNH) Guidance, 'Assessing Connectivity with Special Protection Areas (SPA)' (2016) was consulted. This document provides guidance in relation to the identification of connectivity between proposed development and Special Protection Areas. The guidance takes into consideration the distances species may travel beyond the boundary of their SPAs and provides information on dispersal and foraging ranges of bird species which are frequently encountered when considering plans and projects.
- 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 assessment considers any 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
- 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 24/06/2020. 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 are identified, the site is included within the Likely Zone of Impact and further assessment is required.



Map Legend

- Special Area of Conservation
- Special Protection Area
- Site Location Stranamart, Co. Cavan
- 15km Buffer
- WFD Hydrological Catchments

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Drawing Title: European Designated Sites within 15km -Stranamart

Project Title: Croagh Wind Farm - Replanting Assessment

Drawn By	Checked By
Claire Stephens	David McNicholas
Project No.	Drawing No.
180511	Figure 3.1
Scale	Date
1:180000	24.06.2020

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Table 3.1 Identification of Designated sites within the Likely Zone of Impact

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 and www.daera-ni.gov.uk on the 24/06/2020	Conservation Objectives	Likely Zone of Impact Determination
Special Areas of Conservation (SAC)			
Boleybrack Mountain SAC (002032) **Distance:** 2.0km	› Natural dystrophic lakes and ponds [3160] › Northern Atlantic wet heaths with *Erica tetralix* [4010] › European dry heaths [4030] › Molinia meadows on calcareous, peaty or clayey-silt-laden soils *(Molinion caeruleae*) [6410] › Blanket bogs (* if active bog) [7130]	Detailed conservation objectives for this site (Version 1, August 2016) were reviewed as part of the assessment and are available at www.npws.ie	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this SAC and therefore no potential for indirect effects on the SAC exists as a result of the proposed small scale works. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**
Cuilcagh - Anierin Uplands SAC (000584) **Distance:** 3.8km	› Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae)* [3110] › Natural dystrophic lakes and ponds [3160] › Northern Atlantic wet heaths with *Erica tetralix* [4010] › European dry heaths [4030]	Detailed conservation objectives for this site (Version 1, September 2016) were reviewed as part of the assessment and are available at www.npws.ie	There will be no direct effects as the project footprint is located entirely outside the designated site. Cuilcagh - Anierin Uplands SAC is located approximately 3.8km south-east of the proposed afforestation site and are buffered by a variety of habitats. Although the sites are

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 and www.daera-ni.gov.uk on the 24/06/2020	Conservation Objectives	Likely Zone of Impact Determination
	• Alpine and Boreal heaths [4060] • Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe) [6230] • Blanket bogs (* if active bog) [7130] • Transition mires and quaking bogs [7140] • Petrifying springs with tufa formation (*Cratoneurion*) [7220] • Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*) [8110] • Siliceous rocky slopes with chasmophytic vegetation [8220] • *Hamatocaulis vernicosus* (Slender Green Feather-moss) [6216]		located within the same hydrological catchment, no hydrological connectivity exists between the proposed development and the European designated site. Impacts on all of the listed QI habitats and species can be ruled out due to the distance from the proposed small scale afforestation and the absence of a complete source-pathway-receptor chain for impact. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**
Corratirrim SAC (000979) **Distance:** 4.1km	• Limestone pavements [8240]	Detailed conservation objectives for this site (Version 1,April 2019) were reviewed as part of the assessment and are available at www.npws.ie	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no connectivity between this European site designated for terrestrial habitats and the proposed afforestation works

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 and www.daera-ni.gov.uk on the 24/06/2020	Conservation Objectives	Likely Zone of Impact Determination
			in a separate hydrological sub-catchment. No pathway for indirect effects was identified. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**
Cuilcagh Mountain SAC [UK0016603] **Distance:** 5.0km	› Natural dystrophic lakes and ponds › Northern Atlantic wet heath with *Erica tetralix* › European dry heaths › Alpine and Boreal heath › Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and Caleopsietalia ladani) › Siliceous rocky slopes with chasmophytic vegetation	Detailed conservation objectives for this site (Version 2.1, October 2017) were reviewed as part of the assessment and are available at www.daera-ni.gov.uk	There will be no direct effects as the project footprint is located entirely outside the designated site. Cuilcagh Mountain SAC is located approximately 5km east of the proposed afforestation site and is buffered by a variety of habitats. Although the sites are located within the same hydrological catchment, no hydrological connectivity exists between the proposed development and the European designated site. Impacts on all of the listed QI habitats and species can be ruled out due to the distance from the proposed small scale works area and the absence of a complete source-pathway-receptor chain for impact.

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 and www.daera-ni.gov.uk on the 24/06/2020	Conservation Objectives	Likely Zone of Impact Determination
			No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.
Lough Gill SAC (001976) **Distance:** 12.5km	› Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - type vegetation [3150] › Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites) [6210] › Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [91A0] › Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0]* › *Austropotamobius pallipes* (White-clawed Crayfish) [1092] › *Petromyzon marinus* (Sea Lamprey) [1095] › *Lampetra planeri* (Brook Lamprey) [1096] › *Lampetra fluviatilis* (River Lamprey) [1099] › *Salmo salar* (Salmon) [1106]	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 Generic version 7.0, 2020)	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the site and the European Designated Site. The SAC is located in a separate surface water catchment to the proposed small-scale replacement development. Therefore, no pathway for indirect effects was identified. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**

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 and www.daera-ni.gov.uk on the 24/06/2020	Conservation Objectives	Likely Zone of Impact Determination
	› *Lutra lutra* (Otter) [1355]		
West Fermanagh Scarplands SAC [UK0030300] **Distance:** 12.5km	› Molinia meadows on calcareous, peaty or clayey-silt-laden soils *(Molinion caeruleae*) › Semi-natural dry grasslands and scrubland facies: on calcareous substrates (*Festuco-Brometalia*) › *Tilio-Acerion* forests of slopes, screes and ravines › Alkaline Fens › Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* – type vegetation › Blanket bog (active only) › Northern Atlantic wet heath with *Erica tetralix* › Petrifying springs with tufa formation (*Cratoneuron)*	Detailed conservation objectives for this site (Version 2, December 2014) were reviewed as part of the assessment and are available at www.daera-ni.gov.uk	There will be no direct effects as the project footprint is located entirely outside the designated site. This European site is located in a separate hydrological catchment to the proposed small scale afforestation works. No pathway for indirect effects was identified. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**
Special Protection Area (SPA)			
There are no SPA's within 15km of the replacement site			

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

No European Sites will be affected by the proposed replacement replacement lands.

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

The potential for the proposed development to contribute to a cumulative effect on European Sites was considered. The online planning system for Cavan County Council was consulted on the 24/06/2020.

Additional projects identified in the vicinity of the replacement forestry lands at Stranamart around the townland of Gubaveeny and Grellagh in the last 5 years include.

- Permission demolish existing derelict two storey dwelling house and outbuilding; construct proposed new two storey dwelling house, single storey domestic garage, wastewater treatment unit and percolation area, construct new entrance and all associated site works. Significant further information and revised plans have been received (Planning Ref.: 1778) – Finalised Application Decision: Conditional,
- Permission to (1) Construct an agricultural slatted shed to incorporate slatted area, external feed passage and underground slurry storage tank and (2) Complete all associated and ancillary site works (Planning Ref.: 2100) - Finalised Application Decision: Conditional.

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

The findings of this Screening Assessment are presented following 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, 2001) and 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 (DoEHLG, 2010).

4.1 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 OS maps and aerial photographs of the site of the proposed project.
- Review of other plans and projects within the area.

4.2 Concluding Statement

It is concluded 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 replacement land, individually or in combination with other plans and projects, will not have a significant effect on any European Site.

The proposed afforestation has Technical Approval from the Forest Service and will be undertaken accordingly. This approval is conditional to all associated works being undertaken in accordance with Forest Service requirements. The impacts associated with this afforestation have been classified overall as a neutral impact. As such, when considered in combination with the other land uses in the area, and considering that the forestry guidelines are designed to minimise and prevent impacts to habitats that are outside the site, cumulative impacts on sensitive ecological receptors are not anticipated.

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APPENDIX 2

APPROPRIATE ASSESSMENT SCREENING REPORT – BRACKLOON, CO. ROSCOMMON

Planning and Environmental Consultants

Article 6 (3) Appropriate Assessment Screening Report

Assessment of Forestry Replacement Lands for Croagh Wind Farm at Brackloon, Co. Roscommon



DOCUMENT DETAILS

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Planning and Environmental Consultants

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1. INTRODUCTION

1.1 Background

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 the proposed replacement area is in the townland of Brackloon in Co. Roscommon.

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). 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 assessment in this report is based on a site visit in October 2019 and a desk study was undertaken in 2020. It specifically assesses the potential for the proposed replacement lands 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 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, 2001) and *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* (DoEHLG, 2010).

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.*

1.2 Appropriate Assessment

1.2.1 Screening for Appropriate Assessment

The Habitats Directive (Council Directive 92/43/EEC) is implemented in Ireland by the European Communities (Birds & Natural Habitats) Regulations 2011 (S.I. No.477/2011), the European Communities (Birds & Natural Habitats) (Amendment) Regulations 2015 (S.I. No. 355/2015), and the Planning and Development Acts 2000-2015, as amended. The requirement for AA is set out in Article 6 of the Habitats Directive.

In summary, Article 6(3) of the Directive requires an Appropriate Assessment to be undertaken where there is a possibility of the proposed project – either individually or in combination with other plans and projects – having an effect on a European site (i.e. a Special Area of Conservation (SAC) or a Special Protection Area (SPA)). The AA focuses on the implications that the proposed project may have in the context of the rationale behind why an area was designated for protection. Article 6(3) continues by stating that statutory approval can only be granted if the assessment has shown that there will be no adverse effects on the integrity of the European site. In cases where the integrity of a site may be impacted, then the requirements of Article 6(4) apply.

Therefore, potential impacts on European sites must be considered by the relevant public authority listed under the European Communities (Birds & Natural Habitats) Regulations, 2011 (S.I. No.477/2011). 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. 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.

Statement of Authority

The site was visited by John Hynes (B. Sc., M.Sc., MCIEEM) on the 14th of October 2019. John has over 9 years professional ecological consultancy and management experience. This report has been prepared by Claire Stephens (B.Sc. Env.) and David McNicholas (B.Sc., M.Sc., MCIEEM) of MKO. Claire is an experienced ecologist with over 2 years' professional ecological consultancy experience. David has over 9 years' professional ecological consultancy experience and is a full member of the Chartered Institute of Ecology and Environmental Management. This report has been reviewed by Pat Roberts (B.Sc., MCIEEM) who has over 15 years' experience in ecological assessment and management.

2. DESCRIPTION OF THE PROPOSED REPLACEMENT LANDS

2.1 Site Location

The replacement area is located within the townland of Brackloon, Shankill, Co. Roscommon (Grid Reference: E 178657 N 288747). The replacement site is located approximately 3.7km east of the village of Bellanagare and 8km west of the town of Elphin. The site is accessed off an unnamed local road which bounds the site to the east. A site location map is provided in Figure 2.1.

2.2 Characteristics of the Proposed Replacement Lands

2.2.1 Description of the project

This report provides a description of the proposed replacement land and an assessment of the potential impacts including cumulative impacts associated with afforestation at Brackloon, Co. Roscommon

Construction of the proposed Croagh Wind Farm will require felling of 54.2 hectares of forestry. The site of 7.2ha at Brackloon, Co. Roscommon was identified as a potential forestry replacement area.

2.3 Description of the Baseline Ecological Environment

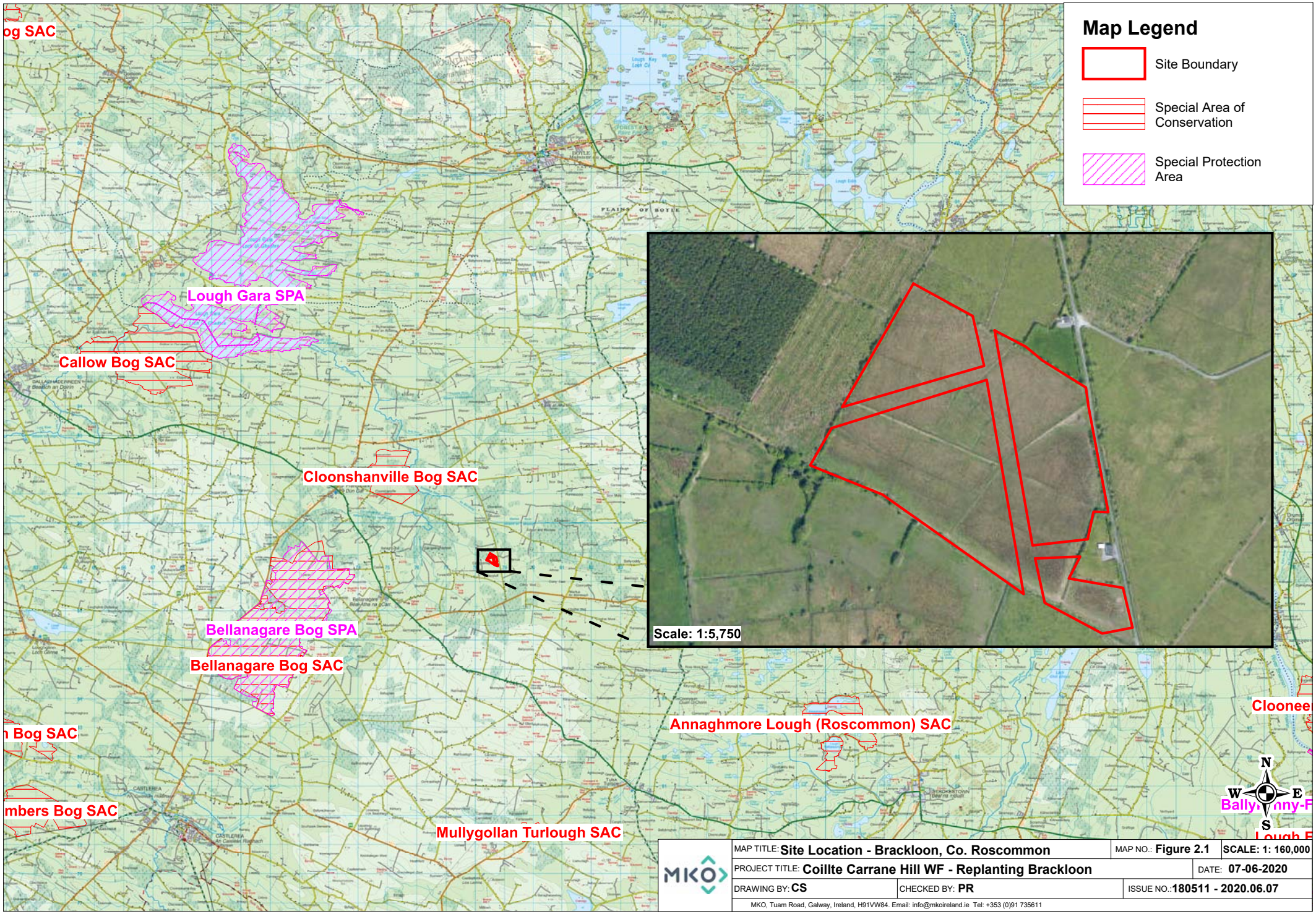
Assessing the impacts of any project and associated activities requires an understanding of the ecological baseline conditions prior to and at the time of the project proceeding. Ecological Baseline conditions are those existing in the absence of proposed activities (CIEEM 2018).

A multidisciplinary walkover survey was conducted on the on the 14th of October 2019 by John Hynes of MKO. The ecological survey was undertaken outside the optimal time of year to undertake a habitat and flora survey (Smith et. al 2011) however all habitats were readily identifiable at the time of the visit. A dedicated invasive species survey was also undertaken during the site visit. During the survey, the site was searched for species listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations (S.I. 477 of 2011).

The site is largely dominated by an ***improved agricultural grassland/wet grassland (GA1/GS4)*** mosaic with field boundaries demarcated by ***hedgerows(WL1)*** (Plate 2.1). This grassland habitat is extensively dominated by rushes (*Juncus* spp.). Other species recorded include cock's-foot (*Dactylus glomerata*), perennial ryegrass (*Lolium perenne*), spear thistle *(Circium vulgare),* flag iris (*Iris pseudacorus),* ivy (Hedera helix) and bramble (*Rubus fructicosus* agg.). The ***hedgerows (WL1)*** are dominated by willow *(Salix* spp.), hawthorn (Crataegus monogyna) and bramble.

A stream categorised as ***eroding/upland river (FW1)***, (Plate 2.2) runs adjacent along the southern boundary of the site, flowing in a north westerly direction and discharging to the Owennaforeesha River, approximately 2.3km downstream of the site.

No habitats which correspond to those that are listed in Annex I of the EU Habitats Directive were identified during the site visit.



MAP TITLE: Site Location - Brackloon, Co. Roscommon		MAP NO.: Figure 2.1	SCALE: 1: 160,000
PROJECT TITLE: Coillte Carrane Hill WF - Replanting Brackloon			DATE: 07-06-2020
DRAWING BY: CS	CHECKED BY: PR		ISSUE NO.: 180511 - 2020.06.07

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Plate 2.1 Improved agricultural grassland/wet grassland (GA1/GS4) mosaic with field boundaries demarcated by hedgerows (WL1)



Plate 2.2 Stream categorised as eroding/upland river (FW1) adjacent along the southern boundary of the site

Invasive Species

No invasive species listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations, 2011 were recorded within the site boundary during the site visit.

2.3.1 Fauna in the Existing Environment

Birds

Records of birds seen and heard on the site of the proposed replacement lands were taken. Common passerines were recorded incidentally within the site. No birds listed on Annex I of the EU Birds Directive were recorded during the field survey. The site provided habitat for a range of common and widespread species but not of significance for rare or protected bird species, notably those associated with SPAs in the wider area. Given the lack of significant habitat for rare or protected bird species, there is no requirement for further bird surveys at the site.

Otter

A comprehensive search for otter was undertaken along a 10m riparian buffer of the stream adjacent to the southern site boundary (NRA, 2008 and Reid, et al 2013). No otter resting or breeding sites and no evidence of otter was recorded within the replacement lands, however, the watercourse along the site boundary is likely to be utilised by commuting and foraging otter.

Bats

There are no structures within the site which may provide suitable roosting habitat for bats. A large open landscape structure dominates the site and though linear features may be used by foraging and commuting bats, overall, the site is considered to have low suitability for bat species.

Other Terrestrial Mammals

No evidence of badger was recorded during the site visit and no other protected mammal species or evidence of such species were recorded within the site boundaries.

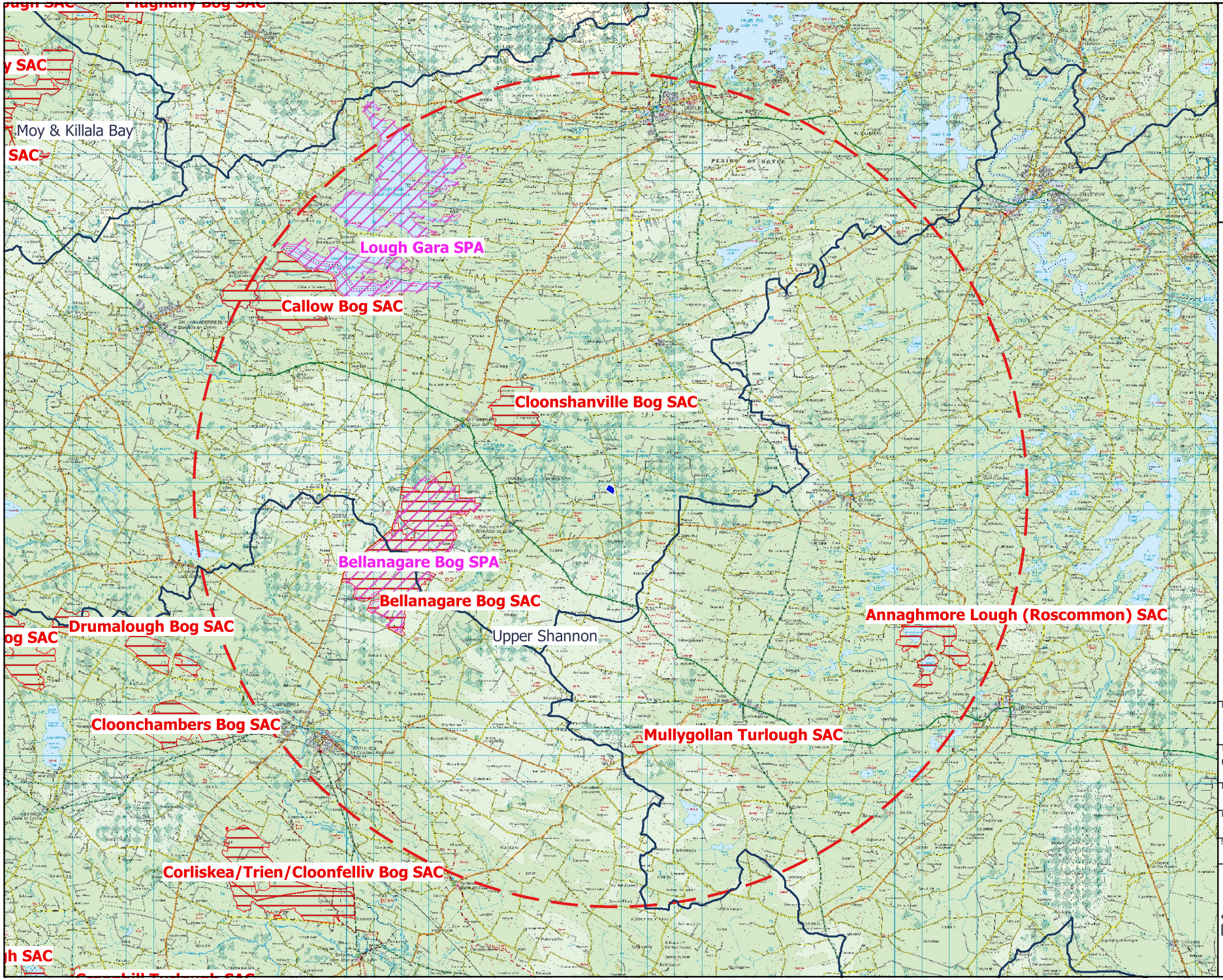
No faunal species listed under the Annexes of the Habitats Directive were recorded during the site visit.

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 replacement lands:

- 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 24/06/2020. The datasets were utilized to identify European Sites which could feasibly be affected by the proposed replacement lands.
- All European Sites within a distance of 15km surrounding the replacement lands 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 replacement lands was also considered in this initial assessment. In this case, no potential connectivity with sites located at a distance of over 15km from the proposed replacement lands was identified.
- The catchment mapping was used to establish or discount potential hydrological connectivity between the site of the proposed replacement lands and any European Sites. The hydrological catchments are also shown in Figure 3.1.
- In relation to Special Protection Areas, in the absence of any specific European or Irish guidance in relation to such sites, the Scottish Natural Heritage (SNH) Guidance, 'Assessing Connectivity with Special Protection Areas (SPA)' (2016) was consulted. This document provides guidance in relation to the identification of connectivity between proposed replacement lands and Special Protection Areas. The guidance takes into consideration the distances species may travel beyond the boundary of their SPAs and provides information on dispersal and foraging ranges of bird species which are frequently encountered when considering plans and projects.
- 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 assessment considers any likely direct or indirect impacts of the proposed replacement lands, 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
- 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 24/06/2020. Figure 3.1 shows the location of the proposed replacement lands in relation to all European sites within 15km of the proposed replacement lands.
- Where potential pathways for Significant Effect are identified, the site is included within the Likely Zone of Impact and further assessment is required.



Map Legend

- Special Area of Conservation
- Special Protection Area
- Site Location Brackloon Co. Roscommon
- 15km Buffer
- WFD Hydrological Catchments

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Drawing Title: European Designated Sites within 15km - Brackloon

Project Title: Croagh Wind Farm - Replanting Assessment

Drawn By	Checked By
Claire Stephens	David McNicholas
Project No.	**Drawing No.**
180511	Figure 3.1
Scale	**Date**
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Table 3.1 Identification of Designated sites within the Likely Zone of Impact

European Sites and distance from proposed replacement lands	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 24/06/2020)	Conservation Objectives	Likely Zone of Impact Determination	Possibility of Significant Effects? (If Yes Progress To Stage 2 Of AA Process)
Special Areas of Conservation (SAC)				
Cloonshanville Bog SAC (000614) **Distance:** 3.3km (4.1km hydrological distance)	› 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, January 2016) were reviewed as part of the assessment and are available at www.npws.ie	There will be no direct effects as the project footprint is located entirely outside the designated site. The proposed afforestation site has surface water connectivity >4.1km downstream with Cloonshanville Bog SAC via a stream, running adjacent along the southern boundary of the site. However, given distance downstream of the terrestrial habitats and nature and small scale of the works as permitted in the technical approval document there is no potential for indirect effects on the SAC. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**	No – Potential for significant effect has been excluded and there is no need to progress to Stage 2 of the Appropriate Assessment process.

European Sites and distance from proposed replacement lands	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 24/06/2020)	Conservation Objectives	Likely Zone of Impact Determination	Possibility of Significant Effects? (If Yes Progress To Stage 2 Of AA Process)
Bellanagare Bog SAC (000592) **Distance:** 3.3km	› 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, November 2015) were reviewed as part of the assessment and are available at www.npws.ie	There will be no direct effects as the project footprint is located entirely outside the designated site. No hydrological connectivity has been identified between the proposed afforestation site designated for terrestrial habitats and this European site. Due to the lack of connectivity between the small-scale replacement site and the European Site, no pathway for indirect effect between the proposal and the designated site exists. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**	No – Potential for significant effect has been excluded and there is no need to progress to Stage 2 of the Appropriate Assessment process.
Mullygollan Turlough SAC [000612] **Distance:** 3.4km	› Turloughs [3180]	Detailed conservation objectives for this site (Version 1, January 2018) were reviewed as part of the assessment and are available at www.npws.ie	There will be no direct effects as the project footprint is located entirely outside the designated site.	No – Potential for significant effect has been excluded and there is no need to progress to Stage 2 of the Appropriate Assessment process.

European Sites and distance from proposed replacement lands	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 24/06/2020)	Conservation Objectives	Likely Zone of Impact Determination	Possibility of Significant Effects? (If Yes Progress To Stage 2 Of AA Process)
			Mullygollan Turlough SAC is located approximately 3.4km south-east of the proposed afforestation site and is buffered by agricultural, forestry, bog and scrub habitats. No hydrological connectivity exists between the proposed replacement lands and the designated site. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**	
Callow Bog SAC (000595) **Distance:** 3.6km	› 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	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this European site designated for terrestrial habitats, located in a separate hydrological sub-catchment. Therefore, no pathway for indirect	No – Potential for significant effect has been excluded and there is no need to progress to Stage 2 of the Appropriate Assessment process.

European Sites and distance from proposed replacement lands	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 24/06/2020)	Conservation Objectives	Likely Zone of Impact Determination	Possibility of Significant Effects? (If Yes Progress To Stage 2 Of AA Process)
			effect between the proposal and the designated site exists. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**	
Annaghmore Lough (Roscommon) SAC [001626] **Distance:** 4.6km	› Alkaline fens [7230] › *Vertigo geyeri* (Geyer's Whorl Snail) [1013]	Detailed conservation objectives for this site (Version 1, January 2019) were reviewed as part of the assessment and are available at www.npws.ie	There will be no direct effects as the project footprint is located entirely outside the designated site. This SAC is located in a separate hydrological catchment to the proposed small-scale afforestation works and there is no connectivity between the afforestation site and the SAC. Impacts on the listed Qualifying Interests can be ruled out due to the distance from the proposed works area and the absence of a complete source-pathway-receptor chain for impact. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**	No – Potential for significant effect has been excluded and there is no need to progress to Stage 2 of the Appropriate Assessment process.

European Sites and distance from proposed replacement lands	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 24/06/2020)	Conservation Objectives	Likely Zone of Impact Determination	Possibility of Significant Effects? (If Yes Progress To Stage 2 Of AA Process)
Tullaghanrock Bog SAC (002354) **Distance:** 4.6km	› 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, December 2015) were reviewed as part of the assessment and are available at www.npws.ie	There will be no direct effects as the project footprint is located entirely outside the designated site. There is no hydrological connectivity between the proposed afforestation site and this European site designated for terrestrial habitats, located in a separate hydrological sub-catchment. Therefore, no pathway for indirect effect between the proposal and the designated site exists. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**	No – Potential for significant effect has been excluded and there is no need to progress to Stage 2 of the Appropriate Assessment process.
Special Protection Area (SPA)				
Bellanagare Bog SPA [004105] **Distance:** 4.6km	› Greenland White-fronted Goose *(Anser albifrons flavirostris)* [A395]	This site has the generic conservation objective: '*To maintain or restore the favourable conservation condition*	There will be no direct effects as the project footprint is located entirely outside the designated site.	No – Potential for significant effect has been excluded and there is no need to progress to Stage 2 of the Appropriate Assessment process.

European Sites and distance from proposed replacement lands	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 24/06/2020)	Conservation Objectives	Likely Zone of Impact Determination	Possibility of Significant Effects? (If Yes Progress To Stage 2 Of AA Process)
		of the bird species listed as Special Conservation Interests of this SPA". (NPWS Generic version 7.0, 2020)	Bellanagare Bog SPA is located approximately 4.6km south-west of the proposed afforestation site and is buffered by agricultural, forestry and peatland habitats. No significant supporting habitat for SCI species within the site and that given the absence of habitat and distance from the SPA no potential for indirect effects as a result of disturbance exist. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**	
Lough Gara SPA [004048] **Distance:** 9.4km (12.9km hydrological distance)	› Whooper Swan (*Cygnus cygnus*) [A038] › 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".*	There will be no direct effects as the project footprint is located entirely outside the designated site. The proposed afforestation site has surface water connectivity >12.9km downstream with Lough Gara SPA via a stream, running adjacent	No – Potential for significant effect has been excluded and there is no need to progress to Stage 2 of the Appropriate Assessment process.

European Sites and distance from proposed replacement lands	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 24/06/2020)	Conservation Objectives	Likely Zone of Impact Determination	Possibility of Significant Effects? (If Yes Progress To Stage 2 Of AA Process)
		(NPWS Generic version 7.0, 2020)	along the southern boundary of the site. However, given the distance downstream of the wetland species and nature and small scale of the works as permitted in the technical approval document there is no potential for indirect effects on the SPA. **No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.**	

3.2 European Sites with the Potential to be Significantly Affected by the Proposed Replacement lands

No European Sites will be affected by the proposed replacement lands.

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

The potential for the proposed replacement lands to contribute to a cumulative effect on European Sites was considered. The online planning system for Roscommon County Council was consulted on the 24/06/2020.

Additional relevant projects identified in the vicinity of the replacement forestry lands around the townland of Shankill, Elphin and Bellanagare in the last 5 years include.

- Permission to construct a Funeral Home, Embalming Theatre and all associated ancillary works at the site located in (Planning Ref.: 1661) – Finalised Application Decision: Conditional,
- Planning permission to carry out refurbishments, to include reroofing and to construct an extension to the existing commercial premises with all associated ancillary works at Elphin (Planning Ref.: 18450) - Finalised Application Decision: Conditional,
- Permission for a change of use from retail/office development to 2 no. apartments at the ground floor of property at (Planning Ref.: 1814) - Finalised Application Decision: Conditional,
- To construct new domestic garage and extension to existing dwelling to contain sunroom together with all associated site works at Shankill Td., Elphin, Co. Roscommon (Planning Ref.: 20114) – New Application Decision Due: 04.07.2020
- Permission to construct extension to existing dwelling to contain sunroom together with all associated site works at (Planning Ref.: 20225) - New Application.

The following plan has been reviewed and taken into consideration as part of this assessment:

- Roscommon County Development Plan 2014-2020

No pathway or mechanism for the proposed replacement lands to result in any significant effect on any European Site was identified when considered on its own during the assessment process and therefore there is no potential for it to contribute to any such effects when considered in-combination with any other plans and projects.

The review of plans and projects that is described above did not reveal any additional potential pathways for effect on European Sites that may have arisen as a result of those plans or projects.

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

The findings of this Screening Assessment are presented following 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, 2001) and 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 (DoEHLG, 2010).

4.1 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 OS maps and aerial photographs of the site of the proposed project.
- Review of other plans and projects within the area.
- Site visit undertaken on the 14th of October 2019 by John Hynes of MKO.

4.2 Concluding Statement

It is concluded 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 replacement land, individually or in combination with other plans and projects, will not have a significant effect on any European Site.

The proposed afforestation has Technical Approval from the Forest Service and will be undertaken accordingly. This approval is conditional to all associated works being undertaken in accordance with Forest Service requirements. The impacts associated with this afforestation have been classified overall as a neutral impact. As such, when considered in combination with the other land uses in the area, and considering that the forestry guidelines are designed to minimise and prevent impacts to habitats that are outside the site, cumulative impacts on sensitive ecological receptors are not anticipated.

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APPENDIX 3

APPROPRIATE ASSESSMENT SCREENING REPORT – BALLARD CO. WICKLOW

Article 6 (3) Appropriate Assessment Screening Report

Assessment of Forestry Replacement Lands for Croagh Wind Farm at Ballard, Co. Wicklow



DOCUMENT DETAILS

Client:	**Coillte Teoranta**
Project Title:	**Assessment of Forestry Replacement Lands for Croagh Wind Farm at Ballard, Co. Wicklow**
Project Number:	**180511**
Document Title:	**Appropriate Assessment Screening Report**
Document File Name:	**AASR F –2020.07.06 -180511**
Prepared By:	**MKO** **Tuam Road** **Galway** **Ireland** **H91 VW84**

Planning and Environmental Consultants

Rev	Status	Date	Author(s)	Approved By
01	Draft	24/06/2020	CS/DMN	PR
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1. INTRODUCTION

1.1 Background

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 the proposed replacement area is in the townland of Ballard in Co. Wicklow.

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). 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 assessment in this report is based on a desk study was undertaken during 2020 as well as site visited on the 18th May 2016 by Faith Wilson Ecological Consultant and on the 29th October 2018 by Malachy Walsh and Partners (Engineering and Environmental Consultants). It specifically assesses the potential for the proposed replacement lands 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 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, 2001) and *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* (DoEHLG, 2010).

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.*

1.2 Appropriate Assessment

1.2.1 Screening for Appropriate Assessment

The Habitats Directive (Council Directive 92/43/EEC) is implemented in Ireland by the European Communities (Birds & Natural Habitats) Regulations 2011 (S.I. No.477/2011), the European Communities (Birds & Natural Habitats) (Amendment) Regulations 2015 (S.I. No. 355/2015), and the Planning and Development Acts 2000-2015, as amended. The requirement for AA is set out in Article 6 of the Habitats Directive.

In summary, Article 6(3) of the Directive requires an Appropriate Assessment to be undertaken where there is a possibility of the proposed project – either individually or in combination with other plans and projects – having an effect on a European site (i.e. a Special Area of Conservation (SAC) or a Special Protection Area (SPA)). The AA focuses on the implications that the proposed project may have in the context of the rationale behind why an area was designated for protection. Article 6(3) continues by stating that statutory approval can only be granted if the assessment has shown that there will be no adverse effects on the integrity of the European site. In cases where the integrity of a site may be impacted, then the requirements of Article 6(4) apply.

Therefore, potential impacts on European sites must be considered by the relevant public authority, listed under the European Communities (Birds & Natural Habitats) Regulations, 2011 (S.I. No.477/2011). 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. 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.

Statement of Authority

The replacement lands were visited on the 18th May 2016 by Faith Wilson Ecological Consultant and on the 29th October 2018 by Malachy Walsh and Partners (Engineering and Environmental Consultants). This report has been prepared by Claire Stephens (B.Sc. Env.) and David McNicholas (B.Sc., M.Sc., MCIEEM) of MKO. Claire is an experienced ecologist with over 2 years' professional ecological consultancy experience. David has over 9 years' professional ecological consultancy experience and is a full member of the Chartered Institute of Ecology and Environmental Management. This report has been reviewed by Pat Roberts (B.Sc., MCIEEM) who has over 15 years' experience in ecological assessment and management.

2. DESCRIPTION OF THE PROPOSED REPLACEMENT LANDS

2.1 Site Location

The forestry replacement land (the site) is located within the townland of Ballard in Co. Wicklow, approximately 1.3km west of the village of Ballinaclash and approximately 4km southwest of the Rathdrum town. Avondale Forest is located 3.5km to the east. (Grid Reference: E 315424 N 184332). The site is accessed via a track directly off a local unnamed road which runs along the southern boundary. A site location map is provided in Figure 2.1.

2.2 Characteristics of the Proposed Replacement Lands

2.2.1 Description of the project

This report provides a description of the forestry replacement land and an assessment of the potential impacts, including in-combination impacts, associated with afforestation at Ballard, Co. Wicklow

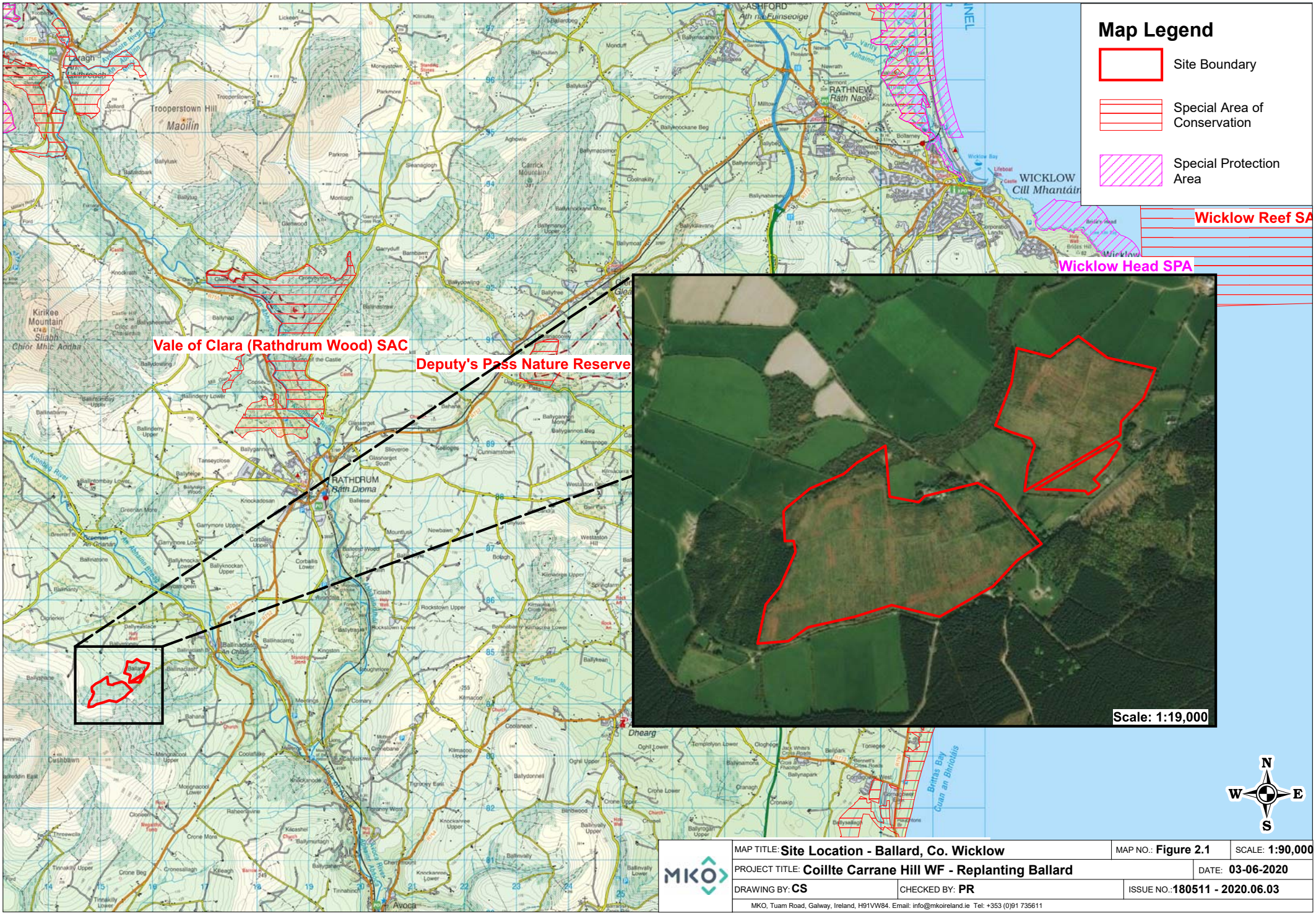
Construction of the proposed Croagh Wind Farm will require felling of 55.1 hectares of forestry. The lands of 39.56ha at Ballard, Co. Wicklow was identified as a potential forestry replacement area.

2.3 Description of the Baseline Ecological Environment

The proposed afforestation site was visited on the 18th May 2016 by Faith Wilson Ecological Consultant and on the 29th October 2018 by Malachy Walsh and Partners (Engineering and Environmental Consultants). The dominant habitats at the site were ***scrub (WS2). In*** the western block, the scrub formed a habitat mosaic with ***dry-humid acid grassland (GS3).*** Pockets of ***dense bracken (HD1***) occurs throughout the site, mostly adjoining disused tracks which are classified as ***recolonising bare ground (ED3).*** The site boundaries are a combination of ***hedgerow (WL1)*** habitat and ***treeline (WL2).*** Both the eastern and western extent of the Ballard site each features a small area of ***Immature woodland (WS2),*** consisting of birch (*Betula* sp.). The western extent of the Ballard site features a small area of ***mixed broadleaved conifer woodland (WD2), conifer plantation (WD4)*** and ***wet grassland (GS4).***

The Ballyeustace Stream, classified as ***depositing/lowland river (FW2***), flows along the north–western and northern boundary of the western compartment and along the northern boundary of the eastern compartment. The sides of this stream are well vegetated by willows (*Salix sp.)* and birch (*Betula* sp.). The shallow drains were dry at the time of the survey and had floral cover of terrestrial plants.

No habitats which correspond to those that are listed in Annex I of the EU Habitats Directive were identified during the site visit.



MAP TITLE: **Site Location - Ballard, Co. Wicklow**		MAP NO.: **Figure 2.1**	SCALE: **1:90,000**
PROJECT TITLE: **Coillte Carrane Hill WF - Replanting Ballard**			DATE: **03-06-2020**
DRAWING BY: **CS**	CHECKED BY: **PR**	ISSUE NO.: **180511 - 2020.06.03**	

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2.3.1 Fauna in the Existing Environment

Bats

There are no structures within the site which may provide suitable roosting habitat for bats. Treelines, hedgerows, woodland habitat and the stream habitat within and around the site are likely to be utilised by commuting and foraging bat species.

Birds

Bird species recorded within the site included jay *(Garrulus glandarius)*, snipe (*Gallinago gallinago*), buzzard (*Buteo buteo),* kestrel (*Falco tinnunculus*) and stonechat *(Saxicola torquata).* The site provided habitat for a range of common and widespread species but not of significance for rare or protected bird species. No evidence of bird species for which surrounding SPAs have been designed were recorded within the site and the site does not provide a significant area of suitable habitat for such species. Bird species recorded within the site were common species. Given the lack of significant habitat for rare or protected bird species, there is no requirement for further bird surveys at the site.

Other faunal species

A comprehensive search of the site for mammals was undertaken. Evidence of badger (a subsidiary sett) and sitka deer was seen while onsite as well as droppings were identified within the afforestation boundary.

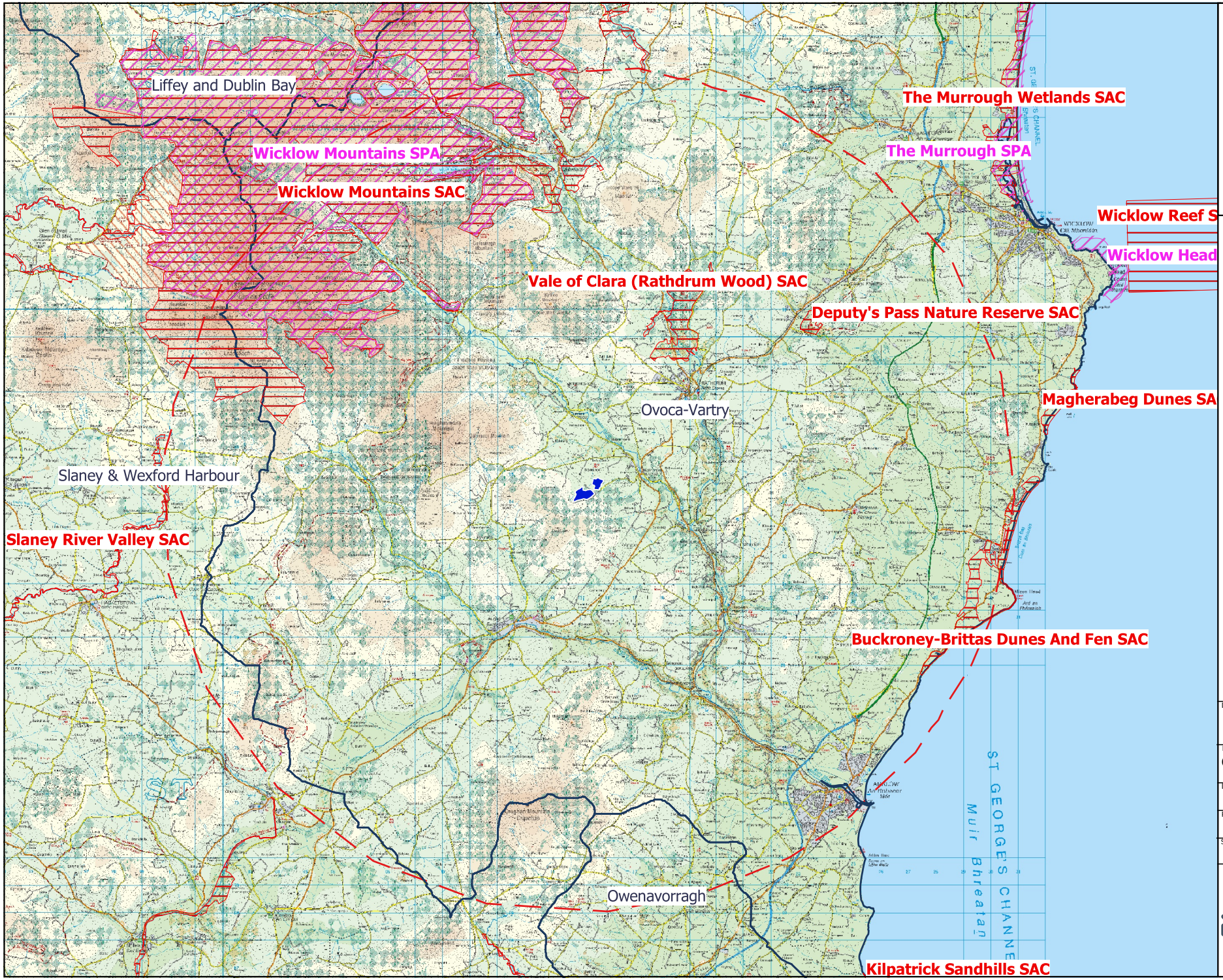
The watercourse along the site boundaries is likely to be utilised by commuting and foraging otter. Otter is listed on Annex II and IV of the EU Habitats Directive and is protected under the Irish Wildlife Act. No suitable habitat for other species of conservation concern was identified within the proposed afforestation site.

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 replacement lands:

- 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 24/06/2020. The datasets were utilized to identify European Sites which could feasibly be affected by the proposed replacement lands.
- All European Sites within a distance of 15km surrounding the replacement lands 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 replacement lands was also considered in this initial assessment. In this case, no potential connectivity with sites located at a distance of over 15km from the proposed replacement lands was identified.
- The catchment mapping was used to establish or discount potential hydrological connectivity between the site of the proposed replacement lands and any European Sites. The hydrological catchments are also shown in Figure 3.1.
- In relation to Special Protection Areas, in the absence of any specific European or Irish guidance in relation to such sites, the Scottish Natural Heritage (SNH) Guidance, 'Assessing Connectivity with Special Protection Areas (SPA)' (2016) was consulted. This document provides guidance in relation to the identification of connectivity between proposed replacement lands and Special Protection Areas. The guidance takes into consideration the distances species may travel beyond the boundary of their SPAs and provides information on dispersal and foraging ranges of bird species which are frequently encountered when considering plans and projects.
- 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 assessment considers any likely direct or indirect impacts of the proposed replacement lands, 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
- 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 24/06/2020. Figure 3.1 shows the location of the proposed replacement lands in relation to all European sites within 15km of the proposed replacement lands.
- Where potential pathways for Significant Effect are identified, the site is included within the Likely Zone of Impact and further assessment is required.



Map Legend

- Special Area of Conservation
- Special Protection Area
- Site Location Ballard, Co. Wicklow
- 15km Buffer
- WFD Hydrological Catchments

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Drawing Title
European Designated Sites within 15km - Ballard

Project Title
Croagh Wind Farm - Replanting Assessment

Drawn By	Checked By
Claire Stephens	David McNicholas
Project No.	Drawing No.
180511	Figure 3.1
Scale	Date
1:180000	24.06.2020

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Table 3.1 Identification of Designated sites within the Likely Zone of Impact

European Sites and distance from proposed replacement lands	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 24/06/2020	Conservation Objectives	Likely Zone of Impact Determination	Possibility of Significant Effects? (If Yes Progress To Stage 2 Of AA Process)
Special Areas of Conservation (SAC)				
Vale of Clara (Rathdrum Wood) SAC (000733) **Distance:** 4.7km	› Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [91A0]	*'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 Generic version 7.0, 2020)	There will be no direct effects as the project footprint is located entirely outside the designated site. This European site is designated for terrestrial habitats and is located in a separate hydrological sub-catchment to the proposed afforestation works. No pathway for indirect effect between the proposal and the designated site exists. No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.	No – Potential for significant effect has been excluded and there is no need to progress to Stage 2 of the Appropriate Assessment process.
Wicklow Mountains SAC (002122) **Distance:** 7.8km	› Oligotrophic waters containing very few minerals of sandy plains *(Littorelletalia uniflorae)* [3110]	Detailed conservation objectives for this site (Version 1, July 2017) were reviewed as part of the assessment and are available at www.npws.ie	There will be no direct effects as the project footprint is located entirely outside the designated site. Wicklow Mountains SAC is located approximately 7.8km north-west of	No – Potential for significant effect has been excluded and there is no need to progress to Stage 2 of the Appropriate Assessment process.

	• Natural dystrophic lakes and ponds [3160] • Northern Atlantic wet heaths with E*rica tetralix* [4010] • European dry heaths [4030] • Alpine and Boreal heaths [4060] • *Calaminaria*n grasslands of the *Violetalia calaminariae* [6130] • Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe) [6230] • Blanket bogs (* if active bog) [7130] • Siliceous scree of the montane to snow levels *(Androsacetalia alpinae and Galeopsietalia ladani)* [8110] • Calcareous rocky slopes with *chasmophytic* vegetation [8210] • Siliceous rocky slopes with *chasmophytic* vegetation [8220] • Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [91A0] • *Lutra lutra* (Otter) [1355]		the proposed afforestation site and are buffered by agricultural, forestry, peatland and scrub habitats. Although the sites are located within the same hydrological catchment, no hydrological connectivity exists between the proposed replacement lands and the designated site. No pathway for effect was identified and the site is not within the Likely Zone of Impact.	

Deputy's Pass Nature Reserve SAC (000717) **Distance:** 9.0km	› Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [91A0]	*'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 Generic version 7.0, 2020)	There will be no direct effects as the project footprint is located entirely outside the designated site. This European site is designated for terrestrial habitats. There is no connectivity between the replacement site and the SAC. Therefore, no pathways for indirect effects were identified. No pathway for effect was identified and the site is not within the Likely Zone of Impact.	
Buckroney-Brittas Dunes and Fen SAC (000729) **Distance:** 13.4km	› Annual vegetation of drift lines [1210] › Perennial vegetation of stony banks [1220] › Mediterranean salt meadows (*Juncetalia maritimi*) [1410] › Embryonic shifting dunes [2110] › Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120] › Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130] › Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) [2150]	Detailed conservation objectives for this site (Version 1,March 2017) were reviewed as part of the assessment and are available at www.npws.ie	There will be no direct effects as the project footprint is located entirely outside the designated site. This European site is located in a separate hydrological sub-catchment to the proposed afforestation works. Given the nature and small scale of the works and the distance between the works and the SAC, no pathways for indirect effects via surface water were identified. No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.	No – Potential for significant effect has been excluded and there is no need to progress to Stage 2 of the Appropriate Assessment process.

	› Dunes with Salix repens ssp. argentea (*Salicion arenariae*) [2170] › Humid dune slacks [2190] › Alkaline fens [7230]			
Slaney River Valley SAC (000781) **Distance:** 14.7km	› Estuaries [1130] › Mudflats and sandflats not covered by seawater at low tide [1140] › Atlantic salt meadows (*Glauco-Puccinellietalia maritimae)* [1330] › *Mediterranean salt meadows* (Juncetalia maritimi) [1410] › Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260] › Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [91A0] › Alluvial forests with *Alnus glutinosa* and Fraxinus excelsior (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0] › *Margaritifera margaritifera* (Freshwater Pearl Mussel) [1029]	Detailed conservation objectives for this site (Version 1, October 2011) were reviewed as part of the assessment and are available at www.npws.ie	There will be no direct effects as the project footprint is located entirely outside the designated site. This European site is located in a separate hydrological catchment to the proposed afforestation works. Given the nature and small scale of the works and the distance between the works and the SAC, no pathways for indirect effects exist. No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.	No – Potential for significant effect has been excluded and there is no need to progress to Stage 2 of the Appropriate Assessment process.

	› *Petromyzon marinus* (Sea Lamprey) [1095] › *Lampetra planeri* (Brook Lamprey) [1096] › *Lampetra fluviatilis* (River Lamprey) [1099] › Alosa fallax fallax (Twaite Shad) [1103] › *Salmo salar* (Salmon) [1106] › *Lutra lutra* (Otter) [1355] › *Phoca vitulina* (Harbour Seal) [1365]			
Special Protection Area (SPA)				
Wicklow Mountains SPA (004040) **Distance:** 7.8km	› Merlin *(Falco columbarius)* [A098] › Peregrine (*Falco peregrinus*) [A103]	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 Generic version 7.0, 2020)	There will be no direct effects as the project footprint is located entirely outside the designated site. The proposed afforestation site is located outside of the core foraging range of Merlin (5km core range) and Peregrine (2km core range) (SHN 2016). The site does not support significant suitable habitat for the SCI species for which the	No – Potential for significant effect has been excluded and there is no need to progress to Stage 2 of the Appropriate Assessment process.

			SPA is designated. Therefore, potential for indirect effects as a result of disturbance can be ruled out. No pathway for significant effect was identified and the site is not within the Likely Zone of Impact.	

3.2 European Sites with the Potential to be Significantly Affected by the Proposed Replacement Lands

No European Sites will be affected by the proposed replacement lands.

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

The potential for the proposed replacement lands to contribute to a cumulative effect on European Sites was considered. The online planning system for Wicklow County Council was consulted on the 24/06/2020.

Additional relevant projects identified in the townland of Ballard, in the vicinity of the replacement forestry lands, around the townland of Ballinaclash in the last 5 years were assessed. These include;

- Permission for a two storey dwelling with connection to services, garage and associated works (Planning Ref.: 161241) - Finalised Application Decision: Conditional,
- Permission for the construction of a dwelling, connection to existing public services and associated site works (Planning Ref.: 16765) - Finalised Application Decision: Conditional,
- Retention of a garage as constructed and all ancillary site works (Planning Ref.: 16759), - Finalised Application Decision: Conditional,
- Permission for a covered silage pit, milking parlour / dairy / plant unit / cattle handling facility, calf shed, construction dirty water tank, silage effluent tank, rainwater harvesting tank, demolition of calf shed (Planning Ref.: 171367) – Finalised Application Decision: Conditional,
- Permission for the construction of a single storey dwelling, garage, bored well, wastewater treatment system together with all associated site works (Planning Ref.: 1750),
- Permission for two semidetached dwellings with connection to services, entrance and site and associated works (Planning Ref.: 191025) - Finalised Application Decision: Conditional
- Permission for 2 no. two storey dwellings with connection to services, surfaced access driveway and associated works (Planning Ref.: 20566) - New Application Decision due: 12.08.2020.

The following plan has been reviewed and taken into consideration as part of this assessment:

- Wicklow County Development Plan 2016 - 2022

The review focused on policies and objectives that relate to European sites. None of the objectives reviewed had the potential to result in cumulative adverse effects on any European Site.

No pathway or mechanism for the proposed replacement lands to result in any significant effect on any European Site was identified when considered on its own during the assessment process and therefore there is no potential for it to contribute to any such effects when considered in-combination with any other plan or project.

The review of plans and projects that is described above did not reveal any additional potential pathways for effect on European Sites that may have arisen as a result of those plans or projects.

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

The findings of this Screening Assessment are presented following 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, 2001) and 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 (DoEHLG, 2010).

4.1 Data Collected to Carry Out Assessment

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

- Site visits: 18th May 2016 & 29th October 2018
- 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 OS maps and aerial photographs of the site of the proposed project.
- Review of other plans and projects within the area.

4.2 Concluding Statement

It is concluded 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 forestry replacement land, individually or in combination with other plans and projects, will not have a significant effect on any European Site.

The proposed afforestation has Technical Approval from the Forest Service and will be undertaken accordingly. This approval is conditional to all associated works being undertaken in accordance with Forest Service requirements. The impacts associated with this afforestation have been classified overall as a neutral impact. As such, when considered in-combination with the other land uses in the area, and considering that the forestry guidelines are designed to minimise and prevent impacts to habitats that are outside the site, cumulative impacts on sensitive ecological receptors are not anticipated.

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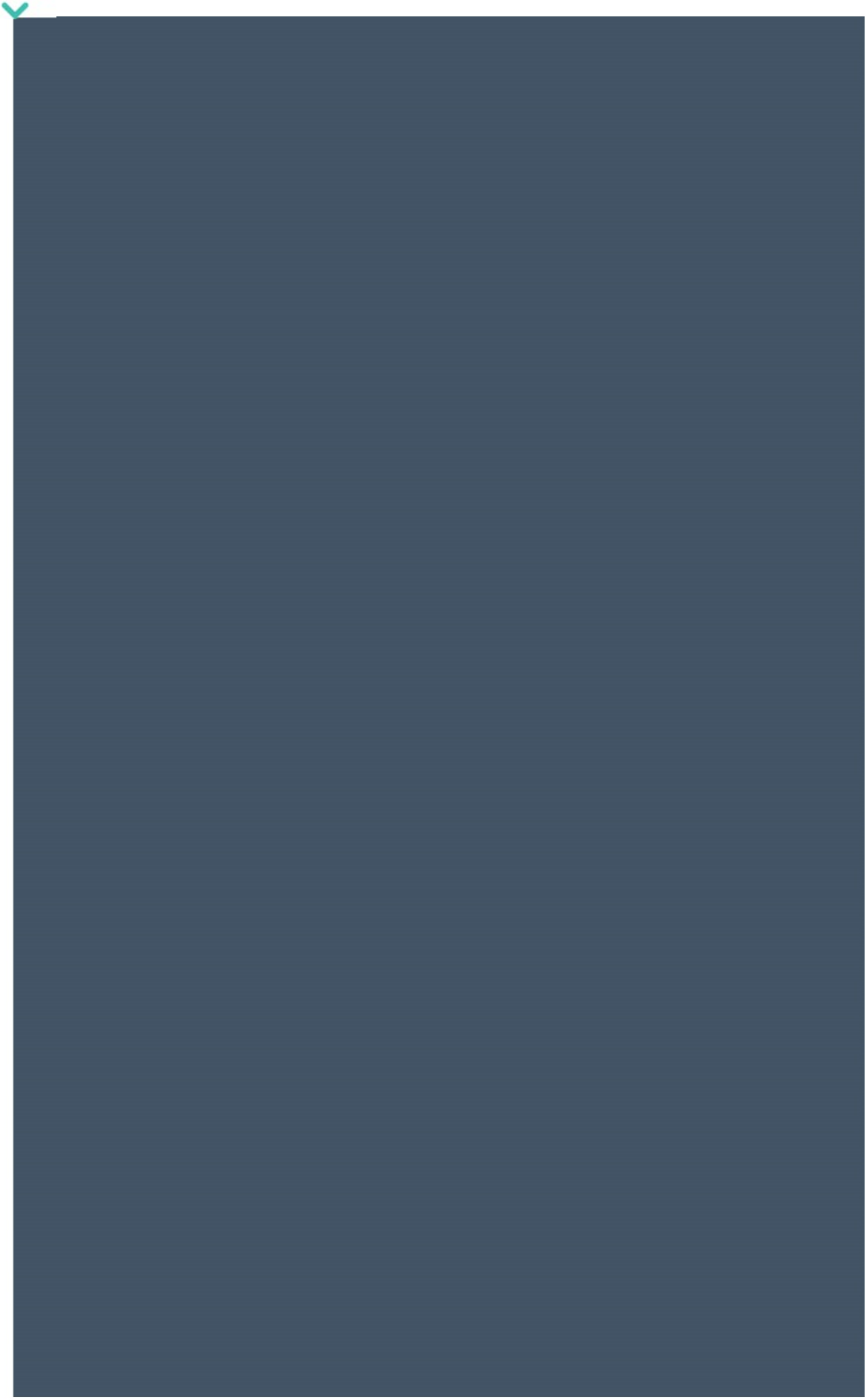
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Planning and Environmental Consultants

Construction and Environmental Management Plan

Proposed Croagh Wind Farm, Co. Leitrim & Co. Sligo



DOCUMENT DETAILS

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Document Title:	**Construction and Environmental Management Plan**
Document File Name:	**CEMP – 2020.07.06 – 180511 - F**
Prepared By:	**MKO** **Tuam Road** **Galway** **Ireland** **H91 VW84**

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1. INTRODUCTION

This Construction and Environmental Management Plan (CEMP) has been developed by McCarthy Keville O' Sullivan Ltd. (MKO) on behalf of Coillte , who intend to apply to both Letrim County Council and Sligo County Council for planning permission to construct a wind energy development that straddles the border between Co Leitrim and Co Sligo, comprising up to 10 no. wind turbines and associated infrastructure, near Drumkeeran, Co. Leitrim.

Should the project secure planning permission, this 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, 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;
- 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. The CEMP also details the mitigation measures to be implemented in order to comply with the environmental commitments outlined in the EIAR. The contractor will be contractually obliged to comply with all such measures.

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 Croagh 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

The core of the proposed development site is located within existing commercial forestry, approximately 5.0 kilometres south of the village of Drumkeeran, Co. Leitrim and 7.3 kilometres southeast of the town of Dromahair, Co. Leitrim at its closest point. Access to the site, during the construction phase, will be via a proposed new construction access road off the R280 Regional Road in Drumkeeran. The principal site entrance for the proposed development during both the construction and operational phase will be via an existing entrance off the L4282 local road.

It is proposed to connect the development to the national electricity grid via an underground cable which will connect the proposed onsite substation to the existing Garvagh substation. This connection and all associated works form part of the planning application.

The proposed development site is used for commercial forestry, with widespread young to mature forestry coverage. Wind energy is also a significant land-use in the vicinity of the proposed Croagh Wind Farm, and includes the operating Garvagh Glebe, Black Banks, Carrane Hill and Geevagh wind farms. The Garvagh Glebe wind farm is located adjacent to the boundary of the proposed development site. In addition to forestry and wind energy, other land-uses in the surrounding area include agriculture, peat-cutting and low-density residential.

2.2 Description of the Development

The proposed development will comprise the construction of up to 10 No. wind turbines and all associated works. The proposed turbines will have a maximum blade tip height of up to 170 metres. The full description of the proposed development is as follows:

1. *Construction of 10 No. wind turbines with a maximum overall blade tip height of up to 170 metres, and associated hardstand areas;*
2. *1 no. 38kV permanent electrical substation including a control building with welfare facilities, all associated electrical plant and equipment, security fencing, all associated underground cabling, waste water holding tank and all ancillary works;*
3. *1 no. permanent Meteorological Mast with a maximum height of up to 100 metres;*
4. *All associated underground electrical and communications cabling connecting the turbines to the proposed wind farm substation;*
5. *All works associated with the connection of the proposed wind farm to the national electricity grid, via underground cabling to the existing Garvagh substation;*
6. *Upgrade of existing tracks and roads, provision of new site access roads and hardstand areas;*
7. *The partial demolition and alteration of two agricultural buildings in the townlands of Sheena and associated junction access and road works to the existing yard, agricultural buildings and agricultural lands in the townlands of Sheena and Derrybofin to provide a link road primarily for construction traffic off the R280. This link road will be used for the delivery of abnormal loads to the site during the construction period and may be used during the operational period if necessary or to facilitate the decommissioning of the wind farm. Following construction, access to the link road will be closed off and the yard/agricultural building will revert to its use for agricultural purposes except if and when required for delivery of abnormal loads during the operational period of the windfarm or to facilitate the decommissioning of the wind farm;*
8. *1 no. borrow pit;*
9. *2 no. peat and spoil repository areas*
10. *2 no. temporary construction compounds;*
11. *Recreation and amenity works, including marked trails, boardwalk and viewing area provision of a permanent amenity car park, and associated recreation and amenity signage*
12. *Site Drainage;*
13. *Permanent Signage;*
14. *Ancillary Forestry Felling to facilitate construction and operation of the proposed development; and*
15. *All associated site development works*

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;
- Correct management of peat stability;
- 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.

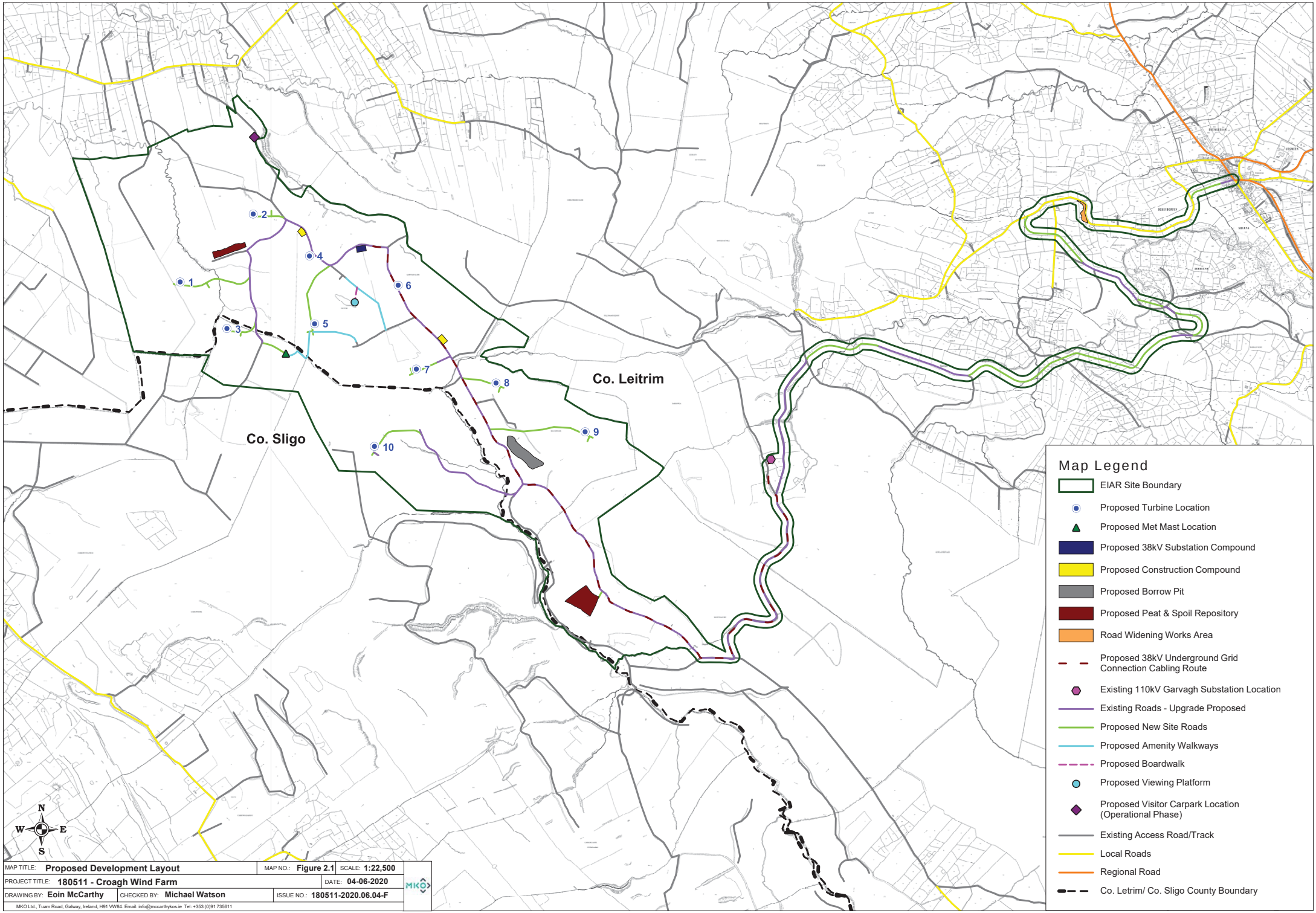
The key site objectives are as follows;

- 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 Impact Assessment Report, Natura Impact Statement and associated planning documentation;
- 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 and Demolition Methodologies is provided below.



MAP TITLE: Proposed Development Layout	MAP NO.: Figure 2.1	SCALE: 1:22,500	
PROJECT TITLE: 180511 - Croagh Wind Farm		DATE: 04-06-2020	
DRAWING BY: Eoin McCarthy	CHECKED BY: Michael Watson	ISSUE NO.: 180511-2020.06.04-F	

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2.4.2 Overview of Proposed Construction Methodology

The proposed construction methodology is summarised under the following main headings:

- Site Access Roads
- Temporary Construction Compound
- Borrow Pit
- Peat and Spoil Repositories
- Site Drainage System
- Culvert crossings
- Proposed Clear-span Watercourse Crossings
- Crane Hardstands
- Turbine and Anemometry Mast Foundations
- Electricity Substation and Control Buildings
- Cable Trenching
- Grid Connection Cabling

This section of the CEMP also includes the methodology for the partial demolition and alteration of two agricultural buildings in the townlands of Sheena and associated junction access road works in the townlands of Sheena and Derrybofin to provide a link road for construction traffic off the R280.

2.4.3 Site Access Roads

The road construction design has taken into account the following key factors as stated in the Fehily Timoney & Company's (FTC) Peat & Spoil Management Plan in Appendix 4-2 of the EIAR:

1. *Buildability considerations*
2. *Serviceability requirements for construction and wind turbine delivery and maintenance vehicles*
3. *Minimise excavation arising*
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 are determined on the prevailing ground conditions encountered along that length of road.

The proposed upgrade to existing roadways and construction of new roadways will incorporate passing bays to allow traffic to pass easily while traveling around the site.

2.4.3.1.1 *Upgrade to Existing Roads or Tracks*

The general construction methodology for upgrading of existing sections of excavated and floating roads or tracks, as presented in FTC's Peat & 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.

5. *For upgrading of existing excavated access tracks the following guidelines apply:*
    a. *Excavation will be required on one or both sides of the existing access track to a competent stratum.*
    b. *Granular fill to be placed and compacted in layers*
    c. *The surface of the existing access track should be overlaid with up to 500mm of selected granular fill.*
    d. *Access roads to be finished with a layer of capping across the full width of the road.*

e. *A layer of geogrid/geotextile may be required at the surface of the existing access road in areas where the existing track shows signs of excessive rutting, etc.*
f. *For excavations in peat and spoil, side slopes shall be not greater than 1 (v):3 (h). Where areas of weaker peat are encountered then shallower slopes will be required to ensure stability.*

6. *For upgrading of existing floated access tracks the following guidelines apply:*
   a. *The make-up of the existing floating access roads on site is generally locally tree brash/trunks laid directly onto the peat surface and/or geotextile overlain by up to 500mm of coarse granular fill/till type (fine granular/cohesive) site won material. It should be noted that there are localised variations in the make-up of the existing floated access tracks on site, frequently no tree brash/trunks were used in the make-up and the presence of a geogrid was also noted in localised sections of the existing track.*
   b. *The surface of the existing access track will be levelled prior the placement of any geogrid/geotextile, where necessary (to prevent damaging the geogrid/geotextile).*
   c. *Where coarse granular fill has been used in the existing floated access road make-up, a layer of geogrid will be placed on top of the existing floated access track.*
   d. *Where fine granular/cohesive type material has been used in the existing floated access road make-up (as is the case on some of the existing access roads in the southeast of the site), a layer of geotextile will be required as a separator layer with a layer of geogrid.*
   e. *The geogrid will be overlaid with up to 500mm of selected granular fill. Granular fill to be placed and compacted in layers.*
7. *The finished road width will have a running width of 5m, with wider sections on bends and corners.*
8. *On side long sloping ground any road widening works required will be done on the upslope side of the existing road where possible.*
9. *At transitions between new floating and existing excavated roads a length of road of about 10 to20m 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.*
10. *A final surface layer shall be placed over the existing access track, to provide a road profile and graded to accommodate wind turbine construction and delivery traffic.*

2.4.3.2 Construction of New Excavated Roads

Excavate and replace type access roads are the conventional method for construction of access roads on peatland sites and the preferred construction technique on this site.

The general methodology for the construction of excavated roads, as presented in FTC's Peat & Spoil Management Plan in Appendix 4-2 of the EIAR, 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 road construction movement monitoring posts will be installed in areas where the peat depth is greater than 2m.*
2. *Interceptor drains will be installed upslope of the access road alignment to divert any surface water away from the construction area.*
3. *Excavation will take place to a competent stratum beneath the peat.*
4. *Road construction will be carried out in sections of approximately 50m lengths i.e. no more than 50m of access road should be excavated without replacement with stone fill.*
5. *Excavation of materials with respect to control of peat stability.*

a. *Acrotelm (top about 0.3 to 0.4m of peat) is generally required for landscaping and shall be stripped and temporarily stockpiled for re-use as required. Acrotelm stripping shall be undertaken prior to main excavations.*
b. *Where possible, the acrotelm shall be placed with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation.*
c. *All catotelm peat (peat below about 0.3 to 0.4m depth) shall be transported immediately on excavation to the borrow pit or peat repositories.*

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 shallower slopes will be required. Battering of the side slopes of the excavations will be carried out as the excavation progresses.*
7. *The excavated access road will be constructed of up to 1000mm of selected granular fill.*
8. *Access roads to be finished with a layer of capping across the full width of the road.*
9. *A layer of geogrid/geotextile may be required at the surface of the competent stratum.*
10. *At transitions between floating and excavated roads a length of road of about 10 to 20m 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.*
11. *Where steeper slopes are encountered along with relatively deep peat (i.e. typically greater than 1m) 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.*
12. *A final surface layer shall be placed over the excavated road and graded to accommodate wind turbine construction and delivery traffic.*

2.4.3.3 Construction of New Floating Roads

In a number of areas across the site of the Proposed Development it will be necessary to construct floating roads over peat.

The general construction methodology for the construction of floating, as presented in FTC's Peat and Spoil Management Plan in Appendix 4-2 of the EIAR, 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 will be installed in areas where the peat depth is greater than 3m.*
2. *Base geogrid to be laid directly onto the existing peat surface along the line of the road in accordance with geogrid provider's requirements.*
3. *The typical make-up of the new floated access road is a minimum of 1000mm of selected granular fill with 2 no. layers of geogrid with possibly the inclusion of a basal layer of tree trunks/brash.*
4. *Granular fill to be placed in layers and compacted in accordance with the TII Specification for Road Works.*
5. *During construction of the floated access roads it may be necessary to include pressure berms either side of the access road in some of the deeper/weaker peat areas. The inclusion of a 2 to 5m wide pressure berm (typically 0.5m in height) either side of the access road at such locations will reduce the likelihood of potential bearing failures beneath the access road.*
6. *The finished running width of the road will be 5m, with wider sections on bends and corners.*
7. *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.*

8. *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.*
9. *Where it is not possible to end-tip over a 10m length of constructed floating road due to the presence of weak deep peat 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.*
10. *Following end-tipping a suitable bulldozer shall be employed to spread and place the tipped stone over the base geogrid along the line of the road.*
11. *A final surface capping layer shall be placed over the full width of the floating road, as per design requirements, to provide a road profile and graded to accommodate wind turbine construction and turbine delivery traffic.*

The 3.75 kilometres of proposed amenity walkways will be constructed using a methodology similar to that of new floating roads, as outlined above. The walkways will measure approximately 2.5m in width.

2.4.4 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 to the turbine manufacturer's specifications. The largest predicted area has been assessed in this EIAR.. 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.

2.4.5 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.

The visitorcar park that is proposed as part of the recreation and amenity facilities will be constructed in a similar manner to the proposed temporary construction compounds.

2.4.6 Borrow Pit

The development will comprise 1 no. borrow pit. It is proposed to obtain the majority of all rock and hardcore material that will be required during the construction of the proposed development from the

on-site borrow pit Usable rock may also be won from other infrastructure construction including the substation and the turbine base excavations.

The proposed borrow pit is located approximately 430 metres west of Turbine No. 9, measures approximately 20,930m^2 in area and is shown in Figure 2.1. The borrow pit will typically be excavated as follows:

- The areas to be used for both borrow pit 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;
- Interceptor drainage ditches will be excavated on all sides of the borrow pit to catch surface water runoff, and direct it to downstream re-distribution locations;
- The borrow pit will be constructed so that the base of the borrow pit is below the level of the adjacent section of access road.
- The bedrock material will be extracted from the borrow pit and stockpiled or used as required;
- The use of material won from the borrow pit will be sequential with new road construction or turbine base formations;
- As the borrow pit excavations progress and become deeper, surface water and groundwater ingress will be removed via pumping to settlement ponds, and re-distribution locally across natural vegetated areas. Where required, additional specialist treatment will be employed to ensure no deterioration in downstream water quality occurs;
- Slopes within the excavated rock formed around the perimeter of the borrow pit will be formed at stable inclinations to suit local in-situ rock conditions.
- Infilling of the peat & spoil will commence at the back edge of the borrow pit and progress towards the borrow pit entrance/rock buttress. Leaving in place upstands/segments ofintact rock which will help to retain the placed peat & spoil and will allow the borrow pit to be developed and infilled in cells.
- A rock buttress is required at the downslope edge of the borrow pit to safely retain the infilled peat and spoil. The height of therock buttresses constructed should be greater than the height of the infilled peat & spoil to prevent any surface peat & spoil run-off. A buttress up to 7m (approx.) in height is likely to be required.
- The rock buttress will be founded on competent strata. The founding stratum for the rock buttress should be inspected and approved by the project geotechnical engineer.
- In order to prevent water retention occurring behind the buttresses, the buttresses will be constructed of coarse boulder fill with a high permeability.
- The surface of the placed peat & spoil will be shaped to allow efficient run-off of surface water from the placed arising's.
- Control of groundwater within the borrow pit will be required.
- Further guidelines on the construction of the borrow pit are included within Section 7.4 of the Peat & Spoil Management Plan (Appendix 4-2 of the EIAR)

Post-construction, the borrow pit area will be permanently secured and a stock-proof fence will be erected around the borrow pit areas to prevent access to these areas. Appropriate health and safety signage will also be erected on this fencing and at locations around the fenced area.

2.4.7 Peat and Spoil Repositories

Two locations have been identified as suitable peat and spoil repository areas and are shown in Figure 4.1. The peat depth within the footprint of the repositories is generally less than 1.5m. Repository No. 1 is located approximately 1,080m south of Turbine No. 9 and measures approximately 24,770 square metres. Repository No. 2 is located approximately 210m southwest of Turbine No. 2 and measures approximately 9,760 square metres. Both repository areas are located adjacent to existing roads.

Both repository areas have a perimeter buttress which will contain and ensure the placed peat and spoil remains stable in the long-term. Prior to the placement of any excavated peat and spoil, the permanent stone buttresses shall be constructed around the perimeter of the repository areas. Construction details for each of the repository areas are shown on the layout drawings in Appendix 4-1 of the EIAR.

The presence of perimeter buttresses will help prevent the flow of any saturated peat which may occur at the surface of the placed peat over the life time of the repository and will also allow some drainage of the placed peat and spoil within the repository areas.

The repository areas in particular the stone buttresses shall be constructed as follows:

- All stone buttresses required within the repository areas will be founded on mineral soil or bedrock i.e. competent strata. The founding stratum for each stone buttress will be inspected and approved by a geotechnical engineer or competent person.
- In order to prevent water retention occurring behind the buttresses, the buttresses will be constructed of coarse boulder fill with a high permeability. The buttresses will be constructed of well graded granular rock fill of about 100mm up to typically 500mm in size. Alternatively, drains will be placed through the buttresses to allow excess water to drain.
- The height of the stone buttresses constructed will be greater than the height of the stored peat and spoil to prevent any surface run-off. The height of the stone buttresses will be a minimum of 0.5m above the height of the placed peat and spoil to prevent any potential for saturated peat to flow out of the repository area.
- The side slopes of the stone buttresses shall be constructed at 45 degrees. The stone buttresses will be widened to allow construction traffic access for tipping purposes during the placement of the excavated peat and spoil.
- An interceptor drain will also be installed upslope of the repository areas. The drain will divert any surface water away from the repository area and hence prevent water from ponding in the area.
- A settlement pond will be required at the lower side of the repository areas.
- A granular layer of material will be required at the base of the stored spoil immediately upslope of the stone buttresses to act as a drainage layer. This drainage layer will aid in preventing a build-up of pore water pressure behind the stone buttress.
- The placement of the excavated spoil will commence at the downslope edge of the repository area against the stone buttress and placement will then continue upslope against the stone buttress and placement will then continue upslope.
- It is important that the surface of the stored spoil be shaped to allow efficient run-off of water from the stored spoil.
- Supervision by a geotechnical engineer or appropriately competent person is required for the construction of the repository area.

The management of excavated peat and overburden and the methods of placement and/or reinstatement are described in detail in FTC's Peat and Spoil Management Plan in Appendix 4-2 of this EIAR.

2.4.8 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 be designed with sufficient flexibility to respond to an early phase incoming flow during the construction phase.

Surface drainage design and management is summarised in Section 3.2 below.

2.4.9 Culvert Crossings on the Wind Farm Site

Culverts will be required where site roads, crane pads and turbine pads cross main forestry drainage networks.

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.

2.4.10 Proposed Clear-span Watercourse Crossing

It is proposed to construct clear-span watercourse crossings along the access roads to Turbine No. 1 and Turbine No. 10 using corrugate metal arches. The locations of these crossings are shown as *Proposed New Watercourse Crossing No. 1* and *No. 2* on the layout drawings included in Appendix 4-1 of this EIAR. It is proposed that these crossings will be constructed using a corrugated metal arch and appropriate backfill.

The typical construction methodology for the installation of a corrugated metal arch and stone clear-span bridge is presented below:

- The access road on the approach to the watercourse will be completed to a formation level which is suitable for the passing of plant and equipment required for the installation of the watercourse crossing.
- The foundation will consist of concrete panels which will be installed on a concrete lean mix foundation to provide a suitable base. The base will be excavated to rock or competent ground with a mechanical excavator with the foundation formed in-situ using a semi-dry concrete lean mix. The base will be excavated along the stream bank with no instream works required.
- The bottom plate of the arch will be bolted to the foundation on both sides of the stream. The top section of the culvert will be bolted together and lifted into position and bolted to the two bottom sections. This sequence will continue until the full length of culvert is in position.
- Once the arch is in position stone backfill will be placed and compacted against the culvert up to the required level above the foundations. A concrete beam will then be shuttered, fixed and poured along the two shoulders of the steel culvert.
- When the concrete beams are cured the filling and compaction of the road will be completed.

A further four new water course crossings will be required as part of the proposed development. The locations of these crossings are shown as *Proposed New Watercourse Crossing No. 3* to *No. 7* on the

layout drawings in Appendix 4-1. It is proposed that these crossings will be constructed using bottomless, pre-cast concrete structures.

The typical construction methodology for the installation of a pre-cast concrete clear-span bridge is presented below:

- The access road on the approach to the watercourse will be completed to a formation level which is suitable for the passing of plant and equipment required for the installation of the watercourse crossing.
- All drainage measures along the proposed road will be installed in advance of the works.
- The abutment will consist of concrete panels which will be installed on a concrete lean mix foundation to provide a suitable base. The base will be excavated to rock or competent ground with a mechanical excavator with the foundation formed in-situ using a semi-dry concrete lean mix. The base will be excavated along the stream bank with no instream works required.
- Access to the opposite side of the river for excavation and foundation installation will require the installation of pre-cast concrete slab across the river to provide temporary access for the excavator.
- All pre-cast concrete panels and slabs/beams will be installed using a crane which will be set up on the bank of the watercourse and will be lifted into place from the bank with no contact with the watercourse.
- A concrete deck will be poured over the beams/slabs which span across the river. This will be shuttered, sealed and water tested before concrete pouring can commence.

The watercourse crossings will be constructed to the specifications of the OPW bridge design guidelines 'Construction, Replacement or Alteration of Bridges and Culverts - A Guide to Applying for Consent under Section 50 of the Arterial Drainage Act, 1945', and in consultation with Inland Fisheries Ireland. Abutments will be constructed from precast units combined with in-situ foundations, placed within an acceptable backfill material.

2.4.11 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. Turbine bases will measure approximately 20 metres in diameter, while the anemometry mast base will measure approximately 25 square metres. They will be formed a minimum of 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 foundation excavation will be raised to formation level by compacted layers of well graded granular material,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 will be done by laying geotextile on the existing surface and a stone layer will then be placed on top of the geotextile by an excavator and compacted in order to give the platform sufficient bearing capacity for the piling rig.

- 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 will 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;
- The 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 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 4.3.4 of Chapter 4 of the EIAR.

2.4.12 Onsite Electricity Substation and Control Building

The proposed electricity 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. Any excess material will be sent to one of the on-site peat repositories or the proposed borrow pit, for reinstatement purposes.
- The dimensions of the onsite substation area have been designed to meet the requirements of the ESB and the necessary equipment to safely and efficiently operate the proposed wind farm;
- A control building will 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 & internal partition walls formed. Scaffold will be erected around the outside of the building for this operation;
- The 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 are to ESB specifications.

2.4.13 Cable Trenching and Grid Connection

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 cables will be bedded with suitable material. The cables will be laid at a depth that meets all national and international requirements, and will generally be approximately 1.3m in depth and 0.6m in width; a suitable marking tape is installed between the cables and the surface (see Plate 2-1 below). On completion, the ground will be reinstated as previously described above. The route of the cable ducts will follow the access track to each turbine location, and are visible on the site layout drawings included as Appendix 4-1 of the EIAR.

The proposed on-site substation will be connected to the existing Garvagh 110kV Electricity Substation via underground grid connection cabling which will be constructed to ESB specifications, using the methodology outlined below.

2.4.14 Grid Connection Construction Methodology

The underground cabling (UGC) works will consist of the installation of ducts in an excavated trench to accommodate power cables, and a fibre communications cable to allow communications between the Croagh Wind Farm Substation and Garvagh Substation.

The UGC will either be a single circuit or a double circuit 38kV connection, in accordance with the requirements and specifications of ESB . The difference between the two connection types is the number of ducts, the number of cables and the width of the trench and associated joint bay chambers. A single circuit connection typically consists of 3 no. 110mm diameter HDPE power cable ducts and 1 no. 110mm

diameter HDPE communications duct to be installed in an excavated trench, typically 600mm wide by 1,220mm deep. A double circuit connection typically consists of 6 no. 110mm diameter HDPE power cable ducts and 2 no. 110mm diameter HDPE communications duct to be installed in an excavated trench, typically 900mm wide by 1,220mm deep. For trench designs there will be variations on the design to adapt to service crossings and watercourse crossings.

The power cable ducts will accommodate the power cables and the communications duct(s) will accommodate a fibre cable(s) to allow communications between the Croagh Wind Farm substation and Garvagh Substation. The ducts will be installed, the trench reinstated in accordance with landowner or local authority specification, and then the electrical cabling/fibre cable is pulled through the installed ducts in approximately 650/750m sections. Construction methodologies to be implemented and materials to be used will ensure that the UGC is installed in accordance with the requirements and specifications of ESB.

The underground cable required to facilitate the grid connection will be laid beneath the surface of the site and/or public road using the following the methodology summarised below, and outlined in detail in TLI Group's Croagh Wind Farm 38kVGrid Connection – Construction Methodology included as Appendix 4-5 of this EIAR:

The Contractor, and their appointed Site Manager, will prepare a targeted Method Statement concisely outlining the construction methodology and incorporating all mitigation and control measures included within the planning application and accompanying reports and as required by planning conditions where relevant;

- All existing underground services shall be identified on site prior to the commencement of construction works;
- At watercourse crossings, the contractor will be required to adhere to the environmental control measures outlined within the planning application and accompanying reports, the final Construction Environmental Management Plan (CEMP) and best practice construction methodologies;
- Where the cable route intersects with culverts, the culvert will remain in place (where possible) and the ducting will be installed either above or below the culvert to provide minimum separation distances in accordance with ESB specifications;
- Traffic management measures will be implemented in accordance with those included in the Chapter 14 of this EIAR and a final Traffic Management Plan will be prepared and agreed with the local authority;
- The excavated trench will be approximately 600/900mm in width and approximately 1220mm deep both within the public road network and within Coillte lands;
- The base of the excavated trench will be lined with sand bedding to be imported to site from a local licensed supplier. The 110mm diameter HDPE cable ducting will be placed into the prepared trench, inspected and backfilled as per Figures 4 & 5;
- Excavated material will be temporarily stockpiled onsite for re-use during reinstatement. Stockpiles will be restricted to less than 2m in height. Stockpiles will be located a minimum of 50m from surface water features and all stockpiling locations will be subject to approval by the Site Manager and Project Ecological Clerk of Works (ECoW);
- Excavated material shall be reused to backfill the trench where appropriate and any surplus material will be transported to either the proposed onsite borrow pit or repository areas;
- Any earthen (sod) banks to be excavated will be carefully opened with the surface sods being stored separately and maintained for use during reinstatement;
- The excavated trench will be dewatered if required, from a sump installed within the low section of the opened trench. Where dewatering is required, silt laden water will be fully and appropriately attenuated, through silt bags, before being appropriately discharged to vegetation or surface water drainage feature (please refer to drainage design in the proposed development);
- Where required, grass will be reinstated by either seeding or by replacing with grass turves;

- No more than a 100 metre section of trench will be opened at any one time. The second 100 metres will only be excavated once the majority of reinstatement has been completed on the first;
- The excavation, installation and reinstatement process will take on average of 1 no. day to complete a 100m section;
- Where the cable is being installed in a roadway, temporary reinstatement may be provided to allow larger sections of road to be permanently reinstated together;
- Following the installation of ducting, pulling the cable will take approximately 1 day between each joint bay, with the jointing of cables taking approximately 1-2 days.



Plate 2-1 Typical Cable Trench View

2.4.14.1 Existing Underground Services

In order to facilitate the installation of the proposed UGC, it may be necessary to relocate existing underground services such as water mains or existing cables. In advance of any construction activity, the contractor will undertake additional surveys of the proposed route to confirm the presence or otherwise of any services. If found to be present, the relevant service provider will be consulted with in order to determine the requirement for specific excavation or relocation methods and to schedule a suitable time to carry out works.

If existing low voltage underground cables are found be present, a trench will be excavated, and new ducting and cabling will be installed along the new alignment and connected to the network on either end. The trench will be backfilled with suitable material to the required specification. Warning strip and marking tape will be laid at various depths over the cables as required. Marker posts and plates will be installed at surface level to identify the new alignment of the underground cable, the underground cables will then be re-energised.

In the event that water mains are encountered the water supply will be turned off by the utility so work can commence on diverting the service. The section of existing pipe will be removed and will be replaced with a new pipe along the new alignment of the service. The works will be carried out in accordance with the utility standards.

2.4.14.2 Joint Bays

Joints Bays are to be provided approximately every 750m - 800m along the UGC route to facilitate the jointing of 2 no. lengths of UGC. The joint bays will be pre-cast concrete structures installed below finished ground level. The joint bay width varies between single and double circuits (2.03 – 2.7m). Joint Bays will be located in the non-load bearing strip of roadways insofar as possible.

In association with Joint Bays, Communication Chambers are required at every joint bay location to facilitate communication links between the Croagh Wind Farm substation and the existing Garvagh 110kV Substation. Earth Sheath Link Chambers are also required approximately every second joint bay along the cable route. Earth Sheath Links are used for earthing and bonding cable sheaths of underground power cables, installed in a flat formation, so that the circulating currents and induced voltages are eliminated or reduced. Earth Sheath Link Chambers and Communication Chambers are located in close proximity to Joint Bays. Earth Sheath Link Chambers and Communication Chambers will typically be pre-cast concrete structures with an access cover at finished surface level. The locations of the joint bays and chambers are shown on the site layout drawings in Appendix 4-1.

The precise siting of all Joint Bays, Earth Sheath Link Chambers and Communication Chambers within the planning corridor is subject to approval by ESBN.

2.4.14.3 Grid Connection Watercourse/Culvert Crossings

Nine watercourse crossing locations were identified along the cable route. All of the watercourse crossings identified are culverts and no bridge crossings have been identified. It is proposed to cross all watercourses using open trenching with either an undercrossing or an overcrossing, depending on the depth of the culvert. A schedule of the culverts identified and the proposed crossing method to be implemented is detailed in Appendix 4-6 of this EIAR and the locations are shown on the site layout drawings included in Appendix 4-1. Should an alternative methodology option be required for individual crossings during the construction process this will be agreed with the relevant authorities including prior to works commencing. The proposed culvert crossing methods are detailed in Figure 2-2 below, the number of ducts will vary between a single and double circuit connection.

Where the cable route intersects with existing watercourses, a detailed construction method statement will be prepared by the Contractor prior to the commencement of construction and is to be approved by the Local Authority and relevant environmental agencies as required.

Inland Fisheries Ireland have published guidelines relating to construction works along water bodies entitled "*Requirements for the Protection of Fisheries Habitats during Construction and Development Works at River Sites*", and these guidelines will be adhered to during the construction of the proposed development.

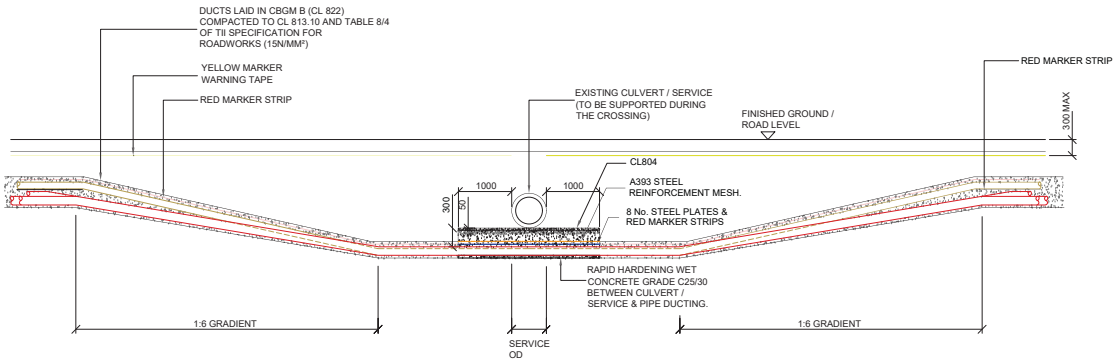
2.4.14.4 Horizontal Direction Drilling

It is not currently proposed to implement Horizontal Directional Drilling (HDD) for any crossings. However, following confirmatory site investigations prior to construction it may be necessary to utilise HDD for some crossings.

Horizontal Direction Drilling (HDD) is a method of drilling under obstacles such as bridges, culverts, railways, water courses, etc. in order to install cable ducts under the obstacle. This method is employed where installing the ducts using standard installation methods is not possible. The proposed HDD methodology is as follows: -

- A works area of circa .40 square metres will be fenced on both sides of a crossing

ISO A1 594mm x 841mm



SECTION A-A

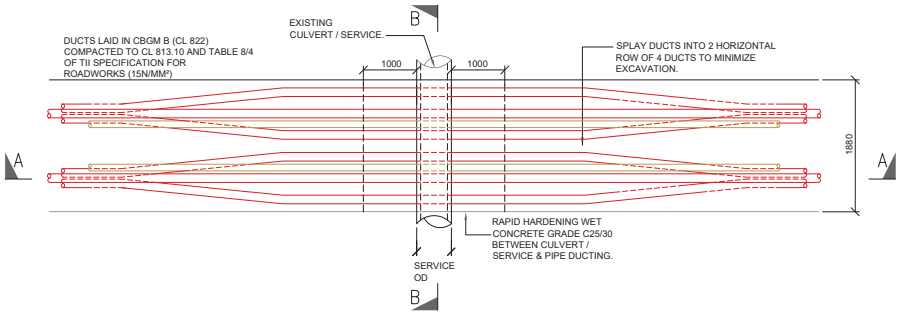
SCALE 1:50

LEGEND

- 110mm Ø HDPE POWER DUCT WITH 12mm DIAMTER PULL ROPE
- 110mm Ø HDPE COMMUNICATION DUCT WITH 12mm DIAMTER PULL ROPE
- RED MARKER STRIP OR STEEL PLATES
- YELLOW MARKER WARNING TAPE
- A393 STEEL REINFORCEMNET MESH
- 6mm GALVANISED STEEL PLATE

NOTES

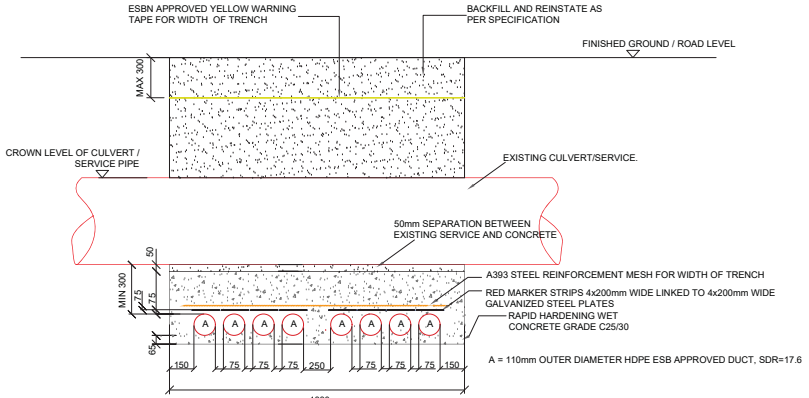
1. This drawing is to be read in conjunction with all other relevant documentation.
2. Do not scale from this drawing use only printed dimensions.
3. All dimensions are in millimetres, all chainages, levels and co-ordinates are in metres unless defined otherwise.
4. This drawing is to be read in conjunction with the project Health & Safety file for any identified potential risks.
5. No excavation shall commence until the contractor has consulted up to date services drawings and carried out an Electromagnetic Locator (EML) Scan.
6. Hand dig only within 500mm of existing services.
7. If compacting CBGM B could cause damage to the culvert / service below, use rapid hardening cement grade C25/30 following engineers prior approval.
8. For standard trench cross section drawings and minimum horizontal separation to existing services, see TLI-05649-213/214 (TREFOIL) and 05649-220 (FLAT).
9. Where depths exceed 3000mm to the top of duct the contractor shall consult the cable system design engineer for phase spacing requirements.
10. For Watermain crossings, see 05649-218



38kV DOUBLE CIRCUIT DETAILS - 1. SERVICE/CULVERT UNDERCROSSING

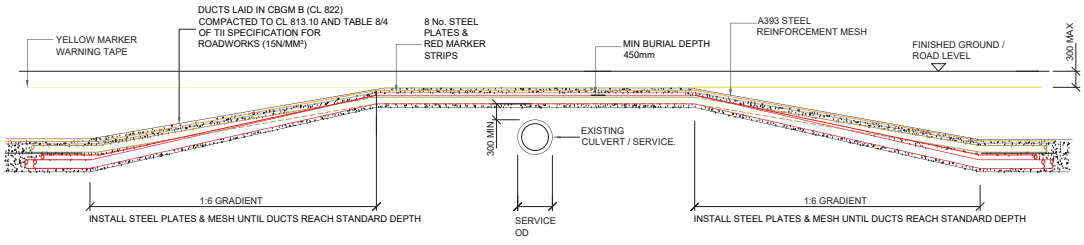
PLAN VIEW

SCALE 1:50



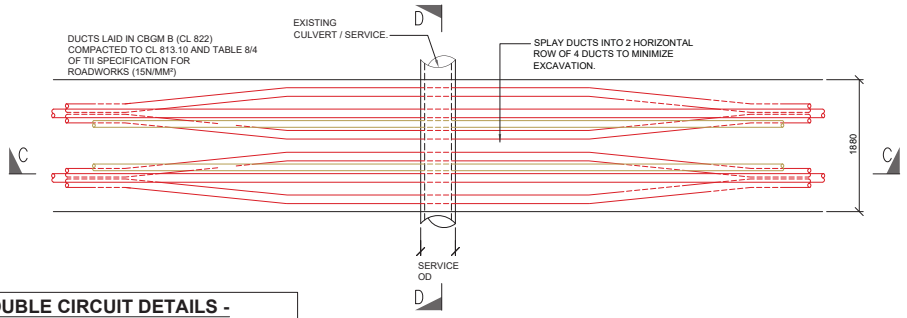
SECTION B-B

SCALE: NTS



SECTION C-C

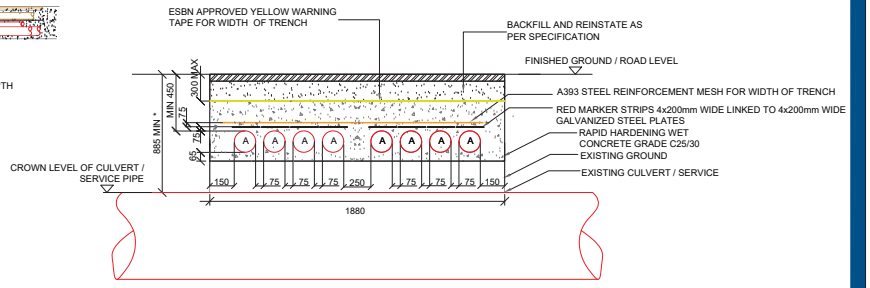
SCALE 1:50



38kV DOUBLE CIRCUIT DETAILS - 2. SERVICE/CULVERT OVERCROSSING

PLAN VIEW

SCALE 1:50



SECTION D-D

SCALE: NTS

A = 110mm OUTER DIAMETER HDPE ESB APPROVED DUCT, SDR=17.6

* ALL EXISTING SERVICES WITH COVER LESS THAN MIN. DIMENSIONS ABOVE SHALL BE CROSSED BY UNDERCROSSING METHOD

Project Management Initials: Designer: CH Checked: SK Approved: RG

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PROJECT

Croagh Wind Farm
38kV Grid Connection

CLIENT

COILLTE

CONSULTANTS

MKO

NOTES: -

- See notes in drawing window

LEGEND: -

Figure 2-2

ISSUE/REVISION

03	01.07.20	Issued for Planning
02	12.06.20	Issued for Planning
01	19.11.19	Issued for Planning
00	29.08.19	Issued for Information
I/R	DATE	DESCRIPTION

PROJECT NUMBER

05-649

SHEET TITLE

38kV Double Circuit - Service/Culvert Crossing Detail

SHEET NUMBER

05649-217(0511-73)

- The drilling rig and fluid handling units will be located on one side of the bridge and will be stored on double bunded 0.5mm PVC bunds which will contain any fluid spills and storm water run-off.
- Entry and exit pits (1m x 1m x 2m) will be excavated using an excavator, the excavated material will be temporarily stored within the works area and used for reinstatement or disposed of to a licensed facility.
- A 1m x 1m x 2m steel box will be placed in each pit. This box will contain any drilling fluid returns from the borehole.
- The drill bit will be set up by a surveyor, and the driller will push the drill string into the ground and will steer the bore path under the watercourse.
- A surveyor will monitor drilling works to ensure that the modelled stresses and collapse pressures are not exceeded.
- The drilled cuttings will be flushed back by drilling fluid to the steel box in the entry pit.
- Once the first pilot hole has been completed a hole-opener or back reamer will be fitted in the exit pit and will pull a drill pipe back through the bore to the entry side.
- Once all bore holes have been completed, a towing assembly will be set up on the drill and this will pull the ducting into the bore.
- The steel boxes will be removed, with the drilling fluid disposed of to a licensed facility.
- The ducts will be cleaned and proven and their installed location surveyed.
- The entry and exit pits will be reinstated to the specification of ESB Networks and the landowner.

A joint bay or transition chamber will be installed on either side of the bridge following the horizontal directional drilling as per ESB requirements. The horizontal direction drilling method is illustrated in Figure 2-3 below.

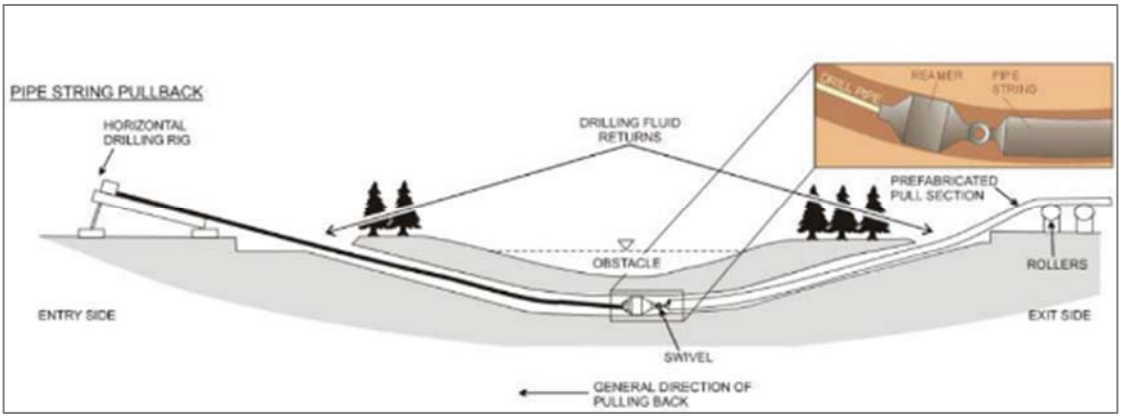


Figure 2-3 Horizontal Directional Drilling Methodology

2.4.15 Proposed Demolition Works

It is proposed to carry out partial demolition works on two agricultural buildings as part of the development of the proposed link road, between the R280 in Drumkeeran and L4282, for turbine component and abnormal load deliveries. A single bay on the northern side of the storage shed will be demolished and the masonry wall will be reconstructed at the end of the adjacent bay. A 6.9m length of the rear masonry wall of the livestock shed will be demolished and part of the gable sheeting will be removed. The central steel support structure will be relocated by one metre to increase the size of the opening at the rear of the livestock shed. This will be replaced with a corrugated, galvanised steel door. This detail is shown in. The demolition will be carried out using the following methodology.

- An inventory of the waste types that will be generated by the demolition works will be carried out.
- Any equipment or miscellaneous materials within northern bay of the storage shed will be removed.

- Removal of all fixtures and supporting structures.
- Removal of the roof sheeting over the northern bay of the storage shed and the section of gable sheeting at the rear of the livestock shed.
- Demolition will be completed by way of a mechanical excavator which will remove the structure and all associated groundworks.
- The demolition of the masonry wall structures will be carried out by a mechanical excavator.
- The majority of the waste generated by the demolition of the existing shed will consist of concrete rubble and stones from the existing wall structure, floor and foundations. This material will be segregated from all other waste components and sent by an authorised waste collector to an authorised waste recovery facility.
- The remaining volume of waste material will not be large enough to warrant any further segregation therefore, all waste generated during the demolition of the building will be deposited into a single skip that will be brought by a waste collector to an appropriately authorised facility.

2.5 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 and will form a permanent part of the national electricity grid.

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 left in situ, for future forestry operations. The amenity and recreation infrastructure will also be left in-situ. Underground cables, including grid connection, will be removed and the ducting left in place. A decommissioning plan will be agreed with the local authorities three months prior to decommissioning the Proposed Development.

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".*

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 could potentially be 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. 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 farms 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. These relate to infrastructure and operational works on forested sites, forest road design, water quality controls for linear projects, forestry road drainage and

management of geotechnical risks. To achieve best practice in terms of water protection through construction management all drainage management is prepared in accordance with guidance contained in the following:

- Forestry Commission (2004): Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh;
- Coillte (2009): Forest Operations & Water Protection Guidelines;
- Forest Service (Draft): Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures;
- Forest Service (2000): Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford;
- Forest Service, (2000): Code of Best Forest Practice – Ireland. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford;
- COFORD (2004): Forest Road Manual – Guidelines for the design, construction and management of forest roads;
- MacCulloch (2006): Guidelines for risk management of peat slips on the construction of low volume low cost roads over peat (Frank MacCulloch Forestry Civil Engineering Forestry Commission, Scotland);
- National Roads Authority (2005): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Wind Farm Development Guidelines for Planning Authorities (September 1996);
- Eastern Regional Fisheries Board: Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites;
- 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 Report No. C648 (2006): CIRIA (Construction Industry Research and Information Association) guidance on 'Control of Water Pollution from Linear Construction Projects';
- CIRIA Report Number C532 (2001): Control of water pollution from construction sites - Guidance for consultants and contractors.; 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. 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

There is an existing drainage network across the site. There are four main watercourses which drain the proposed development site and there are numerous manmade drains that are in place predominately to drain the forestry plantations 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 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 and shown in Appendix 4-5. 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 excavated 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 excavated 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 put in place 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, along with the entire drainage network, 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 and the nature and location of the works.

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 potentially 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 the situation on the ground at a particular time.

In the unlikely 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 Borrow Pit Drainage

While surface water will be contained in the borrow pit area, the design proposal is to control the level of water in the borrow pit area by creating a single point outlet from the basin-like area that will ensure the water does not overtop the pit area. Run-off from the proposed borrow pit areas will be controlled via a single outlet that will be installed at the edge of the borrow pit. The single outfall point will be constructed to manage runoff from the borrow pit and its immediate surrounds. Interceptor drains will already have been installed upgradient of the borrow pit area before any extraction begins.

During the construction phase of the project, it will be necessary to keep the borrow pit area free of standing water while rock is still being extracted. This will be achieved as necessary by using a mobile pump, which will pump water into the same series of drains, settlement ponds and level spreader, which will receive the water from the single outlet.

3.2.6 Peat and Spoil Repository Area Drainage

During the initial placement of peat and subsoil at repository areas, silt fences, straw bales and biodegradable matting will be used to control surface water runoff from the repository areas. ‘Siltbuster’ treatment trains will be employed if previous treatment is not to a high quality.

Drainage from the repository areas will ultimately be routed to an oversized swale and a number of stilling ponds pond and a ‘Siltbuster’ with appropriate storage and settlement designed for a 1 in 100 year 6 hour return period before being discharged to the on-site drains.

The repository areas will be sealed with a digger bucket and vegetated as soon possible to reduce sediment entrainment in runoff. Once re-vegetated and stabilised peat/subsoil reinstatement areas will no longer be a potential source of silt laden runoff

3.2.7 Cable Trench Drainage

Cable trenches are typically developed in short sections (c. 150m), 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, used for landscaping and reinstatements of other areas elsewhere on site.

On steeper slopes, silt fences, as detailed in Section 4.7 of the EIAR will be installed temporarily downgradient of the cable trench works area, or on the downhill slope below where excavated material is being temporarily stored to control run-off.

3.2.8 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, with a permit to refuel, 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. The fuel storage areas, within the temporary construction compounds, 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 any accidental spillage in and outside the refuelling area.

3.2.9 Tree Felling

Tree felling to facilitate the Proposed Development will not be undertaken simultaneously with construction groundworks. Keyhole felling to facilitate construction works will take place prior to groundworks commencing.

Water protection measures will reduce the risk of entrainment of suspended solids and nutrient release in surface watercourses. These measures are derived from best practice guidance documents as outlined in Section 9.5.3.1 of the EIAR. The water protection measures to be adopted during felling operations are set out as follows:

- Machine combinations (i.e. hand-held or mechanical) will be chosen which are most suitable for ground conditions at the time of felling, and which will minimise soils disturbance;
- Trees will be cut manually inside the 50m buffer and using machinery to extract whole trees only;
- Checking and maintenance of roads and culverts will be on-going through any felling operation. No tracking of vehicle through watercourses will occur, as vehicles will use road infrastructure and existing watercourse crossing points. Where possible, existing drains will not be disturbed during felling works;
- Ditches which drain from the proposed area to be felled towards existing surface watercourses will be blocked, and temporary silt traps will be constructed. No direct discharge of such ditches to watercourses will occur. Drains and sediment traps will be installed during ground preparation. Collector drains will be excavated at an acute angle to the contour (~0.3%-3% gradient), to minimise flow velocities. Main drains to take the discharge from collector drains will include water drops and rock armour, as required, where there are steep gradients, and should avoid being placed at right angles to the contour;
- Sediment traps will be sited in drains downstream of felling areas. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of in the peat disposal areas. Where possible, all new silt traps will be constructed on even ground and not on sloping ground;
- In areas particularly sensitive to erosion or where felling inside the 50 metre buffer is required, it will be necessary to install double or triple sediment traps.
- Double silt fencing will also be put down slope of felling areas which are located inside the 50 metre buffer zone;
- All drainage channels will taper out before entering the aquatic buffer zone. This ensures that discharged water gently fans out over the buffer zone before entering the aquatic zone, with sediment filtered out from the flow by ground vegetation within the zone. On erodible soils, silt traps will be installed at the end of the drainage channels, to the outside of the buffer zone;
- Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded. Correct drain alignment, spacing and depth will ensure that erosion and sediment build-up are minimized and controlled;
- Brash mats will be used to support vehicles on soft ground, reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal should take place when they become heavily used and worn. Provision should be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction should be suspended during periods of high rainfall;
- Timber will be stacked in dry areas, and outside a local 50 metre watercourse buffer. Straw bales and check dams to be emplaced on the down gradient side of timber storage/processing sites;
- Works will be carried out during periods of no, or low rainfall, in order to minimise entrainment of exposed sediment in surface water run-off;
- Checking and maintenance of roads and culverts will be on-going through the felling operation;
- No crossing of streams by machinery will be permitted and only travel perpendicular to and away from stream will be allowed;
- Refuelling or maintenance of machinery will not occur within 100m of a watercourse. Mobile bowser, drip kits, qualified personnel will be used where refuelling is required;
- A permit to refuel system will be adopted at the site; and,

- Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed, but care will be taken to avoid removing natural debris deflectors.

Table 3-1 Minimum Buffer Zone Widths (Forest Service, 2000)

Average slope leading to the aquatic zone		Buffer zone width on either side of the aquatic zone	Buffer zone width for highly erodible soils
Moderate	(0 – 15%)	10 m	15 m
Steep	(15 – 30%)	15 m	20 m
Very steep	(>30%)	20 m	25 m

3.2.9.1 Forestry Felling Drainage Management

Before the commencement of any felling works, an Environmental Clerk of Works (ECoW) shall be appointed to oversee the keyhole and extraction works. The ECoW shall be experienced and competent, and shall have the following functions and operate their record using a Schedule of Works Operation Record (SOWOR), as proposed in the planning application:

- Attend the site for the setup period when drainage protection works are being installed, and be present on site during the remainder of the forestry keyhole felling works.
- Prior to the commencement of works, review and agree the positioning by the Operator of the required Aquatic Buffer Zones (ABZs), silt traps, silt fencing (see below), water crossings and onsite storage facilities for fuel, oil and chemicals (see further below).
- Be responsible for preparing and delivering the Environmental Tool Box Talk (TBT) to all relevant parties involved in site operations, prior to the commencement of the works.
- Conduct daily and weekly inspections of all water protection measures and visually assess their integrity and effectiveness in accordance with Section 3.4 (Monitoring and Recording) and Appendix 3 (Site Monitoring Form (Visual Inspections)) of the *Forestry & Freshwater Pearl Mussel Requirements.*
- Take representative photographs showing the progress of operation onsite, and the integrity and effectiveness of the water protection measures.
- Collect water samples for analysis by a 3rd party accredited laboratory, adhering to the following requirements:
    - Surface water samples shall be collected upstream and downstream of the keyhole felling site at suitable sampling locations.
    - Sampling shall be taken from the stream / river bank, with no in-stream access permitted.
    - The following minimum analytical suite shall be used: pH, Electrical Conductivity, Total Suspended Solids, Biochemical Oxygen Demand, Total Phosphorus, Ortho-Phosphate, Total Nitrogen, and Ammonia.
- Review of operator's records for plant inspections, evidence of contamination and leaks, and drainage checks made after extreme weather conditions.
- Prepare and maintain a contingency plan.
- Suspend work where potential risk to water from siltation and pollution is identified, or where operational methods and mitigation measures are not specified or agreed.
- Prepare and maintain a Water Protection Measure Register. This document is to be updated weekly by the ECoW.

3.2.10 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. 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 (See Section 3.4 below).

The 50m wide natural watercourse buffer zone and 20 m existing artificial drainage buffer will be emplaced for the duration of the construction phase. No construction activity will occur within the buffer zone with the exception of bridge and culvert construction. The buffer zone will:

- Prevent any cement based products accidentally entrained in the construction phase drainage system entering directly into watercourses, achieved in part by ending drain discharge outside the 50m buffer zone and allowing percolation across the vegetation of the buffer zone;
- Provide a buffer against accidental direct run-off to surface waters by any pollutants, or by pollutants entrained in surface water run-off.

3.2.11 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.

3.2.12 General Recommendations for Good Construction Practice

Based on the recommendations and control measures given in the FT Peat Stability Assessment (Appendix 8-1 of the EIAR) report being strictly adhered to during construction and the detailed stability assessment carried out for the peat slopes which showed that the site has an acceptable margin of safety.

The risk assessment at each turbine location identified a number of control measures to further reduce the potential risk of peat failure. Access roads to turbines will be subject to the same relevant control measures that apply to the nearest turbine as detailed in the FT Peat Stability Assessment Report.

The following measures which will be implemented during the construction phase of the project will assist in the management of the risks for this site.

- Appointment of experienced and competent contractors;
- The site will be supervised by experienced and qualified personnel;
- Sufficient time will be alloacted for the project to ensure that the potential for initiating peat movement is minimised ((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 as detailed in the peat stability assessment report;
- Set up, maintain and report findings from monitoring systems;
- Ensure construction method statements are followed or where agreed modified/ developed; and,
- Revise and amend the Geotechnical Risk Register as construction progresses.

3.2.13 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 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.

3.2.14 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, 1988 (as amended);
- 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

During field surveys, a search for Invasive Alien Species (IAS) listed under the Third Schedule of the European Communities Regulations 2011 (S.I. 477 of 2015) was conducted. A number of Japanese knotweed (*Fallopia japonica*) plants were recorded adjacent to an existing forestry road, approximately 200m east of Turbine 2 (Grid Ref: E184107 N324067) and in close proximity to the proposed access road, by existing agricultural buildings to the east of the site (Grid Ref: E 190620 N 324296).

No additional species listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations, 2011 were recorded during the survey.

An invasive species management plan for the site will prevent the introduction or spread of any invasive species within the footprint of the works. An invasive species management plan, 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 demolition, 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) 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 waste 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 Demolition Phase Waste Management

Prior to the commencement of any demolition works, as described in Section 2.4.14 above, a full audit of waste material that will be generated will be carried out. A list of expected waste types that may be generated has been drawn up and the European Waste Catalogue Codes pertaining to each waste type is included in Table 3-2. The lists have been prepared following a visit to the proposed development site and inspection of the existing buildings.

Table 3-2 Expected waste types arising from the Demolition Phase

Materials type	Example	EWC Code
Cables	Electrical wiring	17 04 11
Concrete	Surfacing, flooring material	17 01 01
Metals	Steel roof coverings	17 04 07
Mixture of inert material	Sand, stones, plaster, rock	17 01 07
Plastic	PVC frames, electrical fittings	17 02 03
Soil & Stones	Overburden, soil, subsoil	17 05 04

Wood	Misc.	17 02 01

The majority of the waste generated by the demolition works will consist of concrete rubble and stones from the existing wall structures, floors and foundations. This material will be segregated from all other waste components and sent by an authorised waste collector to an authorised waste recovery facility. The remaining volume of waste material will not be large enough to warrant any further segregation, therefore, all waste generated during the demolition of the building will be deposited into a single 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.

3.4.4 Construction Phase Waste Management

3.4.4.1 Description of the Works

The construction of the development will involve the construction of 10 no. turbines, new and upgraded site 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 on-site borrow pit 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 the on-site borrow pit.

The waste types arising from the construction phase of the development are outlined in Table 3-3 below.

Table 3-3 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

Material Type	Example	EWC Code
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.

3.4.4.2 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 will 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.

3.4.4.3 Waste Arising from Construction Activities

All waste generated on site 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 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.

3.4.5 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 being infrastructural material such as the turbine foundations, turbines and the granular material used to construct roads. When 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, as described in Section 3.4.3 above. 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 to an appropriately licensed waste facility.

The waste types arising from the decommissioning of the development are outlined in Table 3-4 below.

Table 3-4 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

3.4.5.1 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.

3.4.5.2 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.

3.4.5.3 Implementation

3.4.5.3.1 *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.

3.4.5.3.2 *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.

3.4.5.3.3 *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

3.4.5.4 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 WMP has been prepared to outline the main objectives that are to be adhered to in the final WMP to be completed in the event planning permission is granted for 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 Letrim County Council, Sligo 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:

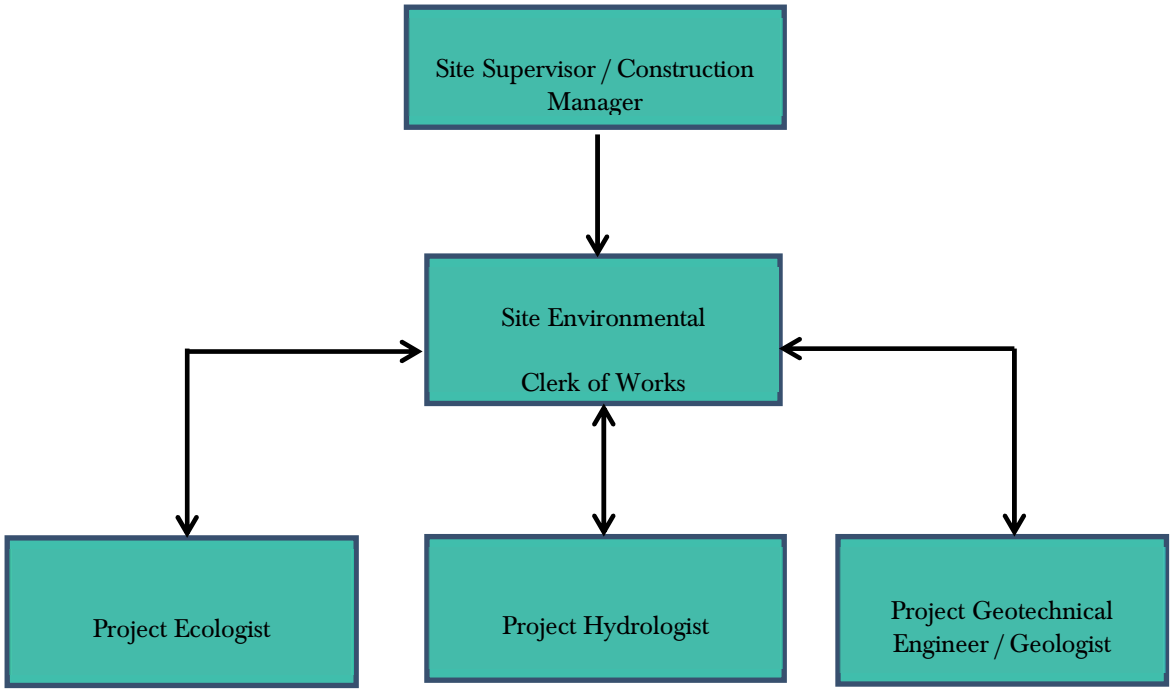


Figure 4-1 Site Management Chain of Command

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:

- 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 final 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 be full time on site during the site preparation/groundworks and will visit site at least once a month during the remainder of the construction phase.

The responsibilities and duties of the Geotechnical Engineer or Geologist will include the following:

- Supervision of all excavation works as part of the construction of the proposed development, 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 Water Quality and Monitoring

4.2.1 Pre-Construction Baseline Monitoring

Water quality field testing and laboratory analysis will be undertaken prior to commencement of felling and construction at the site. The monitoring programme will be subject to agreement with Leitrim County Council and Sligo County Council but will be based on the planning stage programme already carried out.

Analysis will be for a range of parameters with relevant regulatory limits along with EQSs and sampling will be undertaken for each stream that drains from the construction site.

Baseline sampling will be completed on at least two occasions and these should coincide with low flow and high flow stream conditions. The high flow sampling event will be undertaken after a period of sustained rainfall, and the low flow event will be undertaken after a dry spell.

4.2.2 Construction Phase Monitoring

4.2.2.1 Daily Visual Inspections

Daily visual inspections of drains and outfalls will be performed during the construction period to ensure suspended solids are not entering streams and rivers on site, to identify any obstructions to channels and to allow appropriate maintenance of the drainage regime. Should the suspended solids levels measured during construction be higher than the existing levels, the source will be identified and additional mitigation measures implemented.

Inspection sheets and photographic records will be kept on site. Inspection points will include the in-situ field monitoring point locations and the laboratory analysis sampling points. Inspection points will depend on works being completed within the catchment upstream of the identified monitoring locations. Visual inspections will also be completed after major rainfall events, i.e. after events of >25mm rainfall in any 24-hour period and data including photographs will be collected by visual inspections and independently assessed by the supervising hydrologist who will monitor and advise on the records being received.

The following periodic inspection regime will be implemented:

- Daily general visual inspections of site operations and inspections of all watercourses within the site and in the surrounding area by the Environmental Clerk of Works or a

suitably qualified and competent person as delegated by the Environmental Clerk of Works;

- Inspections to include all elements of drainage infrastructure to ensure the system is operating correctly and to identify any maintenance that is required. Any changes, such as discolouration, odour, oily sheen or litter should be noted and corrective action should be implemented. High risk locations such as settlement ponds will be inspected daily. Daily inspections checks will be completed on plant and equipment, and whether materials such as straw bales or oil absorbent materials need replacement;
- Event based inspections by the Environmental Clerk of Works as follows:
    - >10 mm/hr (i.e. high intensity localised rainfall event);
    - >25 mm in a 24-hour period (heavy frontal rainfall lasting most of the day); or,
    - Rainfall depth greater than monthly average in 7 days (prolonged heavy rainfall over a week).
- Monthly site inspections by the Project Hydrologist/ Environmental Clerk of Works during construction phase;
- Quarterly site inspections by the Project Hydrologist/ Environmental Clerk of Works after construction for a period of one year following the construction phase; and,
- A written record will be maintained or available on-site within this Construction Environmental Management Plan (CEMP) which will be maintained on-site during the construction phase.

4.2.2.2 Continuous Turbidity Monitoring

Turbidity monitors or sondes can be installed where required at locations surrounding the wind farm site. The sondes will provide continuous readings for turbidity levels in the watercourse. This equipment will be supplemented by daily visual monitoring at their locations as outlined in the sections below.

4.2.2.3 Monthly Laboratory Analysis

Baseline laboratory analysis of a range of parameters with relevant regulatory limits and EQSs will be undertaken as per water monitoring programme for the overall windfarm development and each primary watercourse along the route. This will not be restricted to just these locations around the immediate wind farm site with further sampling points added as deemed necessary by the Environmental Clerk of Works in consultation with the Project Hydrologist and Site Manager.

4.2.2.4 Field Monitoring

Field chemistry measurements of unstable parameters, (pH, conductivity, temperature) will be taken at the surface water monitoring locations, as per water monitoring programme for the overall wind farm development and each primary watercourse along the route along with at all installed sonde locations. These analyses will be carried out by either the Environmental Clerk of Works or the Project Hydrologist. In-situ field monitoring will be completed on a weekly basis. In-situ field monitoring will also be completed after major rainfall events, i.e. after events of >25mm rainfall in any 24-hour period. The supervising hydrologist will monitor and advise on the readings collected by in-situ field monitoring.

4.2.2.5 Monitoring Parameters

The analytical determinants of the monitoring programme (including limits of detection and frequency of analysis) will be as per S.I. No. 272 of 2009 European Communities Environmental Objectives (Surface Waters) Regulations and European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009. The likely suite of determinants will include:

- pH (field measured)
- Electrical Conductivity (field measured)
- Temperature (field measured)
- Dissolved Oxygen (field measured)
- Total Phosphorus
- Chloride
- Nitrate
- Nitrite
- Total Nitrogen
- Ortho-Phosphate
- Ammonia N
- Biochemical Oxygen Demand
- Total Suspended Solids

4.2.3 Construction Phase Drainage Inspections & Maintenance

Drainage performance will form part of the civil works contract requirements. During the construction phase the effectiveness of drainage measures designed to minimise runoff entering works areas and capture and treatment of potentially silt-laden water from the works areas will be monitored periodically (daily, weekly, and event based monitoring, i.e. after heavy rainfall events) by the Environmental Clerk of Works and/or the Project Hydrologist. The Environmental Clerk of Works will respond to changing weather and drainage conditions on the ground as the project proceeds, to ensure the effectiveness of the drainage design is maintained.

Prior to the commencement of construction an inspection and maintenance plan for the on-site drainage system will be prepared by the Environmental Clerk of Works in consultation with the Project Hydrologist. 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.

Regular inspections of all existing and installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water within the system. Any excess build-up of silt levels at check dams, the settlement ponds, or any other drainage features that may decrease the effectiveness of the drainage feature, will be removed.

The following periodic inspection regime is proposed:

- Daily general visual inspections by Environmental Clerk of Works;
- Weekly (existing & new drains) inspections by the Environmental Clerk of Works and/or the site Construction Manager;
- Inspection to include all elements of drainage systems and all monitoring. Inspections required to ensure that drainage systems are operating correctly and to identify any maintenance that is required. Any changes, such as discolouration, odour, oily sheen or litter should be noted and corrective action should be implemented. High risk locations such as settlement ponds will be inspected daily. Daily inspections checks will be completed on plant and equipment, and whether materials such as silt fencing or oil absorbent materials need replacement;
- Event based inspections by the Environmental Clerk of Works as follows:
- >10 mm/hr (i.e. high intensity localised rainfall event);
- >25 mm in a 24-hour period (heavy frontal rainfall lasting most of the day); or,
- Rainfall depth greater than monthly average in 7 days (prolonged heavy rainfall over a week).
- Monthly site inspections by the Project Hydrologist during construction phase; and,

- Quarterly site inspections by the Project Hydrologist after construction for a period of one year following the construction phase.
- A written record will be maintained or available on-site of all construction phase monitoring undertaken.

4.2.4 Surface Water Monitoring Reporting

Visual inspection and laboratory analysis results of water quality monitoring shall assist in determining requirements for any necessary improvements in drainage controls and pollution prevention measures implemented on site.

It will be the responsibility of the Environmental Clerk of Works to present the ongoing results of water quality and weather monitoring at or in advance of regular site meetings.

Reports on water quality will consider all field monitoring and visual inspections, and results of laboratory analysis completed for that period. Reports will describe how the results compare with baseline data as well as previous reports on water quality. The reports will also describe whether any deterioration or improvement in water quality has been observed, whether any effects are attributable to construction activities and what remedial measures or corrective actions have been implemented. Any proposed alteration to sampling frequency will be agreed with Leitrim County Council and Sligo County Council in advance.

4.2.5 Post Construction Monitoring

4.2.5.1 Monthly Laboratory Analysis Sampling

Monthly sampling for laboratory analysis for a range of parameters adopted during pre-commencement and construction phases will continue for six months after construction is complete. The supervising hydrologist will monitor and advise on the readings being received from the testing laboratory.

4.3 Environmental Awareness and Training

4.3.1 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.

4.3.2 Toolbox Talks

Tool box talks will 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 will be identified and discussed prior to the commencement of the day's activities.

Site meetings will be held on a regular basis involving all site personnel. The objectives of site meetings are to discuss the coming week's 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 will 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 them 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.

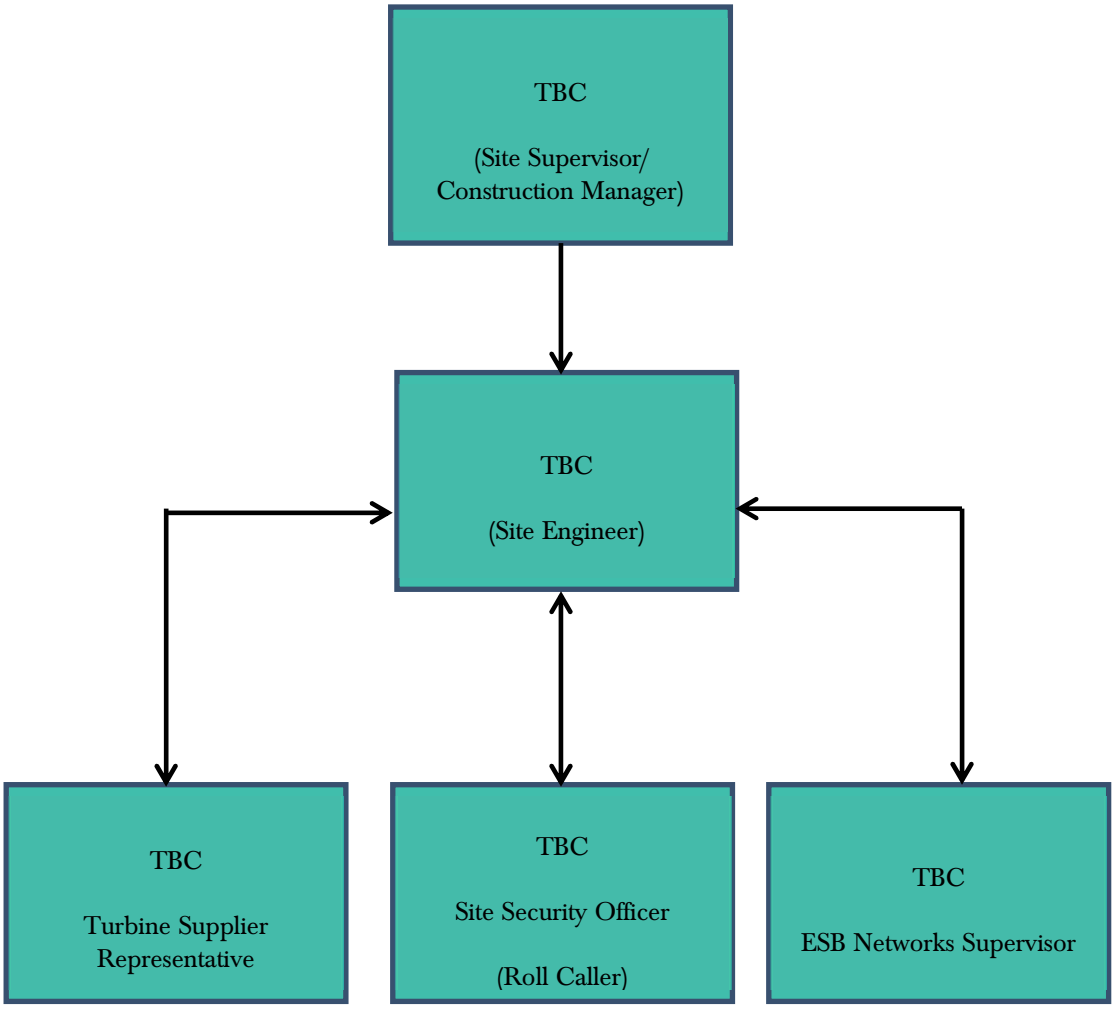


Figure 5-1 Emergency Response Procedure Chain of Command

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.
Peat Instability	Excessive movement of peat on site; onset of peat slide.
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 upon agreement and selection 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, that 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 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 will 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.

12. *All construction activities shall cease within the affected area.*
13. *Increased monitoring at the location shall be carried out. The area will be monitored, as appropriate, until such time as movements have ceased.*
14. *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.*
15. *Such detailed monitoring and awareness will further ensure that the potential for 5.2.2 below is absolutely minimised.*

5.2.2 Onset of Peat Slide

In the very unlikely event of an 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 geotechnical engineer 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 Leitrim County Council and Sligo 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 Leitrim County Council and Sligo 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 5.5-2 Emergency Contacts

Contact	Telephone no.
Emergency Services – Ambulance, Fire, Gardaí	999/112
Doctor – Drumshambo Health Centre	071 964 1105
Hospital – Sligo University Hospital	071 917 1111
ESB Emergency Services	1850 372 999
Gas Networks Ireland Emergency	1850 20 50 50
Gardaí –Drumshambo Garda Station	071 9641002
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

Contact	Telephone no.
Project Supervisor Design Stage (PSDS): MKO	091 735611
Client: Coillte	01 2011111

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 5-5-3 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) and Natura Impact Statement (NIS) prepared as part of the planning permission application to Leitrim County Council and Sligo County Council.

This section of the CEMP groups together all of the mitigation measures presented in the EIAR and NIS respectively. 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 CEMP Section 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 CEMP Section 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	EIAR Chapter 6 CEMP Section 4	An Ecological Clerk of Works (ECoW) or Project Ecologist 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 where required with regular updates in relation to construction progress.
MM5	Site Drainage Plan	CEMP Section 3	The Project Hydrologist/Design Engineer will assist in preparing a site drainage plan before construction commences.
MM6	Preparative Site Drainage Management,	CEMP Section 3	All materials and equipment necessary to implement the drainage mitigation measures will be brought on-site in advance of any works commencing. The drainage measures outlined in the EIS/EIAR will be installed prior to, or at the same time as the works they are intended to drain. An adequate amount of clean stone, silt fencing, stakes, etc. will be kept on site at all times to implement the drainage design measures as necessary.
MM7	Pre-emptive site drainage management	CEMP Section 3	The works programme for the groundworks part of the construction phase of the project will also take account of weather forecasts and predicted rainfall in particular.
MM8	Drainage Inspection	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	Drainage Maintenance	CEMP Section 3	An inspection and maintenance plan for the drainage system on site will be prepared in advance of commencement of any works. Regular inspections of all installed drainage systems will be necessary, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water at parts of the systems where it is not intended. The inspection of the drainage system will be the responsibility of the site Environmental Clerk of Works or the supervising hydrologist.
MM10	Earthworks	EIAR Chapter 8	Drainage and associated pollution control measures will be implemented onsite before the main construction works commence. Where possible drainage controls will be installed during seasonally dry ground conditions. This will reduce the possibility of impact on surface waters by suspended sediment released during construction and entrained in surface run-off.
MM11	Earthworks	EIAR Chapter 8	A 50-metre buffer zone will be maintained around watercourses during the windfarm construction. With the exception of road crossings of streams and associated culvert construction, no development infrastructure, vehicle or plant movement, construction activity or stock-piling of construction materials or construction waste will take place within this zone, and no vegetation will be removed from within this zone.
MM12	Traffic Management Plan, Delivery Programme,	EIAR Chapter 14 Appendix 14-2	› **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 **Traffic Management Plan (TMP)**, specifying details relating to traffic management will be 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: › 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. › Delivery Programme – a programme of deliveries will be submitted to the County Councils 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. › Information to locals – 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 authorities during normal working hours. An "out of hours" emergency number will also be provided. › A Pre and Post 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 to construction commencement to verify and record the condition of the road at the time. 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.

			› Liaison with the relevant local authority - Liaison with the County Councils and An Garda Síochána, will be carried out during the delivery phase of the large turbine vehicles, when an escort for all convoys will be required. Once the surveys have been carried out and "prior to commencement" status of the relevant roads established, (in compliance with the provisions of the CEMP), the Roads section will be informed of the relevant names and contact numbers for the Project Developer/Contractor Site Manager as well as the Site Environmental Manager. › Implementation of temporary alterations to road network at critical junctions – at locations highlighted in section 14.1.8. In addition, in order to minimise the impact on the existing environment during turbine component deliveries the option of blade adaptor trailers will also be used where deemed practicable. › Identification of delivery routes – These routes will be agreed with the County Councils and adhered to by all contractors. › Delivery times of large turbine components - The management plan will include the option to deliver the large wind turbine plant components at night in order to minimise disruption to general traffic during the construction stage. › Travel plan for construction workers – While the assessment above has assumed the worst case in that construction workers will drive to the site, the construction company will be required to provide a travel plan for construction staff, › Additional measures - Various additional measures will be put in place in order to minimise the effects of the development traffic on the surrounding road network including wheel washing facilities on site and sweeping / cleaning of local roads as required. These are set out in the CEMP which is contained in Appendix 4.3. Re-instatement works - All road surfaces and boundaries will be re-instated to pre-development condition, as agreed with the local authority engineers.
MM13	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 or the Community Liaison Officer, who will be the main points 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
MM14	Felling	EIAR Chapter 7	Forestry felling will be conducted outside the general bird breeding season which runs from the 1st of March to the 31st of August.

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: › Safety, Health and Welfare at Work Act 2005 (No. 10 of 2005); › Safety, Health and Welfare at Work (General Application) Regulations 2007 (S.I. No. 299 of 2007), as amended; › Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. 291 of 2013), as amended; and › Safety, Health and Welfare at Work (Work at Height) Regulations 2006 (S.I. No. 318 of 2006). 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 4	Stock-proof fencing will be erected around the borrow pit and peat and spoil repositories if deemed necessary to prevent uncontrolled access to this area. Appropriate health and safety signage will also be erected on this fencing and at locations around the site
MM17	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.
MM18	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.
MM19	Refuelling,	EIAR Chapter 4, 6, 8, 9 CEMP Section 3	On-site refuelling will be carried out using a mobile double skinned, bunded 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 proposed wind farm development. 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 when not in use. Refuelling operations will be carried out only by designated trained and competent operatives holding a permit to refuel. Mobile anti-pollution measures such as drip trays and fuel absorbent mats will be used during all refuelling operations
MM20	Environmental Management- Invasive Species	EIAR Chapter 6 CEMP Section 3	Best practice measures in relation to invasive species are described below: › All earthworks machinery will be thoroughly pressure-washed prior to arrival on site and prior to their further use elsewhere. › Care will be taken not to disturb or cause the movement of invasive species fragments, either intentionally or accidentally. › Stands of Knotweed will be clearly demarcated by temporary fencing and tracking within them will be strictly avoided. A minimum buffer of seven metres will be applied to avoid disturbance of lateral Knotweed rhizomes. › Where works occur within 7m of a Knotweed stand these will be carried out under the supervision of a suitably qualified ecologist. › Should removal of Knotweed off site be required this will be done so under the supervision of an ecologist in line with NPWS licencing. › The machinery must be thoroughly cleaned down under supervision of an ecologist prior to moving away from the Knotweed contaminated area. › All contractors and staff will be briefed about the presence, identification and significance of Knotweed before commencement of works. › Good construction site hygiene will be employed to prevent the spread of these species with vehicles thoroughly cleaned down prior to leaving any site with the

			potential to have supported invasive species. All plant and equipment employed on the construction site (e.g. excavator, footwear, etc.) will be thoroughly cleaned down on site to prevent the spread of invasive plant species such as Knotweed. All clean down must be undertaken in areas with no potential to result in the spread of invasive species. › When working at locations in proximity to natural watercourses, a suitable barrier will be erected between the watercourse and the stand of invasive species. This will assist in preventing the spread of any invasive species into the watercourse during their removal. › Any material that is imported onto any site will be verified by a suitably qualified ecologist to be free from any invasive species listed on the 'Third Schedule' of Regulations 49 & 50 of Regulations 49 and 50 of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2011). This will be carried out by searching for rhizomes and plant material. › Any soils or subsoils contaminated with invasive species will sent for disposal to an authorized waste facility under licence from NPWS. The treatment and control of invasive alien species will follow guidelines issued by the National Roads Authority - The Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads (NRA 2010) and Irish Water (2016) Information and Guidance Document on Japanese Knotweed.
MM21	Plant and Equipment Inspections	EIAR Chapter 8. CEMP Section 3	A programme for the regular inspection of plant and equipment for leaks and fitness for purpose will be developed at the outset of the construction phase.
MM22	Temporary water supply and onsite sanitation	EIAR Chapter 9	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
MM23	Pre-emptive site drainage management	EIAR Chapter 4, 8 CEMP Section 3	The works programme for the groundworks part of the construction phase of the project will also take account of weather forecasts and predicted rainfall in particular.

MM24	Protection of Watercourses	EIAR Chapter 8	During the near stream construction work and tree felling, double row silt fences may be emplaced immediately down-gradient of the working areas for the duration of the construction phase.
MM25	Concrete Deliveries and Management	EIAR Chapter 4	No washing out of any plant used in concrete transport or concreting operations will be carried out onsite. When concrete is delivered to site, only the chute of the delivery truck will be cleaned, using the smallest volume of water necessary, before leaving the site. Concrete trucks will be directed back to their batching plant for washout.
MM26	Concrete Deliveries and Management	EIAR Chapter 4 EIAR Chapter 8	No concrete will be transported around the site in open trailers or dumpers so as to avoid spillage while in transport.
MM27	Concrete Deliveries and Management	EIAR Chapter 4	Clearly visible signs in prominent locations will be placed close to concrete pour areas specifically stating washout of concrete lorries is not permitted on the site
MM28	Concrete Deliveries and Management	EIAR Chapter 4	Main pours will be planned days or weeks in advance. Large pours will be avoided when prolonged periods of heavy rain are forecast.
MM29	Concrete Deliveries and Management	EIAR Chapter 4	Concrete pumps and machine buckets will be restricted from slewing over watercourses while placing concrete.
MM30	Concrete Deliveries and Management	EIAR Chapter 4	Excavations will be sufficiently dewatered before concreting begins. Dewatering will continue while concrete sets.
MM31	Concrete Deliveries and Management	EIAR Chapter 4	Covers will be available for freshly placed concrete to avoid the surface washing away in heavy rain.
MM32	Concrete Deliveries and Management	EIAR Chapter 4 CEMP Section 3	Surplus concrete after completion of a pour will be returned to the concrete suppliers batching plant for recycling.
MM33	Road Cleanliness	EIAR Chapter 4 CEMP Section 3	A road sweeper will be available if any section of the public roads were to be dirtied by trucks associated with the proposed development.

MM34	Road Cleanliness	EIAR Chapter 3 CEMP Section 4	Where it is deemed necessary, wheel washes will be provided near all site entrances to the public road
Drainage Design and Management			
MM35	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.
MM36	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 over land; › 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.
MM37	Watercourse Buffers	EIAR Chapter 9	A self-imposed buffer zone of 50m has been put in place for on-site streams and lakes.
MM38	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.
MM39	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.
MM40	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;
MM41	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.

MM42	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.
MM43	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.
MM44	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.
MM44	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.
MM45	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.
MM46	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. As water is pumped through the bag, the majority of any sediment is retained by the geotextile fabric allowing filtered water to pass through.
MM47	Culvert Upgrades	EIAR Chapter 4, 9	The following mitigation is proposed for completion of windfarm culvert upgrades: › All proposed new natural stream crossings will be bottomless culverts and the existing banks will remain undisturbed as much as possible; › Where the proposed grid connection cabling route follows an existing forestry road or road proposed for upgrade, the cable will pass over or below the culvert within the access road; › Any guidance / mitigation measures proposed by the OPW or the Inland Fisheries Ireland will be incorporated into the design of the proposed crossings;

			› As a further precaution near stream construction work will only be carried out during the period permitted by Inland Fisheries Ireland for in-stream works according to the Eastern Regional Fisheries Board (2004) guidance document "*Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites"*, that is, May to September inclusive. This time period coincides with the period of lowest expected 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; › During the near stream construction work double row silt fences will be emplaced immediately down-gradient of the construction area for the duration of the construction phase. There will be no batching or storage of cement allowed on-site
MM48	Potential Release of Hydrocarbons	EIAR Chapter 9 CEMP Section 3	› Minimal refuelling or maintenance of construction vehicles or plant will take place on site. Off-site refuelling will occur at a controlled fuelling station where possible; › 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 will be re-filled off site, and will be towed around the site by a 4x4 jeep to where machinery is located. 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 and only designated trained and competent operatives with permits to refuel, 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; › Onsite refuelling will be carried out by trained personnel only; › Fuels stored on site will be minimised. Fuel storage areas if required 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
MM49	Plant and equipment inspections	EIAR Chapter 9	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.

MM50	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.
Felling			
51	Felling Licence	EIAR Chapter 4	Felling will be carried out under the terms of a licence application to the Forest Service, as per the Forest Service's policy on granting felling licenses for wind farm developments
52	Clear felling of Coniferous Plantation	EIAR Chapter 4. CEMP Section 3	› Works will be overseen by an ECoW as described above. › Machine combinations (i.e. hand-held or mechanical) will be chosen which are most suitable for ground conditions at the time of felling, and which will minimise soils disturbance; › Trees will be cut manually inside the 50m buffer and using machinery to extract whole trees only; › Checking and maintenance of roads and culverts will be on-going through any felling operation. No tracking of vehicle through watercourses will occur, as vehicles will use road infrastructure and existing watercourse crossing points. Where possible, existing drains will not be disturbed during felling works; › Ditches which drain from the proposed area to be felled towards existing surface watercourses will be blocked, and temporary silt traps will be constructed. No direct discharge of such ditches to watercourses will occur. Drains and sediment traps will be installed during ground preparation. Collector drains will be excavated at an acute angle to the contour (~0.3%-3% gradient), to minimise flow velocities. Main drains to take the discharge from collector drains will include water drops and rock armour, as required, where there are steep gradients, and should avoid being placed at right angles to the contour; › Sediment traps will be sited in drains downstream of felling areas. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of in the peat disposal areas. Where possible, all new silt traps will be constructed on even ground and not on sloping ground; › In areas particularly sensitive to erosion or where felling inside the 50 metre buffer is required, it will be necessary to install double or triple sediment traps. › Double silt fencing will also be put down slope of felling areas which are located inside the 50 metre buffer zone;

			▸ All drainage channels will taper out before entering the aquatic buffer zone. This ensures that discharged water gently fans out over the buffer zone before entering the aquatic zone, with sediment filtered out from the flow by ground vegetation within the zone. On erodible soils, silt traps will be installed at the end of the drainage channels, to the outside of the buffer zone; ▸ Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded. Correct drain alignment, spacing and depth will ensure that erosion and sediment build-up are minimized and controlled; ▸ Brash mats will be used to support vehicles on soft ground, reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal should take place when they become heavily used and worn. Provision should be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction should be suspended during periods of high rainfall; ▸ Timber will be stacked in dry areas, and outside a local 50 metre watercourse buffer. Straw bales and check dams to be emplaced on the down gradient side of timber storage/processing sites; ▸ Works will be carried out during periods of no, or low rainfall, in order to minimise entrainment of exposed sediment in surface water run-off; ▸ Checking and maintenance of roads and culverts will be on-going through the felling operation; ▸ No crossing of streams by machinery will be permitted and only travel perpendicular to and away from stream will be allowed; ▸ Refuelling or maintenance of machinery will not occur within 100m of a watercourse. Mobile bowser, drip kits, qualified personnel will be used where refuelling is required; ▸ A permit to refuel system will be adopted at the site; and, ▸ Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed, but care will be taken to avoid removing natural debris deflectors.

Peat, Subsoils and Bedrock			
MM53	Topsoil/Peat and Subsoil Excavation	EIAR Chapter 8	› Use of the existing road network to reduce peat excavation and borrow pit volumes; › Use of floating roads (where acceptable to do so) to reduce peat excavation volumes; › The peat and subsoil which will be removed during the construction phase will be localised to the Proposed Development infrastructure; › 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;
MM54	Peat instability and failure	EIAR Chapter 8	› A Geotechnical Risk Register will be maintained throughout the construction phase by the Project Engineer which will provide the means to carry out a geotechnical risk assessment and recommend remedial action. › Appointment of experienced and competent contractors; › The site will 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 as detailed in the peat stability assessment report; › Set up, maintain and report findings from monitoring systems; › Ensure construction method statements are followed or where agreed modified/ developed; and,Revise and amend the Geotechnical Risk Register as construction progresses.
MM55	Erosion of Exposed Subsoils and Peat During Construction of Infrastructure	Appendix 4-2	› Peat removed from turbine locations and access roads will be used for landscaping, placed alongside designated access roads, used to reinstate the 1 no. proposed borrow pits or placed in 2 no. repositories. Where possible, the acrotelm shall 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 borrow pits. Re-seeding and spreading/planting of heather and moss cuttings will also be carried out in these areas. These measures will prevent erosion of stored peat in the long term. A full Peat and Spoil Management Plan for the development is included as Appendix 4-2. › Any excess temporary mounded peat in storage for long periods will be sealed using the back of an excavator bucket. This will prevent erosion of soil. Silt fences will be installed around

			stockpiles to limit movement of entrained sediment in surface water runoff. The use of bunds around earthworks and mounds will prevent egress of water from the works. › In order to minimize erosion of mineral subsoils stripping of peat will not take place during extremely wet periods as defined in the Chapter 9 of this EIAR (to prevent increased silt rich runoff). Temporary drainage systems will be required to limit runoff impacts during the construction phase. › During tree felling, brash mats will be used to support vehicles on soft ground, reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place when they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting.
Biodiversity			
MM56	Potential Effects on Peatlands and Associated Habitats	EIAR Chapter 6	The proposed development has been deliberately designed to minimise loss of Upland blanket bog (PB2). Where the development footprint does occur on this habitat at Turbine 1, the proposed development provides for the replacement of peatland habitat through the restoration of forestry (WD4) back to peatland, located adjacent to Turbine 7. This is fully described in the site-specific Biodiversity Management Plan (BMP), provided in Appendix 6-5 of the EIAR. The BMP aims to ensure that there will be no net loss of peatland habitat associated with the proposed development. This has been further developed by the inclusion of an additional peatland enhancement area comprising of degraded Upland blanket bog (PB2) located to the north of Turbine 7. It is proposed to undertake enhancement of this area of peatland through drain blocking and the removal of encroaching conifers (establishing as a result of natural seed dispersal). The location and extent of the habitat replacement and enhancement areas located adjacent to T7 are mapped in the Biodiversity Management Plan, Appendix 6-5 of the EIAR
MM57	Badger	EIAR Chapter 6	› An exclusion zone will be put in place along the section of haul road during the construction phase to ensure works are not undertaken within 30 metres of a known badger sett on site (known to be approx. 40 metres from the proposed footprint). › No works should be undertaken within 150m of any holts at which breeding females or cubs are present.

			▪ No wheeled or tracked vehicles (of any kind) should be used within 20m of active, but non-breeding, otter holts. Light work, such as digging by hand or scrub clearance should also not take place within 15m of such holts, except under licence (TII, 20061). ▪ All of the above works will be undertaken or supervised by an appropriately qualified ecologist.
Ornithology			
MM58	Ornithology	EIAR Chapter 7	Taking a precautionary approach, it is proposed that construction works will commence outside the bird nesting season (1st of March to 31st of August inclusive). Pre-commencement surveys will be undertaken prior to the initiation of works at the wind farm.
MM59	Ornithology	EIAR Chapter 7	▪ 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 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.

[1] *NRA, 2006. Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes. Dublin: Transport Infrastructure Ireland. Available at: www.tii.ie/tii-library/environment/construction-guidelines/Guidelines-for-the-Treatment-of-Otters-prior-to-the-Construction-of-National-Road-Schemes.pdf*

Noise			

MM60	Noise	EIAR Chapter 11	› No plant used on site will be permitted to cause an on-going public nuisance due to noise.
			› The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
			› All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
			› Compressors will be attenuated 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.
			› Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
			› Any plant, such as generators or pumps, which is required to operate outside of general construction hours will be surrounded by an acoustic enclosure or portable screen.
			› During the course of the construction programme, supervision of the works will include ensuring compliance and using methods outlined in British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.
			› The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 7:00hrs and 19:00hrs weekdays and between 7:00hrs and 14:00hrs on Saturdays. However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (i.e. concrete pours, rotor/tower deliveries) it could occasionally be necessary to work out of these hours.
			› Where rock breaking is employed in relation to the proposed borrow pit location, the following are examples of measures that will be considered, where necessary, to mitigate noise emissions from these activities:
			  › Fit suitably designed muffler or sound reduction equipment to the rock breaking tool to reduce noise without impairing machine efficiency.
			  › Ensure all leaks in air lines are sealed.
			  › Use a dampened bit to eliminate ringing.
			  › Erect acoustic screen between compressor or generator and noise sensitive area. When possible, line of sight between top of machine and reception point needs to be obscured.

			› Enclose breaker or rock drill in portable or fixed acoustic enclosure with suitable ventilation.
MM61	Vibration	EIAR Chapter 11	Where blasting is employed in relation to the proposed borrow pit location, the following are examples of measures that will be employed, where necessary, to mitigate noise emissions from these activities: › Restriction of hours within which blasting can be conducted (e.g. 09:00 – 18:00hrs). › Notification to nearby residents before blasting starts (e.g. 24-hour written notification). › The firing of blasts at similar times to reduce the 'startle' effect. › On-going circulars informing people of the progress of the works. › The implementation of an onsite documented complaints procedure. › The use of independent monitoring by external bodies for verification of results. › Trial blasts in less sensitive areas to assist in blast designs and identify potential zones of influence.
Air Quality/Dust			
MM62	Dust Emissions	EIAR Chapter10 CEMP Section 3	› In periods of extended dry weather, dust suppression may be necessary along haul roads, site roads, substation and construction compounds and around the borrow pit area to ensure dust does not cause a nuisance. If necessary, de-silted 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, borrow pit and site compounds 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 which may have the potential to generate dust will be undertaken with tarpaulin cover or similar, where necessary.

			› The transport of dry excavated material from the on-site borrow pit which may have potential to generate dust will be avoided. If necessary, excavated material will be dampened prior to transport from the borrow pits.
MM63	Exhaust Emissions	EIAR Chapter 10	› All construction vehicles and plant will be maintained in good operational order while onsite, thereby minimising any emissions that arise. › All machinery will be switched off when not in use. › The majority of aggregate materials for the construction of the proposed development will be obtained from the borrow pit on site. This will significantly reduce the number of delivery vehicles accessing the site, thereby reducing the amount of emissions associated with vehicle movements.
MM64	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 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			
MM65	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.
MM66	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.
MM67	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.
MM68	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. 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.

Operational Phase			
Health and Safety			
MM69	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. Signs will be erected at suitable locations such as, amenity access points and carparks, setting out the conditions of public access under the relevant legislation and providing normal hours (and out of hours) contact details. Staff associated with the project will conduct frequent visits, which will include inspections to establish whether any signs have been defaced, removed or are becoming hidden by vegetation or foliage, with prompt action taken as necessary. Signs will also be erected at suitable locations across the site as required for the ease and safety of operation of the wind farm. These signs include: › Buried cable route markers at 30m (maximum) intervals and change of cable route direction; › Directions to relevant turbines at junctions; › "No access to Unauthorised Personnel" at appropriate locations; › Speed limits signs at site entrance and junctions; › "Warning these Premises are alarmed" at appropriate locations; › "Danger HV" at appropriate locations; › "Warning – Keep clear of structures during electrical storms, high winds or ice conditions" at site entrance; › "No unauthorised vehicles beyond this point" at specific site entrances; and Other operational signage required as per site-specific hazards.

Drainage Design and Management			
MM70	Wastewater Management	EIAR Chapter 4	The removal and disposal of wastewater from the site will be carried out by a fully permitted waste collector holding valid Waste Collection Permits as issued under the Waste Management (Collection Permit) Regulations, 2007.
MM71	Site Drainage	CEMP Section 4	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.
MM72	Site Drainage	EIAR Chapter 8	During the operational phase of the wind farm runoff from individual turbine hardstanding areas will be not discharged into the existing drain network but discharged locally at each turbine location through settlement ponds and buffered outfalls onto vegetated surfaces
MM73	Fuel Control	EIAR Chapter 8	The substation transformer, and oil storage tanks will be in a concrete bunded capable of holding 110% of the stored oil volume.
Biodiversity			
MM74	Bats	EIAR Chapter 6 and Appendix 6.2.	In order to reduce the value of the habitat for bat species in the areas surrounding the turbines, a buffer of at least 50m between the tip of the blade and any trees or other tall vegetation that could provide high quality foraging habitat for bat species will be implemented. Details of this mitigation and how it is calculated is provided in Appendix 6-2. In addition to this, ongoing monitoring of bat activity will be undertaken for at least 3 years' post construction of the wind farm. This will provide data and information on the actual recorded impact of the wind turbines on the local bat populations. 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 to ensure that no potential for significant effects on bat species remains.
Traffic Management			
MM75	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

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 applications to Leitrim County Council and Sligo County Council.

This section of the Construction and Environment Management Plan groups together all of the monitoring proposals presented in the EIAR and NIS. 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 Chapter 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 3	A pre-commencement invasive species survey shall be completed for the site
MX3	Mammal Survey	EIAR Chapter 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	Ornithology	EIAR Chapter 7	Pre-commencement surveys will be undertaken prior to the initiation of works at the wind farm. A breeding bird survey will be undertaken between April and July. Monitoring will be undertaken by a suitably qualified ornithologist. The survey will include a thorough walkover survey to a 500m radius of the development footprint and/or all works areas, where access allows. If breeding activity of birds of high conservation concern is identified, the nest site will be located, and earmarked for monitoring at the beginning of the first breeding season of the construction phase. If it is found to be active during the construction phase no works shall be undertaken within a 500m buffer (Forestry Commission Scotland 2006; Ruddock & Whitfield 2007) in line with best practise. No works shall be permitted within the buffer until it can be demonstrated that the nest is no longer occupied.
Construction Phase			
MX5	Water Quality and Monitoring	EIAR Chapter 9	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 Chapter 9	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 Chapter 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 Chapter 3=4 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 Chapter 4	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 Chapter 4 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 Chapter 9 CEMP Section 3	The plant used should be regularly inspected for fuel leaks, unnecessary noise generation and general fitness for purpose.
MX12	Drainage Inspection	EIAR Chapter 9 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.

			Noise and vibration monitoring should be considered in accordance with the guidance contained in British Standard BS5528 during the construction phase.
MX14	Archaeological Monitoring	EIAR Chapter 13	› Archaeological monitoring of any geotechnical / engineering trial pits or investigations and a report detailing the results of same. › Archaeological monitoring of ground works during construction. A report on the results of the monitoring shall be compiled and submitted to the relevant authorities on completion of the project.
MX15	Archaeological Monitoring	EIAR Chapter 13	Archaeological monitoring of ground works during construction. A report on the results of the monitoring shall be compiled and submitted to the relevant authorities on completion of the project. › Proposed new road to T1 where it traverses the Garvagh/Garvagh-Glebe watercourse at ITM E583591, N823655 › Proposed New road to T10 where it crosses the stream to the north of T10 at ITM E584754, N822568
MX16	Archaeological Monitoring	EIAR Chapter 13	Archaeological monitoring of topsoil/peat removal of all off-road sections of the proposed haul route during construction. A report on the results of the monitoring shall be compiled and submitted to the relevant authorities on completion of the project.
Operational Phase			
MX17	Post-Construction Monitoring	EIAR Chapter 7 Appendix 7-7	A detailed post-construction Bird Monitoring Programme has been prepared for the operational phase of the Proposed Development, please refer to Appendix 7-7 of the EIAR for further details. The programme of works will monitor parameters associated with collision, displacement/barrier effects and habituation and these surveys will be scheduled to coincide with Years 1, 2, 3, 5, 10 & 15 of the life-time of the wind farm. Monitoring measures are broadly based on guidelines issued by the Scottish Natural Heritage (SNH, 2009). The following individual components are proposed for monitoring years: › Monthly flight activity surveys: vantage point surveys › Distribution and abundance surveys: breeding wader to a 500m radius of the development area, breeding hen harrier surveys and winter hen harrier roost surveys to a 2km radius of the development area.

			› Targeted bird collision surveys (corpse searches) will be undertaken with training dogs. The surveys will include detection and scavenger trials, to correct for these two biases and ensure the resulting data is robust.
MX18	Bat Monitoring	EIAR Chapter 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.
MX19	Drainage Inspection	EIAR Chapter 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 Chapter 11	Post commissioning operational noise monitoring will be undertaken to ensure compliance with the relevant planning noise criteria. In relation to assessment of operational wind turbine noise, the guidance outlined in the IoA GPG and Supplementary Guidance Note 5: Post Completion Measurements (July 2014) will be followed. Should the assessment identify any exceedances of the appropriate criteria, relevant corrective actions will be taken.

8. PROGRAMME OF WORKS

8.1.1 Construction Schedule

The construction phase will take approximately 12-18 months to complete from starting on site to the commissioning of the electrical system.

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 Friday and 7 a.m. to 2 p.m. on Saturdays, 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 of the main construction task items are outlined in Figure 8-1 below, where 1st January has been selected as an arbitrary start date for construction activities.

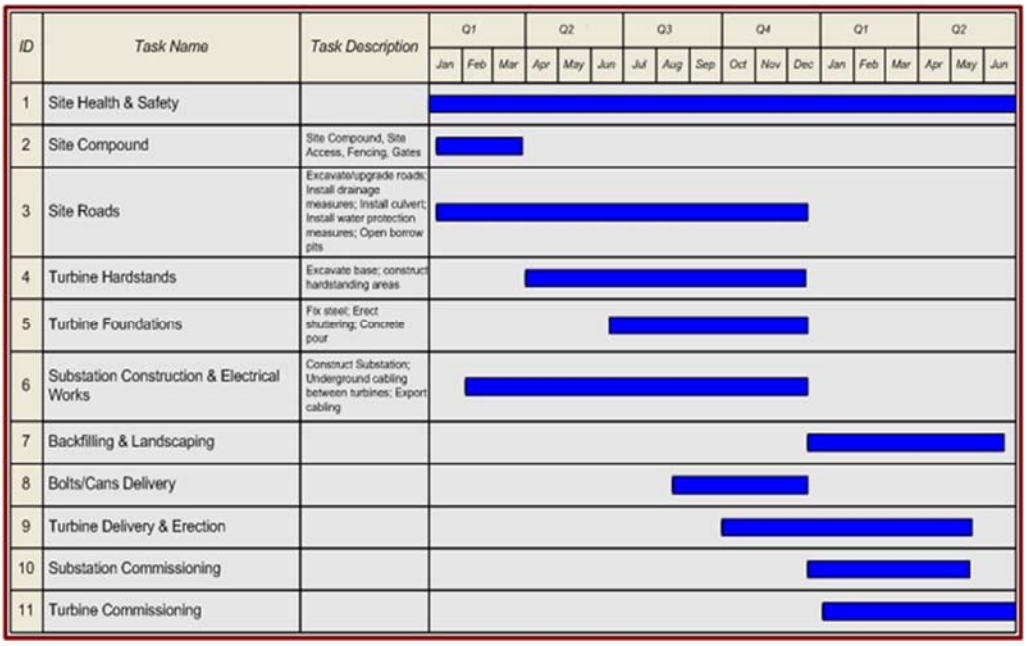


Figure 8-1 Indicative Construction Schedule

9. COMPLIANCE AND REVIEW

9.1.1 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.

9.1.2 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 highlight 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.

9.1.3 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.

9.1.4 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 transmitted to the site staff involved. A Corrective Action Notice will be completed at a later date.

9.1.5 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.

POLLUTION PREVENTION NOTES:

1. Site management proposals are intended to ensure protection against surface water and groundwater pollution, surface water siltation, and stream bank and land erosion.
2. Suitable drainage control measures should be in place at all times to prevent conveyance of significant volumes of silt to off site receiving watercourses.
3. Silty water can arise from dewatering excavations, erosion of exposed/disturbed ground, erosion of temporary stockpiles, plant and wheel wash water, runoff from site roads/tracks, and disturbance of existing field drains and ditches.

Discharges

4. Water containing silt will not be pumped directly to any natural watercourse. All discharges to be made over open ground or into existing field drain with silt trap a minimum 20m from nearest watercourse unless otherwise stated.
5. No excavated material is to be stored within any surface water buffer zone.
6. Pumped water will be directed into track side ditches and treated in settlement ponds and vegetation swales prior to overland discharge.
7. Pumping of clean water from excavations / or over-pumping into field drains/ditches/streams will be completed in a manner that does not cause scour or erosion at the point of release/discharge. This will be done by reducing the flow velocities or by use of splash plates, and other similar discharge controls.
8. Vegetation will NOT be stripped from existing field drains/ditches unless absolutely necessary.

Excavations

9. Where deep excavations are proposed cut-off drains will be use to reduce the amount of surface water entering the excavation. This will be the case around turbine base excavations.

Exposed Ground & Stockpiles

10. The amount of exposed ground and temporary stockpiles open at any one time will be minimised, as far as practicable.

Site tracks

11. Use of track side swales with check dams, and/or filtration check dams will reduce silt in runoff water as required.
12. Check dams to be inspected and cleaned regularly.

Refueling

13. Refuelling will be completed in line with CEMP requirements and away from field drains / ditches and watercourses / waterbodies.
14. Spill kits and drip trays will be available on site for use as required.

Concrete

15. Care will be taken when completing concrete works on site to ensure no discharges of concrete or wash water occurs.
16. Concrete wash water, and waste concrete will be managed appropriately on site.

If water pollution is identified the following steps would be adhered to:

STOP - work in the immediate area should be stopped and the source of the pollution identified.

CONTAIN - the source of the pollution should be bunded using a suitable method. Natural watercourses should be temporarily diverted around the source of pollution.

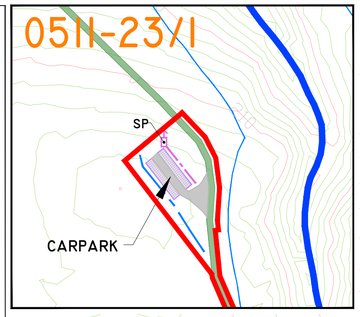
NOTIFY - The relevant authorities (Site Manager / Inland Fisheries Ireland / NPWS / Local Authority etc.) should be notified immediately to ensure that measures can be implemented downstream to protect fisheries and other sensitive areas, if required.

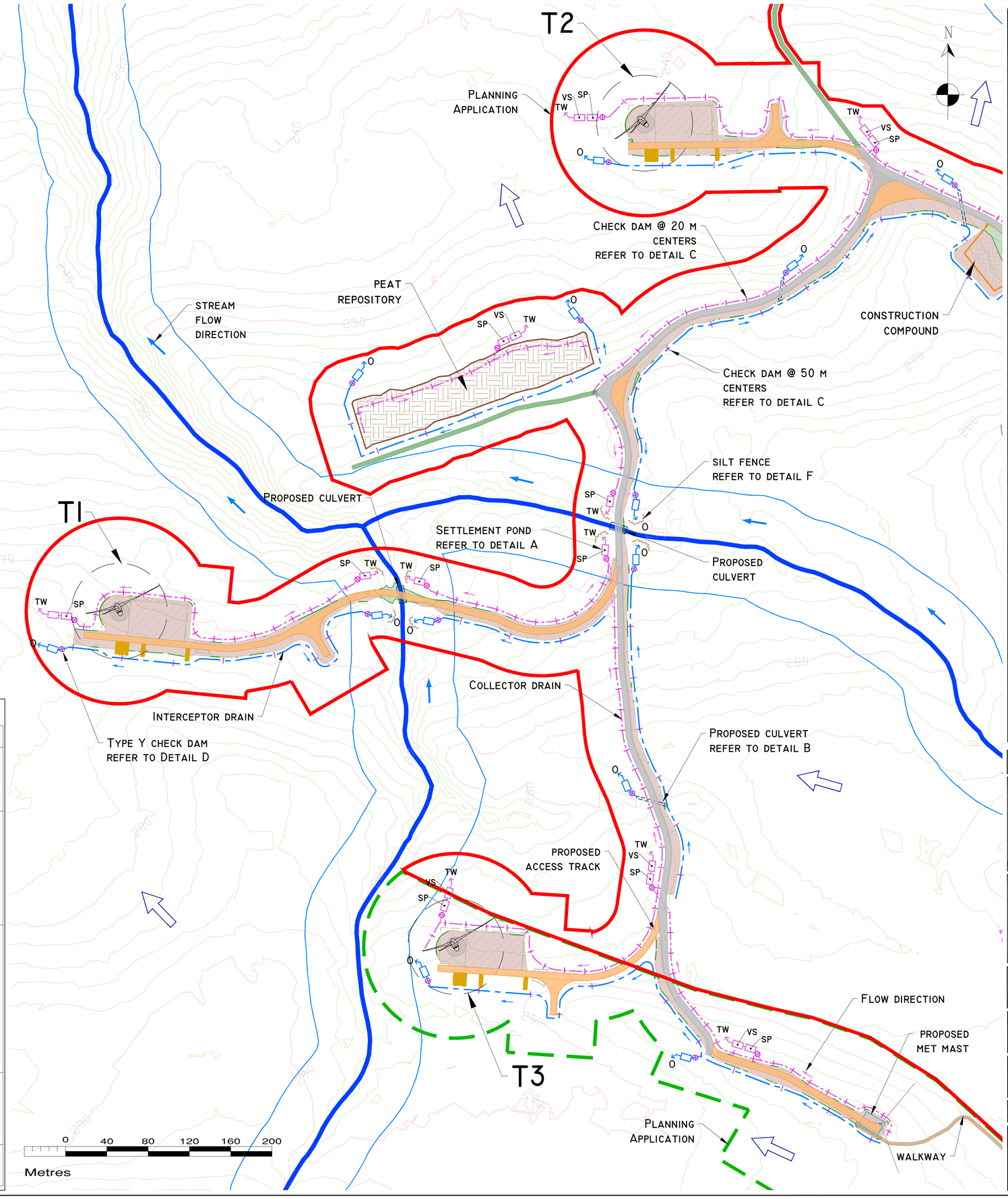
DRAINAGE NOTES:

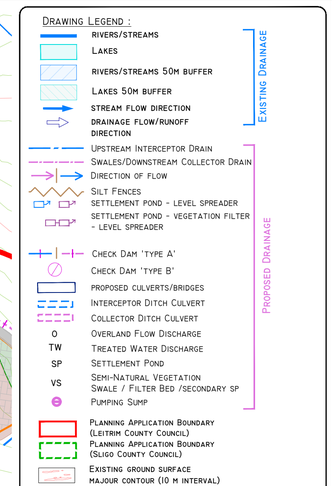
1. Roadway surfacing design and construction to Engineer's Specification.
2. Spare straw bales/silt fencing/ or similar, to be stored on site. The level of silt in runoff during construction is to be monitored visually and excessive silt levels in any area to be temporarily managed by placing silt fences, straw bales / or similar or additional check dams at the problem areas.
3. SUDS system to be constructed prior to, or at the same time as the access tracks. Interim measures such as the placement of straw bales/silt fencing/or similar approved method or additional check dams and silt fences to be employed in all instances where work carried out to construct the access tracks is likely to cause adverse environmental effects through increased silt loadings being generated during the construction phase.
4. Suitable prevention measures should be in place at all times to prevent the conveyance of significant volumes of silt to receiving watercourses. See notes on pollution prevention.
5. Interceptor swales / ditches to be used to collect upstream surface water flows. Regular cross drains / discharge to field ditches will be required to transfer / discharge surface water in interceptor drains to suitable field drain outfall points.
6. Drainage swales / ditches to be excavated adjacent to the access tracks. Regular cross drains to be located along access tracks to prevent excessive volumes of water collecting in the swales / ditches. Locations of cross drains to be agreed with the Engineer on site. Surface water will not be allowed to discharge directly into existing watercourses.
7. Where possible, a buffer zone of >20m to any existing watercourse will be required where over land discharges are proposed from access track swales / ditches.
8. Batters of all proposed swales / ditches to have a slope of between 1 : 1.5 to 1 : 2 depending upon depth of swale/ditch and will be left as cut to re-vegetate with local species.
9. Track side swales / ditches to be shallow with moderate gradients to prevent scouring. In steep areas check dams should be installed to reduce flow velocities and provide source control of silt containment. Where necessary these have been designated in conjunction with settlement ponds and silt traps, prior to discharge.
10. Settlement ponds to be constructed for silt removal at turbine bases and hard stand areas. Pond sizes depends on catchment area served. Sample pond sizes shown on Drawing D501.
11. straw bales / or similar and silt fences to be used also around spoil heaps to mitigate silt runoff. Silt fences may be removed when suitable vegetation cover is established.
12. silt fences to be provide along edge of existing watercourse where works comes within <20m of edge of any ditch / ephemeral channels.
13. Slopes of the swales / ditches to be vegetated or protected from erosion until vegetation has been established. Stripped vegetative layer (peat 'sod' or 'scraw') from excavations to be stored locally and used to line slopes and base of swales / ditches or longitudinal mounds of vegetation swales at field drain discharge points.
14. Areas stripped of vegetation should be kept to a minimum.
15. Clean stone flow control check dams to be made of locally won / geologically similar well graded stone. Aggregate size for stone check dams to be typically 20- 40mm clean stone. On sloping sections of the access tracks, 40mm check dams to be protected from washing away through the placement of 100m stone on the downhill face of the check dam and by wrapping in geotextile.
16. Build up of silt levels at check dams to be removed and disposed of appropriately. Silt levels at check dams to be visually inspected as part of an ongoing drainage maintenance programme during the construction phase. Where check dams become clogged with silt or vegetation, stone check dam to be removed and replaced subsequent to the removal of silt.
17. Spacing and frequency of check dams will be dependent upon longitudinal gradient of swale.
18. Location of filtration check dams (if required) to be agreed on site with Engineer. Settlement ponds to be constructed in a manner where they may be easily infilled at a later date (post completion of the turbine base and hardstand construction). Only suitable materials excavated from the pond to be used to form part of the embankment around the pond.
19. Oil/fuel should be stored within bunded containment structures.
20. silt bags will be used on site at field drain discharge locations, as necessary.

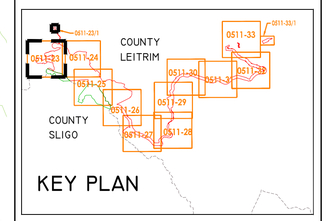
MITIGATION / DRAINAGE COINTROLS AVAILABLE FOR USE ACROSS THE SITE

Management Type	Description of SUDS Drainage Control Methods
Avoidance Controls	1) Application of 50m buffer zones to natural watercourses where possible 2) Application of 10m buffer zones to main drains where possible 3) Using small working areas 4) Working in appropriate weather, and suspending certain work activities in advance of forecasted wet weather
Source Controls:	1) Use of upstream interceptor drains and downstream collector drains / oversized swales, vee-drains, diversion drains, flumes and culvert pipes 2) erosion and velocity control measures such as: A) sand bags B) oyster bags filled with gravel C) filter fabrics D) and other similar/equivalent or appropriate systems 3) Using small working areas 4) Surrounding stockpiles with silt fencing 5) weathering off / sealing peat stockpiles
In-Line Controls:	1) Interceptor drains, vee-drains, oversized swales/collector drains 2) erosion and velocity control measures such as: A) sand bags B) oyster bags filled with gravel C) filter fabrics D) straw bales E) flow limiters F) weirs or baffles G) and/or other similar/equivalent or appropriate systems. 3) silt fences, filter fabrics 4) In stream Sedimats 5) collection sumps, temporary sumps, pumping systems 5) attenuation lagoons 6) sediment traps, stilling / settlement ponds
Water Treatment Controls:	1) Temporary sumps 2) attenuation ponds 3) Temporary storage lagoons 4) Sediment traps, Stilling / Settlement ponds 5) Proprietary settlement systems such as Siltbuster, and/or other similar/equivalent or appropriate systems. 6) Silt dewatering bags
Outfall Controls:	1) Levelspreaders 2) Buffered outfalls 3) Vegetation filters 4) Silt dewatering bags 5) Flow limiters and weirs









Drawing Notes

1. Drawings issued are for planning application purposes only.
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Date	Description	Chkd	Signed

Revisions

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Client: Coillte Teo

Job: Croagh WF

Title: Proposed Drainage Layout

Figure No: 0511-23

Drawing No: P1459-0-0720-A1-0511-23-00A	
Sheet Size: A1	Project No.: P1459-0
Scale: 1:2,000 (A1)	Drawn By: MG/GD
Date: 06/07/2020	Checked By: MG

POLLUTION PREVENTION NOTES:

1. Site management proposals are intended to ensure protection against surface water and groundwater pollution, surface water siltation, and stream bank and land erosion.
2. Suitable drainage control measures should be in place at all times to prevent conveyance of significant volumes of silt to off site receiving watercourses.
3. Silty water can arise from dewatering excavations, erosion of exposed/disturbed ground, erosion of temporary stockpiles, plant and wheel wash water, runoff from site roads/tracks, and disturbance of existing field drains and ditches.

Discharges

4. Water containing silt will not be pumped directly to any natural watercourse. All discharges to be made over open ground or into existing field drain with silt trap a minimum 20m from nearest watercourse unless otherwise stated.
5. No excavated material is to be stored within any surface water buffer zone.
6. Pumped water will be directed into track side ditches and treated in settlement ponds and vegetation swales prior to overland discharge.
7. Pumping of clean water from excavations / or over-pumping into field drains/ditches/streams will be completed in a manner that does not cause scour or erosion at the point of release/discharge. This will be done by reducing the flow velocities or by use of splash plates, and other similar discharge controls.
8. Vegetation will NOT be stripped from existing field drains/ditches unless absolutely necessary.

Excavations

9. Where deep excavations are proposed cut-off drains will be use to reduce the amount of surface water entering the excavation. This will be the case around turbine base excavations.

Exposed Ground & Stockpiles

10. The amount of exposed ground and temporary stockpiles open at any one time will be minimised, as far as practicable.

Site tracks

11. Use of track side swales with check dams, and/or filtration check dams will reduce silt in runoff water as required.
12. Check dams to be inspected and cleaned regularly.

Refueling

13. Refuelling will be completed in line with CEMP requirements and away from field drains / ditches and watercourses / waterbodies.
14. Spill kits and drip trays will be available on site for use as required.

Concrete

15. Care will be taken when completing concrete works on site to ensure no discharges of concrete or wash water occurs.
16. Concrete wash water, and waste concrete will be managed appropriately on site.

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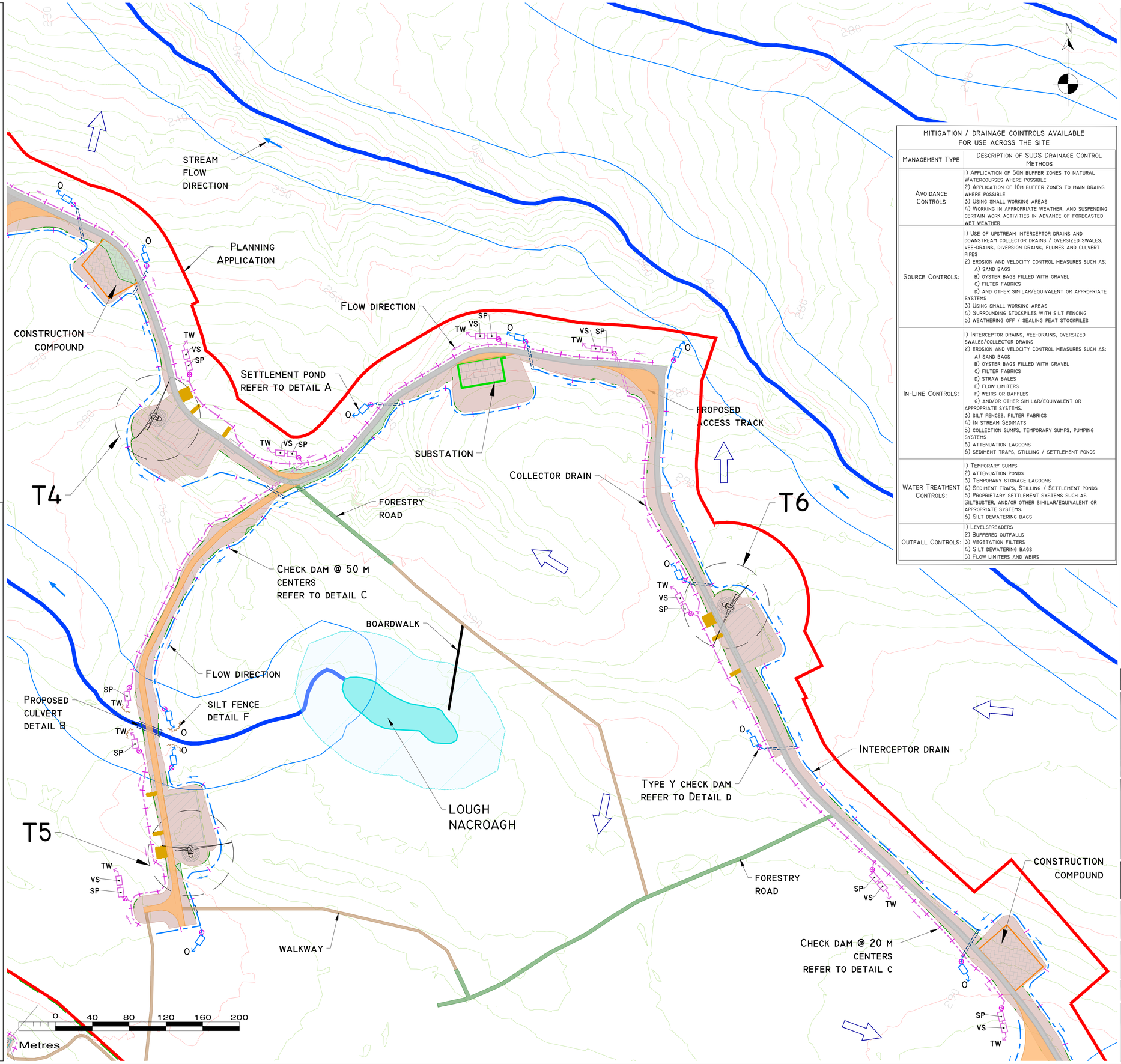
STOP - work in the immediate area should be stopped and the source of the pollution identified.

CONTAIN - the source of the pollution should be bunded using a suitable method. Natural watercourses should be temporarily diverted around the source of pollution.

NOTIFY - The relevant authorities (Site Manager / Inland Fisheries Ireland / NPWS / Local Authority etc.) should be notified immediately to ensure that measures can be implemented downstream to protect fisheries and other sensitive areas, if required.

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3. SUDS system to be constructed prior to, or at the same time as the access tracks. Interim measures such as the placement of straw bales/silt fencing/or similar approved method or additional check dams and silt fences to be employed in all instances where work carried out to construct the access tracks is likely to cause adverse environmental effects through increased silt loadings being generated during the construction phase.
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6. Drainage swales / ditches to be excavated adjacent to the access tracks. Regular cross drains to be located along access tracks to prevent excessive volumes of water collecting in the swales / ditches. Locations of cross drains to be agreed with the Engineer on site. Surface water will not be allowed to discharge directly into existing watercourses.
7. Where possible, a buffer zone of >20m to any existing watercourse will be required where over land discharges are proposed from access track swales / ditches.
8. Batters of all proposed swales / ditches to have a slope of between 1 : 1.5 to 1 : 2 depending upon depth of swale/ditch and will be left as cut to re-vegetate with local species.
9. Track side swales / ditches to be shallow with moderate gradients to prevent scouring. In steep areas check dams should be installed to reduce flow velocities and provide source control of silt containment. Where necessary these have been designated in conjunction with settlement ponds and silt traps, prior to discharge.
10. Settlement ponds to be constructed for silt removal at turbine bases and hard stand areas. Pond sizes depends on catchment area served. Sample pond sizes shown on Drawing D501.
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14. Areas stripped of vegetation should be kept to a minimum.
15. Clean stone flow control check dams to be made of locally won / geologically similar well graded stone. Aggregate size for stone check dams to be typically 20- 40mm clean stone. On sloping sections of the access tracks, 40mm check dams to be protected from washing away through the placement of 100m stone on the downhill face of the check dam and by wrapping in geotextile.
16. Build up of silt levels at check dams to be removed and disposed of appropriately. Silt levels at check dams to be visually inspected as part of an ongoing drainage maintenance programme during the construction phase. Where check dams become clogged with silt or vegetation, stone check dam to be removed and replaced subsequent to the removal of silt.
17. Spacing and frequency of check dams will be dependent upon longitudinal gradient of swale.
18. Location of filtration check dams (if required) to be agreed on site with Engineer. Settlement ponds to be constructed in a manner where they may be easily infilled at a later date (post completion of the turbine base and hardstand construction). Only suitable materials excavated from the pond to be used to form part of the embankment around the pond.
19. Oil/fuel should be stored within bunded containment structures.
20. Silt bags will be used on site at field drain discharge locations, as necessary.



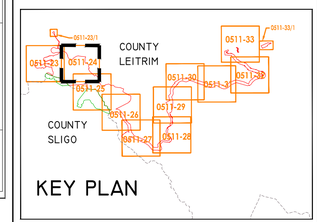
MITIGATION / DRAINAGE COINTROLS AVAILABLE FOR USE ACROSS THE SITE

Management Type	Description of SUDS Drainage Control Methods
Avoidance Controls	1) Application of 50m buffer zones to natural watercourses where possible 2) Application of 10m buffer zones to main drains where possible 3) Using small working areas 4) Working in appropriate weather, and suspending certain work activities in advance of forecasted wet weather
Source Controls:	1) Use of upstream interceptor drains and downstream collector drains / oversized swales, vee-drains, diversion drains, flumes and culvert pipes 2) erosion and velocity control measures such as: A) sand bags B) oyster bags filled with gravel C) filter fabrics D) and other similar/equivalent or appropriate systems 3) Using small working areas 4) Surrounding stockpiles with silt fencing 5) weathering off / sealing peat stockpiles
In-Line Controls:	1) Interceptor drains, vee-drains, oversized swales/collector drains 2) erosion and velocity control measures such as: A) sand bags B) oyster bags filled with gravel C) filter fabrics D) straw bales E) flow limiters F) weirs or baffles G) and/or other similar/equivalent or appropriate systems. 3) silt fences, filter fabrics 4) In stream Sedimats 5) collection sumps, temporary sumps, pumping systems 5) attenuation lagoons 6) sediment traps, stilling / settlement ponds
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Outfall Controls:	1) Levelspreaders 2) Buffered outfalls 3) Vegetation filters 4) Silt dewatering bags 5) Flow limiters and weirs

Drawing Legend :

Existing Drainage
- Rivers/Streams
- Lakes
- Rivers/streams 50m buffer
- Lakes 50m buffer
- Stream flow direction
- Drainage flow/runoff direction

Proposed Drainage
- Upstream Interceptor Drain
- Swales/Downstream Collector Drain
- Direction of flow
- Silt Fences
- Settlement pond - level spreader
- Settlement pond - vegetation filter - level spreader
- Check Dam 'type A'
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- Proposed culverts/bridges
- Interceptor Ditch Culvert
- Collector Ditch Culvert
- O — Overland Flow Discharge
- TW — Treated Water Discharge
- SP — Settlement Pond
- VS — Semi-Natural Vegetation Swale / Filter Bed /secondary sp
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- Planning Application Boundary (Leitrim County Council)
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- Existing ground surface majour contour (10 m interval)
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- Turbine and swept area
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Figure No: 0511-24

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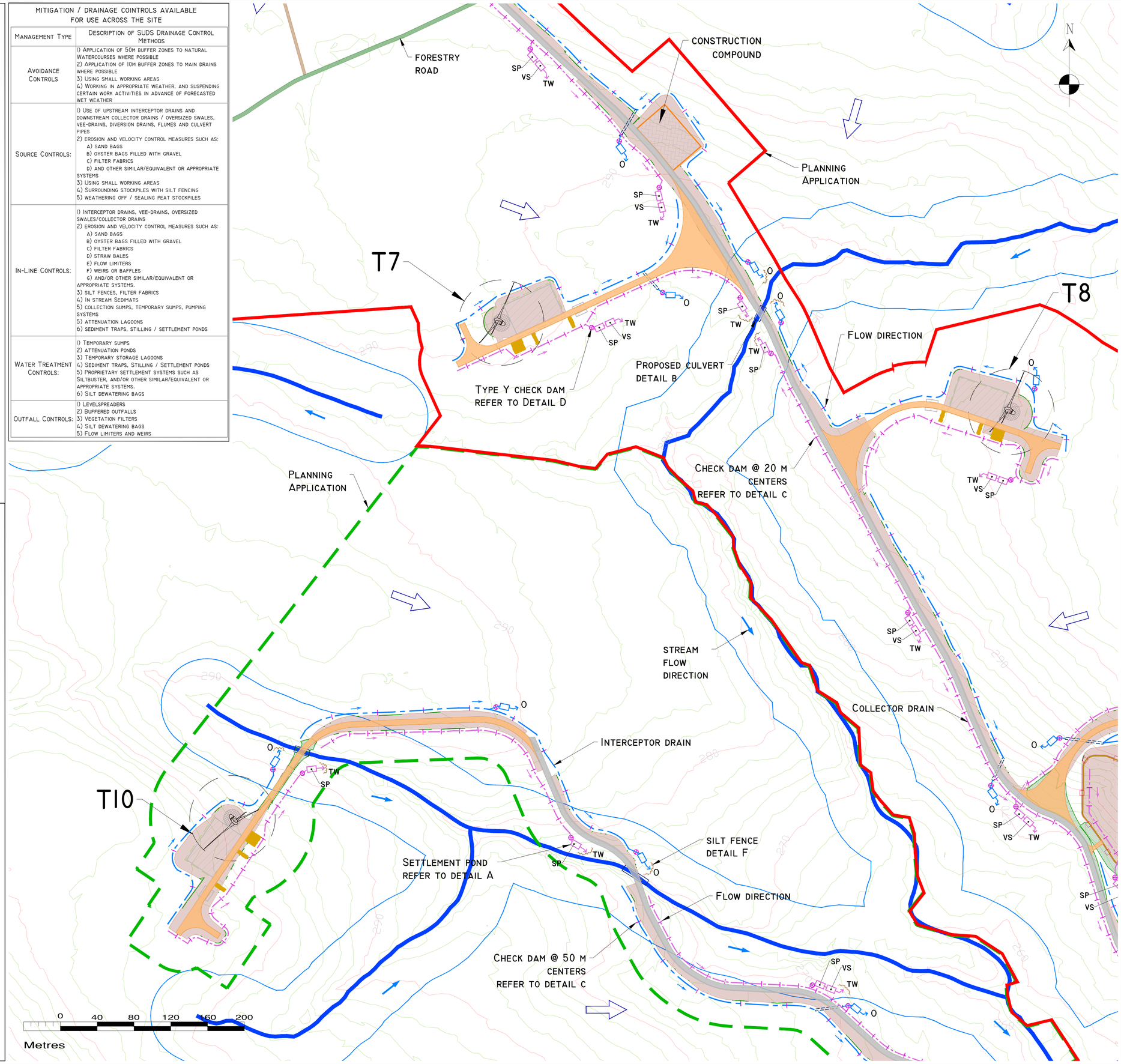
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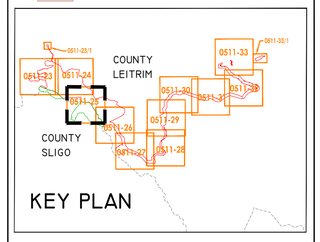
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KEY PLAN

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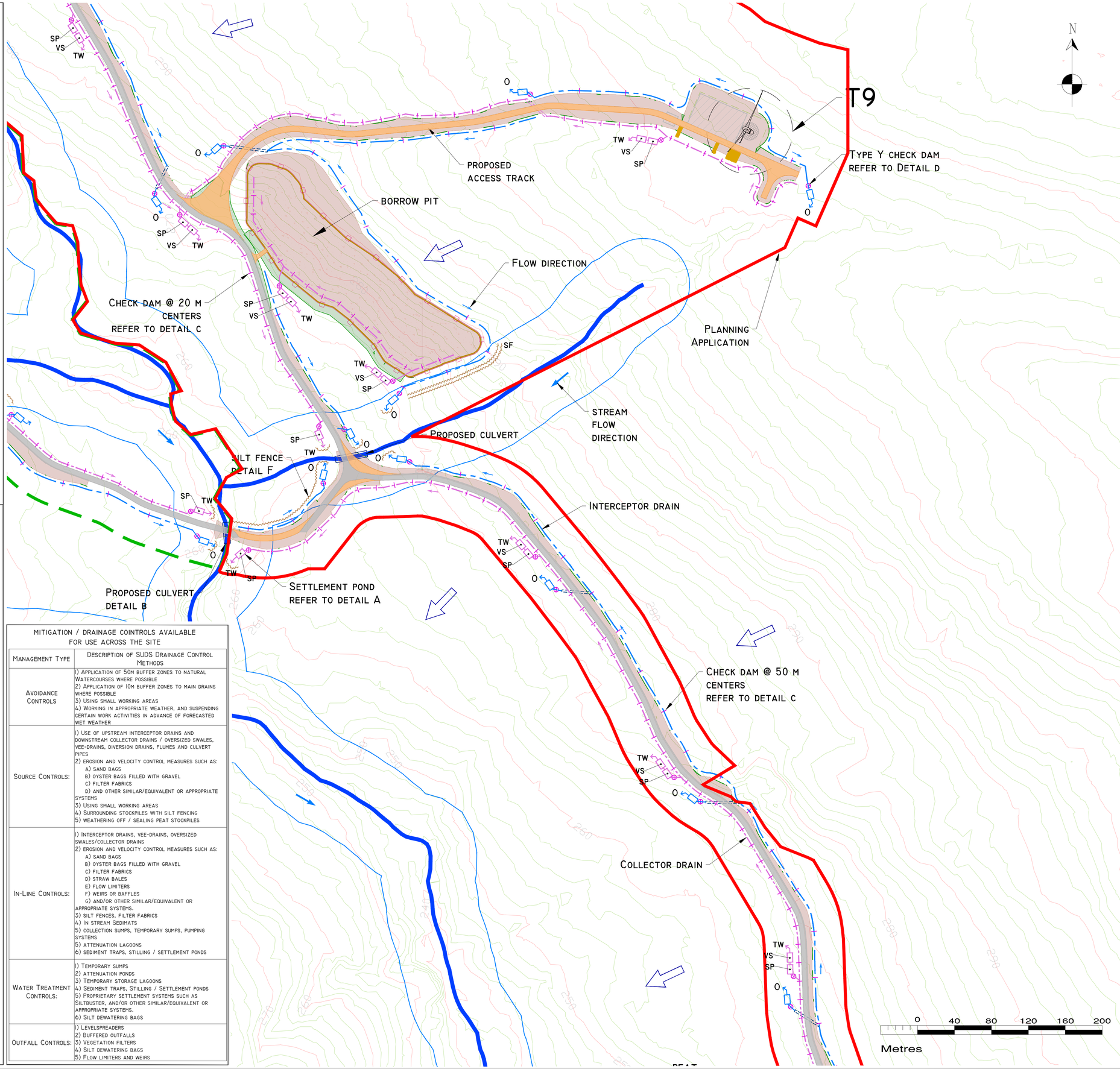
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13. Slopes of the swales / ditches to be vegetated or protected from erosion until vegetation has been established. Stripped vegetative layer (peat 'sod' or 'scraw') from excavations to be stored locally and used to line slopes and base of swales / ditches or longitudinal mounds of vegetation swales at field drain discharge points.
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15. Clean stone flow control check dams to be made of locally won / geologically similar well graded stone. Aggregate size for stone check dams to be typically 20- 40mm clean stone. On sloping sections of the access tracks, 40mm check dams to be protected from washing away through the placement of 100m stone on the downhill face of the check dam and by wrapping in geotextile.
16. Build up of silt levels at check dams to be removed and disposed of appropriately. Silt levels at check dams to be visually inspected as part of an ongoing drainage maintenance programme during the construction phase. Where check dams become clogged with silt or vegetation, stone check dam to be removed and replaced subsequent to the removal of silt.
17. Spacing and frequency of check dams will be dependent upon longitudinal gradient of swale.
18. Location of filtration check dams (if required) to be agreed on site with Engineer. Settlement ponds to be constructed in a manner where they may be easily infilled at a later date (post completion of the turbine base and hardstand construction). Only suitable materials excavated from the pond to be used to form part of the embankment around the pond.
19. Oil/fuel should be stored within bunded containment structures.
20. Silt bags will be used on site at field drain discharge locations, as necessary.

MITIGATION / DRAINAGE COINTROLS AVAILABLE FOR USE ACROSS THE SITE

Management Type	Description of SUDS Drainage Control Methods
Avoidance Controls	1) Application of 50m buffer zones to natural watercourses where possible 2) Application of 10m buffer zones to main drains where possible 3) Using small working areas 4) Working in appropriate weather, and suspending certain work activities in advance of forecasted wet weather
Source Controls:	1) Use of upstream interceptor drains and downstream collector drains / oversized swales, vee-drains, diversion drains, flumes and culvert pipes 2) Erosion and velocity control measures such as: A) Sand bags B) Oyster bags filled with gravel C) Filter fabrics D) and other similar/equivalent or appropriate systems 3) Using small working areas 4) Surrounding stockpiles with silt fencing 5) Weathering off / sealing peat stockpiles
In-Line Controls:	1) Interceptor drains, vee-drains, oversized swales/collector drains 2) Erosion and velocity control measures such as: A) Sand bags B) Oyster bags filled with gravel C) Filter fabrics D) Straw bales E) Flow limiters F) Weirs or baffles G) and/or other similar/equivalent or appropriate systems. 3) Silt fences, filter fabrics 4) In stream Sediments 5) collection sumps, temporary sumps, pumping systems 5) attenuation lagoons 6) sediment traps, stilling / settlement ponds
Water Treatment Controls:	1) Temporary sumps 2) attenuation ponds 3) Temporary storage lagoons 4) Sediment traps, Stilling / Settlement ponds 5) Proprietary settlement systems such as Siltbuster, and/or other similar/equivalent or appropriate systems. 6) Silt dewatering bags
Outfall Controls:	1) Levelspreaders 2) Buffered outfalls 3) Vegetation filters 4) Silt dewatering bags 5) Flow limiters and weirs



Drawing Legend :

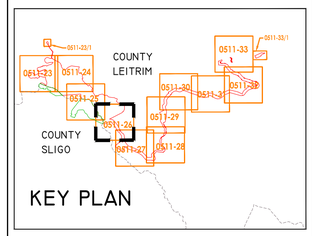
- Rivers/streams
- Lakes
- Rivers/streams 50m buffer
- Lakes 50m buffer
- Stream flow direction
- Drainage flow/runoff direction

Existing Drainage

- Upstream Interceptor Drain
- Swales/Downstream Collector Drain
- Direction of flow
- Silt Fences
- Settlement pond - level spreader
- Settlement pond - vegetation filter - level spreader
- Check Dam 'type A'
- Check Dam 'type B'
- Proposed culverts/bridges
- Interceptor Ditch Culvert
- Collector Ditch Culvert
- O — Overland Flow Discharge
- TW — Treated Water Discharge
- SP — Settlement Pond
- VS — Semi-Natural Vegetation Swale / Filter Bed /secondary sp
- Pumping Sump

Proposed Drainage

- Planning Application Boundary (Leitrim County Council)
- Planning Application Boundary (Sligo County Council)
- Existing ground surface majour contour (10 m interval)
- Existing ground surface minor contour (2 m interval)
- Turbine and swept area
- Turbine foundation
- Crane platform
- Existing road to be upgraded
- Proposed road
- Borrow pit
- Substation
- Construction compound
- Peat repository
- Fill area
- Cut area



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Date	Description	Chkd	Signed

Revisions

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Client: Coillte Teo

Job: Croagh WF

Title: Proposed Drainage Layout

Figure No: 0511-26

Drawing No: P1459-0-0720-A1-0511-26-00A

Sheet Size: A1	Project No.: P1459-0
Scale: 1:2,000 (A1)	Drawn By: MG/GD
Date: 06/07/2020	Checked By: MG

POLLUTION PREVENTION NOTES:

1. Site management proposals are intended to ensure protection against surface water and groundwater pollution, surface water siltation, and stream bank and land erosion.
2. Suitable drainage control measures should be in place at all times to prevent conveyance of significant volumes of silt to off site receiving watercourses.
3. Silty water can arise from dewatering excavations, erosion of exposed/disturbed ground, erosion of temporary stockpiles, plant and wheel wash water, runoff from site roads/tracks, and disturbance of existing field drains and ditches.

Discharges

4. Water containing silt will not be pumped directly to any natural watercourse. All discharges to be made over open ground or into existing field drain with silt trap a minimum 20m from nearest watercourse unless otherwise stated.
5. No excavated material is to be stored within any surface water buffer zone.
6. Pumped water will be directed into track side ditches and treated in settlement ponds and vegetation swales prior to overland discharge.
7. Pumping of clean water from excavations / or over-pumping into field drains/ditches/streams will be completed in a manner that does not cause scour or erosion at the point of release/discharge. This will be done by reducing the flow velocities or by use of splash plates, and other similar discharge controls.
8. Vegetation will NOT be stripped from existing field drains/ditches unless absolutely necessary.

Excavations

9. Where deep excavations are proposed cut-off drains will be use to reduce the amount of surface water entering the excavation. This will be the case around turbine base excavations.

Exposed Ground & Stockpiles

10. The amount of exposed ground and temporary stockpiles open at any one time will be minimised, as far as practicable.

Site tracks

11. Use of track side swales with check dams, and/or filtration check dams will reduce silt in runoff water as required.
12. Check dams to be inspected and cleaned regularly.

Refueling

13. Refuelling will be completed in line with CEMP requirements and away from field drains / ditches and watercourses / waterbodies.
14. Spill kits and drip trays will be available on site for use as required.

Concrete

15. Care will be taken when completing concrete works on site to ensure no discharges of concrete or wash water occurs.
16. Concrete wash water, and waste concrete will be managed appropriately on site.

IF WATER POLLUTION IS IDENTIFIED THE FOLLOWING STEPS WOULD BE ADHERED TO:

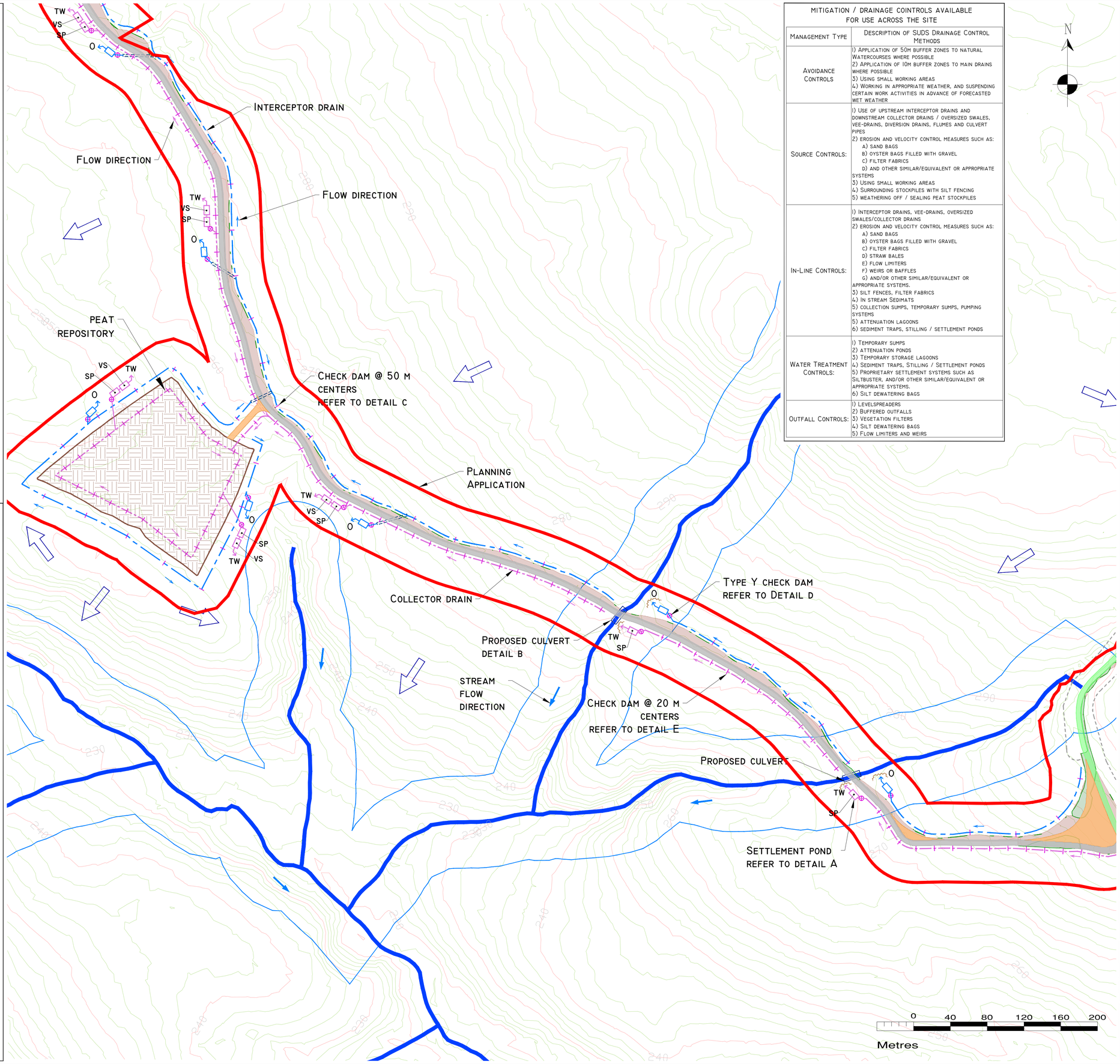
STOP - work in the immediate area should be stopped and the source of the pollution identified.

CONTAIN - the source of the pollution should be bunded using a suitable method. Natural watercourses should be temporarily diverted around the source of pollution.

NOTIFY - The relevant authorities (Site Manager / Inland Fisheries Ireland / NPWS / Local Authority etc.) should be notified immediately to ensure that measures can be implemented downstream to protect fisheries and other sensitive areas, if required.

DRAINAGE NOTES:

1. Roadway surfacing design and construction to Engineer's Specification.
2. Spare straw bales/silt fencing/ or similar, to be stored on site. The level of silt in runoff during construction is to be monitored visually and excessive silt levels in any area to be temporarily managed by placing silt fences, straw bales / or similar or additional check dams at the problem areas.
3. SUDS system to be constructed prior to, or at the same time as the access tracks. Interim measures such as the placement of straw bales/silt fencing/or similar approved method or additional check dams and silt fences to be employed in all instances where work carried out to construct the access tracks is likely to cause adverse environmental effects through increased silt loadings being generated during the construction phase.
4. Suitable prevention measures should be in place at all times to prevent the conveyance of significant volumes of silt to receiving watercourses. See notes on pollution prevention.
5. Interceptor swales / ditches to be used to collect upstream surface water flows. Regular cross drains / discharge to field ditches will be required to transfer / discharge surface water in interceptor drains to suitable field drain outfall points.
6. Drainage swales / ditches to be excavated adjacent to the access tracks. Regular cross drains to be located along access tracks to prevent excessive volumes of water collecting in the swales / ditches. Locations of cross drains to be agreed with the Engineer on site. Surface water will not be allowed to discharge directly into existing watercourses.
7. Where possible, a buffer zone of >20m to any existing watercourse will be required where over land discharges are proposed from access track swales / ditches.
8. Batters of all proposed swales / ditches to have a slope of between 1 : 1.5 to 1 : 2 depending upon depth of swale/ditch and will be left as cut to re-vegetate with local species.
9. Track side swales / ditches to be shallow with moderate gradients to prevent scouring. In steep areas check dams should be installed to reduce flow velocities and provide source control of silt containment. Where necessary these have been designated in conjunction with settlement ponds and silt traps, prior to discharge.
10. Settlement ponds to be constructed for silt removal at turbine bases and hard stand areas. Pond sizes depends on catchment area served. Sample pond sizes shown on Drawing D501.
11. straw bales / or similar and silt fences to be used also around spoil heaps to mitigate silt runoff. Silt fences may be removed when suitable vegetation cover is established.
12. silt fences to be provide along edge of existing watercourse where works comes within <20m of edge of any ditch / ephemeral channels.
13. Slopes of the swales / ditches to be vegetated or protected from erosion until vegetation has been established. Stripped vegetative layer (peat 'sod' or 'scraw') from excavations to be stored locally and used to line slopes and base of swales / ditches or longitudinal mounds of vegetation swales at field drain discharge points.
14. Areas stripped of vegetation should be kept to a minimum.
15. Clean stone flow control check dams to be made of locally won / geologically similar well graded stone. Aggregate size for stone check dams to be typically 20- 40mm clean stone. On sloping sections of the access tracks, 40mm check dams to be protected from washing away through the placement of 100m stone on the downhill face of the check dam and by wrapping in geotextile.
16. Build up of silt levels at check dams to be removed and disposed of appropriately. Silt levels at check dams to be visually inspected as part of an ongoing drainage maintenance programme during the construction phase. Where check dams become clogged with silt or vegetation, stone check dam to be removed and replaced subsequent to the removal of silt.
17. Spacing and frequency of check dams will be dependent upon longitudinal gradient of swale.
18. Location of filtration check dams (if required) to be agreed on site with Engineer. Settlement ponds to be constructed in a manner where they may be easily infilled at a later date (post completion of the turbine base and hardstand construction). Only suitable materials excavated from the pond to be used to form part of the embankment around the pond.
19. Oil/fuel should be stored within bunded containment structures.
20. silt bags will be used on site at field drain discharge locations, as necessary.

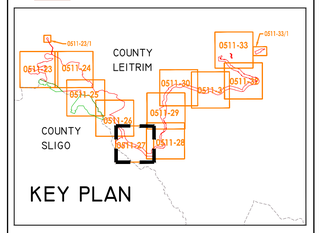


MITIGATION / DRAINAGE COINTROLS AVAILABLE FOR USE ACROSS THE SITE

Management Type	Description of SUDS Drainage Control Methods
Avoidance Controls	1) Application of 50m buffer zones to natural Watercourses where possible 2) Application of 10m buffer zones to main drains where possible 3) Using small working areas 4) Working in appropriate weather, and suspending certain work activities in advance of forecasted wet weather
Source Controls:	1) Use of upstream interceptor drains and downstream collector drains / oversized swales, vee-drains, diversion drains, flumes and culvert pipes 2) erosion and velocity control measures such as: A) sand bags B) oyster bags filled with gravel C) filter fabrics D) and other similar/equivalent or appropriate systems 3) Using small working areas 4) Surrounding stockpiles with silt fencing 5) weathering off / sealing peat stockpiles
In-Line Controls:	1) Interceptor drains, vee-drains, oversized swales/collector drains 2) erosion and velocity control measures such as: A) sand bags B) oyster bags filled with gravel C) filter fabrics D) straw bales E) flow limiters F) weirs or baffles G) and/or other similar/equivalent or appropriate systems. 3) silt fences, filter fabrics 4) In stream Sedimats 5) collection sumps, temporary sumps, pumping systems 5) attenuation lagoons 6) sediment traps, stilling / settlement ponds
Water Treatment Controls:	1) Temporary sumps 2) attenuation ponds 3) Temporary storage lagoons 4) Sediment traps, Stilling / Settlement ponds 5) Proprietary settlement systems such as Siltbuster, and/or other similar/equivalent or appropriate systems. 6) Silt dewatering bags
Outfall Controls:	1) Levelspreaders 2) Buffered outfalls 3) Vegetation filters 4) Silt dewatering bags 5) Flow limiters and weirs

Drawing Legend :

- Existing Drainage
  - Rivers/streams
  - Lakes
  - Rivers/streams 50m buffer
  - Lakes 50m buffer
  - Stream flow direction
  - Drainage flow/runoff direction
- Proposed Drainage
  - Upstream Interceptor Drain
  - Swales/Downstream Collector Drain
  - Direction of flow
  - Silt Fences
  - Settlement pond - level spreader
  - Settlement pond - vegetation filter - level spreader
  - Check Dam 'type A'
  - Check Dam 'type B'
  - Proposed culverts/bridges
  - Interceptor Ditch Culvert
  - Collector Ditch Culvert
  - O Overland Flow Discharge
  - TW Treated Water Discharge
  - SP Settlement Pond
  - VS Semi-Natural Vegetation Swale / Filter Bed /secondary sp
  - Pumping Sump
- Planning Application Boundary (Leitrim County Council)
- Planning Application Boundary (Sligo County Council)
- Existing ground surface majour contour (10 m interval)
- Existing ground surface minor contour (2 m interval)
- Turbine and swept area
- Turbine foundation
- Crane platform
- Existing road to be upgraded
- Proposed road
- Borrow pit
- Substation
- Construction compound
- Peat repository
- Fill area
- Cut area



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Date	Description	Chkd	Signed
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Client: Coilte teo

Job: Croagh WF

Title: Proposed Drainage Layout

Figure No: 0511-27

Drawing No: P1459-0-0720-A1-0511-27-00A

Sheet Size: A1	Project No.: P1459-0
Scale: 1:2,000 (A1)	Drawn By: MG/GD
Date: 06/07/2020	Checked By: MG

POLLUTION PREVENTION NOTES:

1. Site management proposals are intended to ensure protection against surface water and groundwater pollution, surface water siltation, and stream bank and land erosion.
2. Suitable drainage control measures should be in place at all times to prevent conveyance of significant volumes of silt to off site receiving watercourses.
3. Silty water can arise from dewatering excavations, erosion of exposed/disturbed ground, erosion of temporary stockpiles, plant and wheel wash water, runoff from site roads/tracks, and disturbance of existing field drains and ditches.

Discharges

4. Water containing silt will not be pumped directly to any natural watercourse. All discharges to be made over open ground or into existing field drain with silt trap a minimum 20m from nearest watercourse unless otherwise stated.
5. No excavated material is to be stored within any surface water buffer zone.
6. Pumped water will be directed into track side ditches and treated in settlement ponds and vegetation swales prior to overland discharge.
7. Pumping of clean water from excavations / or over-pumping into field drains/ditches/streams will be completed in a manner that does not cause scour or erosion at the point of release/discharge. This will be done by reducing the flow velocities or by use of splash plates, and other similar discharge controls.
8. Vegetation will NOT be stripped from existing field drains/ditches unless absolutely necessary.

Excavations

9. Where deep excavations are proposed cut-off drains will be use to reduce the amount of surface water entering the excavation. This will be the case around turbine base excavations.

Exposed Ground & Stockpiles

10. The amount of exposed ground and temporary stockpiles open at any one time will be minimised, as far as practicable.

Site Tracks

11. Use of track side swales with check dams, and/or filtration check dams will reduce silt in runoff water as required.
12. Check dams to be inspected and cleaned regularly.

Refueling

13. Refuelling will be completed in line with CEMP requirements and away from field drains / ditches and watercourses / waterbodies.
14. Spill kits and drip trays will be available on site for use as required.

Concrete

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16. Concrete wash water, and waste concrete will be managed appropriately on site.

If water pollution is identified the following steps would be adhered to:

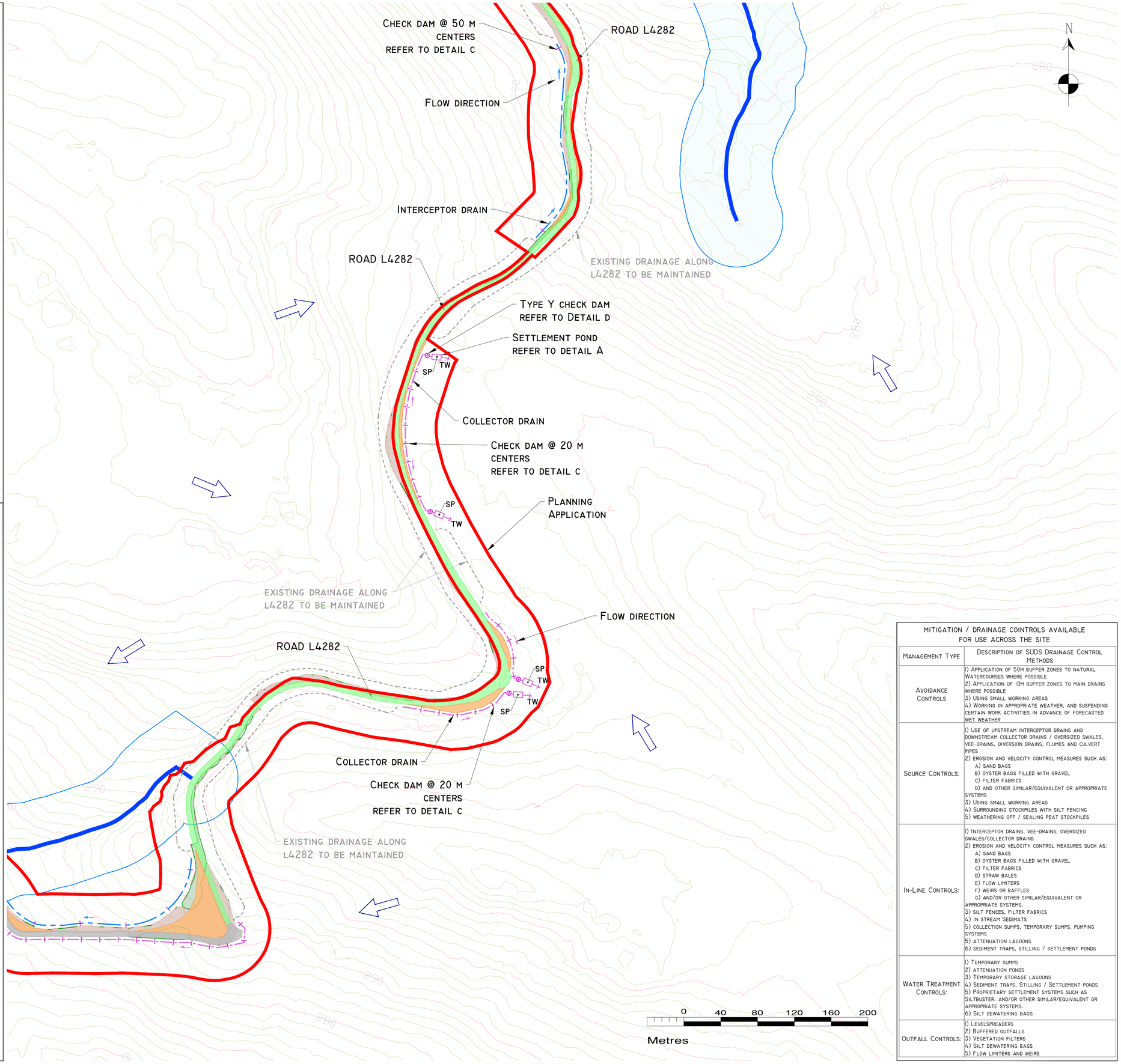
STOP - work in the immediate area should be stopped and the source of the pollution identified.

CONTAIN - the source of the pollution should be bunded using a suitable method. Natural watercourses should be temporarily diverted around the source of pollution.

NOTIFY - The relevant authorities (Site Manager / Inland Fisheries Ireland / NPWS / Local Authority etc.) should be notified immediately to ensure that measures can be implemented downstream to protect fisheries and other sensitive areas, if required.

DRAINAGE NOTES:

1. Roadway surfacing design and construction to Engineer's Specification.
2. Spare straw bales/silt fencing/ or similar, to be stored on site. The level of silt in runoff during construction is to be monitored visually and excessive silt levels in any area to be temporarily managed by placing silt fences, straw bales / or similar or additional check dams at the problem areas.
3. SUDS system to be constructed prior to, or at the same time as the access tracks. Interim measures such as the placement of straw bales/silt fencing/or similar approved method or additional check dams and silt fences to be employed in all instances where work carried out to construct the access tracks is likely to cause adverse environmental effects through increased silt loadings being generated during the construction phase.
4. Suitable prevention measures should be in place at all times to prevent the conveyance of significant volumes of silt to receiving watercourses. See notes on pollution prevention.
5. Interceptor swales / ditches to be used to collect upstream surface water flows. Regular cross drains / discharge to field ditches will be required to transfer / discharge surface water in interceptor drains to suitable field drain outfall points.
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8. Batters of all proposed swales / ditches to have a slope of between 1 : 1.5 to 1 : 2 depending upon depth of swale/ditch and will be left as cut to re-vegetate with local species.
9. Track side swales / ditches to be shallow with moderate gradients to prevent scouring. In steep areas check dams should be installed to reduce flow velocities and provide source control of silt containment. Where necessary these have been designated in conjunction with settlement ponds and silt traps, prior to discharge.
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14. Areas stripped of vegetation should be kept to a minimum.
15. Clean stone flow control check dams to be made of locally won / geologically similar well graded stone. Aggregate size for stone check dams to be typically 20- 40mm clean stone. On sloping sections of the access tracks, 40mm check dams to be protected from washing away through the placement of 100m stone on the downhill face of the check dam and by wrapping in geotextile.
16. Build up of silt levels at check dams to be removed and disposed of appropriately. Silt levels at check dams to be visually inspected as part of an ongoing drainage maintenance programme during the construction phase. Where check dams become clogged with silt or vegetation, stone check dam to be removed and replaced subsequent to the removal of silt.
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19. Oil/fuel should be stored within bunded containment structures.
20. silt bags will be used on site at field drain discharge locations, as necessary.

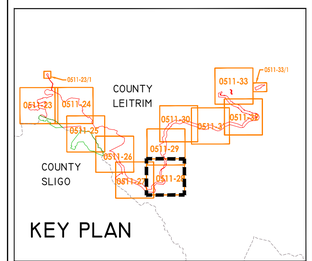


Drawing Legend :

Existing Drainage
- Rivers/Streams
- Rivers/Streams 50m buffer
- Stream flow direction

Proposed Drainage
- Upstream Interceptor Drain
- Swales/Downstream Collector Drain
- Direction of flow
- Silt Fences
- Settlement Pond - Level Spreader
- Check Dam 'Type A'
- Check Dam 'Type B'
- Proposed Culverts/Bridges
- O Overland Flow Discharge
- TW Treated Water Discharge
- SP Settlement Pond
- Pumping Sump
- Large Drainage Arrows

- Planning Application Boundary (Leitrim County Council)
- Planning Application Boundary (Sligo County Council)
- Existing Ground Surface Majour Contour (10 m interval)
- Existing Ground Surface Minor Contour (2 m interval)
- Existing Road to be Upgraded
- Proposed Road
- Road L4282 (No Upgrade) (Existing drainage along road L4282 to be maintained)
- Fill Area
- Cut Area



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MITIGATION / DRAINAGE COINTROLS AVAILABLE FOR USE ACROSS THE SITE

Management Type	Description of SUDS Drainage Control Methods
Avoidance Controls	1) Application of 50m buffer zones to natural Watercourses where possible 2) Application of 10m buffer zones to main drains where possible 3) Using small working areas 4) Working in appropriate weather, and suspending certain work activities in advance of forecasted wet weather
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Outfall Controls:	1) Levelspreaders 2) Buffered outfalls 3) Vegetation filters 4) Silt dewatering bags 5) Flow limiters and weirs

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Client: Coilte teo

Job: Croagh WF

Title: Proposed Drainage Layout

Figure No: 0511-28

Drawing No: P1459-0-0720-A1-0511-28-00A

Sheet Size: A1	Project No.: P1459-0
Scale: 1:2,000 (A1)	Drawn By: MG/GD
Date: 06/07/2020	Checked By: MG

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3. Silty water can arise from dewatering excavations, erosion of exposed/disturbed ground, erosion of temporary stockpiles, plant and wheel wash water, runoff from site roads/tracks, and disturbance of existing field drains and ditches.

Discharges

4. Water containing silt will not be pumped directly to any natural watercourse. All discharges to be made over open ground or into existing field drain with silt trap a minimum 20m from nearest watercourse unless otherwise stated.
5. No excavated material is to be stored within any surface water buffer zone.
6. Pumped water will be directed into track side ditches and treated in settlement ponds and vegetation swales prior to overland discharge.
7. Pumping of clean water from excavations / or over-pumping into field drains/ditches/streams will be completed in a manner that does not cause scour or erosion at the point of release/discharge. This will be done by reducing the flow velocities or by use of splash plates, and other similar discharge controls.
8. Vegetation will NOT be stripped from existing field drains/ditches unless absolutely necessary.

Excavations

9. Where deep excavations are proposed cut-off drains will be use to reduce the amount of surface water entering the excavation. This will be the case around turbine base excavations.

Exposed Ground & Stockpiles

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Site Tracks

11. Use of track side swales with check dams, and/or filtration check dams will reduce silt in runoff water as required.
12. Check dams to be inspected and cleaned regularly.

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13. Refuelling will be completed in line with CEMP requirements and away from field drains / ditches and watercourses / waterbodies.
14. Spill kits and drip trays will be available on site for use as required.

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16. Concrete wash water, and waste concrete will be managed appropriately on site.

If water pollution is identified the following steps would be adhered to:

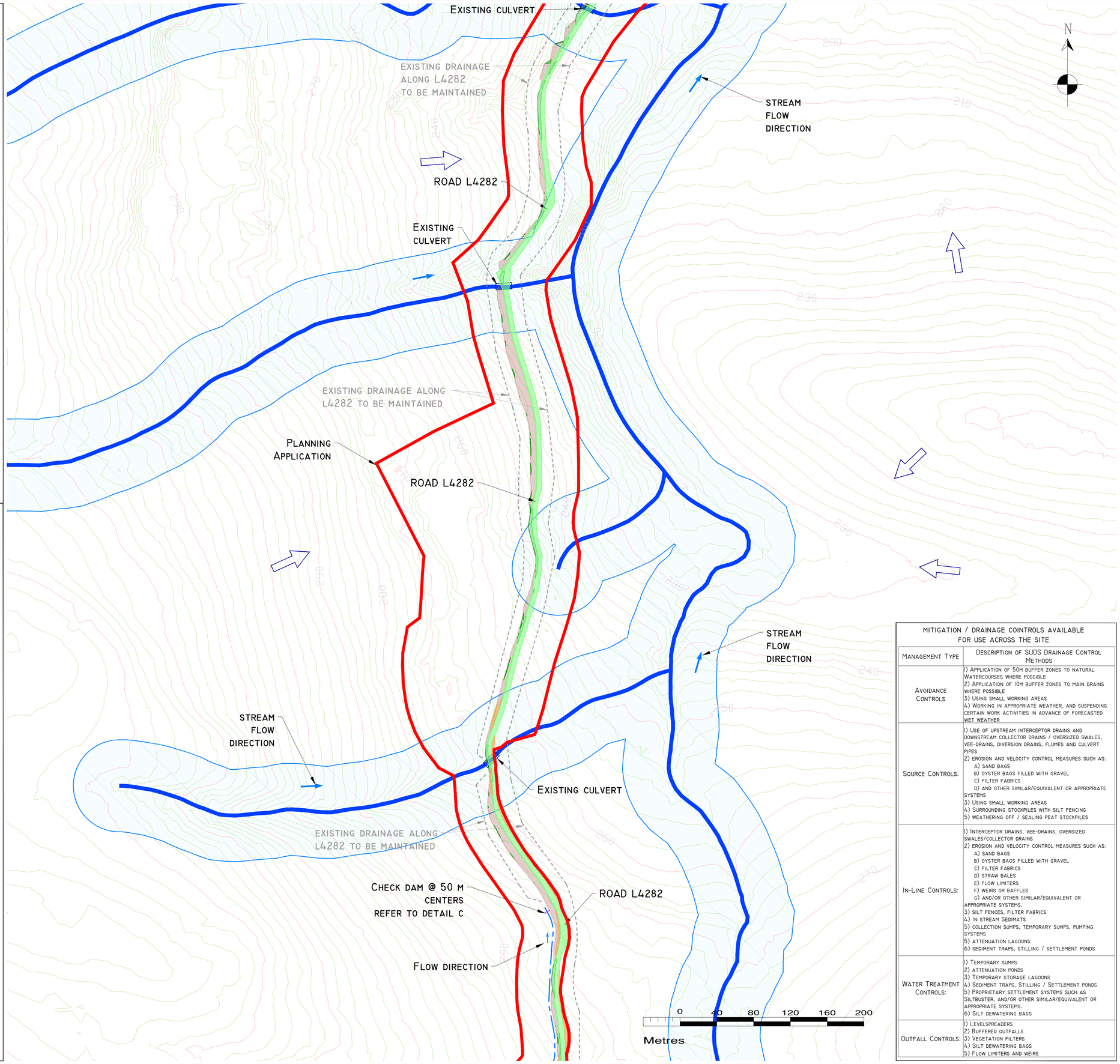
STOP - work in the immediate area should be stopped and the source of the pollution identified.

CONTAIN - the source of the pollution should be bunded using a suitable method. Natural watercourses should be temporarily diverted around the source of pollution.

NOTIFY - The relevant authorities (Site Manager / Inland Fisheries Ireland / NPWS / Local Authority etc.) should be notified immediately to ensure that measures can be implemented downstream to protect fisheries and other sensitive areas, if required.

DRAINAGE NOTES:

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2. Spare straw bales/silt fencing/ or similar, to be stored on site. The level of silt in runoff during construction is to be monitored visually and excessive silt levels in any area to be temporarily managed by placing silt fences, straw bales / or similar or additional check dams at the problem areas.
3. SUDS system to be constructed prior to, or at the same time as the access tracks. Interim measures such as the placement of straw bales/silt fencing/or similar approved method or additional check dams and silt fences to be employed in all instances where work carried out to construct the access tracks is likely to cause adverse environmental effects through increased silt loadings being generated during the construction phase.
4. Suitable prevention measures should be in place at all times to prevent the conveyance of significant volumes of silt to receiving watercourses. See notes on pollution prevention.
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7. Where possible, a buffer zone of >20m to any existing watercourse will be required where over land discharges are proposed from access track swales / ditches.
8. Batters of all proposed swales / ditches to have a slope of between 1 : 1.5 to 1 : 2 depending upon depth of swale/ditch and will be left as cut to re-vegetate with local species.
9. Track side swales / ditches to be shallow with moderate gradients to prevent scouring. In steep areas check dams should be installed to reduce flow velocities and provide source control of silt containment. Where necessary these have been designated in conjunction with settlement ponds and silt traps, prior to discharge.
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14. Areas stripped of vegetation should be kept to a minimum.
15. Clean stone flow control check dams to be made of locally won / geologically similar well graded stone. Aggregate size for stone check dams to be typically 20- 40mm clean stone. On sloping sections of the access tracks, 40mm check dams to be protected from washing away through the placement of 100m stone on the downhill face of the check dam and by wrapping in geotextile.
16. Build up of silt levels at check dams to be removed and disposed of appropriately. Silt levels at check dams to be visually inspected as part of an ongoing drainage maintenance programme during the construction phase. Where check dams become clogged with silt or vegetation, stone check dam to be removed and replaced subsequent to the removal of silt.
17. Spacing and frequency of check dams will be dependent upon longitudinal gradient of swale.
18. Location of filtration check dams (if required) to be agreed on site with Engineer. Settlement ponds to be constructed in a manner where they may be easily infilled at a later date (post completion of the turbine base and hardstand construction). Only suitable materials excavated from the pond to be used to form part of the embankment around the pond.
19. Oil/fuel should be stored within bunded containment structures.
20. silt bags will be used on site at field drain discharge locations, as necessary.

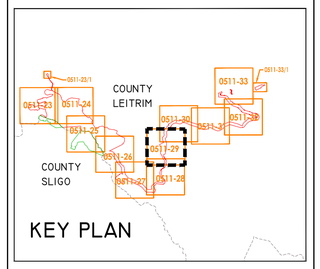


MITIGATION / DRAINAGE COINTROLS AVAILABLE FOR USE ACROSS THE SITE

Management Type	Description of SUDS Drainage Control Methods
Avoidance Controls	1) Application of 50m buffer zones to natural Watercourses where possible 2) Application of 10m buffer zones to main drains where possible 3) Using small working areas 4) Working in appropriate weather, and suspending certain work activities in advance of forecasted wet weather
Source Controls:	1) Use of upstream interceptor drains and downstream collector drains / oversized swales, vee-drains, diversion drains, flumes and culvert pipes 2) Erosion and velocity control measures such as: A) Sand bags B) Oyster bags filled with gravel C) Filter fabrics D) and other similar/equivalent or appropriate systems 3) Using small working areas 4) Surrounding stockpiles with silt fencing 5) Weathering off / sealing peat stockpiles
In-Line Controls:	1) Interceptor drains, vee-drains, oversized swales/collector drains 2) Erosion and velocity control measures such as: A) Sand bags B) oyster bags filled with gravel C) Filter fabrics D) straw bales E) Flow limiters F) weirs or baffles G) and/or other similar/equivalent or appropriate systems. 3) Silt fences, filter fabrics 4) In stream Sedimats 5) collection sumps, temporary sumps, pumping systems 5) attenuation lagoons 6) sediment traps, stilling / settlement ponds
Water Treatment Controls:	1) Temporary sumps 2) Attenuation ponds 3) Temporary storage lagoons 4) Sediment traps, Stilling / Settlement ponds 5) Proprietary settlement systems such as Siltbuster, and/or other similar/equivalent or appropriate systems. 6) Silt dewatering bags
Outfall Controls:	1) Levelspreaders 2) Buffered outfalls 3) Vegetation filters 4) Silt dewatering bags 5) Flow limiters and weirs

Drawing Legend :

- Existing Drainage
  - Rivers/Streams
  - Rivers/Streams 50m buffer
  - Stream flow direction
- Proposed Drainage
  - Upstream Interceptor Drain
  - Swales/Downstream Collector Drain
  - Direction of flow
  - Silt Fences
  - Settlement pond - level spreader
  - Check Dam 'type A'
  - Check Dam 'type B'
  - proposed culverts/bridges
  - O Overland Flow Discharge
  - TW Treated Water Discharge
  - SP Settlement Pond
  - Pumping Sump
  - large drainage arrows
- Planning Application Boundary (Leitrim County Council)
- Planning Application Boundary (Sligo County Council)
- Existing ground surface majour contour (10 m interval)
- Existing ground surface minor contour (2 m interval)
- existing road to be upgraded
- proposed road
- road L4282 (no upgrade) (existing drainage along road L4282 to be maintained)
- fill area
- cut area



KEY PLAN

Drawing Notes

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Date	Description	Chkd	Signed

Revisions

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Client: Coilte teo

Job: Croagh WF

Title: Proposed Drainage Layout

Figure No: 0511-29

Drawing No: P1459-0-0720-A1-0511-29-00A

Sheet Size: A1	Project No.: P1459-0
Scale: 1:2,000 (A1)	Drawn By: MG/GD
Date: 06/07/2020	Checked By: MG

POLLUTION PREVENTION NOTES:

1. Site management proposals are intended to ensure protection against surface water and groundwater pollution, surface water siltation, and stream bank and land erosion.
2. Suitable drainage control measures should be in place at all times to prevent conveyance of significant volumes of silt to off site receiving watercourses.
3. Silty water can arise from dewatering excavations, erosion of exposed/disturbed ground, erosion of temporary stockpiles, plant and wheel wash water, runoff from site roads/tracks, and disturbance of existing field drains and ditches.

Discharges

4. Water containing silt will not be pumped directly to any natural watercourse. All discharges to be made over open ground or into existing field drain with silt trap a minimum 20m from nearest watercourse unless otherwise stated.
5. No excavated material is to be stored within any surface water buffer zone.
6. Pumped water will be directed into track side ditches and treated in settlement ponds and vegetation swales prior to overland discharge.
7. Pumping of clean water from excavations / or over-pumping into field drains/ditches/streams will be completed in a manner that does not cause scour or erosion at the point of release/discharge. This will be done by reducing the flow velocities or by use of splash plates, and other similar discharge controls.
8. Vegetation will NOT be stripped from existing field drains/ditches unless absolutely necessary.

Excavations

9. Where deep excavations are proposed cut-off drains will be use to reduce the amount of surface water entering the excavation. This will be the case around turbine base excavations.

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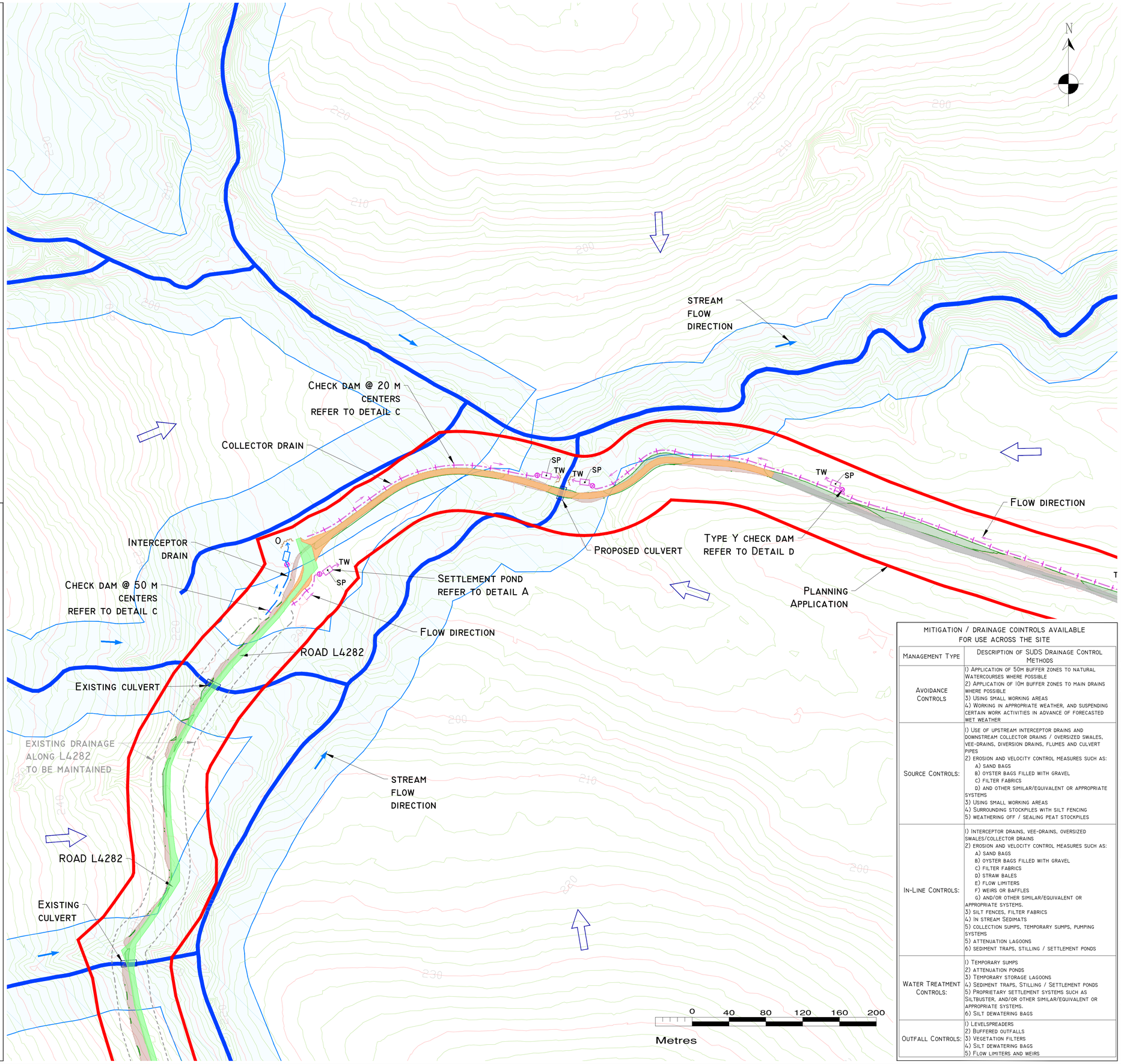
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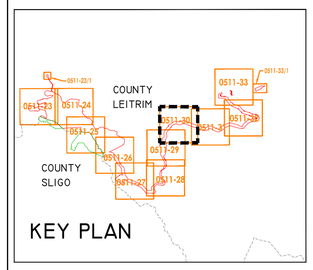


DRAWING LEGEND :

EXISTING DRAINAGE
- RIVERS/STREAMS
- RIVERS/STREAMS 50M BUFFER
- STREAM FLOW DIRECTION

PROPOSED DRAINAGE
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- SWALES/DOWNSTREAM COLLECTOR DRAIN
- DIRECTION OF FLOW
- SILT FENCES
- SETTLEMENT POND - LEVEL SPREADER
- CHECK DAM 'TYPE A'
- CHECK DAM 'TYPE B'
- PROPOSED CULVERTS/BRIDGES
- O OVERLAND FLOW DISCHARGE
- TW TREATED WATER DISCHARGE
- SP SETTLEMENT POND
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- LARGE DRAINAGE ARROWS

- PLANNING APPLICATION BOUNDARY (LEITRIM COUNTY COUNCIL)
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- EXISTING GROUND SURFACE MAJOUR CONTOUR (10 M INTERVAL)
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- EXISTING ROAD TO BE UPGRADED
- PROPOSED ROAD
- ROAD L4282 (NO UPGRADE) (EXISTING DRAINAGE ALONG ROAD L4282 TO BE MAINTAINED)
- FILL AREA
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Date	Description	Chkd	Signed

Revisions

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Client: Coilte teo

Job: Croagh WF

Title: Proposed Drainage Layout

Figure No: 0511-30

Drawing No: P1459-0-0720-A1-0511-30-00A

Sheet Size: A1	Project No.: P1459-0
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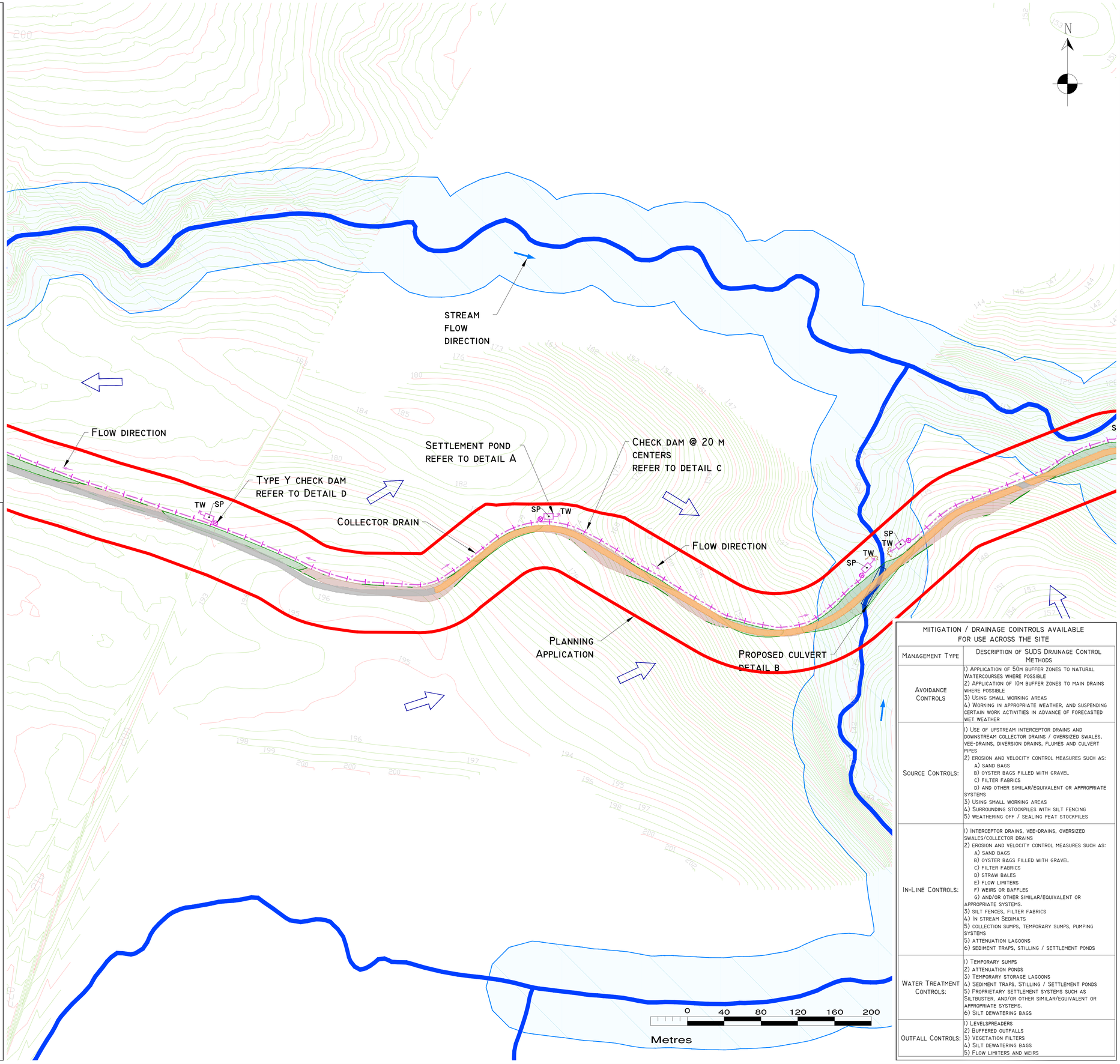
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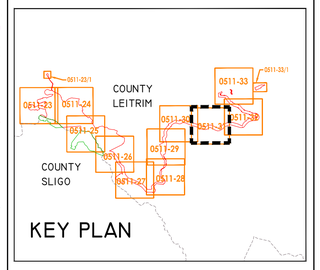


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- CUT AREA



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MITIGATION / DRAINAGE COINTROLS AVAILABLE FOR USE ACROSS THE SITE

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In-Line Controls:	1) Interceptor drains, vee-drains, oversized swales/collector drains 2) Erosion and velocity control measures such as: A) Sand bags B) Oyster bags filled with gravel C) Filter fabrics D) Straw bales E) Flow limiters F) Weirs or baffles G) And/or other similar/equivalent or appropriate systems. 3) Silt fences, filter fabrics 4) In stream Sedimats 5) Collection sumps, temporary sumps, pumping systems 5) Attenuation lagoons 6) Sediment traps, stilling / settlement ponds
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Outfall Controls:	1) Levelspreaders 2) Buffered outfalls 3) Vegetation filters 4) Silt dewatering bags 5) Flow limiters and weirs

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Date	Description	Chkd	Signed

Revisions

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Client: COILTE TEO

Job: CROAGH WF

Title: PROPOSED DRAINAGE LAYOUT

Figure No: 0511-31

Drawing No: P1459-0-0620-A1-0511-31-00A

Sheet Size: A1	Project No.: P1459-0
Scale: 1:2,000 (A1)	Drawn By: MG/GD
Date: 03/06/2020	Checked By: MG

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2. Suitable drainage control measures should be in place at all times to prevent conveyance of significant volumes of silt to off site receiving watercourses.
3. Silty water can arise from dewatering excavations, erosion of exposed/disturbed ground, erosion of temporary stockpiles, plant and wheel wash water, runoff from site roads/tracks, and disturbance of existing field drains and ditches.

Discharges

4. Water containing silt will not be pumped directly to any natural watercourse. All discharges to be made over open ground or into existing field drain with silt trap a minimum 20m from nearest watercourse unless otherwise stated.
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7. Pumping of clean water from excavations / or over-pumping into field drains/ditches/streams will be completed in a manner that does not cause scour or erosion at the point of release/discharge. This will be done by reducing the flow velocities or by use of splash plates, and other similar discharge controls.
8. Vegetation will NOT be stripped from existing field drains/ditches unless absolutely necessary.

Excavations

9. Where deep excavations are proposed cut-off drains will be use to reduce the amount of surface water entering the excavation. This will be the case around turbine base excavations.

Exposed Ground & Stockpiles

10. The amount of exposed ground and temporary stockpiles open at any one time will be minimised, as far as practicable.

Site tracks

11. Use of track side swales with check dams, and/or filtration check dams will reduce silt in runoff water as required.
12. Check dams to be inspected and cleaned regularly.

Refueling

13. Refuelling will be completed in line with CEMP requirements and away from field drains / ditches and watercourses / waterbodies.
14. Spill kits and drip trays will be available on site for use as required.

Concrete

15. Care will be taken when completing concrete works on site to ensure no discharges of concrete or wash water occurs.
16. Concrete wash water, and waste concrete will be managed appropriately on site.

IF WATER POLLUTION IS IDENTIFIED THE FOLLOWING STEPS WOULD BE ADHERED TO:

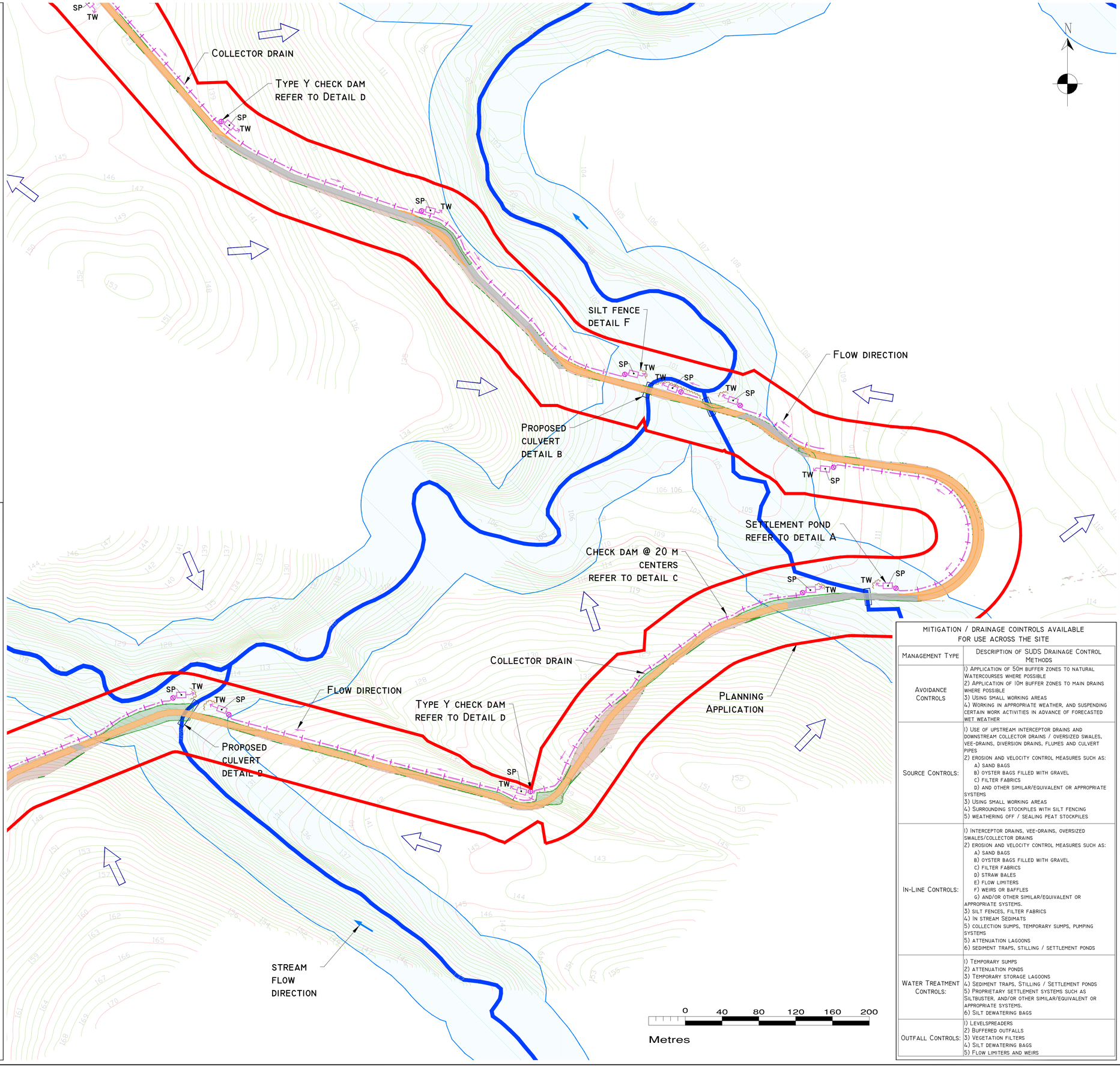
STOP - work in the immediate area should be stopped and the source of the pollution identified.

CONTAIN - the source of the pollution should be bunded using a suitable method. Natural watercourses should be temporarily diverted around the source of pollution.

NOTIFY - the relevant authorities (Site Manager / Inland Fisheries Ireland / NPWS / Local Authority etc.) should be notified immediately to ensure that measures can be implemented downstream to protect fisheries and other sensitive areas, if required.

DRAINAGE NOTES:

1. Roadway surfacing design and construction to Engineer's Specification.
2. Spare straw bales/silt fencing/ or similar, to be stored on site. The level of silt in runoff during construction is to be monitored visually and excessive silt levels in any area to be temporarily managed by placing silt fences, straw bales / or similar or additional check dams at the problem areas.
3. SUDS system to be constructed prior to, or at the same time as the access tracks. Interim measures such as the placement of straw bales/silt fencing/or similar approved method or additional check dams and silt fences to be employed in all instances where work carried out to construct the access tracks is likely to cause adverse environmental effects through increased silt loadings being generated during the construction phase.
4. Suitable prevention measures should be in place at all times to prevent the conveyance of significant volumes of silt to receiving watercourses. See notes on pollution prevention.
5. Interceptor swales / ditches to be used to collect upstream surface water flows. Regular cross drains / discharge to field ditches will be required to transfer / discharge surface water in interceptor drains to suitable field drain outfall points.
6. Drainage swales / ditches to be excavated adjacent to the access tracks. Regular cross drains to be located along access tracks to prevent excessive volumes of water collecting in the swales / ditches. Locations of cross drains to be agreed with the Engineer on site. Surface water will not be allowed to discharge directly into existing watercourses.
7. Where possible, a buffer zone of >20m to any existing watercourse will be required where over land discharges are proposed from access track swales / ditches.
8. Batters of all proposed swales / ditches to have a slope of between 1 : 1.5 to 1 : 2 depending upon depth of swale/ditch and will be left as cut to re-vegetate with local species.
9. Track side swales / ditches to be shallow with moderate gradients to prevent scouring. In steep areas check dams should be installed to reduce flow velocities and provide source control of silt containment. Where necessary these have been designated in conjunction with settlement ponds and silt traps, prior to discharge.
10. Settlement ponds to be constructed for silt removal at turbine bases and hard stand areas. Pond sizes depends on catchment area served. Sample pond sizes shown on Drawing D501.
11. straw bales / or similar and silt fences to be used also around spoil heaps to mitigate silt runoff. silt fences may be removed when suitable vegetation cover is established.
12. silt fences to be provide along edge of existing watercourse where works comes within <20m of edge of any ditch / ephemeral channels.
13. Slopes of the swales / ditches to be vegetated or protected from erosion until vegetation has been established. Stripped vegetative layer (peat 'sod' or 'scraw') from excavations to be stored locally and used to line slopes and base of swales / ditches or longitudinal mounds of vegetation swales at field drain discharge points.
14. Areas stripped of vegetation should be kept to a minimum.
15. Clean stone flow control check dams to be made of locally won / geologically similar well graded stone. Aggregate size for stone check dams to be typically 20- 40mm clean stone. On sloping sections of the access tracks, 40mm check dams to be protected from washing away through the placement of 100m stone on the downhill face of the check dam and by wrapping in geotextile.
16. Build up of silt levels at check dams to be removed and disposed of appropriately. Silt levels at check dams to be visually inspected as part of an ongoing drainage maintenance programme during the construction phase. Where check dams become clogged with silt or vegetation, stone check dam to be removed and replaced subsequent to the removal of silt.
17. Spacing and frequency of check dams will be dependent upon longitudinal gradient of swale.
18. Location of filtration check dams (if required) to be agreed on site with Engineer. Settlement ponds to be constructed in a manner where they may be easily infilled at a later date (post completion of the turbine base and hardstand construction). Only suitable materials excavated from the pond to be used to form part of the embankment around the pond.
19. Oil/fuel should be stored within bunded containment structures.
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DRAWING LEGEND :

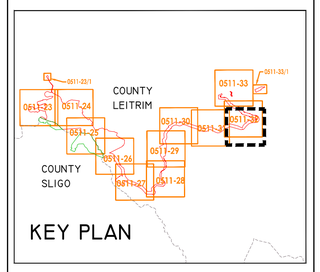
- RIVERS/STREAMS
- RIVERS/STREAMS 50M BUFFER
- STREAM FLOW DIRECTION

EXISTING DRAINAGE

- UPSTREAM INTERCEPTOR DRAIN
- SWALES/DOWNSTREAM COLLECTOR DRAIN
- DIRECTION OF FLOW
- SILT FENCES
- SETTLEMENT POND - LEVEL SPREADER
- CHECK DAM 'TYPE A'
- CHECK DAM 'TYPE B'
- PROPOSED CULVERTS/BRIDGES
- O OVERLAND FLOW DISCHARGE
- TW TREATED WATER DISCHARGE
- SP SETTLEMENT POND
- PUMPING SUMP
- LARGE DRAINAGE ARROWS

PROPOSED DRAINAGE

- PLANNING APPLICATION BOUNDARY (LEITRIM COUNTY COUNCIL)
- PLANNING APPLICATION BOUNDARY (SLIGO COUNTY COUNCIL)
- EXISTING GROUND SURFACE MAJOUR CONTOUR (10 M INTERVAL)
- EXISTING GROUND SURFACE MINOR CONTOUR (2 M INTERVAL)
- EXISTING ROAD TO BE UPGRADED
- PROPOSED ROAD
- ROAD L4282 (NO UPGRADE) (EXISTING DRAINAGE ALONG ROAD L4282 TO BE MAINTAINED)
- FILL AREA
- CUT AREA



KEY PLAN

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Revisions

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web: www.hydroenvironmental.ie

Client: Coilte teo

Job: Croagh WF

Title: Proposed Drainage Layout

Figure No: 0511-32

Drawing No: P1459-0-0720-A1-0511-32-00A

Sheet Size: A1	Project No.: P1459-0
Scale: 1:2,000 (A1)	Drawn By: MG/GD
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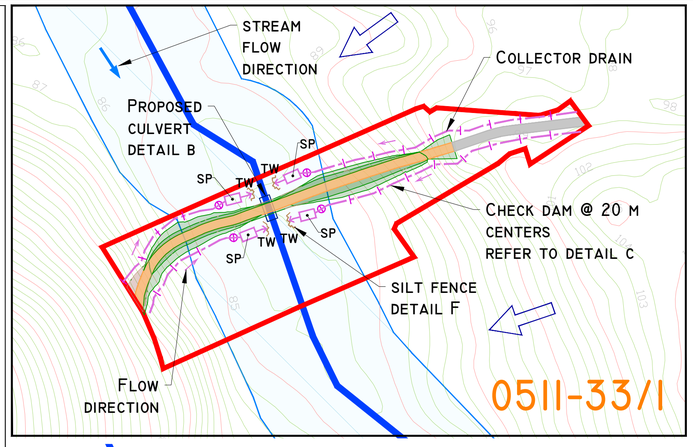
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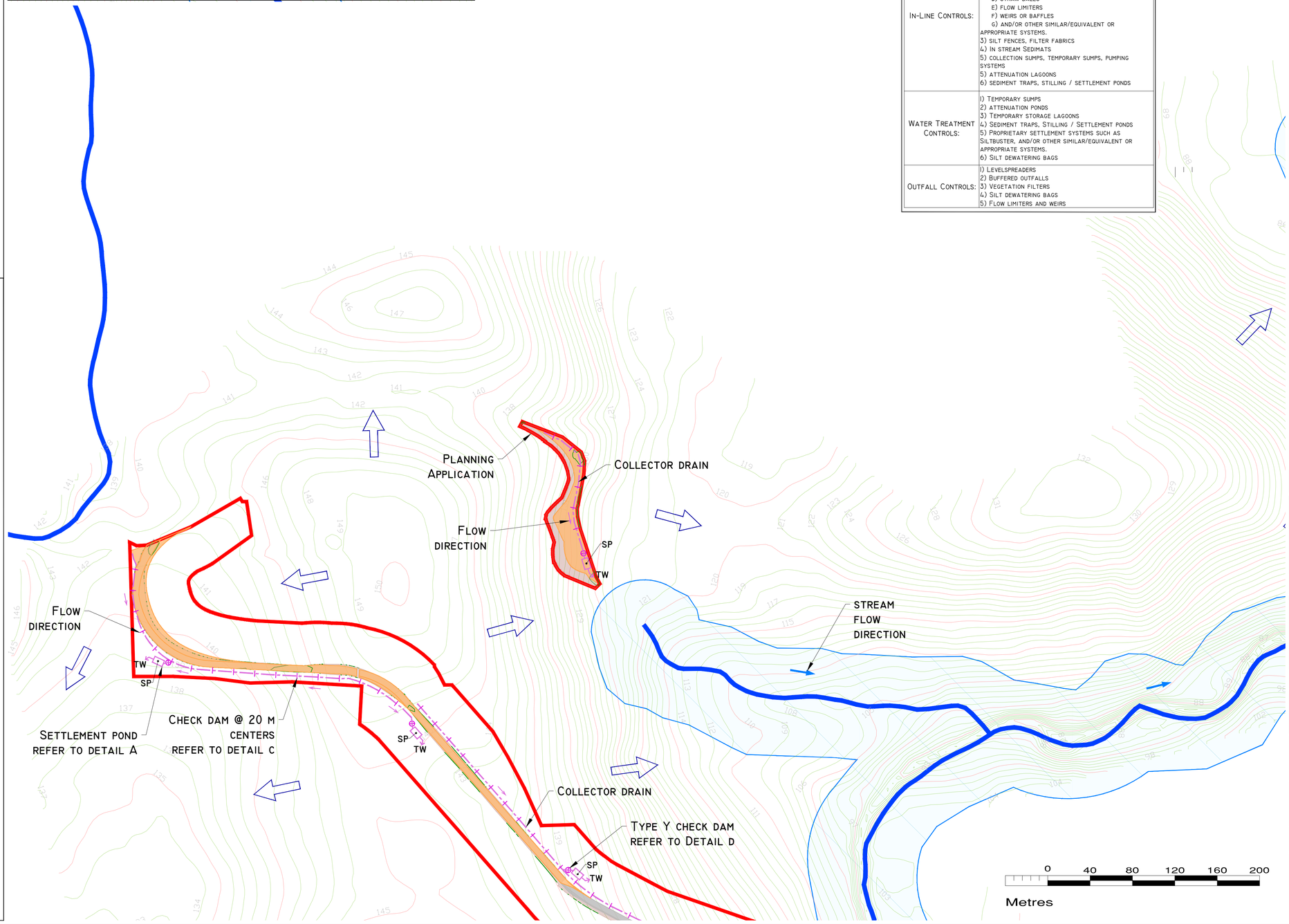
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N

Drawing Legend :

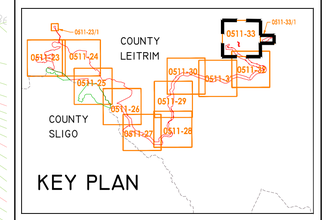
- Rivers/streams
- Lakes
- rivers/streams 50m buffer
- Lakes 50m buffer
- Stream flow direction
- Drainage flow/runoff direction

(Existing Drainage)

- Upstream Interceptor Drain
- Swales/Downstream Collector Drain
- Direction of flow
- Silt Fences
- Settlement pond - level spreader
- Settlement pond - vegetation filter - level spreader
- Check Dam 'type A'
- Check Dam 'type B'
- proposed culverts/bridges
- Interceptor Ditch Culvert
- Collector Ditch Culvert
- O Overland Flow Discharge
- TW Treated Water Discharge
- SP Settlement Pond
- VS Semi-Natural Vegetation Swale / Filter Bed /secondary sp
- Pumping Sump

(Proposed Drainage)

- Planning Application Boundary (Leitrim County Council)
- Planning Application Boundary (Sligo County Council)
- Existing ground surface majour contour (10 m interval)
- Existing ground surface minor contour (2 m interval)
- turbine and swept area
- turbine foundation
- crane platform
- existing road to be upgraded
- proposed road
- borrow pit
- substation
- construction compound
- peat repository
- fill area
- cut area



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Date	Description	Chkd	Signed

Revisions

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Client: Coillte Teo

Job: Croagh WF

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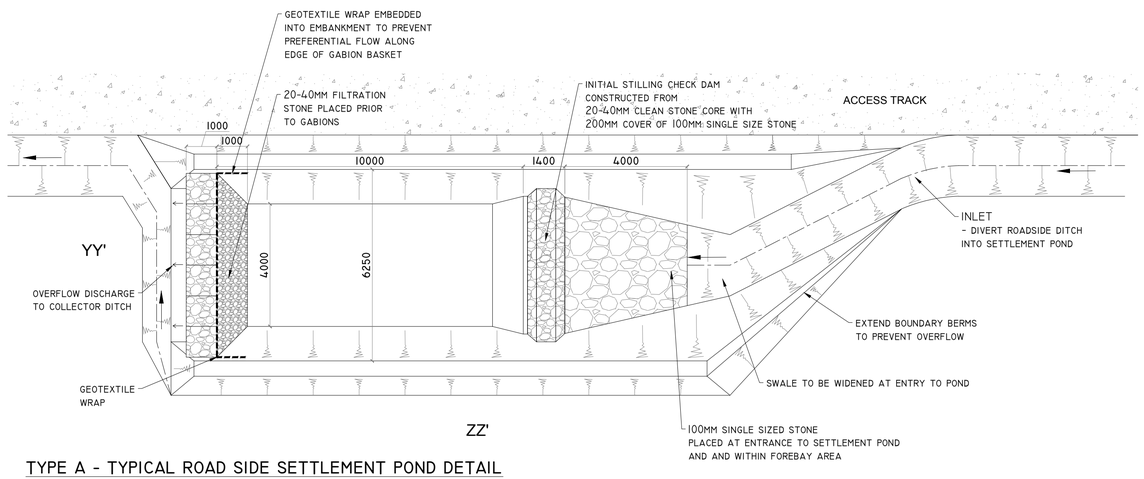
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Date: 06/07/2020	Checked By: MG

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Metres

DETAIL A1

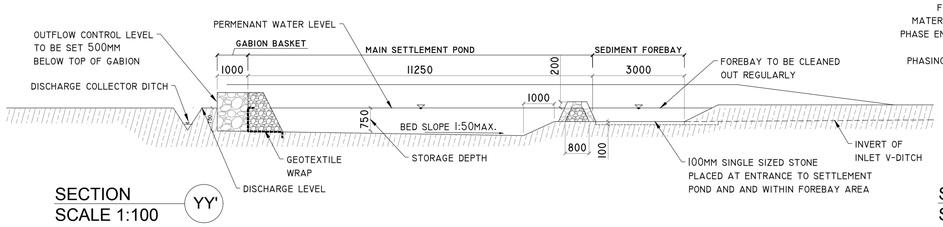


TYPE A - TYPICAL ROAD SIDE SETTLEMENT POND DETAIL

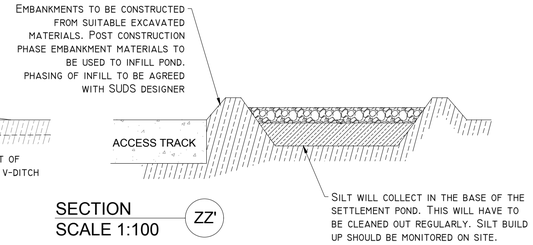
SCALE 1:200 (NOTE DIMENSIONS VARY DEPENDING ON CATCHMENT SIZE - SEE ATTACHED TABLE)

EXAMPLE SETTLEMENT POND SIZES

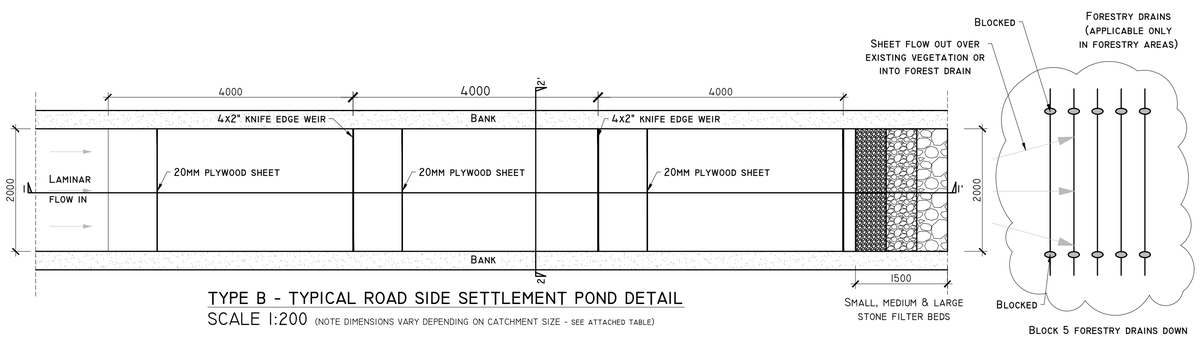
POND SIZE W [M] x L [M] x D [M]			CATCHMENT SIZE (M^2)		
RETURN PERIOD	*50 YRS*	STORM DURATION	500	1000	2000
6HR RETENTION FOR COARSE SILT		6 HRS	2.8 x 9 x 1 M	4 x 13 x 1 M	5.7 x 18 x 1 M
11HR RETENTION FOR MEDIUM SILT		12 HRS	3.2 x 10 x 1 M	4.5 x 14 x 1 M	6.4 x 20 x 1 M
24HR RETENTION FOR FINE SILT		24 HRS	3.5 x 11 x 1 M	5 x 16 x 1 M	7 x 22 x 1 M



SECTION YY'
SCALE 1:100

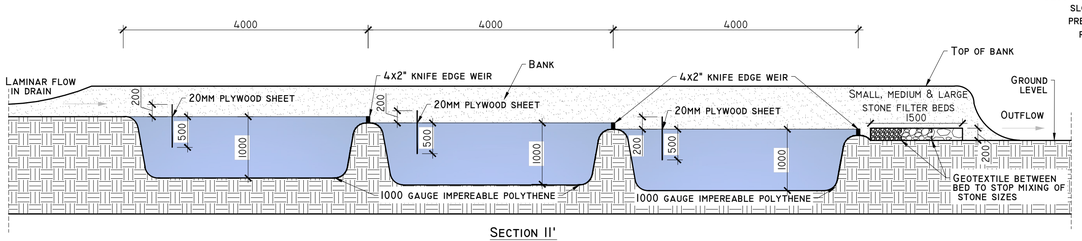


SECTION ZZ'
SCALE 1:100

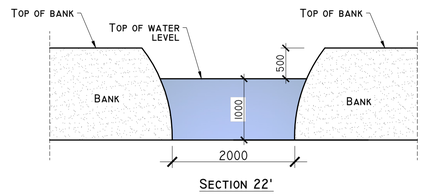


TYPE B - TYPICAL ROAD SIDE SETTLEMENT POND DETAIL

SCALE 1:200 (NOTE DIMENSIONS VARY DEPENDING ON CATCHMENT SIZE - SEE ATTACHED TABLE)

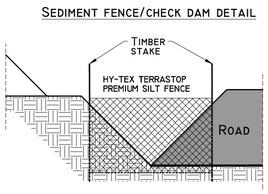


SECTION 11'



SECTION 22'

SEDIMENT FENCE/CHECK DAM DETAIL



DETAIL A2

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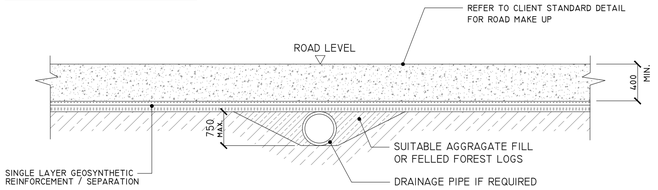
Job: CROAGH WF

Title: DRAINAGE DETAILS 1

Figure No: 0511-34

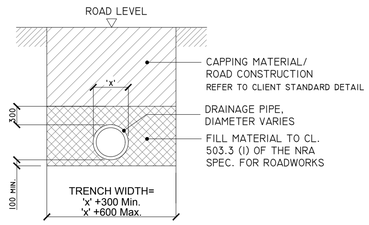
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DETAIL B



'TYPE A' CULVERT - DRAINAGE CROSSING BENEATH FLOATING ROAD

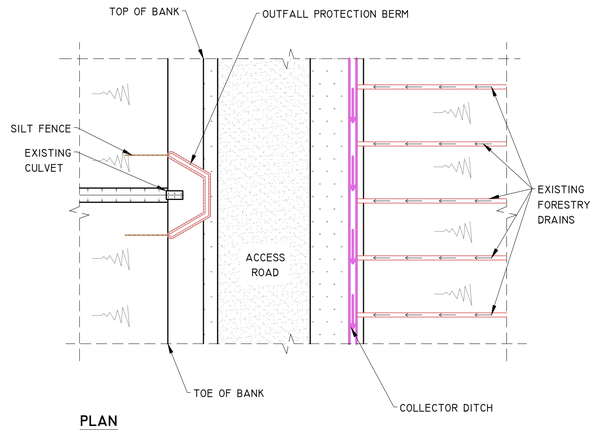
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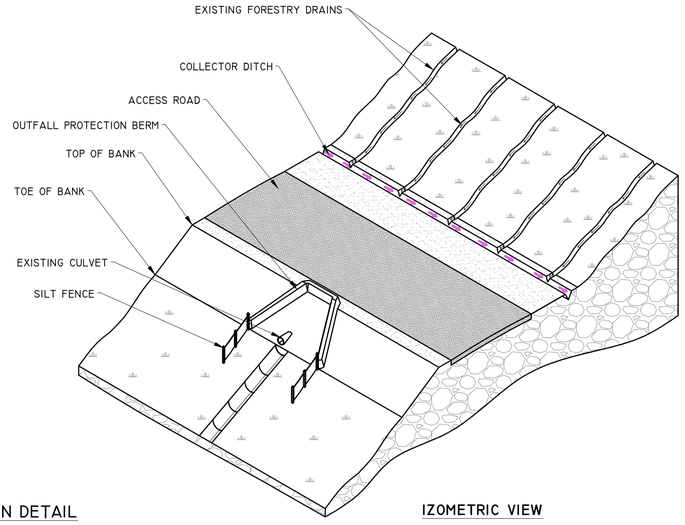
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SCALE 1:50

DETAIL BI



PLAN

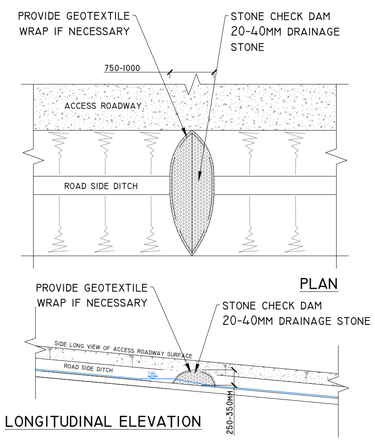


IZOMETRIC VIEW

CULVET - OUTFALL PROTECTION DETAIL

SCHEMATIC - NOT TO SCALE

DETAIL C



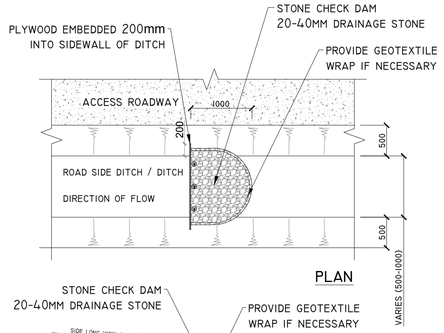
PLAN

LONGITUDINAL ELEVATION

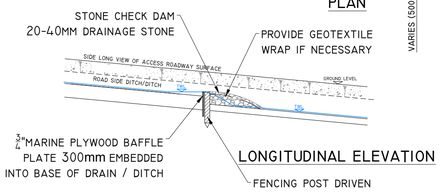
TYPE X - CHECK DAM DETAIL

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DETAIL D



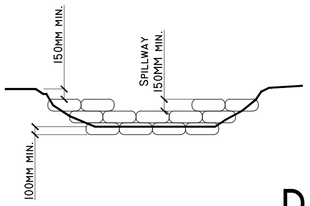
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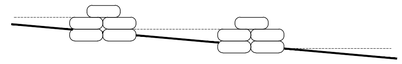


LONGITUDINAL ELEVATION

TYPE Y - CHECK DAM DETAIL

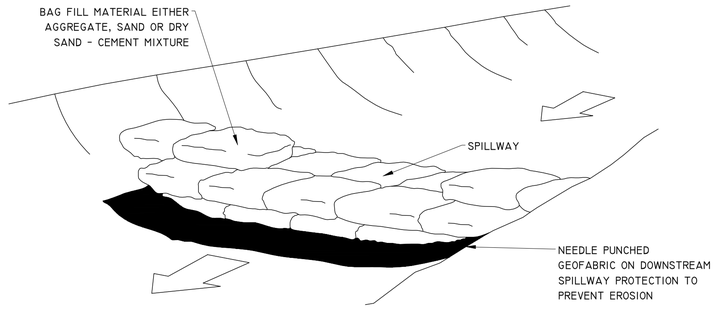
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NOTE: SPACING OF CHECK DAMS ALONG
CENTRELINE AND SCOUR PROTECTION
BELOW EACH CHECK DAM

DETAIL CI



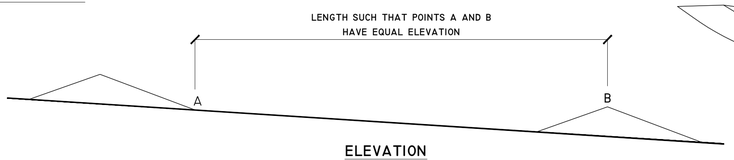
TEMPORARY CHECK DAM / SETTLEMENT POND OVERFLOW
SAND FILLED BAG CONSTRUCTION

SCHEMATIC - NOT TO SCALE

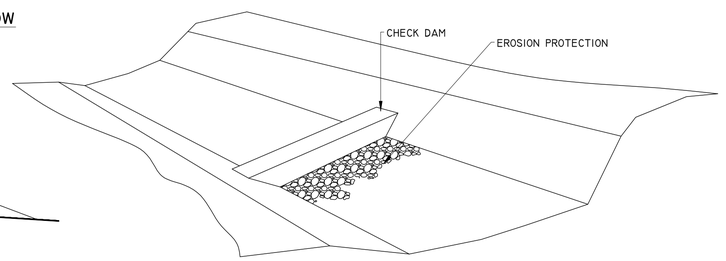
DETAIL C2

TEMPORARY CHECK DAM / SETTLEMENT POND OVERFLOW

SCHEMATIC - NOT TO SCALE



ELEVATION



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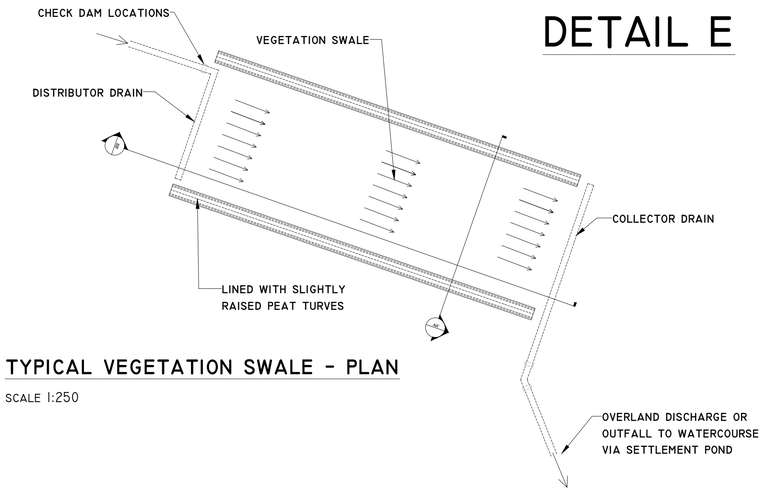
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Title: DRAINAGE DETAILS 2

Figure No: 0511-35

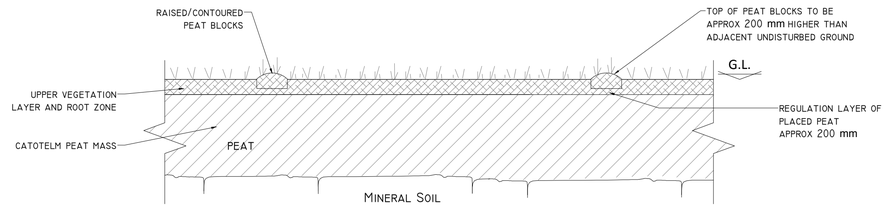
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DETAIL E



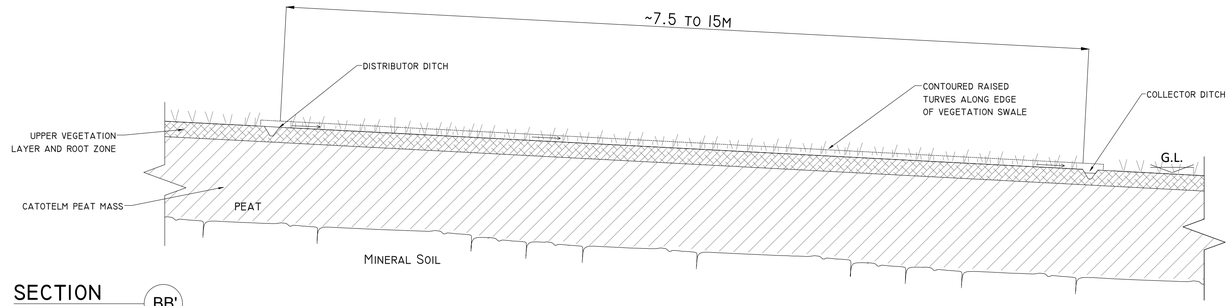
TYPICAL VEGETATION SWALE - PLAN

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SECTION AA'

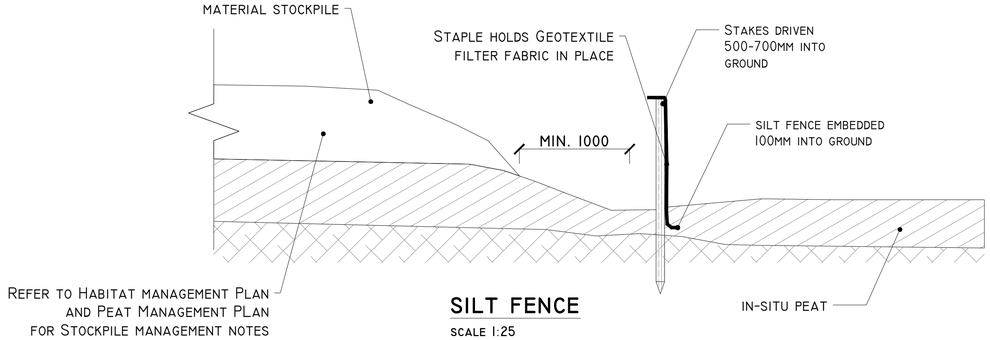
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SECTION BB'

SCALE 1:100

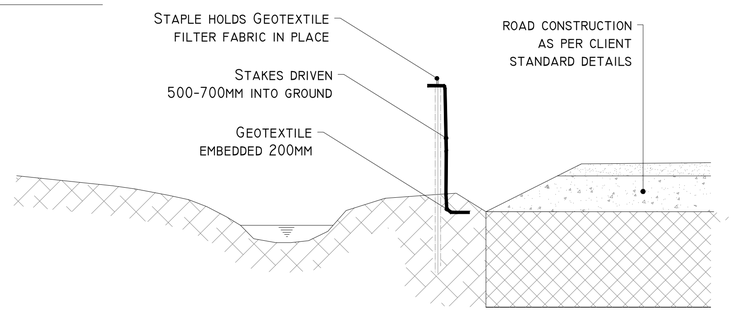
DETAIL F-I



SILT FENCE

SCALE 1:25

DETAIL F-II



SILT FENCE FOR WATERCOURSE PROTECTION

SCALE 1:25

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Job: Croagh WF

Title: Drainage Details 3

Figure No: 0511-36

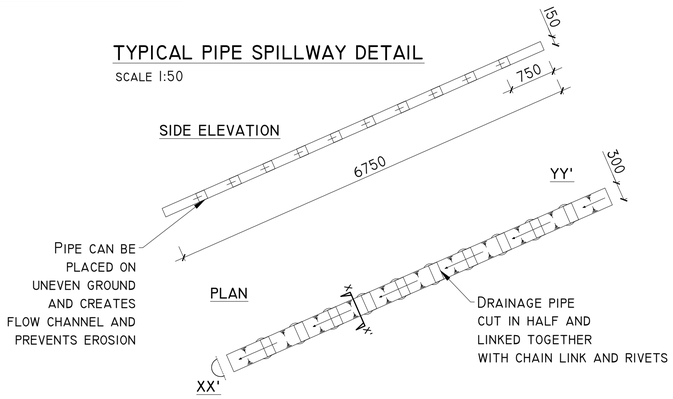
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DETAIL G

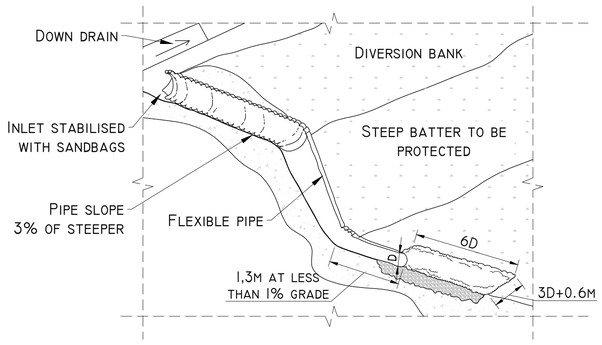
TYPICAL PIPE SPILLWAY DETAIL

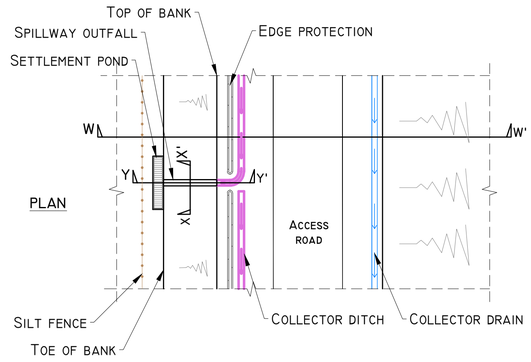
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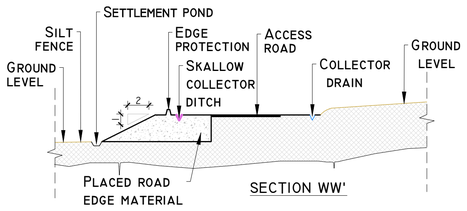


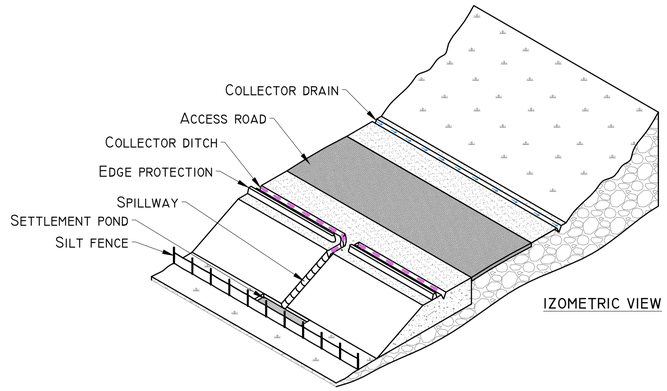
TYPICAL PIPE SPILLWAY DETAIL

SCHEMATIC - NOT TO SCALE









SPILLWAY OUTFALL PLAN

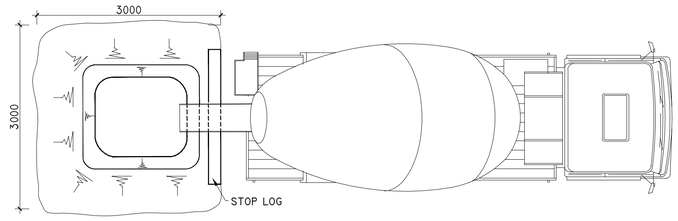
SCHEMATIC - NOT TO SCALE

DETAIL H

TEMPORARY CONCRETE WASH OUT PIT

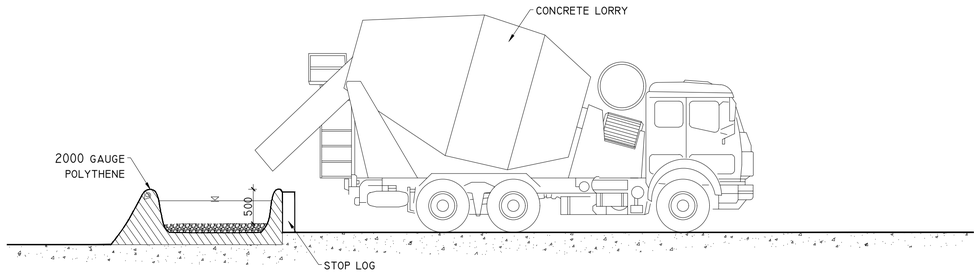
SCALE 1:50

PLAN



ELEVATION

DETAIL I



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Job: Croagh WF

Title: Drainage Details 4

Figure No: 0511-37

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Construction Methodology

Croagh Wind Farm
38kV Grid Connection from Proposed Substation to Grid node
[Garvagh]



Report Ref: 05649-R-G01-04

Client: Coillte C/o MKO

Revision:	Author:	Checked:	Date:	Notes:
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01	SK	RG	19.11.19	*Updated following Client Review*
02	SK	RG	28.04.20	*Updated for Single/Double Circuit*
03	SK	RG	12.06.20	*Updated following Client Review*
04	SK	RG	01.07.20	*Updated following Coillte Review*

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1.0 Introduction

The purpose of this document is to outline and explain the construction techniques and methodologies which will be implemented during construction of the proposed Croagh Wind Farm 38kV grid connection to the existing ESB owned Garvagh 110kV Substation. The grid connection will consist entirely of an underground cable (UGC) network with the majority of the UGC to be installed within existing Coillte forestry roads and a small section to be installed in the public road, which will be upgraded as part of the proposed wind farm development.

For the purposes of the grid connection design, it is assumed that the Maximum Export Capacity of the proposed wind farm will be 48MW (The MEC will not exceed 50MW). It is not yet known if this MEC will require a single circuit or double circuit 38kV connection to Garvagh Substation. This will be determined by ESB/EirGrid following more detailed analysis as part of the grid connection offer process. For the purposes of the planning application a double circuit connection has been designed, however, design details for a single circuit connection have also been provided. Design details for a single circuit connection have also been provided should this ultimately be determined that this is the most appropriate connection method by the system operator and further to detailed design. The difference between the two connection types is the number of ducts, the number of cables and the width of the trench and associated joint bay chambers.

The UGC works will consist of the installation of ducts in an excavated trench to accommodate power cables, and a fibre communications cable to allow communications between the Croagh Wind Farm Substation and Garvagh Substation.

This document outlines the methodologies to be employed during construction and should be read in conjunction with all other specialist reports which accompany the planning application.

2.0 Proposed 38kV Underground Cable Route

The proposed UGC route is approximately 6.2km in length and runs in a north westerly direction from the 110kV ESB Garvagh Substation to the proposed 38kV Substation at Croagh Windfarm. The proposed route is located in Garvagh Substation access roads and the existing Coillte/wind farm access road network, with a small section of the route to be installed in the L4282 local road.

The proposed location of the UGC within the proposed site boundary will be subject to confirmatory site investigations and ESB design approval prior to construction.

Figure 1, below, outlines the proposed underground cable route, with each section of the route being discussed in detail at Table 1.

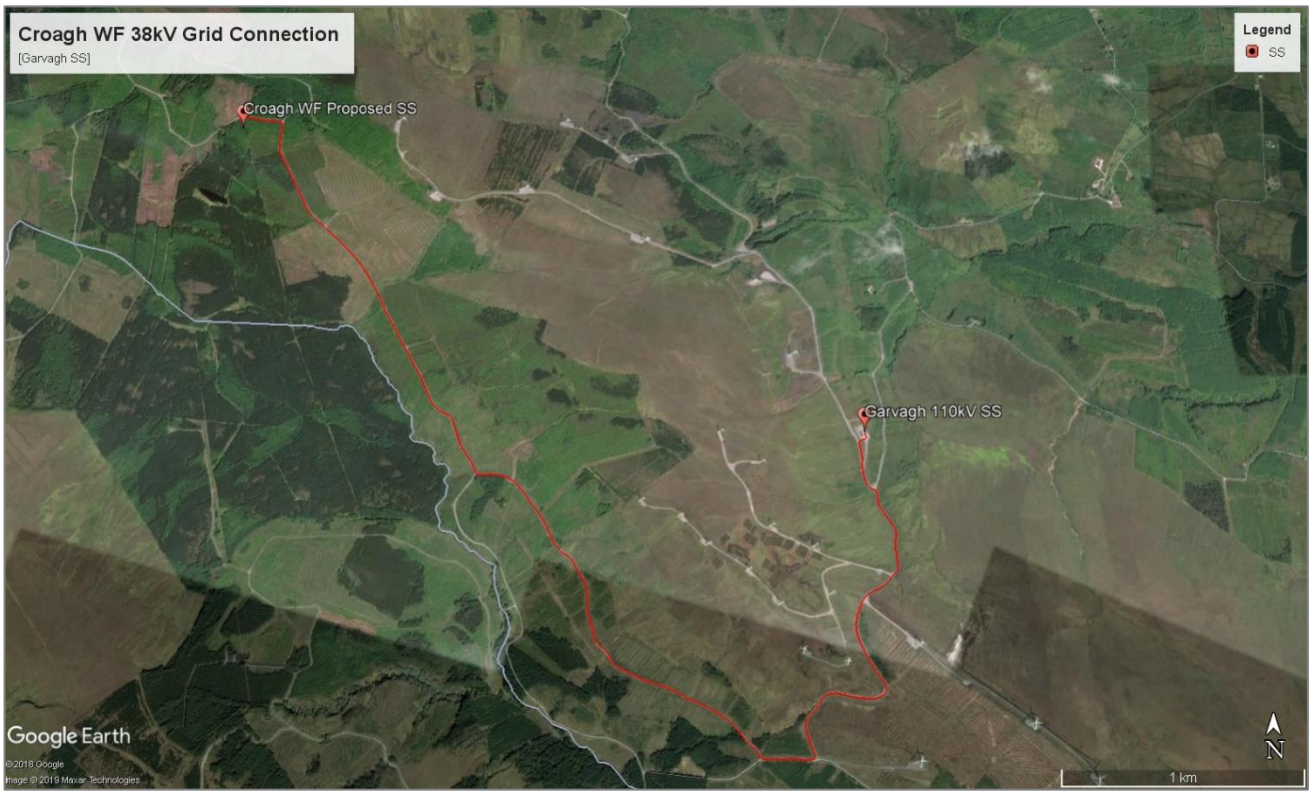


Figure 1 - Grid Connection Route Location

Tables 1 and **2** of this report outline the design features of the proposed UGC route.

Table 1 – Approximate Route Location of Preliminary Design:		
Coillte Forestry Roads	**Garvagh Substation Access Road**	**Public Road (L4282)**
4,383 m	264 m	1,567 m

Table 1 - Garvagh 110kV SS to Croagh Wind Farm – UGC Location Summary

The table below separates the UGC route into a number of sections and describes the specific construction requirements of each individual section.

Table 2 - Summary of Grid Connection Design Route	
Section	**Description**
Section 1 1,952 m	**Garvagh SS to Wind Farm Site Entrance** The proposed UGC will exit Garvagh Substation where it will follow the short Garvagh Substation access road until it meets the L4282 local road. The UGC will then follow the L4282 local road south until for approx. 1,500m before merging onto the Coillte/windfarm access roads.

Table 2 - Summary of Grid Connection Design Route	
Section	**Description**
	The UGC will be installed within the curtilage of the road for the entirety of this section. It should be noted that the L4282 local road is also used by the public for access. Access routes to the work areas will be via the existing Coillte road network and the public road network. All plant and equipment employed on the proposed works will be subject to good site organisation (signage, vehicles parked within work areas, etc.) and hygiene (washing down plant and cleaning road surfaces as required), particularly during construction activities. <u>Features</u> *Section 1 contains 2 No. joint bays:* Joint bays, described in Section 7.6 below, will be located within the curtilage of the existing road, below ground and finished/reinstated to the required roads specification. Joint bays will have associated communication chambers and link boxes which will have a surface access hatch which will match existing ground levels. ▪ Joint Bay 01 (JB-01) will be located approx. 797m south of the Garvagh Substation. The joint bay will be installed within the access road at a wide section of the road where there is a junction with another access road. ▪ Joint Bay 02 (JB-02) will be located within the access road on a straight section of the road. JB-02 will be located approx. 751m after JB-01. *Section 1 has 3 Culvert Crossing:* There are no bridge structures on this route, however there are a number of large culvert crossings. ▪ Culvert 1 is a 300mm HDPE culvert which will be crossed using an undercrossing method. ▪ Culvert 2 is a 400mm HDPE culvert which will be crossed using an undercrossing method. ▪ Culvert 3 is a 600mm concrete culvert which will be crossed using an overcrossing method. ▪ Culvert 4 is a concrete culvert which will be crossed using an undercrossing method. *(Culvert dimension TBC following SI)* All culvert crossing methods are described in Section 8 below and in Appendix A of this report.
Section 2	**Windfarm Site Boundary to proposed Croagh SS**

Table 2 - Summary of Grid Connection Design Route	
Section	**Description**
4,262 m	On reaching the wind farm site entrance the UGC will continue on Coillte access roads in a northerly direction towards the proposed Croagh wind farm substation. This road will be upgraded as part of the wind farm site construction. The UGC will be installed within the access road carriageway or within the verge, for the entirety of this section until it reaches the proposed Croagh Substation. Features *Section 2 contains 5 No. joint bays:* Joint bays will be located below ground and finished/reinstated to the required roads specification. Joint bays will have associated communication chambers and link boxes which will have a surface access hatch which will match existing ground levels. ▪ Joint Bay 03 (JB-03) will be located within the access road at a section where the road widens. JB-03 will be located approx. 809m after JB-02. ▪ Joint Bay 04 (JB-04) will be located within the access road at a section where the road widens. JB-04 will be located approx. 793m after JB-03. ▪ Joint Bay 05 (JB-05) will be located within the access road at a section where the road widens at a junction. JB-05 will be located approx. 753m after JB-04. ▪ Joint Bay 06 (JB-06) will be located within the access road at a section where the road widens at a junction. JB-06 will be located approx. 813m after JB-05. ▪ Joint Bay 07 (JB-07) will be located within the existing access road at a section where the road will be widened to facilitate a new section of access road to one of the new turbines to be constructed. JB-07 will be located approx. 743m after JB-06. *Section 2 has 5 Culvert Crossings:* ▪ Culvert 5 is a 1050mm concrete culvert which will be crossed using an overcrossing method. ▪ Culvert 6 is a 400mm concrete which will be crossed using an overcrossing method. ▪ Culvert 7 is a box culvert which will be crossed using an overcrossing method. *(Culvert dimension TBC following SI)* ▪ Culvert 8 is a box culvert which will be crossed using an undercrossing method. *(Culvert dimension TBC following SI)* ▪ Culvert 9 is a 1300mm culvert which will be crossed using an overcrossing method.
Refer to Figure 1 and to the planning drawings submitted for location details.	

Table 2 - Summary of Grid Connection Design Route	
Section	**Description**
Note: The precise location of the proposed route within the planning application boundary may be subject to minor change as result of the outcome of the detailed design process.	

Table 2 - Summary of Grid Connection Design Route

3.0 Access Routes to Work Area

The majority of the proposed underground cable will be installed within existing Coillte access roads which will be accessed via the existing public road network. The contractor(s) will be required to utilise the local public road network in the vicinity of the work area and from there utilise existing wind farm and forestry access tracks, where appropriate.

In the event planning permission is granted for the proposed development, the Traffic Management Plan will address the requirements of any relevant planning conditions, including any additional mitigation measures which are conditioned. Some localised work areas may require a road closure where it is not possible to safely implement a Stop/Go system. Where road closures are necessary, a suitable diversion will be implemented using appropriate signage, following consultation with Leitrim County Council.

Detailed design of the proposed route will be completed following the planning application process. Careful and considered local consultation will be carried out, to minimise the amount of disturbance caused during works. All plant and equipment employed during the proposed works (e.g. diggers, tracked machines, footwear etc.) will be inspected prior to arrival on site and on leaving site and cleaned where necessary to prevent the spread of dust and invasive aquatic / riparian species.

If necessary, a low ground pressure excavator may be utilised. This machine is designed to spread its weight across a wider area thereby reducing the pressure exerted on the ground. Local consultation will be carried out with all relevant landowners to ensure that any potential disturbance will be minimised. Prior to the commencement of construction, the contractor will assess all access routes and determine the requirement for bog mats. Bog mats are used to spread the weight of machinery over a greater area to prevent damage to the ground (Figure 2). Any such requirements will be incorporated into the relevant method statement.



Figure 2 - Temporary Aluminium Panel Tracks

4.0 Traffic Management

Traffic management and road signage will be in accordance with the Department of Transport: Traffic Signs Manual - Chapter 8: Temporary Traffic Measures and Signs for Road Works and in agreement with Leitrim County Council. All work on public roads will be subject to the approval of a road opening license application by Leitrim County Council. The contractor will prepare a detailed traffic management plan for inclusion as part of the road opening applications. Where road widths allow, the UGC installation works will allow for one side of the road to be open to traffic at all times by means of a 'Stop/Go' type traffic management system, where a minimum 2.5m roadway will be maintained at all times.

Where it is not possible to implement a 'Stop/Go' system a full road closure will be required. Temporary traffic signals will be implemented to allow road users safely pass through the works area by channelling them onto the open side of the road. Typically, the trenching and ducting for the UGC will be installed in 100m sections, and no more than 100m will be excavated without the majority of the previous section being reinstated. Where the construction requires the crossing of a road, works on one carriageway will be completed before the second carriageway is opened, to maintain traffic flows.

All construction vehicles will be parked appropriately within the works area so as not to cause additional obstruction or inconvenience to road users or local residents. The traffic signals will be in place prior to the works commencing and will remain in place until after the works are completed. The public road will be checked regularly and maintained free of mud and debris. Road sweeping will be carried out as appropriate to ensure construction traffic does not adversely affect the local road condition.

In the event of emergency; steel plates, which will be available on site, can be put in place across the excavation to allow traffic to flow on both sides of the road. All traffic management measures will comply with those outlined in the Traffic Management Section of the EIAR included as part of the Planning Application and will be incorporated into a detailed Traffic Management Plan to be prepared, in consultation with Leitrim County Council, prior to the commencement of development.

5.0 Road Opening Licence

The proposed grid connection works may require a road opening licence under Section 254 of the Planning and Development Act 2000-2015 from Leitrim County Council. A Traffic Management Plan (TMP) will be agreed with Leitrim County Council prior to the commencement of the development where required. The TMP will outline the location of traffic management signage, together with the location of any necessary road closures and the routing of appropriate diversions. Where diversions are required, these will be agreed with Leitrim County Council in advance of the preparation of the final TMP.

6.0 Site Investigations

It is proposed to carry out site investigations along the cable route as part of the detailed design following the planning application process. This will be completed prior to construction to confirm design assumptions and to confirm the conditions predicted in the EIAR.

The following items will be carried out on the proposed UGC route in advance of the construction works:

- Slit trenches at locations of major service crossings (Full road width).
- Trial holes along the cabling route to confirm ground conditions and thermal resistivity of the soil.

Traffic Management – Single lane Closure with Stop/Go system in place.

Equipment:

- 4x4 vehicle
- Concrete vibrator
- Wheeled dumper
- Soil compactor
- 360° tracked excavator (only rubber tracked machines will be allowed on public roads)

7.0 UGC Construction Methodology

The UGC will either be a single circuit or a double circuit 38kV connection, as to be determined in the next phase of the project in accordance with the requirements and specifications of ESB . The difference between the two connection types is the number of ducts, the number of cables and the width of the trench and associated joint bay chambers. A single circuit connection typically consists of 3 no. 110mm diameter HDPE power cable ducts and 1 no. 110mm diameter HDPE communications duct to be installed in an excavated trench, typically 600mm wide by 1,220mm deep. A double circuit connection typically consists of 6 no. 110mm diameter HDPE power cable ducts and 2 no. 110mm diameter HDPE communications duct to be installed in an excavated trench, typically 900mm wide by 1,220mm deep. For trench designs there will be variations on the design to adapt to service crossings and watercourse crossings.

The power cable ducts will accommodate the power cables and the communications duct(s) will accommodate a fibre cable(s) to allow communications between the Croagh Wind Farm substation and Garvagh Substation. The ducts will be installed, the trench reinstated in accordance with landowner or Leitrim County Council specification, and then the electrical cabling/fibre cable is pulled through the installed ducts in approximately 700-850m sections. Construction methodologies to be implemented and materials to be used will ensure that the UGC is installed in accordance with the requirements and specifications of ESB.

7.1 Trenching Methodology

The following section outlines the methodology to be followed during trenching works:

- The Contractor, and their appointed Site Manager, will prepare a targeted Method Statement concisely outlining the construction methodology and incorporating all mitigation and control measures included within the planning application and accompanying reports and as required by planning conditions where relevant;
- All existing underground services shall be identified on site prior to the commencement of construction works;
- At watercourse crossings, the contractor will be required to adhere to the environmental control measures outlined within the planning application and accompanying reports, the final Construction Environmental Management Plan (CEMP) and best practice construction methodologies;
- Where the cable route intersects with culverts, the culvert will remain in place (where possible) and the ducting will be installed either above or below the culvert to provide minimum separation distances in accordance with ESB specifications;
- Traffic management measures will be implemented in accordance with those included in the Traffic Management Section of the EIAR and a final Traffic Management Plan will be prepared and agreed with Leitrim County Council;
- The excavated trench will be approximately 600/900mm in width and approximately 1220mm deep both within the public road network and within Coillte lands;
- The base of the excavated trench will be lined with sand bedding to be imported to site from a local licensed supplier. The 110mm diameter HDPE cable ducting will be placed into the prepared trench, inspected and backfilled as per Figures 4 & 5;
- Excavated material will be temporarily stockpiled onsite for re-use during reinstatement. Stockpiles will be restricted to less than 2m in height. Stockpiles will be located a minimum of 50m from surface water features and all stockpiling locations will be subject to approval by the Site Manager and Project Ecological Clerk of Works (ECoW);
- Excavated material shall be reused to backfill the trench where appropriate and any surplus material will be transported to either the proposed onsite borrow pit or repository areas;
- Any earthen (sod) banks to be excavated will be carefully opened with the surface sods being stored separately and maintained for use during reinstatement;
- The excavated trench will be dewatered if required, from a sump installed within the low section of the opened trench. Where dewatering is required, silt laden water will be fully and appropriately attenuated, through silt bags, before being appropriately discharged to vegetation or surface water drainage feature (please refer to drainage design in the proposed development);
- Where required, grass will be reinstated by either seeding or by replacing with grass turves;

- No more than a 100 metre section of trench will be opened at any one time. The second 100 metres will only be excavated once the majority of reinstatement has been completed on the first;
- The excavation, installation and reinstatement process will take on average of 1 no. day to complete a 100m section;
- Where the cable is being installed in a roadway, temporary reinstatement may be provided to allow larger sections of road to be permanently reinstated together;
- Following the installation of ducting, pulling the cable will take approximately 1 day between each joint bay, with the jointing of cables taking approximately 1-2 days.



Figure 3 - Typical 38kV Underground Duct Installation (Single Circuit)

7.2 Ducting Installation Methodology

For the trenching and ducting works the following step by step methodology will apply:

1. Grade, smooth and trim trench floor when the required 1220mm depth and 600/900mm width have been obtained.
2. 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 drawings.
3. 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.
4. Carefully surround and cover ducts with CBGM B in accordance with the design drawings and specifications and thoroughly compact without damaging ducts.
5. Place cable protection strips on compacted CBGM B directly over the ducts.
6. 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.

7. Carefully surround and cover ducts with CBGM B material in accordance with the drawings and thoroughly compact without damaging ducts.
8. Place red cable protection strip on top of compacted CBGM B over each set of ducts as shown on the drawings.
9. 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.
10. 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 and/or landowners, unless otherwise agreed with local authorities.
11. For unsurfaced/grass sections (including verges), 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, as per Figures 4 & 5;
12. 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. All the works should be witnessed by ESBN Clerk of Works (CoW) as required.

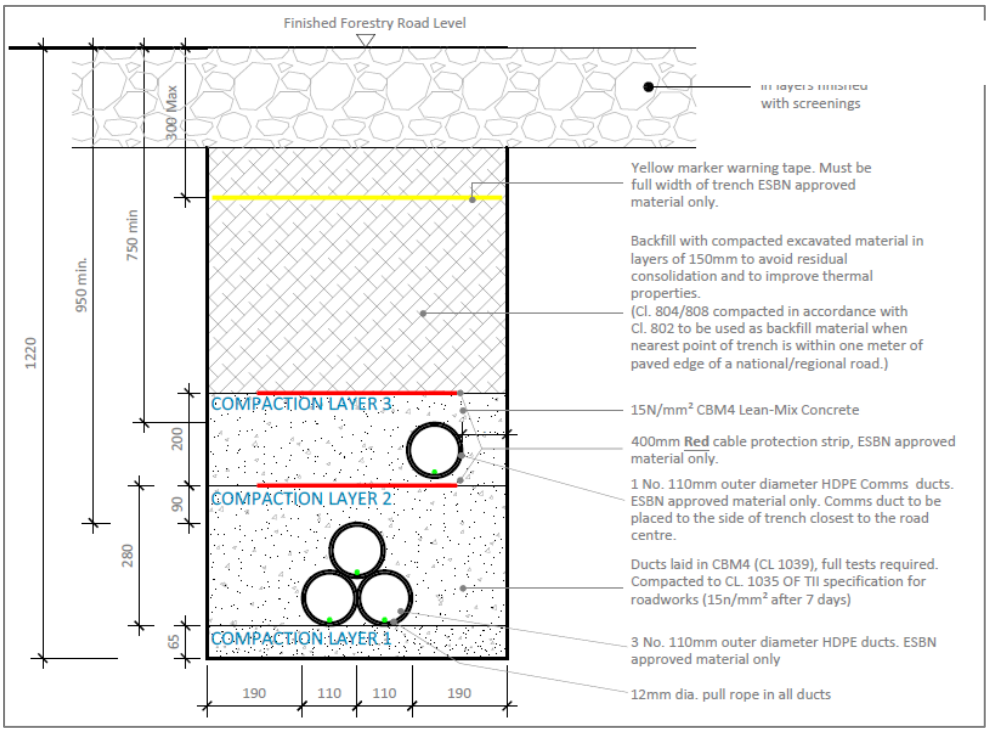


Figure 4 - Typical 38kV Single Circuit Trench in Forestry Road Section

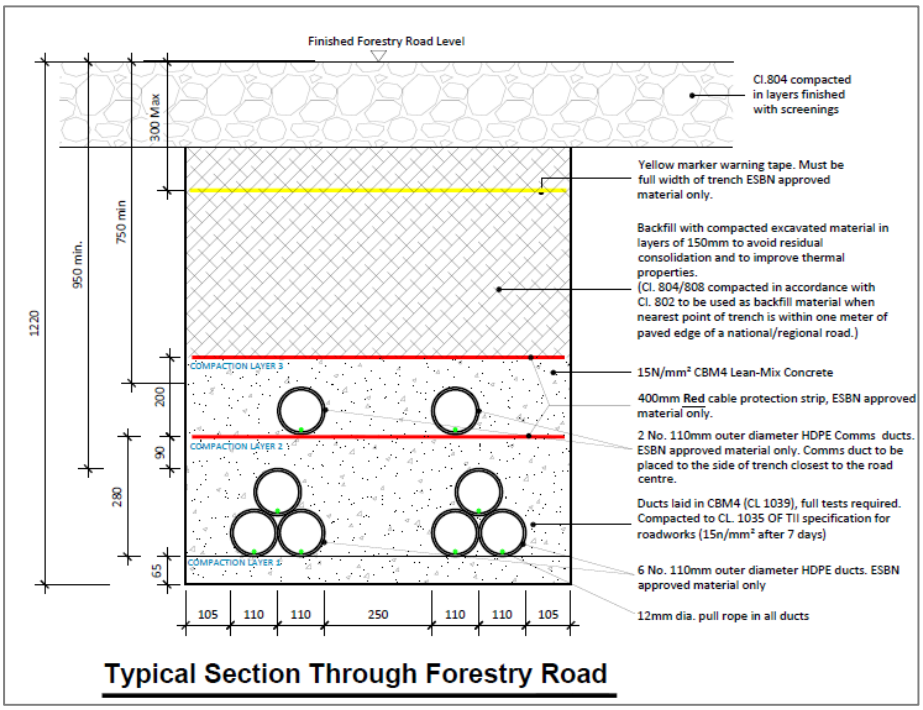


Figure 5 - Typical 38kV Double Circuit Trench in Forestry Road Section

Equipment and Personnel:

- 2-3 General Operatives;
- 1 Excavator Operator;
- 1 no. tracked excavator (only rubber tracked machines will be allowed on public roads);
- 1 no. dumper or tractor and trailer.

Materials:

- Sand for pipe bedding;
- Ready-mix Concrete where necessary (delivered to site);
- Trench backfilling material (excavated material and aggregates) to relevant specifications;
- 110mm diameter HDPE ducting;
- Temporary Surface Reinstatement Materials.

7.2.1 Windfarm / Forestry / Garvagh Substation Access Tracks

The majority of the 38kV route is located within existing Coillte access and public roads that will be upgraded as part of the proposed development. Where the cable is installed in windfarm / forestry / Garvagh Substation access tracks the location where the cable is laid will depend on several factors, width of track, bends along the track and crossings. In the proposed locations where the track needs to be widened stone will be brought in to build up the area to the same level of the track. The excess material from the track will be used elsewhere on reinstatement works.

Once all construction works are complete, the work areas will be reinstated with excavated soil and either seeded out with native species, allowed to vegetate naturally or reinstated with excavated grass turves and will be restored to their original condition. This work will be carried out in consultation with the landowner and in line with any relevant measures outlined in the planning application, CEMP and planning conditions.

7.3 Marker posts

Surface cable markers will be placed along the route where cable depth is unavoidably shallow, due to constraints such as existing services, to indicate the precise location of the UGC. These markers will be metallic plates in accordance with ESB standards.

Marker posts will be used on unsurfaced/grass sections (including verges),routes to delineate the cable route and joint bay positions. Corrosion proof aluminium triangular danger sign, with 700mm base, and with centred lightning symbol, on engineering grade fluorescent yellow background shall be installed in adequately sized concrete foundations, see Fig 6 below. Marker posts shall also be placed in the event that burial depth is not to standard. Siting of marker posts to be dictated by ESBN as part of the detailed design process.

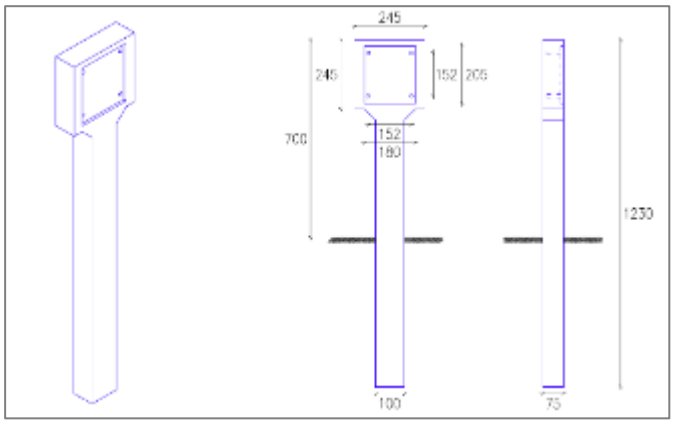


Figure 6 - Typical ESB Marker Posts Example

7.4 Managing Excess Material from Trench

All excavated material will be temporarily stored adjacent to the trench prior to re-use in the trench reinstatement (where applicable). Stockpiles will be restricted to less than 2m in height. Where excess peat and spoil material exists, it will be transported to either the proposed onsite borrow pit or one of the peat repository areas. Excavated tar from the public road network will be transported off site by an appropriately authorised waste collector and disposed of at an appropriately licenced waste facility.

7.5 Storage of Plant and Machinery

All plant, machinery and equipment will be stored on site within the works area or within the temporary construction compound to be located within the proposed Croagh Wind Farm site. Oils and fuels will be stored in an appropriately bunded area within the temporary construction compound.

7.6 Joint Bays and Associated Chambers

Joints Bays are to be provided approximately every 700m - 850m along the UGC route to facilitate the jointing of 2 no. lengths of UGC. 38kV Joint Bays are proposed to be approximately 2.03/2.73m x 4.5m x 1.275m pre-cast concrete structures installed below finished ground level. The joint bay width varies between single and double circuits (2.03 – 2.73m). Joint Bays will be located in the non-load bearing strip of roadways insofar as possible, however given the narrow profile of local roads this may not always be possible.

In association with Joint Bays, Communication Chambers are required at every joint bay location to facilitate communication links between the Croagh Wind Farm substation and the existing Garvagh 110kV Substation. Earth Sheath Link Chambers are also required approximately every second joint bay along the cable route. Earth Sheath Links are used for earthing and bonding cable sheaths of underground power cables, installed in a flat formation, so that the circulating currents and induced voltages are eliminated or reduced. Earth Sheath Link Chambers and Communication Chambers are located in close proximity to Joint Bays. Earth Sheath Link Chambers and Communication Chambers will typically be pre-cast concrete structures with an access cover at finished surface level.

The precise siting of all Joint Bays, Earth Sheath Link Chambers and Communication Chambers within the planning corridor is subject to approval by ESBN.

Equipment and Personnel:

- 2-3 General Operatives
- 1 Excavator Operator
- 360˚ tracked excavator (only rubber tracked machines will be allowed on public roads)
- 1 no. tracked dumper or tractor and trailer

Materials:

- Sand for pipe bedding
- Ready-mix Concrete where necessary (delivered to site);
- Trench backfilling material (excavated material and aggregates) to relevant specifications;
- 110mm diameter HDPE ducting
- Precast Chamber Units / Construction materials for chambers

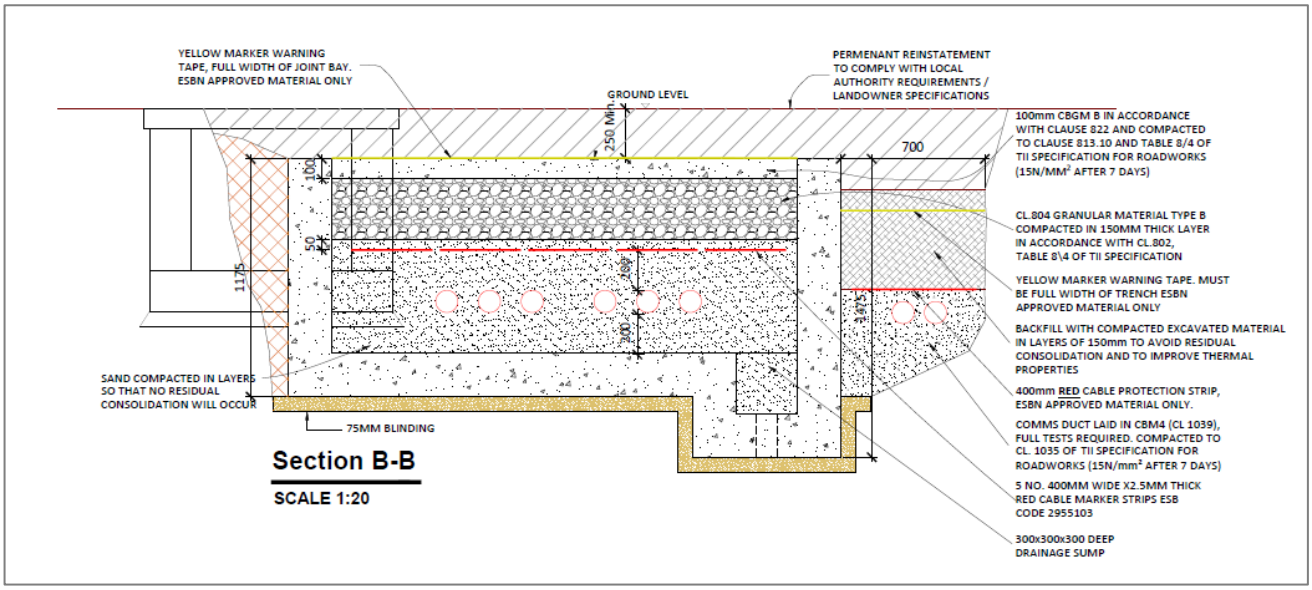


Figure 7 - Typical Section Through 38kV Double Circuit Joint Bay

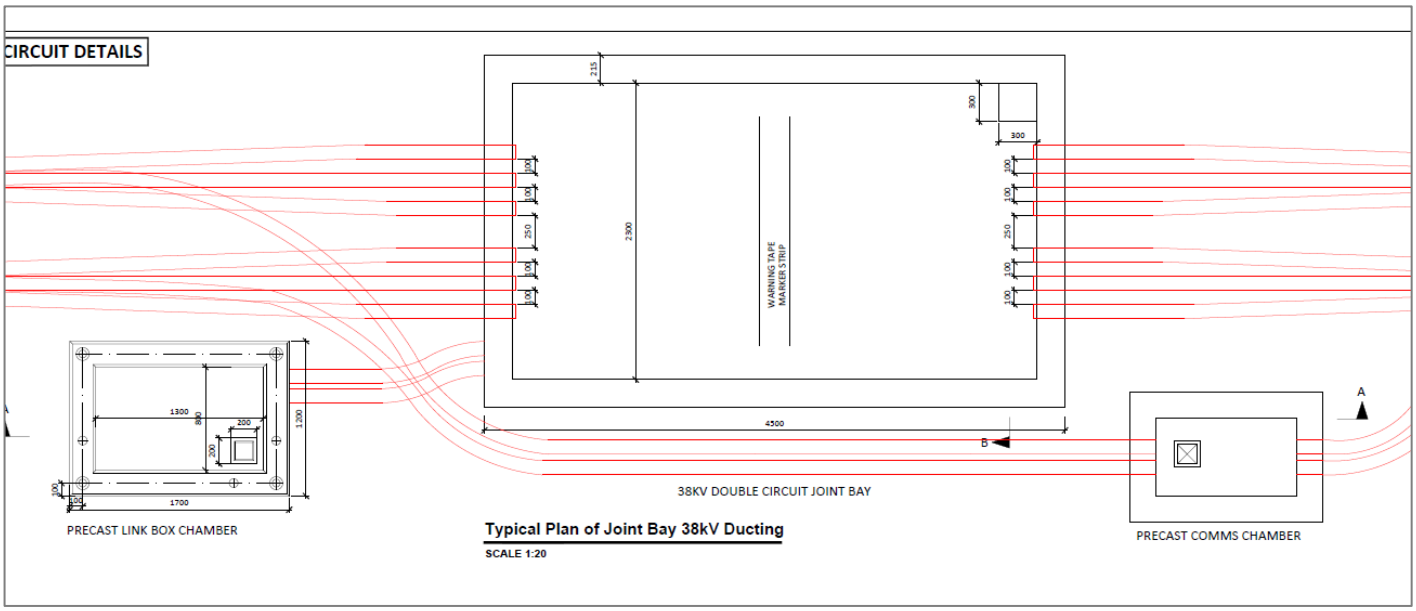


Figure 8 Proposed 38kV Double Circuit Joint Bay and Link Box Plan Details

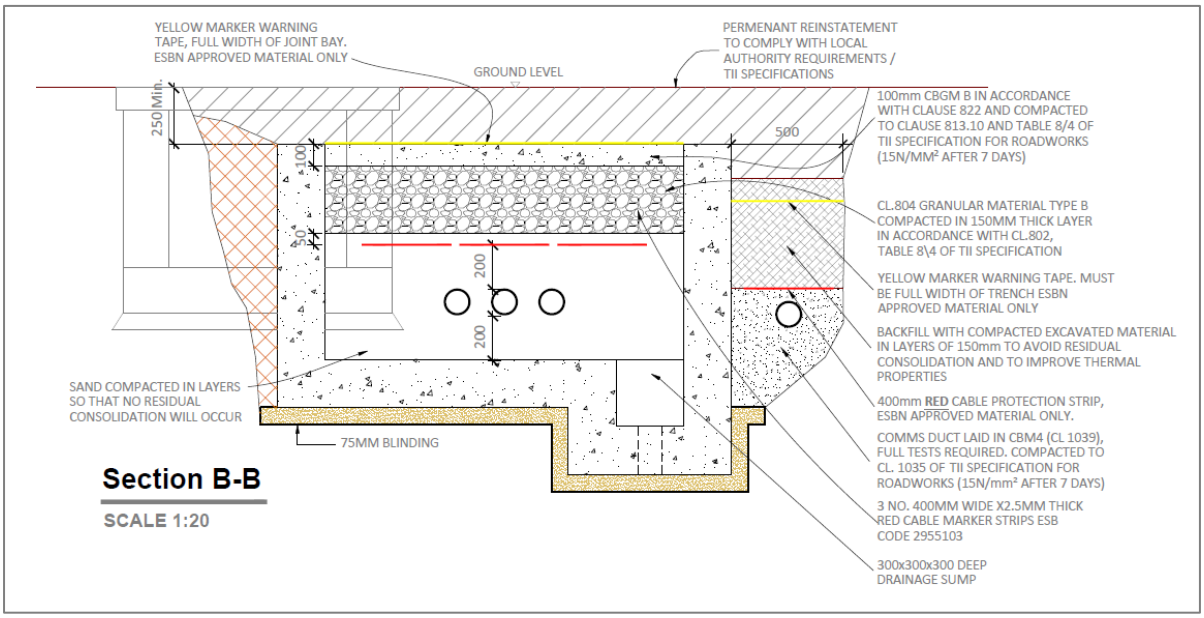


Figure 9 - Typical Section Through 38kV Single Circuit Joint Bay

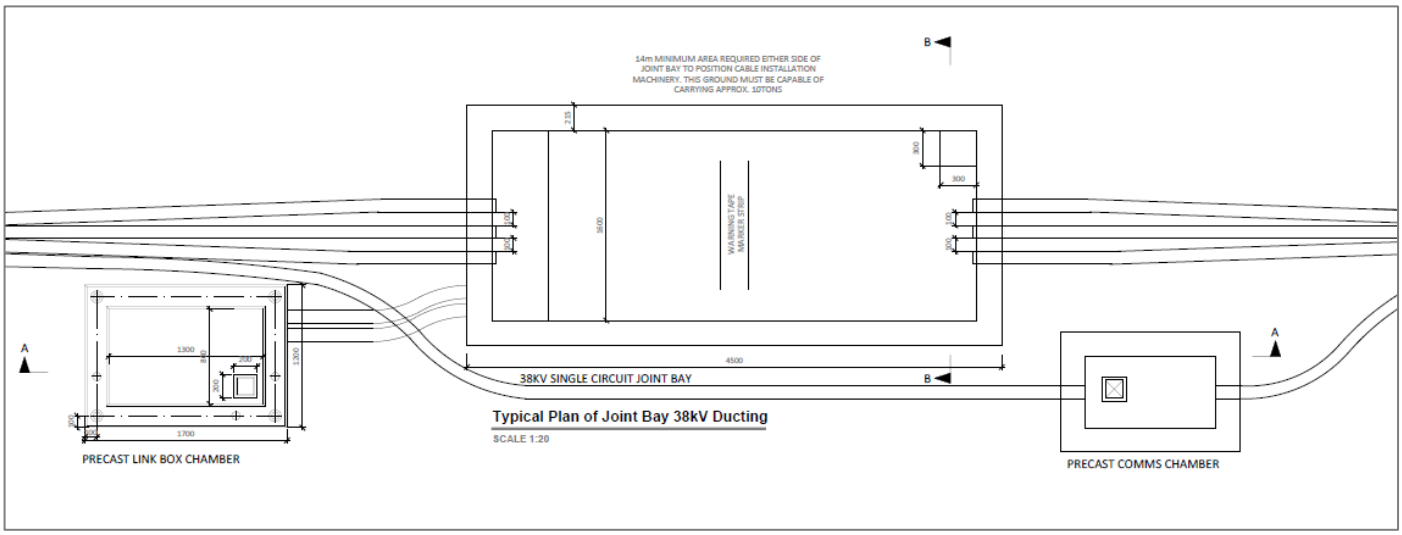


Figure 10 Proposed 38kV Single Circuit Joint Bay and Link Box Plan Details

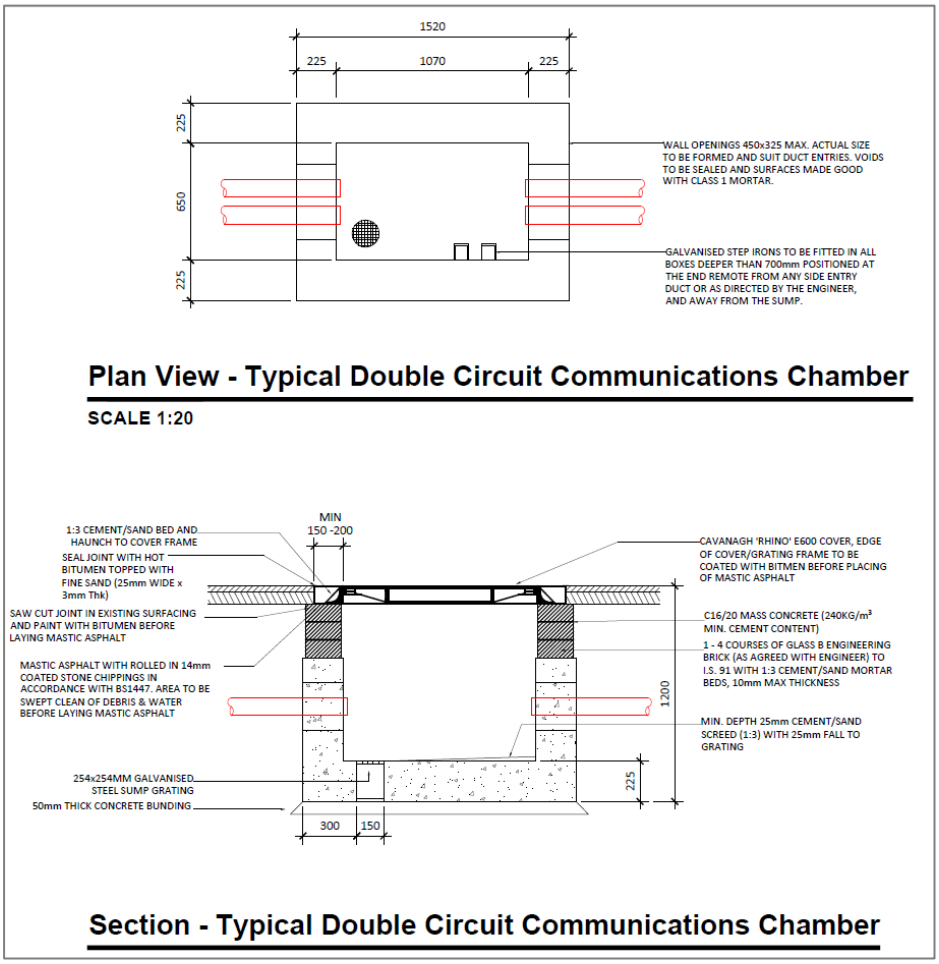


Figure 11 - Typical Communications Chamber

8.0 Watercourse Crossings

Nine watercourse crossing locations were identified along the cable route. All of the watercourse crossings identified are culverts and no bridge crossings have been identified. It is proposed to cross all watercourses

using open trenching with either an undercrossing or an overcrossing, depending on the depth of the culvert. A schedule of the culverts identified and the proposed crossing method to be implemented is detailed in Appendix A of this report. A detailed site survey of all watercourses/culverts will be completed as part of the next phase of the project prior to construction. The proposed culvert crossing methods are detailed in Figures 12 and 13 below, the number of ducts will vary between a single and double circuit connection.

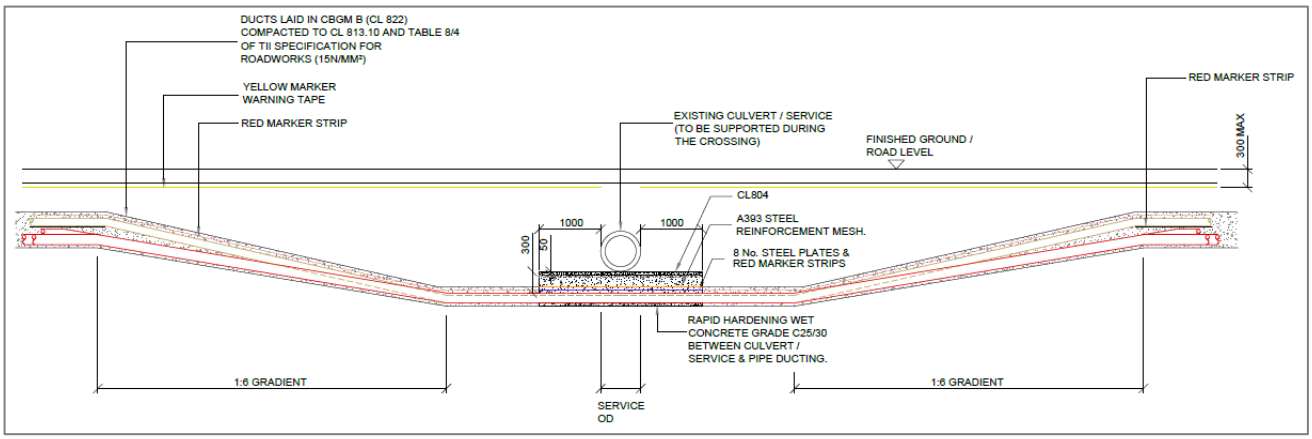


Figure 12 – 38kV Double Circuit Culvert Undercrossing

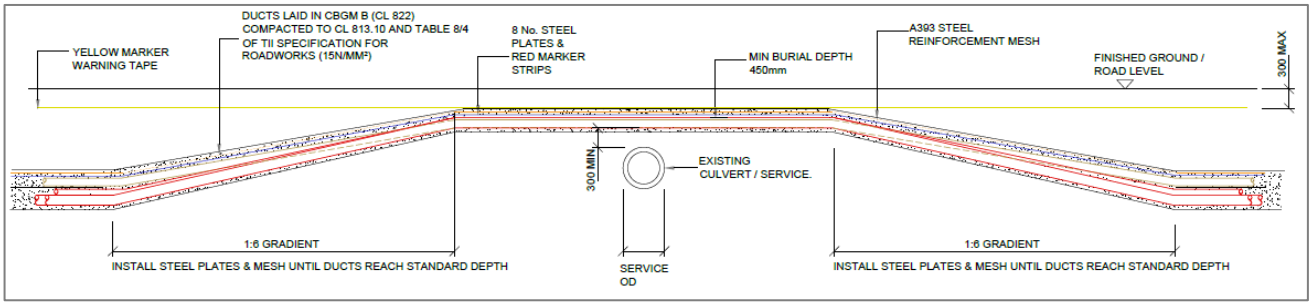


Figure 13 - 38kV Double Circuit Culvert Overcrossing

Where the cable route intersects with existing watercourses, a detailed construction method statement will be prepared by the Contractor prior to the commencement of construction and is to be approved by the Local Authority and relevant environmental agencies as required.

Inland Fisheries Ireland have published guidelines relating to construction works along water bodies entitled 'Requirements for the Protection of Fisheries Habitats during Construction and Development Works at River Sites", and these guidelines will be adhered to during the construction of the proposed development.

8.1 Horizontal Direction Drilling (HDD)

It is not currently proposed to implement Horizontal Directional Drilling (HDD) for any crossings. However, following confirmatory site investigations prior to construction it may be necessary to utilise HDD for some crossings.

Horizontal Direction Drilling (HDD) is a method of drilling under obstacles such as bridges, culverts, railways, water courses, etc. in order to install cable ducts under the obstacle. This method is employed where installing the ducts using standard installation methods is not possible. The proposed HDD methodology is as follows: -

1. A works area of circa .40m^2 will be fenced on both sides of a crossing
2. The drilling rig and fluid handling units will be located on one side of the bridge and will be stored on double bunded 0.5mm PVC bunds which will contain any fluid spills and storm water run-off.
3. Entry and exit pits (1m x 1m x 2m) will be excavated using an excavator, the excavated material will be temporarily stored within the works area and used for reinstatement or disposed of to a licensed facility.
4. A 1m x 1m x 2m steel box will be placed in each pit. This box will contain any drilling fluid returns from the borehole.
5. The drill bit will be set up by a surveyor, and the driller will push the drill string into the ground and will steer the bore path under the watercourse.
6. A surveyor will monitor drilling works to ensure that the modelled stresses and collapse pressures are not exceeded.
7. The drilled cuttings will be flushed back by drilling fluid to the steel box in the entry pit.
8. Once the first pilot hole has been completed a hole-opener or back reamer will be fitted in the exit pit and will pull a drill pipe back through the bore to the entry side.
9. Once all bore holes have been completed, a towing assembly will be set up on the drill and this will pull the ducting into the bore.
10. The steel boxes will be removed, with the drilling fluid disposed of to a licensed facility.
11. The ducts will be cleaned and proven and their installed location surveyed.
12. The entry and exit pits will be reinstated to the specification of ESB Networks and the landowner.
13. A joint bay or transition chamber will be installed on either side of the bridge following the horizontal directional drilling as per ESB requirements.

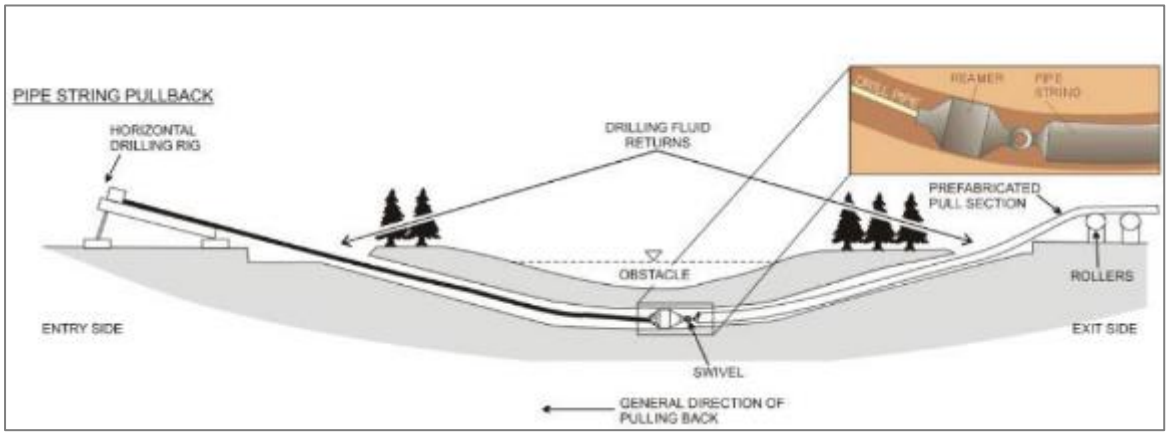


Figure 14 - Typical HDD Installation

9.0 Best Practice Design and Construction & Environmental Management Methodology

Prior to commencement of construction works the contractor will draw up detailed Method Statements which will be informed by this Construction Methodology, environmental protection measures included within the planning application, measures proposed within the CEMP, and the guidance documents and best practice measures listed below. This method statement will be adhered to by the contractors and will be overseen by the Project Manager, Environmental Manager and ECoW where relevant.

The following documents will contribute to the preparation of the method statements in addition to those measures proposed below:

- Inland Fisheries Ireland (2016) *Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters*. Inland Fisheries Ireland*, Dublin,*
- *National Roads Authority (2008) Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes*. National Roads Authority, Dublin;
- E. Murnane, A. Heap and A. Swain. (2006) *Control of water pollution from linear construction projects.* Technical guidance (C648). CIRIA;
- E. Murnane et al., (2006) *Control of water pollution from linear construction projects*. Site guide (C649). CIRIA.
- Murphy, D. (2004) Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites. Eastern Regional Fisheries Board, Dublin;
- H. Masters-Williams et al (2001) *Control of water pollution from construction sites. Guidance for consultants and contractors* (C532);
- Enterprise Ireland (unknown). *Best Practice Guide (BPGCS005) Oil storage guidelines;*
- Law, C. and D'Aleo, S. (2016) *Environmental good practice on site pocket book*. (C762) 4th edition. CIRIA;
- CIRIA *Environmental Good Practice on Site (fourth edition) (C741) 2015*.

The proposed works will be carried out by employing accepted good work practices during construction, and environmental management measures such as those discussed below. Please note that the following measures will be supplemented by further specific environmental protection measures that will be included in method statements prepared for specific tasks during the works and will form part of the final CEMP. These method statements will be prepared prior to the construction phase of the proposed wind farm and will incorporate all of the mitigation measures identified in the EIAR and NIS as well as the requirements of any relevant planning conditions, including any additional mitigation measures which are conditioned.

- All materials required for the ducting works shall be stored at the temporary construction compounds within the Croagh Wind Farm site and transported to the works zone immediately prior to construction;
- Where drains and watercourses are crossed with underground cables, the release of sediment will be prevented through the implementation of best practice construction methodologies (See Section 4.7 of EIAR).

- Weather conditions will be taken into account when planning construction activities to minimise risk of run off from site;
- Provision of 50m exclusion zones and barriers (silt fences) between any excavated material and any surface water features to prevent sediment washing into the receiving water environment;
- If dewatering is required as part of the proposed works e.g. in trenches for underground cabling or in wet areas, water must be treated prior to discharge;
- The contractor shall ensure that silt fences are regularly inspected and maintained during the construction phase;
- If very wet ground must be accessed during the construction process bog mats/aluminium panel tracks will be used to enable access to these areas by machinery, the requirement for bog mats will be confirmed prior to construction. However, works will be scheduled to minimise access requirements during winter months;
- The contractor shall ensure that all personnel working on site are trained in pollution incident control response. A regular review of weather forecasts of heavy rainfall is required and the Contractor is required to prepare a contingency plan for before and after such events;
- Daily visual inspections of drains and outfalls will be performed during the construction period to ensure suspended solids are not entering streams and rivers on site, to identify any obstructions to channels and to allow appropriate maintenance of the drainage regime. Should the suspended solids levels measured during construction be higher than the existing levels, the source will be identified and additional mitigation measures implemented;
- Excavations will be left open for minimal periods to avoid acting as a conduit for surface water flows.
- Only emergency breakdown maintenance will be carried out on site. Emergency procedures and spillage kits will be available and construction staff will be familiar with emergency procedures.
- Appropriate containment facilities will be provided to ensure that any spills from vehicles are contained and removed off site. Adequate stocks of absorbent materials, such as sand or commercially available spill kits shall be available;
- Concrete or potential concrete contaminated water run-off will not be allowed to enter any watercourses. Any pouring of concrete (delivered to site ready mixed) will only be carried out in dry weather. Washout of concrete trucks shall be strictly confined to a designated and controlled wash-out area within the Croagh Wind Farm site; remote from watercourses, drainage channels and other surface water features;
- Entry by plant equipment, machinery, vehicles and construction personnel into watercourses or wet drainage ditches shall not be permitted. All routes used for construction traffic shall be protected against migration of soil or waste water into watercourses;
- Cabins, containers, workshops, plant, materials storage and storage tanks shall be located within the temporary construction compounds and will not be located near any surface water channels and will be located beyond the 50m hydrological buffer at all times.

10.0 Relocation of Existing Services

In order to facilitate the installation of the proposed UGC, it may be necessary to relocate existing underground services such as water mains or existing cables. In advance of any construction activity, the contractor will undertake additional surveys of the proposed route to confirm the presence or otherwise of any services. If found to be present, the relevant service provider will be consulted with in order to determine the requirement for specific excavation or relocation methods and to schedule a suitable time to carry out works.

10.1 Underground Cables

If existing low voltage underground cables are found be present, a trench will be excavated, and new ducting and cabling will be installed along the new alignment and connected to the network on either end. The trench will be backfilled with suitable material to the required specification. Warning strip and marking tape will be laid at various depths over the cables as required. Marker posts and plates will be installed at surface level to identify the new alignment of the underground cable, the underground cables will then be re-energised.

10.2 Water Mains

The water supply will be turned off by the utility so work can commence on diverting the service. The section of existing pipe will be removed and will be replaced with a new pipe along the new alignment of the service. The works will be carried out in accordance with the utility standards.

11.0 Implementation of Environmental Protection Measures

All environmental protection measures contained with the EIAR and NIS which accompanies the planning application will be incorporated into the final CEMP and construction method statements prior to the commencement of development and will be implemented in full during the construction phase. The Project Manager and Site Manager will be responsible for the implementation of measures following consultation with the Environmental Manager and ECoW where necessary.

The implementation of environmental protection measures, invasive species management and waste management will be addressed within the CEMP. Please see Appendix 4.4 of the EIAR for the initial CEMP.

Appendix A – Culvert Crossing Schedule

Culvert Crossing Schedule					
Culvert No.	Dimensions (mm)	Material	Approx. Cover (mm)	Proposed Crossing Methodology	Photo
1.	300 Ø	HDPE	450	Under Crossing	
2.	400 Ø	HDPE	840	Under Crossing	
3.	600 Ø	Concrete	1810	Over Crossing	
4.	Unknown [TBC follow SI]	Concrete	970	Under Crossing	*No photo available*
5.	1050Ø	Concrete	2600	Over Crossing	
6.	400 Ø	Concrete	2300	Over Crossing	
7.	Unknown [TBC follow SI]	Box Culvert	2000	Over Crossing	
8.	Unknown [TBC follow SI]	Box Culvert	1100	Under Crossing	
9.	1300 Ø	Unknown [TBC follow SI]	2500	Over Crossing	

Summary of main conclusions reached in 25 reviews of the research literature on wind farms and health.

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2. Schmidt JH, Klokker M (2014) Health effects related to wind turbine noise exposure: a systematic review. PLoS ONE 9(12): e114183. doi:10.1371/journal.pone.0114183
3. 2014: McCunney RJ, Mundt KA, Colby WD, Dobie R, Kaliski K, Blais M. Wind turbines and health: a critical review of the scientific literature. Journal of Occupational & Environmental Medicine 2014; 56(11):pe108-130.
4. 2014: Knopper LD, Olson CA, McCallum LC, Whitfield Aslund ML, Berger RG, Souweine K, McDaniel M. Wind turbines and human health. Frontiers in Public Health 2014; 19 June
5. 2014: Arra I, Lynn H, Barker K, Ogbuneke C, Regalado S. Systematic review 2013: association between wind turbines and human distress. Cureus 6(5): e183. doi:10.7759/cureus.183 [Note: this review is a very poor quality paper published in a non-indexed, pay-to-publish journal. A detailed critique of it can be found at the end of this file.]
6. 2014: National Health and Medical Research Council (Australia). University of Adelaide full report (296pp) and draft consultation report (26pp). Final Report (Feb 15 2015)
7. 2013: VTT Technical Research Centre of Finland. (in Finnish) – summary at end of document
8. 2013: Department of Health, Victoria (Australia) Wind farms, sound and health.
9. 2012: Massachusetts Department of Environmental Protection. Independent Expert Science Panel Releases Report on Potential Health Effects of Wind Turbines
10. 2012: Oregon Wind Energy Health Impact Assessment.
11. 2011: Fiumicelli D. Windfarm noise dose-response: a literature review. Acoustics Bulletin 2011; Nov/Dec:26-34 [copies available from simon.chapman@sydney.edu.au]
12. 2011: Bolin K et al. Infrasound and low frequency noise from wind turbines: exposure and health effects. Environmental Res Let 2011;
13. 2010: Knopper LD, Ollsen CA. Health effects and wind turbines: a review of the literature. Environmental Health 2010; 10:78
14. 2010: UK Health Protection Agency Report on the health effects of infrasound
15. 2010: NHMRC (Australia) Rapid Review of the evidence
16. 2010: Chief Medical Officer of Health in Ontario
17. 2010: UK Health Protection Agency. Environmental noise and health in the UK. A report by the Ad Hoc Expert Group on Noise and Health. (this report is about all environmental noise)

18. 2009: Minnesota Department of Health. Environmental Health Division. Public Health Impacts of Wind Turbines.
19. 2009: Colby et al. Wind Turbine Sound and Health Effects: An Expert Panel Review.
20. 2008: Chatham-Kent Public Health Unit.
21. 2007: National Research Council (USA): Impact of wind energy development on humans (Chapter 4: pp97-120) of: Environmental Impacts of Wind-Energy Projects.
22. 2006: Context and Opinion Related to the Health Effects of Noise Generated by Wind Turbines, Agence Française de Sécurité Sanitaire de l'Environnement et du Travail(Affset), 2006. (in French only)
23. 2005: Jakobsen J. Infrasound emission from wind turbines. *J Low Frequency Noise, Vibration and Active Control* 2005; 24(3):145-155
24. 2004: Leventhall G. Low frequency noise and annoyance. *Noise & Health 2004;*.6(23):59-72
25. 2003: Eja Pedersen's Review for the Swedish EPA

Reviews of the evidence - extracted highlights

Direct health effects from noise and WTS

- "There is no consistent evidence that noise from wind turbines—whether estimated in models or using distance as a proxy—is associated with self-reported human health effects. Isolated associations may be due to confounding, bias or chance." NHMRC (2014) full report

- "There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines." *Source: NHMRC 2010*
http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/new0048_evidence_review_wind_turbines_and_health.pdf

- "There is no evidence that the audible or sub-audible sounds emitted by wind turbines have any direct adverse physiological effects." *Source: Colby 2009 review*
http://199.88.77.35/EFiles/docs/CD/PlanCom/10_0426_IT_100416160206.pdf

- "... surveys of peer-reviewed scientific literature have consistently found no evidence linking wind turbines to human health concerns." *Source: CanWEA*
http://www.canwea.ca/pdf/CanWEA%20-%20Addressing%20concerns%20with%20wind%20turbines%20and%20human%20health.pdf

- "There is insufficient evidence that the noise from wind turbines is directly... causing health problems or disease." *Source: Massachusetts review*
http://www.mass.gov/dep/energy/wind/turbine_impact_study.pdf

- "There is no reason to believe, based on the levels and frequencies of the sounds and... sound exposures in occupational settings, that the sounds from wind turbines could plausibly have direct adverse health consequences." *Source: Colby 2009 review* http://199.88.77.35/EFiles/docs/CD/PlanCom/10_0426_IT_100416160206.pdf

- "... while some people living near wind turbines report symptoms such as dizziness, headaches, and sleep disturbance, the scientific evidence available to date does not demonstrate a direct causal link between wind turbine noise and adverse health effects. The sound level from wind turbines at common residential setbacks is not sufficient to cause hearing impairment or other direct health effects..." *Source: Ontario CMOH Report* http://www.health.gov.on.ca/en/public/publications/ministry_reports/wind_turbine/wind_turbine.pdf

- "... the audible noise created by a wind turbine, constructed at the approved setback distance does not pose a health impact concern."*Source: Chatham-Kent Public Health Unit* http://www.harvestingwindsupport.com/blog/wp-content/uploads/2011/03/Chatham-KentHealth-and-Wind-.pdf

- There is no evidence for a set of health effects, from exposure to wind turbines that could be characterized as a "Wind Turbine Syndrome." *Source: Massachusetts review* http://www.mass.gov/dep/energy/wind/turbine_impact_study.pdf

- "... there is not an association between noise from wind turbines and measures of psychological distress or mental health problems." *Source: Massachusetts review* http://www.mass.gov/dep/energy/wind/turbine_impact_study.pdf

- "Evidence that environmental noise damages mental health is… inconclusive." *Source: Ad Hoc Expert Group on Noise and Health* http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1279888026747

- "…no association was found between road traffic noise and overall psychological distress…"*Source: Ad Hoc Expert Group on Noise and Health* http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1279888026747

- "To date, no peer reviewed scientific journal articles demonstrate a causal link between people living in proximity to modern wind turbines, the noise (audible, low frequency noise, or infrasound) they emit and resulting physiological health effects." *Source: Knopper&Ollson review* http://www.ehjournal.net/content/pdf/1476-069X-10-78.pdf
  "... there is no scientific evidence that noise at levels created by wind turbines could cause health problems other than annoyance..." *Source: Eja Pedersen 2003 Review* http://www.naturvardsverket.se/Documents/publikationer/620-5308-6.pdf

  "None of the... evidence reviewed suggests an association between noise from wind turbines and pain and stiffness, diabetes, high blood pressure, tinnitus, hearing

impairment, cardiovascular disease, and headache/migraine." *Source: Massachusetts review* http://www.mass.gov/dep/energy/wind/turbine_impact_study.pdf

"...there are no evidences that noise from wind turbines could cause cardiovascular and psycho-physiological effects." *Source: Eja Pedersen 2003 Review* http://www.naturvardsverket.se/Documents/publikationer/620-5308-6.pdf

"…there was no evidence that environmental noise was related to raised blood pressure…"*Source: Ad Hoc Expert Group on Noise and Health* http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1279888026747

- "The health impact of the noise created by wind turbines has been studied and debated for decades with no definitive evidence supporting harm to the human ear." *Source: Chatham-Kent Public Health Unit* http://www.harvestingwindsupport.com/blog/wp-content/uploads/2011/03/Chatham-KentHealth-and-Wind-.pdf

- "The electromagnetic fields produced by the generation and export of electricity from a wind farm do not pose a threat to public health..."*Source: NHMRC 2010* http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/new0048_evidence_review_wind_turbines_and_health.pdf

- "... no consistent associations were found between wind turbine noise exposure and symptom reporting, e.g. chronic disease, headaches, tinnitus and undue tiredness." *Source: Bolin et al 2011 Review* http://iopscience.iop.org/1748-9326/6/3/035103/pdf/1748-9326_6_3_035103.pdf

- "... low level frequency noise or infrasound emitted by wind turbines is minimal and of no consequence... Further, numerous reports have concluded that there is no evidence of health effects arising from infrasound or low frequency noise generated by wind turbines." *Source: NHMRC 2010* http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/new0048_evidence_review_wind_turbines_and_health.pdf

- "... renewable energy generation is associated with few adverse health effects compared with the well documented health burdens of polluting forms of electricity generation..." *Source: NHMRC 2010* http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/new0048_evidence_review_wind_turbines_and_health.pdf

- "Although opposition to wind farms on aesthetic grounds is a legitimate point of view, opposition to wind farms on the basis of potential adverse health consequences is not justified by the evidence." *Source: Chatham-Kent Public Health Unit* http://www.harvestingwindsupport.com/blog/wp-content/uploads/2011/03/Chatham-KentHealth-and-Wind-.pdf

- "What is apparent is that numerous websites have been constructed by individuals or groups to support or oppose the development of wind turbine projects, or media sites

reporting on the debate. Often these websites state the perceived impacts on, or benefits to, human health to support the position of the individual or group hosting the website. The majority of information posted on these websites cannot be traced back to a scientific, peer-reviewed source and is typically anecdotal in nature. In some cases, the information contained on and propagated by internet websites and the media is not supported, or is even refuted, by scientific research. This serves to spread misconceptions about the potential impacts of wind energy on human health..." *Source: Knopper&Ollson review* http://www.ehjournal.net/content/pdf/1476-069X-10-78.pdf

- Afsset was mandated by the Ministries responsible for health and the environment to conduct a critical analysis of a report issued by the *Académie nationale de medicine* that advocated the use of a minimum 1,500 metre setback distance for 2.5 MW wind turbines or more. The Affset report concluded that "It appears that the noise emitted by wind turbines is not sufficient to result in direct health consequences as far as auditory effects are concerned. [...] A review of the data on noise measured in proximity to wind turbines, sound propagation simulations and field surveys demonstrates that a permanent definition of a minimum 1,500 m setback distance from homes, even when limited to windmills of more than 2.5 MW, does not reflect the reality of exposure to noise and does not seem relevant."

Annoyance

- "... wind turbine noise is comparatively lower than road traffic, trains, construction activities, and industrial noise."*Source: Chatham-Kent Public Health Unit* http://www.harvestingwindsupport.com/blog/wp-content/uploads/2011/03/Chatham-KentHealth-and-Wind-.pdf

- "There is consistent evidence that noise from wind turbines—whether estimated in models or using distance as a proxy—is associated with annoyance, and reasonable consistency that it is associated with sleep disturbance and poorer sleep quality and quality of life. However, it is unclear whether the observed associations are due to wind turbine noise or plausible confounders" NHMRC (2014) full report

- "The perception of noise depends in part on the individual - on a person's hearing acuity and upon his or her subjective tolerance for or dislike of a particular type of noise. For example, a persistent "whoosh" might be a soothing sound to some people even as it annoys others."*Source: NRC 2007* http://www.vawind.org/assets/nrc/nrc_wind_report_050307.pdf

- "... some people might find [wind turbine noise annoying. It has been suggested that annoyance may be a reaction to the characteristic "swishing" or fluctuating nature of wind turbine sound rather than to the intensity of sound." *Source: Ontario CMOH Report*

http://www.health.gov.on.ca/en/public/publications/ministry_reports/wind_turbine/wind_turbine.pdf

- "… being annoyed can lead to increasing feelings of powerlessness and frustration, which is widely believed to be at least potentially associated with adverse health effects over the longer term."*Source: Ad Hoc Expert Group on Noise and Health* http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1279888026747

- "Wind turbine annoyance has been statistically associated with wind turbine noise, but found to be more strongly related to visual impact, attitude to wind turbines and sensitivity to noise." *Source: Knopper&Ollson review* http://www.ehjournal.net/content/pdf/1476-069X-10-78.pdf

- "... self reported health effects like feeling tense, stressed, and irritable, were associated with noise annoyance and not to noise itself..." *Source: Knopper&Ollson review* http://www.ehjournal.net/content/pdf/1476-069X-10-78.pdf

- "... many of the self reported health effects are associated with numerous issues, many of which can be attributed to anxiety and annoyance." *Source: Knopper&Ollson review* http://www.ehjournal.net/content/pdf/1476-069X-10-78.pdf

- "To date, no peer reviewed articles demonstrate a direct causal link between people living in proximity to modern wind turbines, the noise they emit and resulting physiological health effects. If anything, reported health effects are likely attributed to a number of environmental stressors that result in an annoyed/stressed state in a segment of the population." *Source: Knopper&Ollson review* http://www.ehjournal.net/content/pdf/1476-069X-10-78.pdf

- "… some community studies are biased towards over-reporting of symptoms because of an explicit link between…noise and symptoms in the questions inviting people to remember and report more symptoms because of concern about noise." *Source: Ad Hoc Expert Group on Noise and Health* http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1279888026747

- "... it is probable that some persons will inevitably exhibit negative responses to turbine noise wherever and whenever it is audible, no matter what the noise level." *Source: Fiumicelli review abstract*

- "The major source of uncertainty in our assessment is related to the subjective nature of response to sound, and variability in how people perceive, respond to, and cope with sound." *Source: Oregon review* http://public.health.oregon.gov/HealthyEnvironments/TrackingAssessment/HealthImpactAssessment/Documents/Oregon%20Wind%20Energy%20HIA%20Public%20comment.pdf

- "... sleep difficulties, as well as feelings of uneasiness, associated with noise annoyance could be an effect of the exposure to noise, although it could just as well be that

respondents with sleeping difficulties more easily appraised the noise as annoying." *Source: NHMRC 2010* http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/new0048_evidence_review_wind_turbines_and_health.pdf

- "Even noise that falls within known safety limits is subjective to the recipient and will be received and subsequently perceived positively or negatively."*Source: Chatham-Kent Public Health Unit* http://www.harvestingwindsupport.com/blog/wp-content/uploads/2011/03/Chatham-KentHealth-and-Wind-.pdf

- "... annoyance was strongly correlated with a negative attitude toward the visual impact of wind turbines on the landscape..." *Source: NHMRC 2010* http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/new0048_evidence_review_wind_turbines_and_health.pdf

- "Respondents tended to report more annoyance when they also noted a negative effect on landscape, and ability to see the turbines was strongly related to the probability of annoyance."*Source: Minnesota Health Dept 2009* http://www.health.state.mn.us/divs/eh/hazardous/topics/windturbines.pdf

- "[It is proposed that annoyance is not a direct health effect but an indication that a person's capacity to cope is under threat. The person has to resolve the threat or their coping capacity is undermined, leading to stress related health effects... Some people are very annoyed at quite low levels of noise, whilst other are not annoyed by high levels." *Source: NHMRC 2010* http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/new0048_evidence_review_wind_turbines_and_health.pdf

- "Further, sounds, such as repetitive but low intensity noise, can evoke different responses from individuals… Some people can dismiss and ignore the signal, while for others, the signal will grow and become more apparent and unpleasant over time… These reactions may have little relationship to will or intent, and more to do with previous exposure history and personality." *Source: Minnesota Health Dept 2009* http://www.health.state.mn.us/divs/eh/hazardous/topics/windturbines.pdf

- "Stress and annoyance from noise often do not correlate with loudness. This may suggest [that other factors impact an individual's reaction to noise… individuals with an interest in a project and individuals who have some control over an environmental noise are less likely to find a noise annoying or stressful." *Source: Minnesota Health Dept 2009* http://www.health.state.mn.us/divs/eh/hazardous/topics/windturbines.pdf

- "There is a possibility of learned aversion to low frequency noise, leading to annoyance and stress..." *Source: Leventhall 2005 review* http://www.noiseandhealth.org/article.asp?issn=1463-1741;year=2004;volume=6;issue=23;spage=59;epage=72;aulast=Leventhall

- "Noise produced by wind turbines generally is not a major concern for humans beyond a half mile or so because various measures to reduce noise have been implemented in the design of modern turbines."*Source: NRC 2007* http://www.vawind.org/assets/nrc/nrc_wind_report_050307.pdf

- "Noise… levels from an onshore wind project are typically in the 35-45 dB(A) range at a distance of about 300 meters... These are relatively low noise or sound-pressure levels compared with other common sources such as a busy office (~60 dB(A)), and with nighttime ambient noise levels in the countryside (~20-40 dB(A))." *Source: NRC 2007* http://www.vawind.org/assets/nrc/nrc_wind_report_050307.pdf

- "Complaints about low frequency noise come from a small number of people but the degree of distress can be quite high. There is no firm evidence that exposure to this type of sound causes damage to health, in the physical sense, but some people are certainly very sensitive to it." *Source: Ad Hoc Expert Group on Noise and Health* http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1279888026747

- "… there is the theoretical possibility that annoyance may lead to stress responses and then to illness. If there is no annoyance then there can be no mechanism for any increase in stress hormones by this pathway… if stress-related adverse health effects are mediated solely through annoyance then any mitigation plan which reduces annoyance would be equally effective in reducing any consequent adverse health effects. It would make no difference whether annoyance reduction was achieved through actual reductions in sound levels, or by changes in attitude brought about by some other means." *Source: Ad Hoc Expert Group on Noise and Health* http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1279888026747

<u>Infrasound</u>

- "Infrasound is audible when the sound levels are high enough. The hearing threshold for infrasound is much higher than other frequencies. Infrasound from wind farms is at levels well below the hearing threshold and is therefore inaudible to neighbouring residents. There is no evidence that sound which is at inaudible levels can have a physiological effect on the human body . This is the case for sound at any frequency, including infrasound." http://docs.health.vic.gov.au/docs/doc/5593AE74A5B486F2CA257B5E0014E33C/$FILE/Wind%20farms,%20sound%20and%20%20health%20-%20Technical%20information%20WEB.pdf

- "Claims that infrasound from wind turbines directly impacts the vestibular system have not been demonstrated scientifically... evidence shows that the infrasound levels near wind turbines cannot impact the vestibular system." http://www.mass.gov/dep/public/press/0112wind.htm
- "There is no evidence that infrasound ... [from wind turbines ... contributes to perceived annoyance or other health effects." *Source: Bolin et al 2011 Review* http://iopscience.iop.org/1748-9326/6/3/035103/pdf/1748-9326_6_3_035103.pdf

- "There is no consistent evidence of any physiological or behavioural effect of acute exposure to infrasound in humans." *Source: UK HPA Report* http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1265028759369

- "... self reported health effects of people living near wind turbines are more likely attributed to physical manifestation from an annoyed state than from infrasound." *Source: Knopper&Ollson review* http://www.ehjournal.net/content/pdf/1476-069X-10-78.pdf

- "... infrasound from current generation upwind model turbines [is well below the pressure sound levels at which known health effects occur. Further, there is no scientific evidence to date that vibration from low frequency wind turbine noise causes adverse health effects." *Source: Ontario CMOH Report* http://www.health.gov.on.ca/en/public/publications/ministry_reports/wind_turbine/wind_turbine.pdf

- "It would appear... that infrasound alone is hardly responsible for the complaints... from people living up to two km from the large downwind turbines." *Source: Jakobsen 2005 review* http://multi-science.metapress.com/content/w6r4226247q6p416/

- "From a critical survey of all known published measurement results of infrasoundfrom wind turbines it is found that wind turbines of contemporary design with therotor placed upwind produce very low levels of infrasound. Even quite close to theseturbines the infrasound level is far below relevant assessment criteria, including thelimit of perception."*Source: Jakobsen 2005 review* http://multi-science.metapress.com/content/w6r4226247q6p416/

- "With older downwind turbines, some infrasound also is emitted each time a rotor blade interacts with the disturbed wind behind the tower, but it is believed that the energy at these low frequencies is insufficient to pose a health hazard." *Source: NRC 2007* http://www.vawind.org/assets/nrc/nrc_wind_report_050307.pdf

Shadow flicker

- "Scientific evidence suggests that shadow flicker [from the rotating blades of wind turbines does not pose a risk for eliciting seizures as a result of photic stimulation." *Source: Massachusetts review* http://www.mass.gov/dep/energy/wind/turbine_impact_study.pdf

- Shadow flicker from wind turbines… is unlikely to cause adverse health impacts in the general population. The low flicker rate from wind turbines is unlikely to trigger seizures in people with photosensitive epilepsy. Further, the available scientific evidence suggests that very few individuals will be annoyed by the low flicker frequencies expected from most modern wind turbines." *Source: Oregon review* http://public.health.oregon.gov/HealthyEnvironments/TrackingAssessment/HealthImpa

ctAssessment/Documents/Oregon%20Wind%20Energy%20HIA%20Public%20comment.pdf

- "Flicker frequency due to a turbine is on the order of the rotor frequency (i.e., 0.6-1.0 Hz), which is harmless to humans. According to the Epilepsy Foundation, only frequencies above 10 Hz are likely to cause epileptic seizures." *Source: NRC 2007* http://www.vawind.org/assets/nrc/nrc_wind_report_050307.pdf

Community & social response to wind turbines

- The perception of sound as noise is a subjective response that is influenced by factors related to the sound, the person, and the social/environmental setting. These factors result in considerable variability in how people perceive and respond to sound... Factors that are consistently associated with negative community response are fear of a noise source... [and noise sensitivity..." *Source: Oregon review* http://public.health.oregon.gov/HealthyEnvironments/TrackingAssessment/HealthImpactAssessment/Documents/Oregon%20Wind%20Energy%20HIA%20Public%20comment.pdf

- "Wind energy developments could indirectly result in positive health impacts... if they increase local employment, personal income, and community-wide income and revenue. However, these positive effects may be diminished if there are real or perceived increases in income inequality within a community." *Source: Oregon review* http://public.health.oregon.gov/HealthyEnvironments/TrackingAssessment/HealthImpactAssessment/Documents/Oregon%20Wind%20Energy%20HIA%20Public%20comment.pdf

- "Effective public participation in and direct benefits from wind energy projects (such as receiving electricity from the neighboring wind turbines) have been shown to result in less annoyance in general and better public acceptance overall." *Source: Massachusetts review* http://www.mass.gov/dep/energy/wind/turbine_impact_study.pdf

- "... people who benefit economically from wind turbines [are less likely to report noise annoyance, despite exposure to similar sound levels as those people who [are not economically benefiting." *Source: NHMRC 2010* http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/new0048_evidence_review_wind_turbines_and_health.pdf

- "Landowners... may perceive and respond differently (potentially more favorably) to increased sound levels from a wind turbine facility, particularly if they benefit from the facility or have good relations with the developer..." *Source: Oregon review* http://public.health.oregon.gov/HealthyEnvironments/TrackingAssessment/HealthImpactAssessment/Documents/Oregon%20Wind%20Energy%20HIA%20Public%20comment.pdf

- "The level of annoyance or disturbance experienced by those hearing wind turbine sound is influenced by individuals' perceptions of other aspects of wind energy facilities,

such as turbine visibility, visual impacts, trust, fairness and equity, and the level of community engagement during the planning process." *Source: Oregon review* http://public.health.oregon.gov/HealthyEnvironments/TrackingAssessment/HealthImpactAssessment/Documents/Oregon%20Wind%20Energy%20HIA%20Public%20comment.pdf

- "Wind energy facilities... can indirectly result in positive health impacts by reducing emissions of [green house gases and harmful air pollutants, and... Communities near fossil-fuel based power plants that are displaced by wind energy could experience reduced risks for respiratory illness, cardiovascular diseases, cancer, and premature death." *Source: Oregon review* http://public.health.oregon.gov/HealthyEnvironments/TrackingAssessment/HealthImpactAssessment/Documents/Oregon%20Wind%20Energy%20HIA%20Public%20comment.pdf

- "The environmental and human-health risk reduction benefits of wind-powered electricity generation accrue through its displacement of electricity generation using other energy sources (e.g., fossil fuels), thus displacing the adverse effects of those other generators." *Source: NRC 2007* http://www.vawind.org/assets/nrc/nrc_wind_report_050307.pdf

- "Community engagement at the outset of planning for wind turbines is important and may alleviate health concerns about wind farms. Concerns about fairness and equity may also influence attitudes towards wind farms and allegationsabout effects on health. These factors deserve greater attention in future developments." *Source: Ontario CMOH Report* http://www.health.gov.on.ca/en/public/publications/ministry_reports/wind_turbine/wind_turbine.pdf

Summary of 2013 VTA Finnish report

VTT Technical Research Centre of Finland has published a new study with a conclusion that wind turbines do not cause any adverse health effects. The study consisted of a review of nearly 50 scientific research articles conducted in Europe, USA, Australia and New Zealand over the past 10 years.

Due to the increased number of wind power projects in Finland, a growing concern has arisen among the public regarding the possible negative impacts wind energy production may have on human health. VTT Technical Research Centre of Finland conducted a comprehensive literature review covering nearly 50 scientific research articles. The review concluded that in the light of current scientific research, there is no evidence to show that the infrasound produced by modern wind turbines is anything but harmless.

The sound of a nearby wind farm is does not possess such qualities or volume that it would cause physical symptoms to humans. The study also concluded that the infra sounds below the auditory threshold does not constitute a health hazard. Additionally, most of the infra sound caused by a wind farm is mixed with other infra sound from the environment and

does therefore not cause any additional exposure. According to the research articles reviewed, the low frequency sound with potential hazardous health impacts would have to be of a higher volume than that caused by wind farms, in order to have an impact on our health. Also, concern that shadow flicker may cause epileptic seizures are overruled in the research material. Such seizures cannot be caused by the type of flicker the slow rotation speed of the wind turbine blades produce.

Commentary: Major problems with recent systematic review on wind farms and distress.

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At least 20 reviews of the evidence on whether wind turbines cause health problems including stress have been published since 2003 (1). Cureus recently published another (2) where the authors referenced none of these.

Highlights of the findings of these reviews may be found here (1). The most recent (2014) review by Australia's peak health and medical agency, The National Health and Medical Research Council (3) concluded:

"There is no consistent evidence that noise from wind turbines… is associated with self reported human health effects. Isolated associations may be due to confounding, bias or chance. There is consistent evidence that noise from wind turbines—whether estimated in models or using distance as a proxy—is associated with annoyance, and reasonable consistency that it is associated with sleep disturbance and poorer sleep quality and quality of life. However, it is unclear whether the observed associations are due to wind turbine noise or plausible confounders."

and

"The association between estimated noise level and annoyance was significantly affected by the visual attitude of the individual (i.e. whether they found wind farms beautiful, or ugly and unnatural) in the three studies that assessed this as a potential confounding factor. Residents in [one] study with a negative attitude to the visual impact of wind farms on the landscape had over 14 times the odds of being annoyed compared with those people without a negative visual attitude. …This means that factors other than the noise produced by wind turbines contribute to the annoyance experienced by survey respondents."

Against this background, I was curious to see what a new systematic review would conclude. According to the Cureus website, the new paper was peer reviewed. This is difficult to understand because of the sheer volume of major and minor problems it contains. Together, these make its contribution valueless to scholarly understanding of the

phenomenon of noise and health complaints about wind farms. The paper shows many signs of poor understanding of the subject matter of their review, of critical appraisal methods, of some basic conventions in systematic reviewing, of structuring in scientific writing, and much more besides.

The problems commence in the first line of the abstract where the confusing statement is made that "the proximity of wind turbines to residential areas has been associated with a higher level of complaints compared to the general population." I assume here that they are trying to say that those living near turbines have a higher prevalence of health complaints like sleep disturbance and general "human distress" than in the wider population. The prevalence of sleeping problems in general populations is as high as 33% (4) and reference material exists that quantifies the prevalence of many health problems in general populations (5, 6). Instead, the authors support their statement with a reference to a small qualitative study of 15 people both affected and unaffected by turbines (7). No conclusions about the prevalence of health problems in communities near turbines or in matched comparison populations can be drawn from that paper. I know of no published evidence that would allow such a statement to be made.

The authors state that their search strategy located 18 eligible papers but that these were based on six original studies. They explain that the 12 non-original "studies" (several of which were reviews or commentaries) were then excluded. Yet in their "key results" they proceed to describe the characteristics of all 18 papers and thus act as if these were not excluded ("All 18 peer-reviewed studies captured in our review found an association…").

The authors do not appear to understand what an "outcome" is. The abstract lists "outcome" variables that are not outcomes at all (such as study quality and journal name). These are independent variables, not dependent ones.

Their eligibility criteria for study selection are perplexing. What for example, is the difference between "peer-reviewed studies" and "studies published in peer-reviewed journals"? So too, is their noting that they searched the Cochrane Library for relevant studies. The Cochrane Library is a repository of reviews of evidence for health interventions, not for data on the prevalence of health complaints.

The authors seem not to understand the difference between studies and trials. For obvious reasons, there have been no trials conducted in this area.

Their main conclusions are that:

An association exists between wind turbines and distress in humans.

The existence of a dose-response relationship (between distance from wind turbines and distress) and the consistency of the association across studies .. argues for the credibility of this association.

The first conclusion is very imprecise and sweeping and ripe for being megaphoned by anti-wind farm interest groups as if it actually meant something. One of the six original studies reviewed (Salt & Hullar) (8) should have never been included in this review – see below. The Nissenbaum et a study (9) is listed as of moderate quality with a low risk of bias. Yet all three authors and two out of three reviewers of that paper are members of Society for Wind Vigilance, an anti-wind organization. Nissenbaum has been raising health concerns in study areas for several years, potentially biasing collected data. Neither of these problems is mentioned in this review. Two critiques of this study were published in Noise and Health pointing out the very poor quality of the results, analysis and the overstatements of conclusions (10, 11).

The Shepherd et al study (12) which the authors rate as of "high" quality, failed to make any mention that the small wind farm community involved had for years been subjected to a local wind farm opposition group fomenting anxiety about health issues (13). Indeed, with one exception (14), the five studies referenced were performed in areas where complaints of annoyance were being raised. But such farms are unlikely to be representative of all wind farms. As our work shows, over nearly 65% of wind farms in Australia have never received a single complaint (15), and 73% of complainants in Australia are concentrated around just 6/51 farms. The failure of the authors to note this fundamental problem of study sample selection bias is another major problem.

Among the five "original" studies they considered satisfied their selection criteria was a paper by Salt & Hullar (8). This paper is not in any way a "study" of "the association between wind turbines and human distress." It reports no original empirical data and is essentially a backgrounder on infrasound and the "possibility" that wind turbine might create auditory distress. It is unfathomable why this paper was included in the data set.

Table 2 purports to be a meaningful summary of the findings of these six studies on the association between turbine exposure and "distress". I would defy anyone to make any sense of the Table, particularly the column headed "does [sic] response".

By way of comparison to the lack of detail provided by the authors of this review, it is instructive to look at the results from the Dutch study which formed the basis of the

Pedersen 2009 paper(14) which were further analysed by Bakker et al (16) who noted that sleep disturbance was assessed by a question dealing with the frequency of sleep disturbance by environmental sound ("how often are you disturbed by sound?"). Two thirds of all respondents reported not being disturbed by any sound at all. Disturbance by traffic noise or other mechanical sound was reported by 15.2% of the respondents. Disturbance by the sound of people and of animals was reported by 13.4% of the respondents. Relevantly, disturbance by the sound of wind turbines was reported by only 4.7% of the respondents (6% in areas deemed to be quiet and 4% in areas deemed to be noisy). Bakker and colleagues (16) note that it was not clear from the study if there was a primary source causing sleep disturbance and how respondents attributed being awakened by different environmental sound sources. What was clear was that wind turbines were less frequently reported as a sleep disturbing sound source, than other environmental sounds irrespective of the area type (quiet versus noisy). Analysis showed that among respondents who could hear wind turbine sound, annoyance was the only factor that predicted sleep disturbance. The authors speculated that being annoyed might contribute to a person's sensitivity for any environmental sound, and the reaction might be caused by the combination of all sounds present. It might also be the case that people annoyed by wind turbine noise attribute their experience of sleep disturbance to wind turbine noise, even if that was not the source of their awakening.

Swathes of the paper are given over to descriptions of their efforts to rate the levels of evidence in the four reviewed studies. But they never ever describe their approach in any way that might permit replication of how they went about such rating. How was level of evidence actually determined? It should have been explicitly defined in the text. Their discussion of the risk of bias across studies is bizarre. "The quality of the study could be confounded by journal name and author". Surely the authors mean here that the evaluation of the quality of the study could be biased by this knowledge. The term "confounded" has another meaning.

Their "key results" consist of no more than five bullet points. These read like draft notes-to-self (eg: None of these studies captured in our review found any association (potential publication bias)".

The authors chose to use the term "distress" instead of "annoyance". The American Medical Dictionary defines distress as 1. Mental or physical suffering or anguish or 2. Severe strain resulting from exhaustion or trauma. Annoyance on the other hand is defined as 1. The act of annoying or the state of being annoyed or 2. A cause of irritation or vexation; a nuisance. (The American Heritage Dictionary of the English Language, Fourth Edition copyright 2000) and is generally identified as a highly subjective state in medical literature. It is clear that the authors chose a stronger term than was used by the majority of studies. Most literature refers to annoyance, while the referenced alternative of "Wind Turbine Syndrome" was coined in a vanity press published case study with extraordinary weaknesses of selection bias, methodology and analysis (17). Similarly, "extreme annoyance" is rarely used in the

literature. Annoyance is by far the most commonly used term in the material referenced, so it is unclear why “distress” was chosen.

The paper is riddled with imprecise, mangled and contradictory language. For example: key finding 1: “All 18 peer-reviewed studies captured in our review found an association…” and key finding 2: “None of these studies captured in our review found any association (potential publication bias)”; infelicitous prose: “these complaints are coined in research”; “There might be a theoretical incline to give studies in high impact journals higher quality…”; basic grammatical errors: “the study’s principle outcome”; “there was no missing data.” It is unconventionally structured with extremely scant results and methods sections providing no adequate explanations of how key decisions on quality or bias were made.

The publication of this very poor paper is regrettable.

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Impact of wind turbines on house prices in Scotland

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Summary

This report presents the main findings of a research project estimating the impact on house prices from wind farm developments. It is based on analysis of over 500,000 property sales in Scotland between 1990 and 2014.

The methodology builds on research on the impact from wind farms on house prices in England (Gibbons 2014). This study improves the way the impact is estimated by looking at the impact of both single turbines and whole wind farms.

To control for the normal fluctuations in house prices we used a 'control group' that closely resembles the characteristics of the dwellings in the study but without being exposed to a wind farm. This provides prices that can be used to interpret a wind farm's impact on the price of dwellings nearby. As such a result showing no effect means that the house price of the property with a wind farm close by has increased or decreased at the same rate as the properties in the control group.

The study looked at both natural landscape and built environment in relation to how exposed a dwelling is to the visual impact of the wind farm.

Key findings

1. **No evidence of a consistent negative effect on house prices:** Across a very wide range of analyses, including results that replicate and improve on the approach used by Gibbons (2014), we do not find a consistent negative effect of wind turbines or wind farms when averaging across the entire sample of Scottish wind turbines and their surrounding houses. Most results either show no significant effect on the change in price of properties within 2km or 3km, or find the effect to be positive.

2. **Results vary across areas:** The results vary across different regions of Scotland. Our data do not provide sufficient information to enable us to rigorously measure and test the underlying causes of these differences, which may be interconnected and complex.

Our results persist under a variety of assumptions:

- whether or not we account for the visibility of turbines;
- whether we base the analysis on individual turbines or entire wind farms;
- whether we account for building heights or use only the natural terrain when estimating turbine visibility; and
- whether we follow individual dwellings over time or use postcode averages.

The complexity of the findings may be due to:

- attitudes towards wind farms and their benefits potentially varying across regions and different social and economic groups;
- Scotland having a higher proportion of its turbines located in remote areas; and
- the fact that some wind farms provide economic or leisure benefits (e.g. community funds or increasing access to rural landscapes through providing tracks for cycling, walking or horse riding).

Additionally these factors are not mutually exclusive. It is likely that they affect house prices simultaneously, and to varying degrees in different locations.

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Introduction and background

The Scottish Government has committed to a target for renewables to generate the equivalent of 100% of Scotland's electricity demand by 2020[5]. Onshore wind power is playing a central part in decarbonising Scotland's energy supply.

The rapid growth in onshore wind (both in Scotland and globally) has been accompanied by an interest in understanding the impacts of onshore wind development, both positive and negative. The overall economic benefits of investment and spending are relatively straightforward to measure[6]; impacts on communities less so. Survey-based approaches consistently show a majority in favour of renewable power generation in principle but paint a more mixed picture for those directly affected by nearby wind farm development[7].

There is now a substantial body of research on the local impacts of wind farms. Some of this research has looked at measurable effects on house price in order to understand the objective effects on communities, beyond stated views. Have properties near to, or in sight of, new wind farm developments seen price changes that differ from other houses? Until recently, all extant studies had consistently found no robust evidence of any such price impact. One of the most recent studies, by RenewableUK and the Centre for Economics and Business Research, used seven wind farm case studies across England and Wales, and came to the same conclusion: either no impact or even a slight positive one[8].

Very shortly after that study, however, Steve Gibbons looked again at English and Welsh wind farms using a larger data-set and property prices between 2000 and 2012, and found evidence for negative price impacts[9]. In Gibbons' analysis of previous house price studies[10], the key problem he identifies is sample size: while some studies contain many properties, the number of observations actually used to estimate the price impact tends to be too low to be statistically reliable. Many also do not compare price changes across time. Gibbons' research design allows for comparison of much larger groups of property prices before and after wind farms became operational, allowing for more robust results.

The present study bases its price impact analysis on Gibbons' approach, including his use of a landscape analysis to determine whether properties can likely see a turbine[11], or whether line of sight is blocked. Line of sight analysis allows us to test whether visibility of turbines affects house prices differently to proximity alone, by separating visible and non-visible turbines into two groups. We have also explored ways of improving on Gibbons' approach, greatly increasing the resolution and precision of the data. These improvements are listed below:

1. Whilst we replicate Gibbons' approach using average house price per postcode and postcode-centre for housing location, we also repeat the analysis using individual property prices based on full address locations.
2. We use a dataset of wind turbines that includes their exact location and tip height, rather than the centre-point of wind farms. Relying on the centre-point of wind farms might be particularly problematic in a Scottish context where some wind farms are very spread out. When turbines are dispersed in this way, it is possible for a house to be a very long way from the centre of the wind farm, but very close to a peripheral turbine.
3. Our landscape analysis uses 5 metre grid squares (versus 200 metre in Gibbons). Combined with the exact property locations and turbine locations, this gives much more accurate lines of sight.

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[10] Ibid. p.179

[11] Why 'likely'? - The real landscape may differ in ways the model has not captured - for example, vegetation may be blocking a view.

4. Taking advantage of this higher resolution, we have also added building height data (where available) to test whether buildings may block a property's view.

The following section describes the data used in more detail, and then explains the two key steps in producing the analysis: the line of sight analysis and the econometric house price analysis. The full results are then presented, before concluding with some possible explanations for the findings.

Details of the house price impact analysis

Overview of the data and method

In this section, we outline the data sources for the project and explain how they were used to produce the house price impact analysis. The following four sub-sections describe the **four sources of data** used:

1. House price data for Scotland from January 1990 to March 2014.
2. Wind turbines that became operational between November 1995 and December 2014.
3. Digital Elevation Model (DEM) data for the Scottish landscape, giving height above sea-level for 5-metre grid squares covering the whole of Scotland.
4. Building height data, added to the DEM data.

We shall then detail the two steps of data preparation and analysis. The first step was to carry out a line of sight analysis identifying which houses could most likely see at least one turbine. This provided full details for each house of the number of visible turbines and their distance. The second step was to use this information, along with property price change over time (and a number of other control variables; see below), to produce the final house price impact analysis.

House price data

Data for property prices in Scotland comes from two previously unlinked versions of price data from Registers of Scotland (RoS). By linking these, the house price record covers just over 23 years (1990 to March 2014). While RoS record every Scottish sale, the analysis here drops any sales that, for a number of reasons, were not suitable. For example, not all properties could be exactly geocoded because the RoS record contained insufficient address information to obtain a location match and had to be excluded.

Only repeat sales (properties that sold more than once within the time period of the data) were used in the house price analysis. Following properties over time in this way helps us to compare like with like when estimating the house price impact of turbines being constructed. One limitation of this repeat sales approach is that we do not know whether there have been major changes to the dwelling over time. However, provided changes to dwellings are fairly randomly distributed across all dwellings in the data, this should not have a big effect on the results. In total, the RoS data provided 637,000 repeat-sale properties, accounting for just over 1.7 million sales.

Following Gibbons, we restricted the properties used in the analysis to those within 15km of at least one turbine (i.e. within the green circles in Figure 2). This is done, as Gibbons says, because "as the distance to the wind farm increases, the number of other potential coincident and confounding factors increases, making any attempt to identify wind farm impacts less credible"[12]. This reduces the total number of properties in the analysis to 509,275.

Wind turbines

Three sources have been combined to produce the wind turbine dataset:

1. Precise wind turbine locations were acquired from Ordnance Survey's "Points of interest" (POI) data, freely available through an academic license[13]. Its latest incarnation (as of late 2015) is much more comprehensive than previous versions. This data is collated for Ordnance Survey by PointX (www.pointx.co.uk). The POI turbine data itself is mainly supplied to Ordnance Survey by RenewableUK.
2. Dates that wind farms became operational were 'scraped' from RenewableUK's website (www.renewableuk.com) and then matched to turbines.

[12] Gibbons, 'Gone with the Wind'. p.180

[13] Code and guidance for extracting specific types of POI data are accessible at the Sheffield Methods Institute github page: github.com/SheffieldMethodsInstitute/windfarmsHousePrices

3. Turbine tip height information was collated through direct research of planning applications and other publicly available sources[14].

Figure 1 shows the cumulative rise in the number of turbines becoming operational in Scotland from 1995 onwards; the total reaches just over 2,500 turbines by the end of 2014.

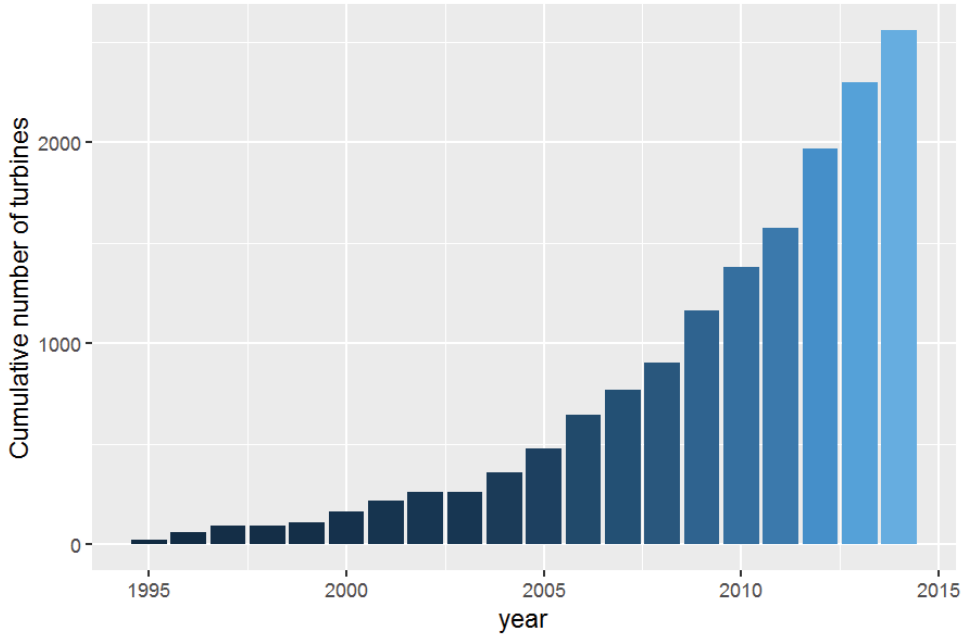


Figure 1: Number of operational wind turbines in Scotland, cumulative from 1995 to 2014

Landscape and building height data

To determine whether a turbine is likely to be viewable from a particular property, we need to know if any landscape features intervene to block the view. This requires using a 3D 'Digital Elevation Model' (DEM) of the Scottish terrain, onto which houses and turbines can be added. We use Ordnance Survey's "OS Terrain 5" DEM, which provides height above sea level for every 5-by-5 metre grid point.

The OS Terrain 5 data can be used to identify which houses have their lines of sight blocked by the physical landscape, but this does not account for the effect of other buildings. To correct for this, we also use building height data for the majority of properties in Scotland, combining Ordnance Survey's Mastermap with LIDAR data from the Centre for Environmental Data Analysis (CEDA). The OS Terrain 5 DEM data's 5 metre resolution is fine enough to allow addition of building footprints and heights derived from the Mastermap and CEDA data.

On the map of Scotland in Figure 2, areas for which we used building data are shown with the yellow (Mastermap) and red (CEDA) grid areas. Where both sources covered the same area, we used the slightly better quality Mastermap data. These two sources do not cover all buildings in Scotland, but because data exists for all the larger conurbations, 84% percent of properties have a line of sight that crosses building height data and so could potentially have that view blocked. Calculations are run both with and without building heights for comparison, with the latter using the 84% subset of houses that may have had a line of sight blocked by a building.

[14] The majority of the work tracking down tip heights was done by Dr Ellie Bates, University of Edinburgh.

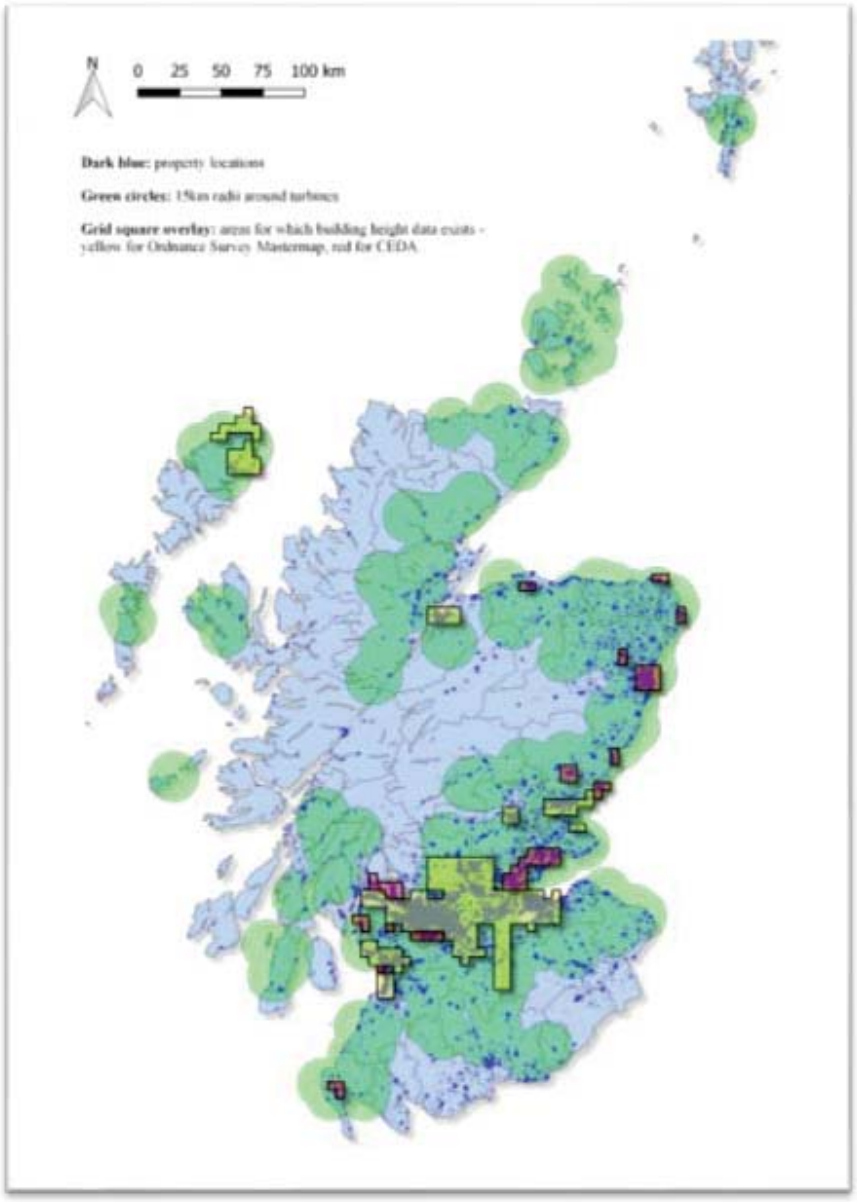


Figure 2: Scotland - housing data location (dark blue), turbine 15km radii and building height data location

Analysis step 1: Which houses can likely see turbines? 'Line of sight' analysis

The econometric analysis requires the following information for each repeat-sale property:

- Which turbines, if any, are within 15km?
- How close is each of them to the property?
- Of those turbines within this 15km range, which are visible to this property and which likely cannot be seen?

We used Pythagoras' Theorem to compute distances between each dwelling and turbine. To estimate turbine visibility, we used 'line of sight' analysis (also known as "intervisibility" analysis)[15]. Figure 3 and Figure 4 illustrate how this process is carried out using the example of a particular property in Glasgow that has its line of sight blocked by another building. 136 batches of housing, turbine and landscape data are processed - these figures use a batch covering the Cathkin Braes wind turbine, installed in 2013[16]. (Other batches process larger groups of turbines together, e.g. the Whitelee wind farm to south of Glasgow in Figure 3 is processed in one batch.)

The dotted line on the map of Glasgow in Figure 3 marks an 8.7km line of sight between this example property and the Cathkin Braes turbine. Figure 4 gives the landscape cross-section for this same line (with horizontal distance at 1/8th scale, relative to height), showing how the DEM landscape data - both with and without building heights - is used. The line starts two metres above ground level on the site of the house[17] and 'looks' towards the turbine blade tip height. If the highest point of the tip is visible above landscape and buildings, the line of sight is clear. In this example, for landscape alone, the house (left-hand side of graph) has a clear line of sight. If building heights are used, however (green in Figure 4), line of sight is blocked.

This process was repeated for all properties. The addition of building height data blocked a great many more from view of a turbine. Without building heights, 80% of properties within 15km of a turbine are identified as having a line of sight to at least one. This drops to 32% when building heights are used - an unsurprising result given how many properties are located in conurbations. Note that this binary visibility result says nothing about a turbine's actual visual impact which will depend on proximity. For example, a visible turbine will presumably have a much bigger visual impact when viewed from nearby properties compared with the view from houses 15km away. As Gibbons says:

> "Existing literature based on fieldwork suggests that large turbines are potentially perceptible up to 20km or more in good visibility conditions, but 10 to 15km is more typical for a casual observer and details of individual turbines are lost by 8km."[18]

[15] Code and guidance for this is available at the Sheffield Methods Insitute github page: github.com/SheffieldMethodsInstitute/windfarmsHousePrices

[16] See e.g. "£5m city turbine will be visible around world (From Evening Times)." 2013. www.eveningtimes.co.uk/news/13256714.__5m_city_turbine_will_be_visible_around_world

[17] The building data for the house is discounted: for the building height check, line of sight is only checked once the line has got past the building's edge.

[18] Gibbons p.180

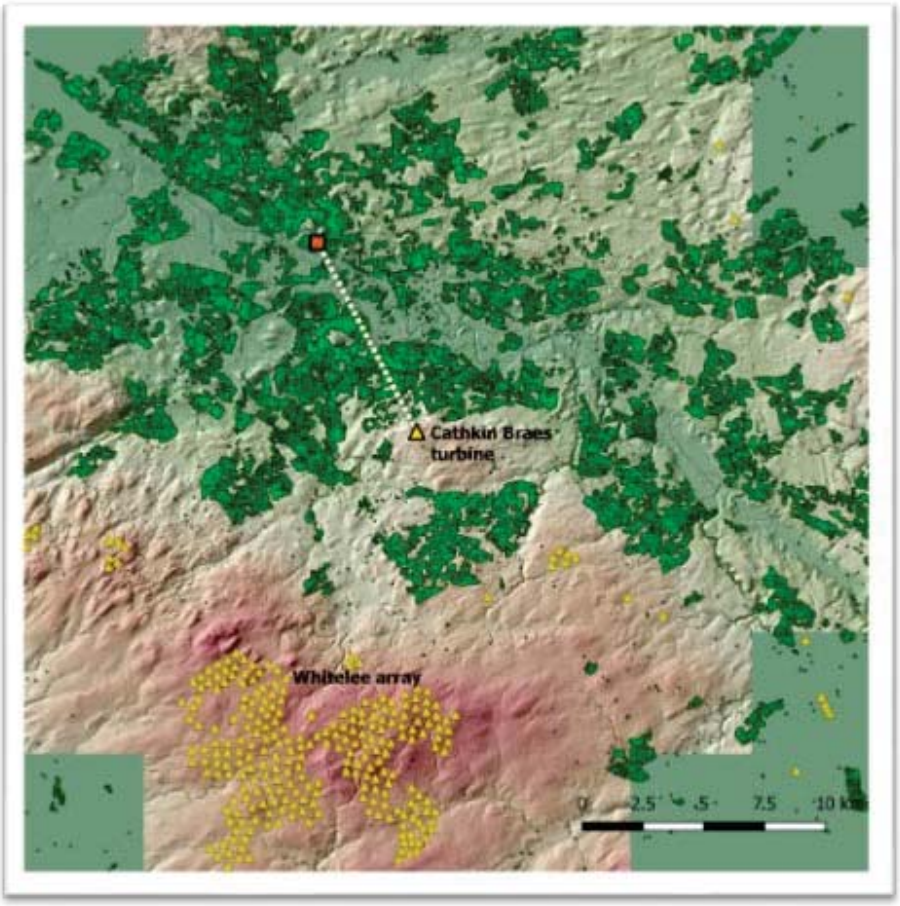


Figure 3: Digital Elevation Model for Glasgow area. Repeat-sales properties in green. Wind turbines are yellow triangles. Dotted line is an example line of sight (matches figure below) for a sample Glasgow property to Cathkin Braes turbine tip.

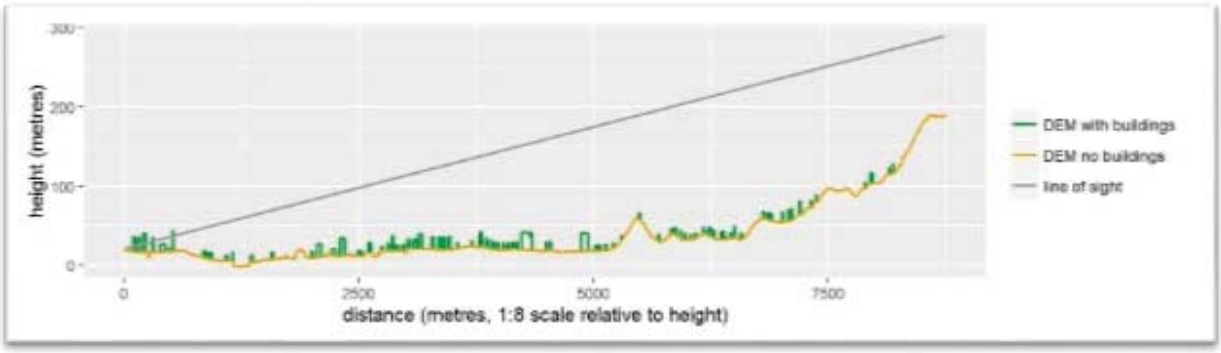


Figure 4: example line of sight blocked by buildings that would not be blocked by landscape alone. Matches dotted line in above figure. Property on left, Cathkin Braes turbine tip on right. Note horizontal distance is 1/8 of actual scale, relative to height.

Analysis step 2: house price impact using 'difference in differences'

The aim of the econometric analysis described in this section is to assess the house price impact as distance increases, both for visible and non-visible turbines and wind farms.

We use a "difference in differences" approach to identify the causal effect of wind turbine proximity and visibility. This approach seeks to estimate how rates of change in house prices differ between properties "exposed" to wind turbines (through proximity and/or visibility) compared with those that are not exposed. We use only `repeat sale' properties, as described above. We label properties exposed to wind turbines - those we want to identify any price impact for - as the "treatment group".

To measure the causal effect of wind turbine exposure, we would ideally like to know how the same dwelling's change in price over time is affected by the presence or absence of a wind farm. Clearly, observing both states at the same time is not possible. Instead, we construct a "control group" that closely resembles the characteristics of the treatment group but has not been exposed to a wind farm. The control group thus provides us with a counterfactual dwelling price, which we interpret as what the price would have been if the treatment group had not been in proximity to, or in sight of, wind turbines. This setup allows us to compare the average change in 'exposed' dwellings' house price to the average change in 'unexposed' dwellings' house price before and after turbines become operational - a so called *difference-in-differences* framework.

The first difference is how much the treatment and control groups change price between the chosen time periods. The second difference is how these two changes compare. This second difference is labelled the "treatment effect", i.e. the causal impact of wind farm developments on house price growth. If we were to produce the same findings as Gibbons, with the treatment group's price increasing **less** than the control group, then the impact of wind turbines on house price growth would be negative. For example, if we find a house price impact of -10%, this means that prices in the treatment group went up by 10% less than they did in the control group. On the other hand, if we find a positive effect, say 10%, this means that prices in the treatment group went up by 10% more than in the control group.

Note that a key assumption in the difference-in-differences framework is that the treatment and control groups show the same trends in house price growth in the pre-treatment period (the 'common trends assumption'), which means that they are subject to the same influences on price before the turbine is installed.

For all results, we repeated our difference-in-differences analysis using a large variety of additional controls that control for possible unobserved factors. This is the same as the "fixed effects" approach used by Gibbons (2014). The essential principle of a fixed effects approach is to allow fixed (i.e. constant over time) differences in subsets of the data to be accounted for. Including fixed effects allows the analysis to control for factors that we cannot easily measure (such as cultural differences or unknown economic, political or physical factors) but are likely to be fairly constant over time and may cause different price trends. The most intuitive fixed effects are regional. For example, there might be different house price trends across NUTS2 regions because of differences in the fixed characteristics across regions, such as their physical geography. These differences can be controlled for using fixed effects even if we do not have detailed data on the different underlying characteristics. This may be important if wind farms are sited taking these features into account.

All of the results presented in this report include basic fixed effects that control for variations in overall house price trends and differences in property characteristics. We use annual and quarterly fixed-effect controls to flexibly account for house price trends. Since we are looking at repeat sales, our estimations further include a set of house fixed effects - allowing each property its own trend line - that absorb any time-invariant house characteristics such as its footprint size or number of bedrooms. These are the "basic" controls used in all the results reported here.

We then add a number of additional controls to the models in order to test sensitivity. First, a number of geographic controls are added, allowing different house price effects over time by including fixed effects for slope (for each individual property), elevation (height above sea level for each property) and aspect (which compass direction the property's slope is facing, indicating which direction their predominant view is likely to be). Second, we add controls for different price effects across distance rings. These controls are in line with the ones used by Gibbons (2014). In addition, we allow house prices to differ between Scotland's four NUTS2 regions and include a set of region-by-year interactions. These additional fixed effects results are provided in the appendices.

Results

We present three sets of results. We start with the Gibbons (2014) approach, which is based on postcode averages for house prices and computes proximity and visibility using the centre point of entire wind farms (rather than individual turbines). We then compare these baseline results with outputs based on more fine-grained analysis that follows individual dwellings over time and calculates turbine proximity and visibility based on individual wind turbines. This is done both for visibility based just on terrain, and also visibility that also accounts for any buildings that may block the view.

Result #1: Analysis based on Postcode Averages & Wind Farm Centre Points ('centroids') (Gibbons)

Figure 5 shows the percentage impact on house price growth of a dwelling close to a wind farm being able to see the wind farm (blue line) compared with not being able to see the wind farm (red line). The approach used to derive this first set of results is similar to Gibbons (2014). They are based on:

- the change in average house prices in a given postcode before and after a wind farm became operational (rather than individual dwellings); and
- the effect of entire wind farms (rather than individual turbines).

Compared to the individual-property-level repeat sales analysis, one may think of this as a repeat sales estimation at the postcode level. However, instead of looking at the same house selling multiple times, we now look at multiple transactions in the same postcode. The implicit assumption is that houses within the same postcode unit are very similar and could be used interchangeably.

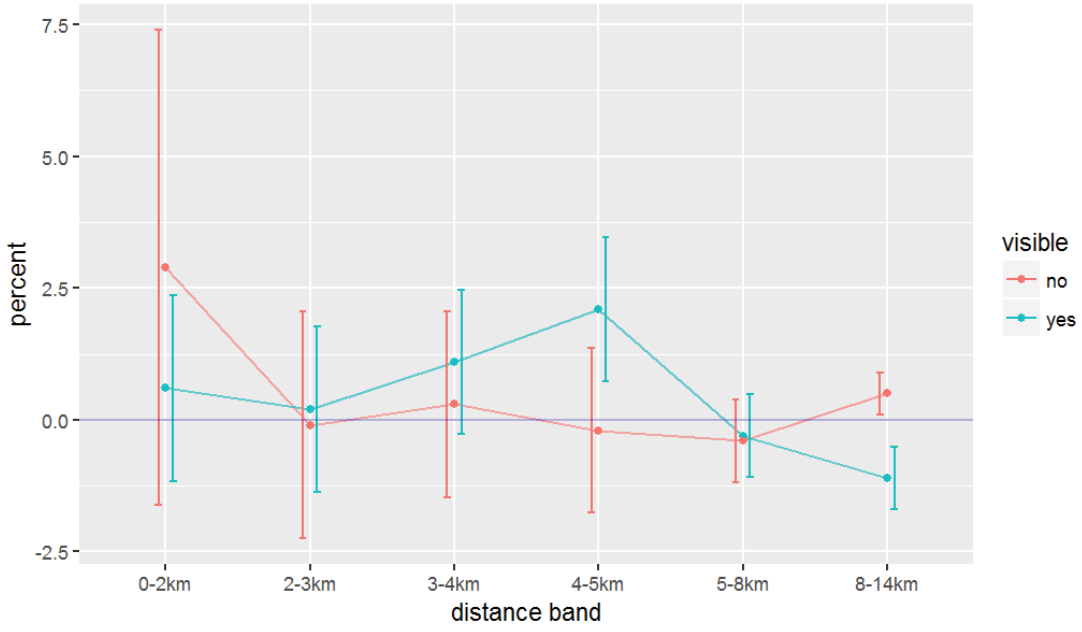


Figure 5: Result #1: Percent difference in the change of house price

(Postcode/wind farm centroids[19], **whole wind farm** visible/not visible.)

The horizontal axis shows the distance between the postcode of dwellings and the centre of the wind farm. These distances are grouped into 6 bands: (i) 0-2km, (ii) 2-3km, (iii) 3-4km, (iv) 4-5km, (v) 5-8km, and (vi) 8-14km. The vertical bars show the confidence intervals for each estimate. If the confidence interval is narrow, depicted by a short vertical bar, it means the estimate is precise. The longer the bar, the wider the confidence interval,[20] and the less precise the estimate is. If this vertical bar is entirely above zero, it means the result suggests a significant[21] positive effect on house price change caused by the construction of the wind farm. If the vertical bar lies entirely below zero, it means that the effect is significantly negative. If the vertical bar extends above and below zero, as is the case for most of the estimates in Figure 5, it means that there is no significant effect, either positive or negative. In other words, we cannot rule out a zero effect at the 95% confidence level.

A zero effect does not mean that house price growth has flat-lined. Rather it means that the treatment group (those properties that are in close proximity to a wind turbine) have a similar house price growth trajectory as the control group (those properties that are not in close proximity to a wind turbine).

The results in Figure 5 suggest that visible turbines have a positive effect on house prices (the blue line is above zero for the first four distance bands). However, the majority of confidence intervals extend above and below zero. This suggests that there is no significant house price effect in the first three distance bands, but a possible slight positive effect for visible turbines in the 4-5km band, dropping to a negative effect in the 8-14km band.

As discussed above, we repeated our analysis using a large variety of different specifications that control for a variety of possible unobserved factors using the same "fixed effects" approach used by Gibbons (2014). The results of the key variations from this exercise are presented in Figure A1 in the appendix, where Figure 5 is replicated in Figure A1(A) for comparison. We can see that the results are broadly consistent with Figure 5 in that none of the graphs show significant negative impacts of wind turbines on house price growth in the first three distance bands. Some graphs do, however, suggest a significant **positive** impact on house price growth, particularly in the second distance band (2-3 km), and particularly for visible turbines (see graphs (B), (C), (D), (F), and (H) of Figure A1). A more detailed description of the results in Figure A1 is presented in the Appendix.

Result #2: Analysis based on Repeat Sales & Individual Turbines

Figure 6 shows results based on the repeat sales of individual properties and the impact on house price growth after individual turbines become operational[22]. Here we see a significant positive impact on house price growth in the first distance band (1-2km) for properties that cannot see any turbines, but this effect is much smaller and statistically insignificant for properties in the same distance band that can see turbines. Note that the positive effect on properties, for which turbines are visible, becomes statistically significant in the second, third and fourth distance bands. The two furthest distance bands, however, do indicate negative price impacts. Though these results are mixed, as confidence intervals for visible/not visible turbines cross or touch the zero line.

Results of the sensitivity analysis—comparison with a variety of different fixed effects—are presented in Figure A2 in the appendix. Again, these different versions of the results tell a similar story with the positive impact on house price growth

[19] Centroid means centre point of an aerial unit (e.g. postcode) or multiple points.
[20] Based on the 95% level of confidence, which is the standard threshold used in statistical studies.
[21] Statistical "significance", in this context, means that there is less than a 5% chance that an estimated negative or positive house price impact is purely due to random variation in the data.
[22] Again, this is replicated in the appendix, figure A2(A).

tending to diminish with distance for properties that cannot see turbines, but rising then falling with distance for properties that can see turbines.

Crucially, there are no consistent signs of negative impacts on house price growth in the first three distance bands. In these results, the negative signal in the furthest two bands is again mixed, with no completely consistent pattern either side of zero.

Note that at shorter distances, confidence intervals tend to be larger. This is unsurprising, as sample sizes at shorter distances are smaller (there are not many houses very close to turbines) and so there will necessarily be more uncertainty in our estimates at close distances.

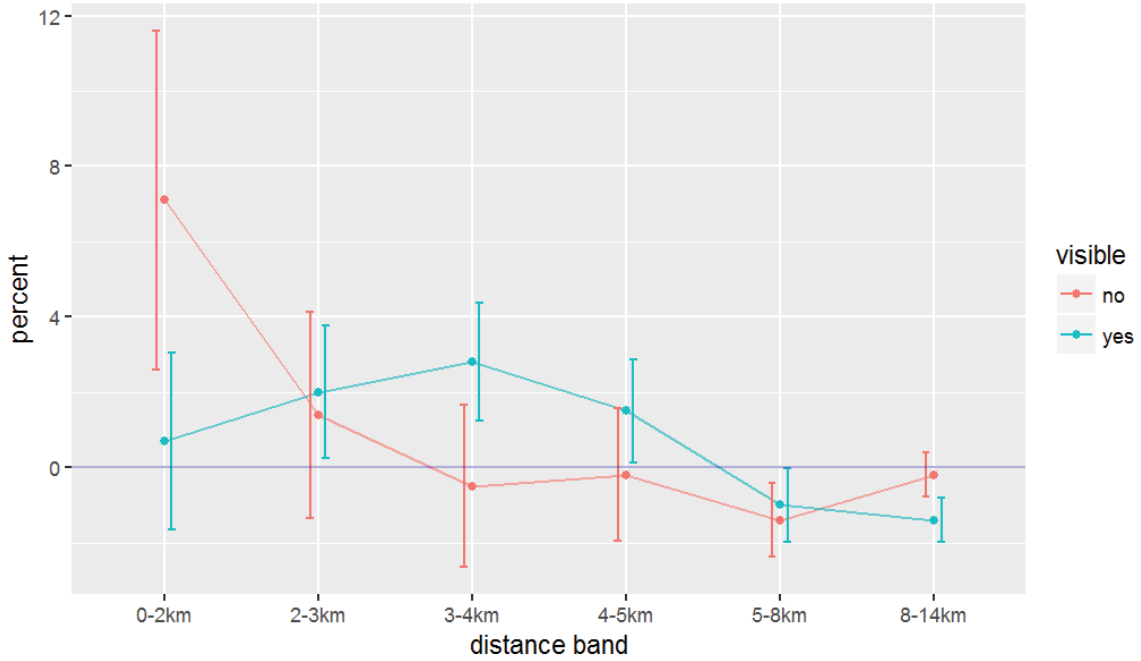


Figure 6: Result #2: Percent difference in the change of house price

(All repeat sales, turbine visible / not visible)

Results for individual repeat sales properties (Figure A2, appendix) show much the same pattern, but with larger percentage effects. The larger non-visible turbine effects at very close distance do, again, have large confidence intervals - but these do not cross the zero line. For both the centroid and repeat-sales results, any impact on house price growth tends to drop off as distances increase, though there is a great deal of variability in this response.

Repeat-sales results take advantage of having individual turbine data to distinguish between responses to turbines over and under 100 metres to tip height (appendix, figures A2(E) and A2(F); A3(E) and A3(F)). Sub-100 metre turbines are associated with consistent negative house price impacts, if they can be seen - but, again, confidence intervals cross the zero line. This is not the case for those out of sight, however.

Turbines over 100 metres in height are very similar to the main results - with perhaps a more clear decay of positive effect over distance for non-visible turbines. It is worth noting that: (a) Aberdeenshire has a large proportion of the sub-100 metre turbines and (b) most of the above 100 metre turbines were built after 2006, so this difference in response could be rooted in these different times and places.

Result #3: Analysis based on Repeat Sales & Individual Turbines, Taking into Account Building Heights

One disadvantage with both Result #1 (the Gibbons approach) and Result #2 (the individual houses/turbines approach) is that the visibility estimates do not take into account the possibility of buildings (as opposed to natural features) blocking the line of sight to turbines and wind farms.

Figure 7 shows the results of an analysis based on the repeat sales of individual properties and the impact on house price change after individual turbines become operational taking into account the height of buildings that might block the view of turbines. (Again, the appendix shows the results of the sensitivity analysis for these results in Figure A3). While the main findings remain similar to Results #1 and #2 in that there are no consistent signs of negative house price effects in the first three distance bands, it is clear that the estimates of impacts of visible and non-visible turbines on house price changes appear to be much closer in Result #3. Looking across all the results in Appendix figure A3, for both visible and non-visible turbines, the impact on house price growth seems to be more positive in the second distance band (2-3km) than in the closest distance band (0-2km), but then declines in distance bands three and four. As with the previous result, there appear to be negative price impacts in the last two distance bands, particularly for visible turbines, but these results are less consistent in the sensitivity analysis.

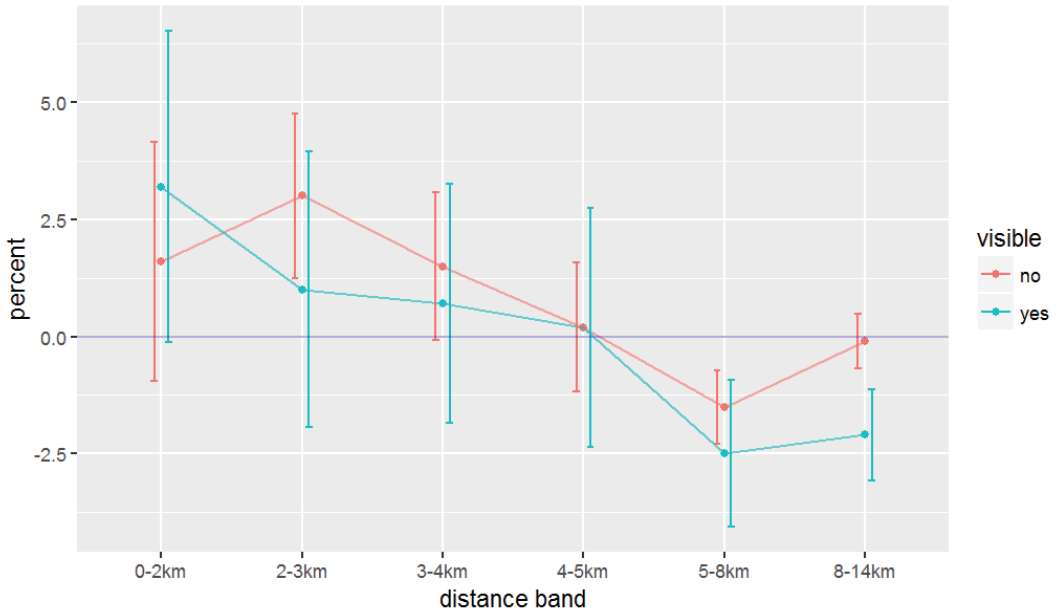


Figure 7: Result #3 Percent difference in the change of house price

(All repeat sales, turbine visible / not visible, using building height data for line-of-sight)

While results using building height data in Figure 7 are broadly similar to those relying on terrain-based line of sight, for some of these regressions there are quite different results even for properties that cannot "see" a turbine. This is because it uses a different sample of houses - only those that have lines of sight that cross areas that have available building height data. If this is not done, it is impossible to know whether a property has a clear line of sight due to no

buildings blocking it, or just that no building height data was available. As mentioned above, this still accounts for 84% of properties - but these are all in the larger conurbations. The properties that "can see" and "cannot see" are, of course, also different. The building height results, then, say more about the impact of wind turbines in urban areas than the non-building height sample.

The main difference in the building height result is in the nearest distance band where the effects on house price growth for properties whose line of sight is blocked by a building are noticeably smaller in comparison to those with line of sight blocked by terrain. With terrain only, visible and non-visible appeared to show a quite different response (Figure 6), but when the building height data are included (Figure 7), the impact of visible and non-visible turbines both have the same direction of change as distance is increased (though again, the wide confidence intervals mean there is considerable uncertainty surrounding the estimates).

The pattern of difference between sub-100-metre turbines (Figure A3(E)) and those over (Figure A3(F)) is similar to the terrain-based results once the uncertainty surrounding estimates is taken into account. For turbines less than 100 metres that can be seen despite building height, there appear to be large impacts on the price growth of properties in close proximity, and these impacts diminish at further distances, but the confidence intervals are so wide, we cannot be sure that the effects are different to zero for any of the distance bands, visible or non-visible. Much more precise results are available for turbines over 100m with statistically significant positive effects for the second distance band (2-3km) in Figure A3(F).

Summary and possible explanations for the results

In summary, we have not found any consistent evidence of a negative impact of wind turbines on house price growth. Generally speaking the effect is either positive at particular distance bands (2-3km) or not distinguishable from zero.

Note again that a zero effect does not mean that house price growth has flat-lined. Rather, it means that there is no significant difference between the house price growth of the treatment group (properties close to turbines) and that of the control group (properties far away from turbines).

A positive effect means that the treatment group has a higher rate of house price growth than the control group. The repeat sales analysis, for example, finds a positive effect of 2% for houses in the 2-3km distance band that can see a turbine (Figure 6). This means that the value of those houses went up by 2% more than the increase in value of dwellings in the control group.

We also find some evidence that that the impact of wind turbines on house price growth appears to vary across different regions of Scotland. This finding has not, as far as we are aware, been systematically tested in previous UK studies using the rigorous methods applied here.

There is some evidence from the results that property prices respond differently to wind turbines in different parts of Scotland. It must be emphasised, this finding is somewhat tentative. Using the current method, sample sizes are too small to be fully reliable. However, it does suggest that while some areas see the positive impacts described above, others may see negative impacts.

Results for Angus/Dundee and Clackmannanshire/Fife regions, all clustered north of the Firth of Forth, appear to see some negative impacts for visible turbines, though most of these have confidence intervals crossing or just touching zero. In contrast, North and South Lanarkshire show the most positive price impacts at close distances. Other regions either produce no geographical results due to data limitations, or are very mixed.

Our data do not provide sufficient information to enable us to rigorously measure and test the underlying causes of these differences which may be interconnected and complex. Differential impacts may arise, for example, from interactions between variations in physical terrain, urban social structures, local approaches to turbine development policy and community engagement.

We now conclude the report by offering a number of possible explanations for our findings.

Heterogeneous and changing preferences

The reason our results are consistently different to those reported by Gibbons (2014) might be because attitudes towards wind farms may be different in Scotland than in other parts of the UK, and may also vary significantly within Scotland, and between individuals. Attitudes may also have varied over time – e.g. in response to public debates about energy futures or rural economic development. So our complex findings may reflect genuine complexity and fluidity in the preferences and attitudes of homeowners across Scotland over the time period considered.

Location of turbines

In Scotland, a much higher proportion of turbines are likely to be located on moors and mountains, and in much more remote areas than in England and Wales. These differences in terrain might be another important reason for the discrepancies between our results and those of Gibbons (2014), as might the potential alternative uses of the land on which turbines are constructed. For example, in remote mountain locations, there may be fewer alternative commercially viable uses for the land and so the opportunity cost in terms of foregone alternative revenue streams from the land may be smaller. In contrast, high quality farmland locations in England and Wales may well have more valuable

alternative uses that have to be foregone, both now and in the future, if turbines are constructed. This may itself affect the attitudes of, and financial impact on, local residents and businesses.

Amenity and economic benefits

The positive house price impacts presented above may also reflect the fact that some wind farms provide economic and leisure benefits to the surrounding areas.

- E.g.1: The Whitelee wind farm had 25,000 visitors in the first two years of opening[23] and provides 130kms of tracks for walkers, cyclists, horse riders and dog walkers. These benefits may be substantial and may offset any negative aesthetic or noise effects. The positive effect of such amenities might be particularly strong if the previous land use was essentially barren and of little aesthetic merit. The effects, positive and negative, are likely to vary geographically but not necessarily in the same way.
- E.g.2: Some renewable energy companies provide community and development funds to fund a range of projects that benefit the locality and potentially generate employment. The SSE Clyde wind farm fund[24], for example, is expected to provide a total of £17.5 million for local projects that boost local investment and employment, offer training, prevent poverty, or benefit the local or social environment in some way. Such initiatives may improve the quality of life of local residents and increase house prices accordingly.

Patterns of social stratification

Attitudes towards wind turbines and the economic benefits may vary across different social and economic groups. If the location of these groups relative to the location of wind farms varies (e.g. because affluent households are more concentrated in the outskirts in some cities than in others) then the house price responses might vary depending on location.

For example, Kavanagh, Lee and Pryce (2016)[25] find that poverty is much more concentrated in the inner city in Dundee than it is in Edinburgh. The maps in Figure 11 below make the same point using the Scottish Index of Multiple Deprivation. Note also that Kavanagh, Lee and Pryce (2016) identify significant change in the geographic patterns of poverty between 2001 and 2010. Since wind turbines tend to be located in rural areas, households living near the edge of the city are most likely to be affected, either positively or negatively, and variations in the pattern of wealth over time and between cities might affect the pattern of house price impact.

[23] http://www.pfr.co.uk/cloich/15/Wind-Power/23/Tourism/

[24] See for example http://www.southlanarkshire.gov.uk/info/200168/getting_involved_in_your_community/571/sse_clyde_wind_farm_fund

25 Kavanagh, L., Lee, D. and Pryce, G. (forthcoming) Is Poverty Decentralising? Quantifying Uncertainty in the Decentralisation of Urban Poverty. Annals of the American Association of Geographers, freely available here: http://bit.ly/2dAihAX

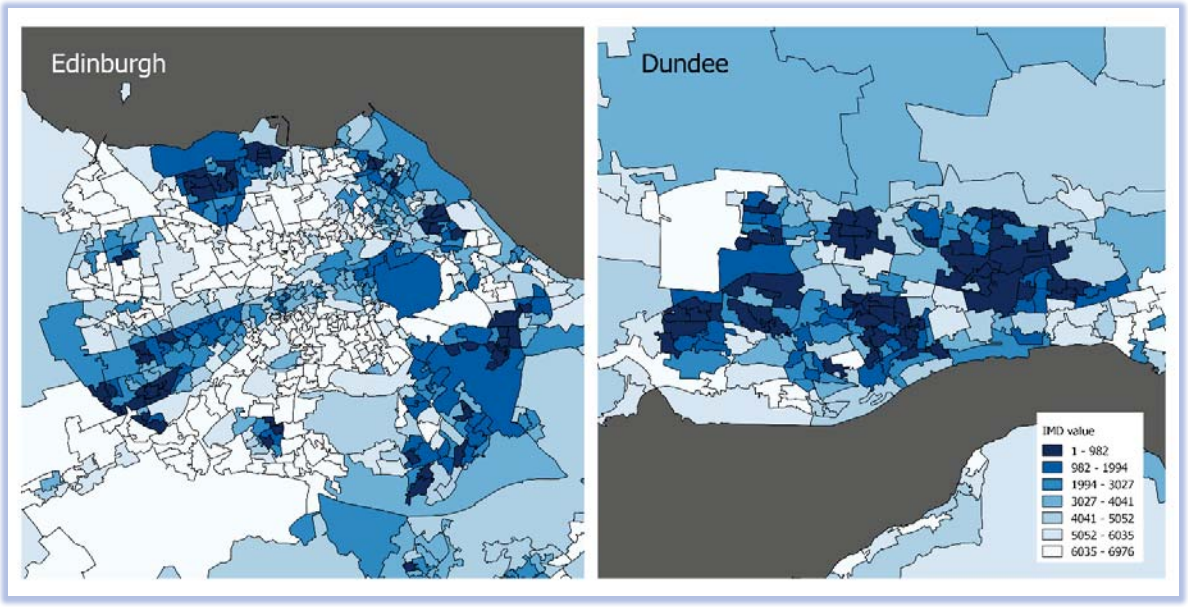


Figure 11: 2011 Scottish Index of Multiple Deprivation in Edinburgh and Dundee. Lower values (darker blue) are more deprived areas, higher values are less deprived.

Overall, those who are likely to be able to see a wind turbine typically live in lower value houses (and presumably have lower incomes) than those who cannot (Figure 12). It may be that those on lower incomes are less averse to wind turbines, perhaps because the marginal benefit of any community fund or other positive spillover from wind farm projects is larger relative to their disposable income.

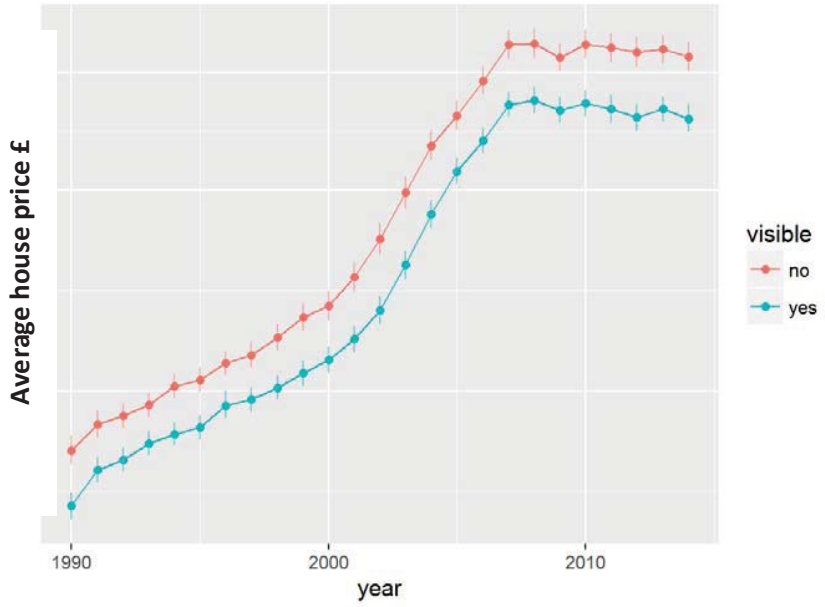


Figure 12: Average annual house prices (plotted on log scale) for houses that will have a turbine in sight at some point within the timeframe of the study vs. those that do not

Interactions between multiple causes

These explanations are not mutually exclusive. It is likely that they affect house prices simultaneously, and to varying degrees in different locations.

These forces may also reinforce or negate each other. They may each wax and wane over time and have different effects at different spatial scales leading to a complex and fluid set of potential outcomes at each point in time.

Further research would be needed to identify which of these effects is most prevalent and persistent. However, it should be noted that the data we collated for this project are unlikely to be sufficient to disentangle these effects in a robust way.

Appendix: Sensitivity analysis

Introduction

We noted above that we use a "fixed effect" methodology to control for a wide range of factors that we cannot observe or measure directly. Provided these factors remain fairly constant over time, we can control for their impact on price trends by introducing additional categorical variables into the analysis. All of the results presented in this report include basic fixed effects that control for differences in dwelling attributes, such as number of bedrooms, which we assume remain constant over time.

We also experimented with a wide number of additional controls. This allows us to test whether our results are robust to changes in how the analysis is set up. For example, we included fixed effects that allow different house price effects to occur over time for: the land gradient (for each individual property); elevation (height above sea level for each property); and aspect (which compass direction the property's slope is facing, indicating which direction their predominant view is likely to be). We also included controls for different price effects across distance rings and we allowed house prices to differ between Scotland's four NUTS2 regions and include a set of region-by-year interactions.

The impacts of these different specifications are presented in the graphs below for each of main categories of results presented under the labels A1, A2, and A3 which relate to the headings used in the main body of the report:

- Figure A1 reports sensitivity analysis for Result #1: Analysis based on Postcode Averages & Wind Farm Centre-Points ('centroids') (Gibbons),
- Figure A2 reports sensitivity analysis for Result #2: Analysis based on Repeat Sales & Individual Turbines
- Figure A3 reports sensitivity analysis for Result #3: Analysis based on Repeat Sales & Individual Turbines, Taking into Account Building Heights

You will see that each of the three figures contains eight sub-graphs, labelled (A) to (H) which give results for each type of fixed effects analysis. The labels for each are explained below:

The first sub-figure, labelled (A), is the "basic" fixed effects used in all analyses:

- **(A) "properties"**: includes fixed effects for time and properties. Note that these results are the same as the results used in the main sections above: they include the same time fixed effects and the property-level fixed effects as those used in Figures 5, 6 and 7 and follow the method described in the "Analysis Step 2" section above. We reproduce them below for ease of comparison with the additional results.

Sub-figures (B) to (D) in Figures A1, A2 and A3 below each add an extra fixed effect on top of the last. In order, these are:

- **(B) "geography":** fixed effects for slope, elevation and aspect;
- **(C) "rings"**: fixed effects for properties in each distance ring from turbines (or wind farms for figure A1);
- **(D) "NUTS2"**: fixed effects for Scotland's four NUTS2 regions.

Each sensitivity analysis includes a further four sub-figures. These run separate analyses on a particular subset of the data, with each of them using the full set of fixed effects. All three break down properties by their distance from the Scottish coast:

- **(G) "Coast < 2km"**: contains only coastal properties – i.e. those within 2km of the coast;
- **(H) "Coast > 2km"**: contains only inland properties – i.e. those located 2km or more beyond any coastal point.

Sub-figures (E) and (F) vary depending on whether the analysis is based on postcodes/wind farm centre-points or individual dwellings/turbines:

In **Figure A1** the analysis is based on postcode and wind farm centre-points and the results are broken down by wind farm size:

- **A1(E) "Single turbines"**: looks just at single turbine sites;
- **A1(F) "More than one turbine"**: looks at sites with more than one turbine.

In **Figures A2 and A3**, the analysis is based on individual turbines (rather than entire wind farms), and so we can estimate the impact of turbine height:

- **A2(E) and A3(E) "Turbines < 100m"**: plots the impact of turbines that are less than 100m tall;
- **A2(F) and A3(F) "Turbines < 100m"**: plots the impact of turbines over 100m tall.

Note that all graphs in the appendix have the same scale for the vertical axis, which is limited to the plus/minus 15% price change interval. This was done to make each sub-figure directly comparable. Any confidence intervals (i.e. the vertical bars plotted for each estimate) beyond this range are cut off at the 15% limit.

Sensitivity analysis for result #1: based on Postcode Averages & Wind Farm Centre-Points ('centroids') (Gibbons)

The results in the graphs (E) and (F) of Figure A1 allow us to compare the effects of "wind farms" consisting of single turbines (graph A1(E)) and those with two turbines or more (graph A1(F)). Single-turbine effects have wider confidence intervals making the estimates less precise and not statistically different from zero. The estimates are also noticeably less precise for coastal locations (A1(G)) than for inland properties (A1(H)). Controlling for "geography" using fixed effects for slope, elevation and aspect (A1(B)), distance rings (A1(C)) and NUTS2 region (A1(D)) yields relatively precise positive house price effects particularly for the 2-3km distance band.

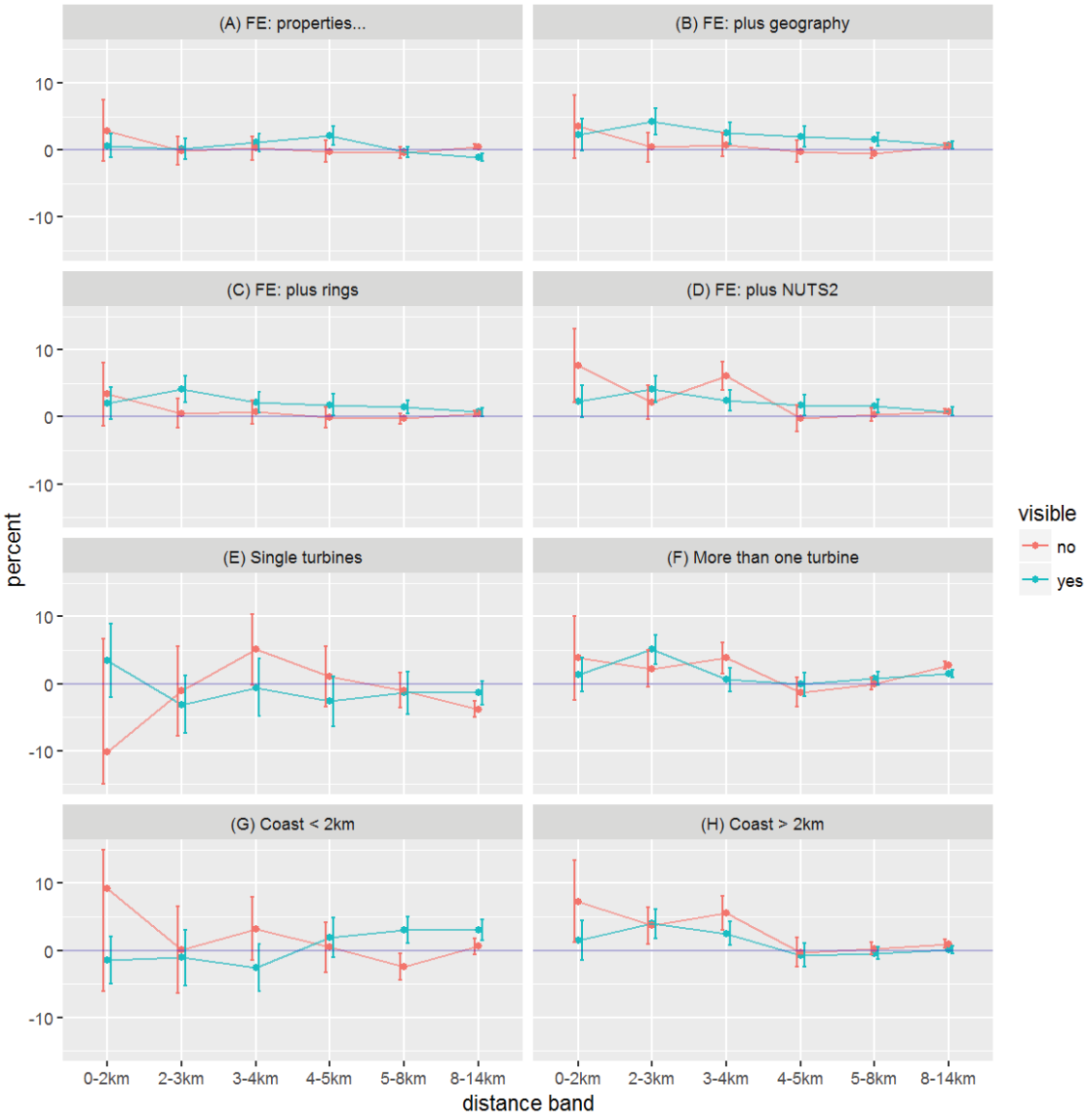


Figure A1: Percent difference in the change of house price

(Postcode/wind farm centroids, whole wind farm visible / not visible)

Sensitivity analysis for result #2: based on Repeat Sales & Individual Turbines

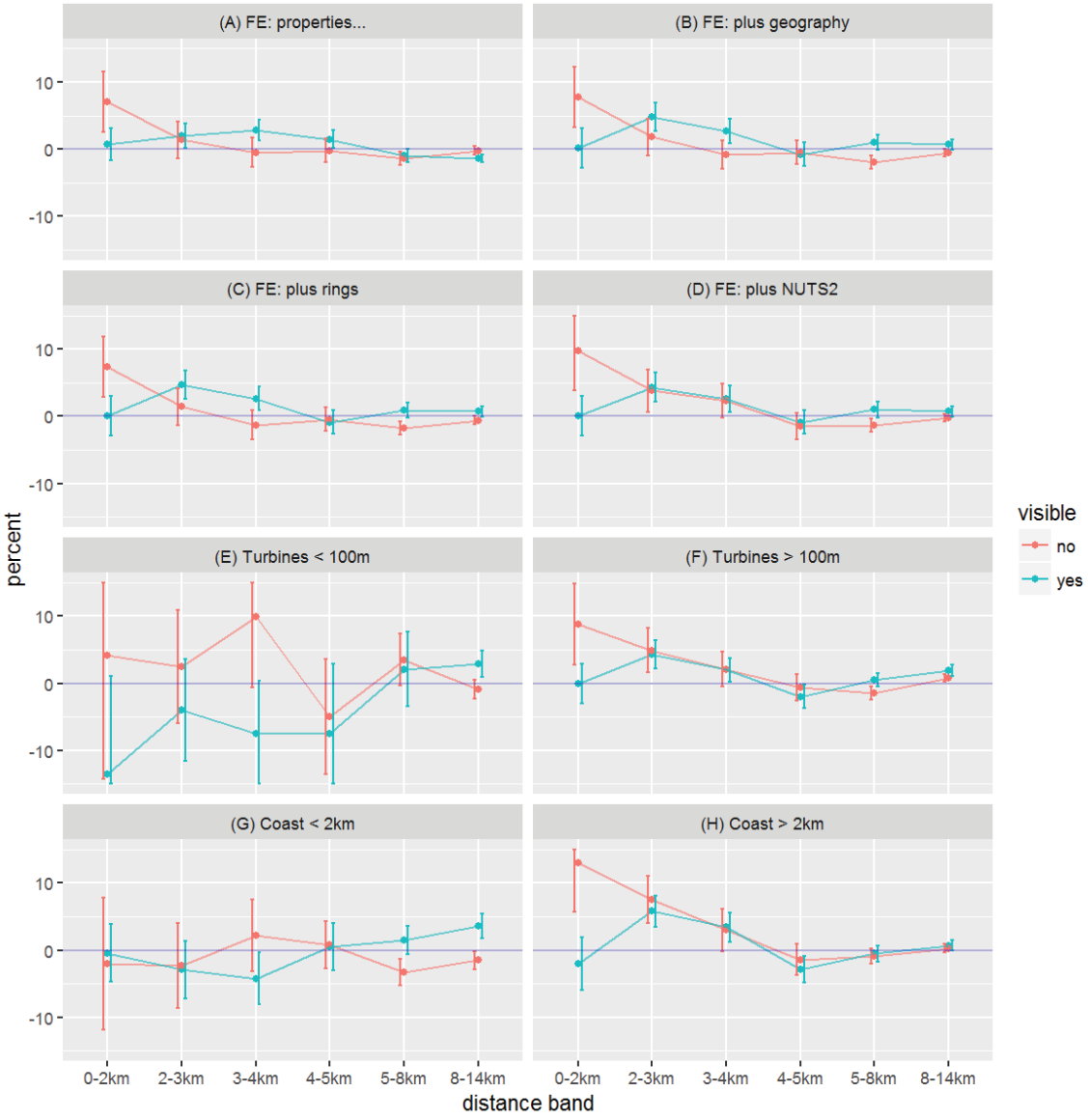


Figure A2: Percent difference in the change of house price

(All repeat sales, turbine visible / not visible)

Sensitivity analysis for result #3: based on Repeat Sales & Individual Turbines and Taking into Account Building Heights

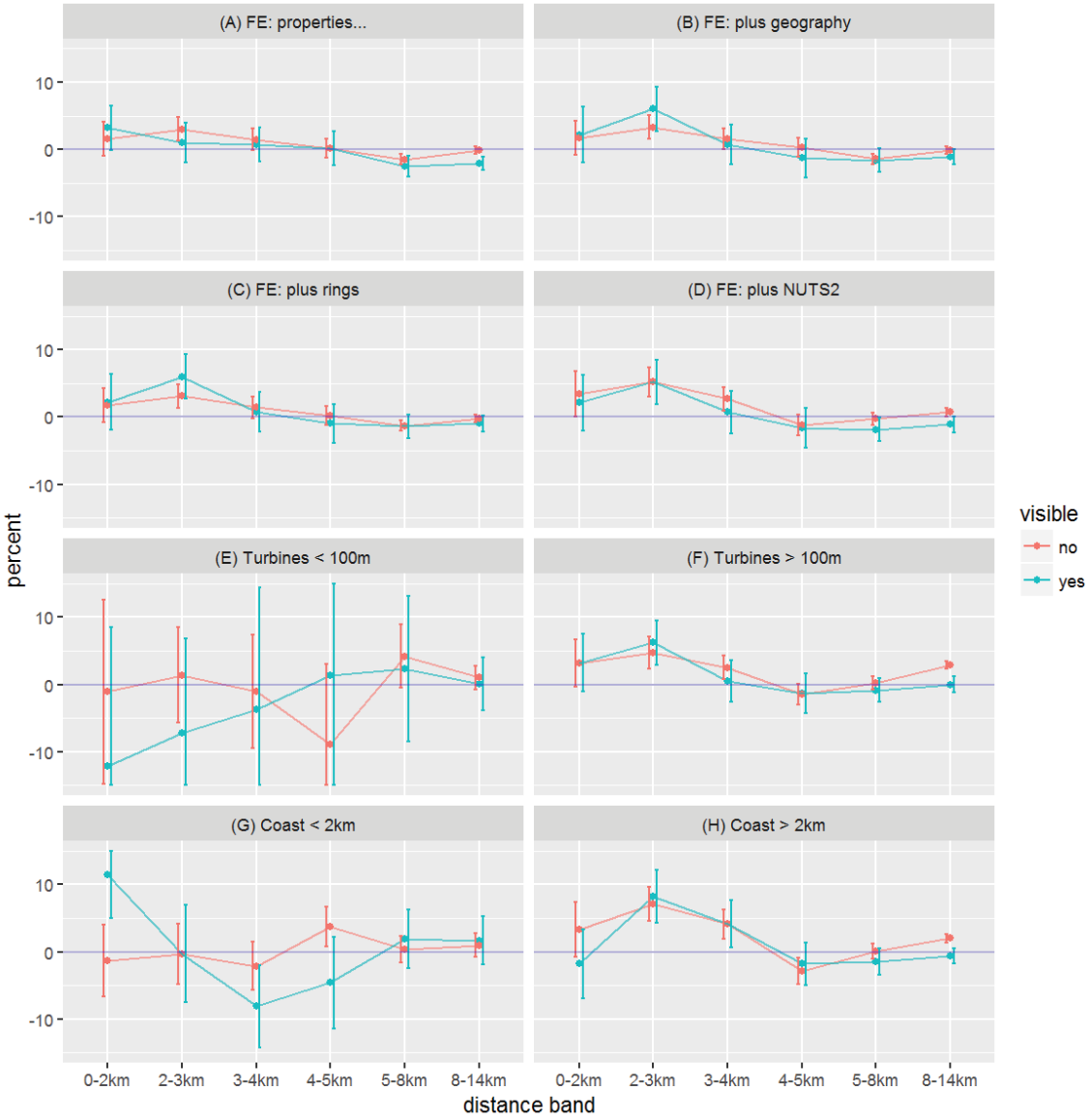


Figure A3: Percent difference in the change of house price

(All repeat sales, turbine visible / not visible accounting for building heights)

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Appendix 6-1 – Botanical study

Botanical Survey, Croagh Wind Farm

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1. INTRODUCTION

1.1 Introduction

MKO were commissioned to undertake detailed botanical surveys to determine the nature of the habitats occurring within the EIAR study area boundary at the proposed Croagh windfarm. The detailed assessments focussed on the development footprint, particularly the turbine base at T1, as this is located on peatland habitat. As the remainder of the infrastructure is located within mature or second rotation forestry and existing forestry access tracks, a description of these habitats are provided in Section 6.6.1, Chapter 6 of the EIAR. Where habitats of high conservation value, including Poor fen and flush (PF2) and Transition mire and quaking bog (PF3) were recorded within the study area, but outside of the proposed development footprint, these were subject to assessment and are included in this report. The results of these surveys provided additional data on habitats occurring within EIAR study area boundary. The detailed botanical surveys were undertaken on the 24th & 26th April 2019, 5th July 2019 and 14th August 2019.

2. SURVEY METHODS

Each area described below was chosen to provide as accurate a description of the habitat types recorded within the development footprint as possible. A minimum of three relevés were recorded of the most commonly occurring habitats within the site which were spatially and botanically representative of the habitat type.

A total of 14 relevés were undertaken at habitats of conservation value within the EIAR study area. Relevés that were undertaken in peatland followed methods that were set out in the following document:

- *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.*

All species were readily identifiable during the survey. 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).

2.1 Statement of Authority

Field surveys were undertaken by James Owens (BSc., MSc.) on the 24th & 26th April 2019, 5th July 2019 and 14th August 2019. James has over 5 years' consultancy experience and is a competent expert in undertaking ecological surveys. In addition to the below botanical data, the lands within the wider study area were also surveyed in detail during habitat mapping survey work and walkover surveys. These surveys also informed the ecological constraints identification process.

3. RESULTS

Detailed botanical surveys of the entire turbine infrastructure footprint was undertaken during site visits undertaken on the 24th & 26th April 2019, 5th July 2019 and 14th August 2019. As all but one turbine, T1, is located within highly modified coniferous plantation forestry, the below sections provide the detailed quadrat data for the peatland and flush habitats occurring around T1. In addition, examples of the wet grassland habitat along the site access track is also provided.

The remaining turbines located within coniferous plantation forestry were found to be dominated by Sitka spruce and some lodgepole pine. The forestry within the site varies in its 'crop' cycle comprising of mature forestry, semi-mature forestry, second rotation forestry and clear-fell. An example of the forestry occurring within the site is provided in Plate 3-1.



Plate 3-1 Example of second rotation forestry (WD4) occurring within the proposed development site, with mature forestry in the background.

3.1 Quadrat 1 – Proposed access road to Turbine 1

Table 3-1 Botanical Survey

	Grid reference: E183600 N323608	Date: 26/04/2019
Common Name	**Scientific Name**	**% Cover**
Ling heather	*Calluna vulgaris*	45
Carnation sedge	*Carex panicea*	0.5
Cross-leaved heath	*Erica tetralix*	1
Common cottongrass	*Eriophorum angustifolium*	0
Hare's-tail cottongrass	*Eriophorum vaginatum*	30
Soft rush	*Juncus effusus*	0.5
Deergrass	*Trichophorum cespitosum germanicum*	0.5
Bilberry	*Vaccinium myrtillus*	0.5
	Hylocomium splendens	1
	Sphagnum capillifolium	3
	Rhytidiadelphus loreus	30
Habitat Classification as per the Irish Vegetation Classification (IVC)		*Vaccinium myrtillus - Racomitrium lanuginosum (HE3F)*



Plate 3-2 Example of recolonising bare peat within the study area around T1

3.2 Quadrat 2 – Example of raised bog habitat at Turbine 1

Table 3-2 Botanical Survey – Quadrat 2

Quadrat 2	Grid reference: E183540 N323611	Date: : 26/04/2019
Common Name	Scientific Name	% Cover
Ling heather	*Calluna vulgaris*	80
Cross-leaved heath	*Erica tetralix*	0.5
Hare's-tail cottongrass	*Eriophorum vaginatum*	5
Purple moor-grass	*Molinia caerulea*	10
Bilberry	*Vaccinium myrtillus*	0.5
	Cladonia portentosa	10
	Hylocomium splendens	10
	Sphagnum capillifolium	5
	Rhytidiadelphus loreus	3
	Polytrichum commune	0.5
Habitat Classification as per the Irish Vegetation Classification (IVC)		*Erica cinerea* - *Calluna vulgaris* (HE2D)



Plate 3-3 Example of blanket bog vegetation within the study area around T1

3.3 Quadrat 3 – Example of vegetation within forestry ride east of Turbine 1

Table 3-3 Botanical Survey – Quadrat 3

Quadrat 3	Grid reference: G 83694 23615	Date: 26/04/2019
Common Name	Scientific Name	% Cover
Sweet vernal grass	*Anthoxanthum odoratum*	1
Ling heather	*Calluna vulgaris*	15
Common sedge	*Carex nigra*	0.5
Hare's-tail cottongrass	*Eriophorum vaginatum*	40
Tormentil	*Potentilla erecta*	0.5
	Hylocomium splendens	40
	Sphagnum palustre	5
	Rhytidiadelphus loreus	10
	Rhytidiadelphus squarrosus	0.5
	Polytrichum commune	5
	Scleropodium purum	5
Habitat Classification as per the Irish Vegetation Classification (IVC)		*Vaccinium myrtillus* - *Racomitrium lanuginosum* (HE3A)

+ indicates presence, below 1% cover



Plate 3-4 Example of vegetation within forestry ride west of Turbine 1

3.4 Quadrat 4 – Proposed access road to Turbine 1

Table 3-4 Botanical Survey – Quadrat 4

Quadrat 4	Grid reference: IG 83591 23647	Date: 05/07/2019
Common Name	**Scientific Name**	**% Cover**
Ling heather	*Calluna vulgaris*	65
Cross-leaved heath	*Erica tetralix*	2
Hare's-tail cottongrass	*Eriophorum vaginatum*	10
Bilberry	*Vaccinium myrtillus*	5
	Hylocomium splendens	5
	Sphagnum capillifolium	40
	Rhytidiadelphus loreus	3
	Scleropodium purum	1
	Hypnum jutlandicum	0.5
Habitat Classification as per the Irish Vegetation Classification (IVC)		*Vaccinium myrtillus - Racomitrium lanuginosum [HE3F]*



Plate 3-5 Example of blanket bog vegetation within the study area around T1

3.5 Quadrat 5 - Proposed access road to Turbine 1

Table 3-5 Botanical Survey – Quadrat 5

Quadrat 5	Grid reference: IG 83572 23650	Date: 05/07/2019
Common Name	**Scientific Name**	**% Cover**
Creeping bentgrass	*Agrostis stolonifera*	1
Bottle sedge	*Carex rostrata*	2
Common cottongrass	*Eriophorum angustifolium*	15
Yorkshire fog	*Holcus lanatus*	5
Jointed rush	*Juncus articulatus*	5
Bogbean	*Menyanthes trifoliata*	55
Marsh cinquefoil	*Potentilla palustris*	3
Common sorrel	*Rumex acetosa*	0.5
	Hylocomium splendens	5
	Sphagnum palustre	1
	Sphagnum fallax	25
	Rhytidiadelphus squarrosus	0.5
Habitat Classification as per the Irish Vegetation Classification (IVC)		*Menyanthes trifoliata – Potentilla palustris* [FE2E]

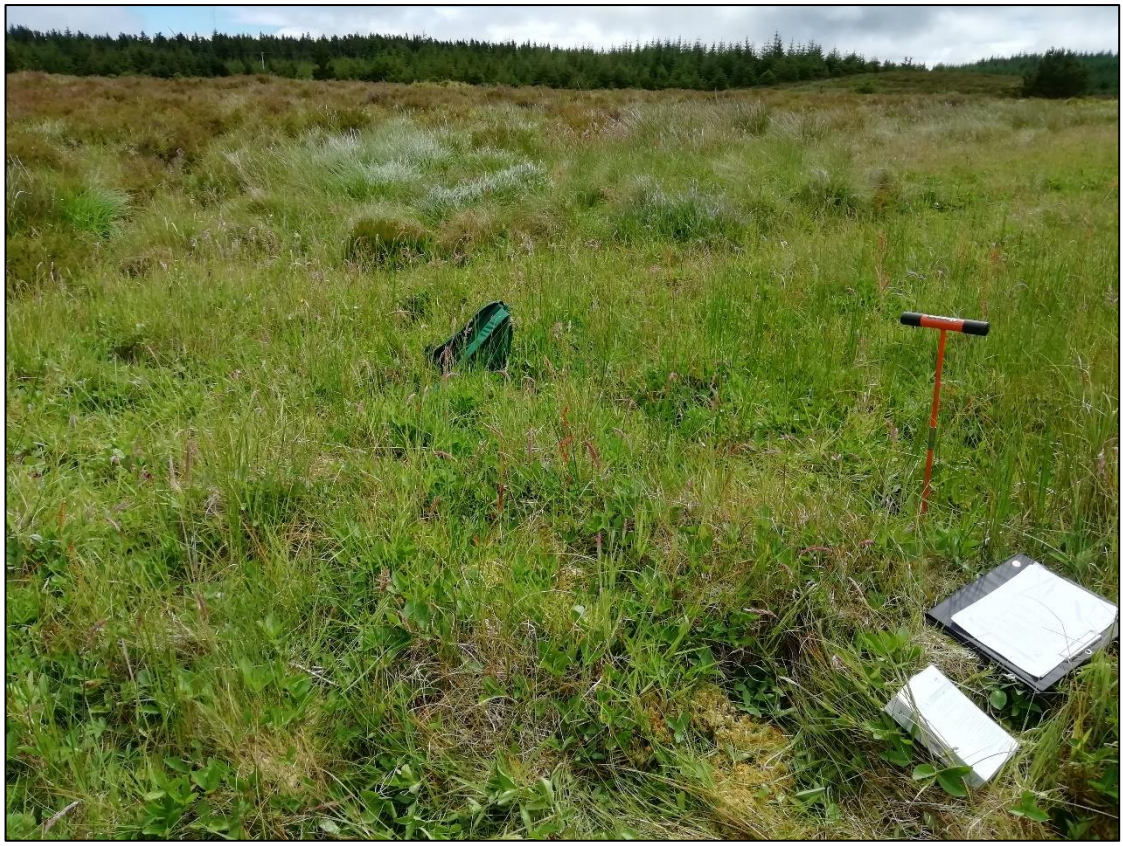


Plate 3-6 Example of flush habitat within the study area around T1

3.6 Quadrat 6 – Blanket bog west of Turbine 1

Table 3-6 Botanical Survey – Quadrat 6

Quadrat 6	Grid reference: IG 83373 23629	Date: 05/07/2019
Common Name	**Scientific Name**	**% Cover**
Creeping bentgrass	*Agrostis stolonifera*	5
Sweet vernal grass	*Anthoxanthum odoratum*	10
Ling heather	*Calluna vulgaris*	3
Star sedge	*Carex echinata*	2
Common sedge	*Carex nigra*	0.5
Heath spotted orchid	*Dactylorhiza maculata*	2
Wavy hair grass	*Deschampsia flexuosa*	10
Marsh willowherb	*Epilobium palustre*	1
Yorkshire fog	*Holcus lanatus*	5
Jointed rush	*Juncus articulatus*	2
Soft rush	*Juncus effusus*	2
Heath woodrush	*Luzula multiflora*	2
Heath milkwort	*Polygala serpyllifolia*	0.5
Tormentil	*Potentilla erecta*	15
Devils-bit scabious	*Succisa pratensis*	25
	Hylocomium splendens	5
	Sphagnum fallax	10
	Rhytidiadelphus squarrosus	10
	Polytrichum commune	1
Habitat Classification as per the Irish Vegetation Classification (IVC)		*Nardus stricta - Galium saxatile* [GL4D]



Plate 3-7 Example of more grass dominated vegetation within the blanket bog to the east of T1

3.7 Quadrat 7 - Blanket bog west of Turbine 1

Table 3-7 Botanical Survey – Quadrat 7

Quadrat 7	Grid reference: IG 83361 23616	Date: 05/07/2019
Common Name	**Scientific Name**	**% Cover**
Ling heather	*Calluna vulgaris*	60
Wavy hair grass	*Deschampsia flexuosa*	0.5
Hare's-tail cottongrass	*Eriophorum vaginatum*	15
Tormentil	*Potentilla erecta*	2
Bilberry	*Vaccinium myrtillus*	4.5
	Hylocomium splendens	5
	Sphagnum palustre	2
	Sphagnum fallax	5
	Sphagnum capillifolium	1
	Rhytidiadelphus loreus	20
	Scleropodium purum	10
Habitat Classification as per the Irish Vegetation Classification (IVC)		*Vaccinium myrtillus* - *Racomitrium lanuginosum* [HE3F]

+ indicates presence, below 1% cover



Plate 3-8 Example of raised bog vegetation within the study area around T1

3.8 Quadrat 8 - Blanket bog south of Turbine 3

Table 3-8 Botanical Survey – Quadrat 8

Quadrat 8	Grid reference: IG 83821 23472	Date: 05/07/2019
Common Name	Scientific Name	% Cover
Ling heather	*Calluna vulgaris*	90
Wavy hair grass	*Deschampsia flexuosa*	0.5
Sitka spruce	*Picea sitchensis*	2
Bilberry	*Vaccinium myrtillus*	10
	Cladonia portentosa	0.5
	Sphagnum capillifolium	25
	Rhytidiadelphus loreus	20
	Scleropodium purum	1
Habitat Classification as per the Irish Vegetation Classification (IVC)		*Vaccinium myrtillus* - *Racomitrium lanuginosum* [HE3A]



Plate 3-9 Example of vegetation occurring within coniferous forestry plantation south of T3

3.9 Quadrat 9 – Example of fen habitat south east of Turbine 1

Table 3-9 Botanical Survey – Quadrat 9

Quadrat 9	Grid reference: IG 83583 23590	Date: 14/08/2019
Common Name	Scientific Name	% Cover
Bottle sedge	*Carex rostrata*	5
Heath spotted orchid	*Dactylorhiza maculata*	0.5
Wavy hair grass	*Deschampsia flexuosa*	3
Common cottongrass	*Eriophorum angustifolium*	2
Hare's-tail cottongrass	*Eriophorum vaginatum*	1
Sharp-flowered rush	*Juncus acutiflorus*	2
Yorkshire fog	*Holcus lanatus*	15
Bogbean	*Menyanthes trifoliata*	60
Common sorrel	*Rumex acetosa*	0.5
Cranberry	*Vaccinium oxycoccos*	1
	Sphagnum palustre	5
	Sphagnum fallax	30
	Mean vegetation height	25cm
Habitat Classification as per the Irish Vegetation Classification (IVC)		*Menyanthes trifoliata – Sphagnum recurvum agg. Mire* [FE2E]



Plate 3-10 Example of fen habitat south east of Turbine 1

3.10 Quadrat 10 - Example of poor fen habitat southeast of Turbine 1

Table 3-10 Botanical Survey – Quadrat 10

Quadrat 10	Grid reference: IG 83569 23588	Date: 14/08/2019
Common Name	Scientific Name	% Cover
Sharp-flowered rush	*Juncus acutiflorus*	55
Yorkshire fog	*Holcus lanatus*	5
Soft Rush	*Juncus effusus*	3
Tormentil	*Potentilla erecta*	25
Common sorrel	*Rumex acetosa*	10
Devils-bit scabious	*Succisa pratensis*	4
	Sphagnum fallax	15
	Rhytidiadelphus squarrosus	35
	Polytrichum commune	0.5
Habitat Classification as per the Irish Vegetation Classification (IVC)		*Agrostis canina/vinealis - Rhytidiadelphus squarrosus* [GL4D]

+ indicates presence, below 1% cover



Plate 3-11 Example of poor fen habitat southeast of Turbine 1

3.11 Quadrat 11 – Example of fen and mire habitat southwest of Turbine 1

Table 3-11 Botanical Survey – Quadrat 11

Quadrat 11	Grid reference: IG 83520 23599	Date: 14/08/2019
Common Name	Scientific Name	% Cover
Bottle sedge	*Carex rostrata*	5
Wavy hair grass	*Deschampsia flexuosa*	10
Hare's-tail cottongrass	*Eriophorum vaginatum*	50
Yorkshire fog	*Holcus lanatus*	15
Bogbean	*Menyanthes trifoliata*	2
Common sorrel	*Rumex acetosa*	10
	Sphagnum fallax	25
Habitat Classification as per the Irish Vegetation Classification (IVC)		*Menyanthes trifoliata – Sphagnum recurvum agg. Mire* [FE2E]



Plate 3-12 Example of fen and mire habitat southwest of Turbine 1

3.12 Quadrat 12 - Example of blanket bog habitat southwest of Turbine 1

Table 3-12 Botanical Survey – Quadrat 12

Quadrat 12	Grid reference: IG 83527 23606	14/08/2019
Common Name	Scientific Name	% Cover
Ling heather	*Calluna vulgaris*	10
Hare's-tail cottongrass	*Eriophorum vaginatum*	15
Bilberry	*Vaccinium myrtillus*	10
	Hylocomium splendens	5
	Sphagnum fallax	10
	Rhytidiadelphus loreus	30
	Scleropodium purum	5
Habitat Classification as per the Irish Vegetation Classification (IVC)		*Calluna vulgaris* - *Hylocomium splendens* [HE3A]



Plate 3-13 Example of blanket bog habitat southwest of Turbine 1

3.13 Quadrat 13 – Example of wet grassland along site access road

Table 3-13 Botanical Survey – Quadrat 13

Quadrat 13	Grid reference: IG 91600 23328	Date: 14/08/2019
Common Name	**Scientific Name**	**% Cover**
Creeping bentgarss	*Agrostis stolonifera*	5
Sweet vernal grass	*Anthoxanthum odoratum*	5
Common mouse-ear	*Cerastium fontanum*	0.5
Marsh thistle	*Cirsium palustre*	1
Meadowsweet	*Filipendula ulmaria*	0.5
Yorkshire fog	*Holcus lanatus*	10
Jointed rush	*Juncus articulatus*	65
Soft rush	*Juncus effusus*	3
Water forget-me-not	*Myosotis scorpioides*	0.5
Ribwort plaintain	*Plantago lanceolata*	5
Tormentil	*Potentilla erecta*	3
Meadow buttercup	*Ranunculus acris*	2
Yellow rattle	*Rhinanthus minor*	0.5
Common sorrel	*Rumex acetosa*	2
Red clover	*Trifolium pratense*	3
Marsh ragwort	*Senecio aquaticus*	0.5
Devils-bit scabious	*Succisa pratensis*	3
	Rhytidiadelphus squarrosus	15
Habitat Classification as per the Irish Vegetation Classification (IVC)		*Juncus effusus - Holcus lanatus* [GL2B]

+ indicates presence, below 1% cover



Plate 3-14 – Example of wet grassland along site access road

3.14 Quadrat 14– Example of wet grassland along site access road

Table 3-14 Botanical Survey – Quadrat 14

Quadrat 14	Grid reference: IG 91464 23227	Date: 14/08/2019
Common Name	Scientific Name	% Cover
Creeping bentgarss	*Agrostis stolonifera*	5
Sweet vernal grass	*Anthoxanthum odoratum*	1
Carnation sedge	*Carex panicea*	5
Common mouse-ear	*Cerastium fontanum*	0.5
Marsh thistle	*Cirsium palustre*	1
Marsh willowherb	*Epilobium palustre*	0.5
Marsh bedstraw	*Galium palustre*	0.5
Yorkshire fog	*Holcus lanatus*	15
Jointed rush	*Juncus articulatus*	40
Ragged robin	*Lychnis flos cuculi*	2
Meadow buttercup	*Ranunculus acris*	3
Lesser spearwort	*Ranunculus flammula*	1
Red clover	*Trifolium pratense*	20
Devils-bit scabious	*Succisa pratensis*	1
Common dandelion	*Taraxacum officinale agg*	0.5
	Rhytidiadelphus squarrosus	15
Habitat Classification as per the Irish Vegetation Classification (IVC)		*Juncus acutiflorus - Rhytidiadelphus squarrosus* {GL1E}



Plate 3-15 – Example of wet grassland along site access road

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Appendix 6-2 Bat Survey Report

Croagh Wind Farm



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1. INTRODUCTION

MKO was commissioned to complete a comprehensive assessment of the potential effects on bats of a proposed wind farm at Croagh, Co. Leitrim and Co. Sligo. This report provides details of the bat surveys undertaken, including survey design, methods and results, and the assessment of potential effects of the development on bats. Where necessary, mitigation is prescribed to minimise likely significant effects.

Bat surveys were undertaken throughout 2019 and were designed in accordance with Scottish Natural Heritage's guidance Bats and onshore wind turbines: survey, Assessment and mitigation (SNH, 2019). Bat surveys employed a combination of methods, including desktop study, habitat and landscape assessments, roost inspections, manual activity surveys and static detector surveys at ground level and at height.

1.1 Background

Wind energy provides a clean, sustainable alternative to fossil fuels in generating electricity. However, wind energy development can impact wildlife, directly through mortality and indirectly through disturbance and habitat loss. Bat fatalities have been reported at wind energy facilities around the world, raising concern about the cumulative impacts of such developments on bat populations (Arnett et al. 2016). No large-scale studies have been undertaken in Ireland to date. However, a study from the UK estimated bat fatalities at 0 – 5.25 bats per turbine per month (Mathews et al. 2016). While these results are not directly applicable to Ireland due to differences in bat species and behaviour, Ireland shares more similarities with bat assemblages of Great Britain, compared to those of mainland Europe.

Investigative research in North America and mainland Europe have revealed the mechanisms for bat mortality at wind turbines. Fatalities arise from direct collision with moving turbine blades (Horn et al. 2008, Cryand et al. 2014) and barotrauma (Baer Wald et al. 2008), i.e. internal injuries caused by air pressure changes. Why bats fly in the vicinity of wind turbines has been attributed to several different behavioural and environmental factors, e.g. habitat associations, weather conditions and, species ecology.

Pre-construction bat surveys are undertaken to gain an insight into bat activity in the absence of turbines and to predict and mitigate against any future risks identified. Survey design and analyses of results at the proposed development site was undertaken with reference to the latest policy and legislation, scientific literature and industry guidelines. Any spatial, temporal or behavioural factors that may put bats at risk were fully considered.

1.2 Bat Survey and Assessment Guidance

Several guidelines for surveying bats at wind energy developments have been produced in Europe, the UK and Ireland.

At a European level, the Advisory Committee to the EUROBATS Agreement, to which Ireland is a signatory, have produced Guidelines for Consideration of Bats in Wind Farm Projects which outlines an approach for assessing the potential impacts of wind turbines on bats during planning, construction and operation phases (Rodrigues, 2015). However, these guidelines are based on continental scenarios and include more diverse species and behaviours than those typical of Ireland. As such, EUROBATS guidance may recommend a level of survey that may prove inappropriate in Irish scenarios. Nevertheless, the guidance is evidence-based and provides a useful European context, within which Member States are encouraged to produce specific national guidance, focusing on local circumstances.

Bat Conservation Ireland produced Wind Turbine/Wind Farm Development Bat Survey Guidelines (BCI, 2012a). This document provides advice to practitioners and decision makers in Ireland on necessary qualifications for surveyors, health and safety considerations, pre-construction and post-construction survey methodologies and information to be included in a report. In the absence of comprehensive Irish research, these guidelines provide generalised methodology rather than detailed technical advice.

The second edition of the UK Bat Conservation Trust *Bat Survey Good Practice Guidelines* (Hundt, 2012) includes a chapter (Chapter 10) on survey methodologies for assessing the potential impacts of wind turbines on bats. The document provides technical guidance for consultants carrying out impact assessments. However, the recommendations are not based on any research findings specific to the UK. A third edition to the guidelines, published in early 2016, removed the chapter on surveying wind turbine developments. Prior to the publication of the BCT guidelines, Natural England's Bat and Onshore Wind Turbines: Interim Guidance provided a pragmatic interpretation of the EUROBATS recommendations, as applied to onshore wind energy facilities in the UK (Natural England, 2014). In addition, the Chartered Institute of Ecology and Environmental Management (CIEEM)publishes advice on best practice as well as updates on the current state of knowledge in the Technical Guidance Series and in the quarterly publication In Practice.

In 2019, Scottish Natural Heritage published B*ats and Onshore Wind Turbines: Survey, Assessment and Mitigation* (SNH 2019). The purpose of the guidance is to help planners, developers and ecological consultants to consider the potential effects of onshore wind energy developments on bats. The emphasis is on direct impacts such as collision mortality, but there is reference throughout to the need for a full impact assessment requiring wider consideration of other (indirect) effects. The Guidance replaces previous guidance on the subject; notably that published by Natural England and Chapter 10 of the Bat Conservation Trust publication Bat Surveys: Good Practice Guidelines (2nd edition), (Hundt, 2012) and tailors the generic Eurobats guidance on assessing the impact of wind turbines on European bats (Rodrigues et al. (2014)). The document guides the user through the key elements of survey, impact assessment and mitigation.

The survey scope, assessment and mitigation provided in this report is accordance with SNH 2019 Guidance.

1.3 Statement of Authority

Scope development and project management was undertaken by Dr. Úna Nealon and John Hynes. Úna'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. John is a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM) and has over 7 years professional ecological consultancy experience and is a former member of the Bat Conservation Ireland management council

Bat surveys were conducted by MKO ecologists Claire Stephens (BSc), Aoife Joyce (BSc, MSc), Luke Dodebier (BSc), Sara Fissolo (BSc) and Daire O'Shaughnessy. Staff have relevant academic qualifications and are competent experts in undertaking bat surveys to this level.

Data analysis was undertaken by Luke Dodebier and Aoife Joyce and results were compiled by Úna Nealon. Impact assessment, the design of mitigation and final reporting was completed by Luke Dodebier and Aoife Joyce and reviewed by Pat Roberts (BSc, MCIEEM). Pat has over 14 years' experience in management and ecological assessment. He has supervised the majority of ecological assessments (300+) completed by the company, including more recently, over 200 assessments required in accordance with Article 6(3) of the Habitats Directive.

1.4 Irish Bats: Legislation, Policy and Status

Ireland has nine resident bat species, comprising more than half of Ireland's native terrestrial mammals (Montgomery et al., 2014). All Irish bats are protected under European legislation, namely the Habitats Directive (92/43/EEC). All Irish species are listed under Annex IV of the Directive, requiring strict protection for individuals, their breeding sites and resting places. The lesser horseshoe bat (*Rhinolophus hipposideros)* is further listed under Annex II of the Directive, requiring the designation of conservation areas for the species. Under this Directive, Ireland is obliged to maintain the favourable conservation status of Annex-listed species. This Directive has been transposed into Irish law through the European Communities (Birds and Natural Habitats) Regulations 2011.

In addition, Irish species are further protected by national legislation (Wildlife Acts 1976-2019 as amended). Under this legislation, it is an offence to intentionally disturb, injure or kill a bat, or disturb its roost. Any work at a roost site must be carried out with the agreement of the National Parks and Wildlife Service (NPWS).

The NPWS monitors the conservation status of European protected habitats and species and reports their findings to the European Commission every 6 years. The most recent report for the Republic of Ireland was submitted in 2019. Table 1.1 summarises the current conservation status of Irish bat species and identified threats to Irish bat populations.

Table 1.1 Irish bat species conservation status & threats (NPWS, 2019).

Bat Species	Conservation Status	Principal Threats
Common pipistrelle *Pipistrellus pipistrellus*	Favourable	**A05** Removal of small landscape features for agricultural land parcel consolidation (M) **A14** Livestock farming (without grazing) [impact of anti-helminthic dosing on dung fauna] (M) **B09** Clear--cutting, removal of all trees (M) **F01** Conversion from other land uses to housing, settlement or recreational areas (M) **F02** Construction or modification (e.g. of housing and settlements) in existing urban or recreational areas (M) **F24** Residential or recreational activities and structures generating noise, light, heat or other forms of pollution (M) **H08** Other human intrusions and disturbance not mentioned above (Dumping, accidental and deliberate disturbance of bat roosts (e.g. caving) (M) **L06** Interspecific relations (competition, predation, parasitism, pathogens) (M) **M08** Flooding (natural processes) **D01** Wind, wave and tidal power, including infrastructure (M)
Soprano pipistrelle *Pipistrellus pygmaeus*	Favourable	
Nathusius' pipistrelle *Pipistrellus nathusii*	Unknown	
Leisler's bat *Nyctalus leisleri*	Favourable	
Daubenton's bat *Myotis daubentoni*	Favourable	
Natterer's bat *Myotis nattereri*	Favourable	
Whiskered bat *Myotis mystacinus*	Favourable	
Brown long-eared bat *Plecotus auritus*	Favourable	
Lesser horseshoe bat *Rhinolophus hipposideros*	Inadequate	

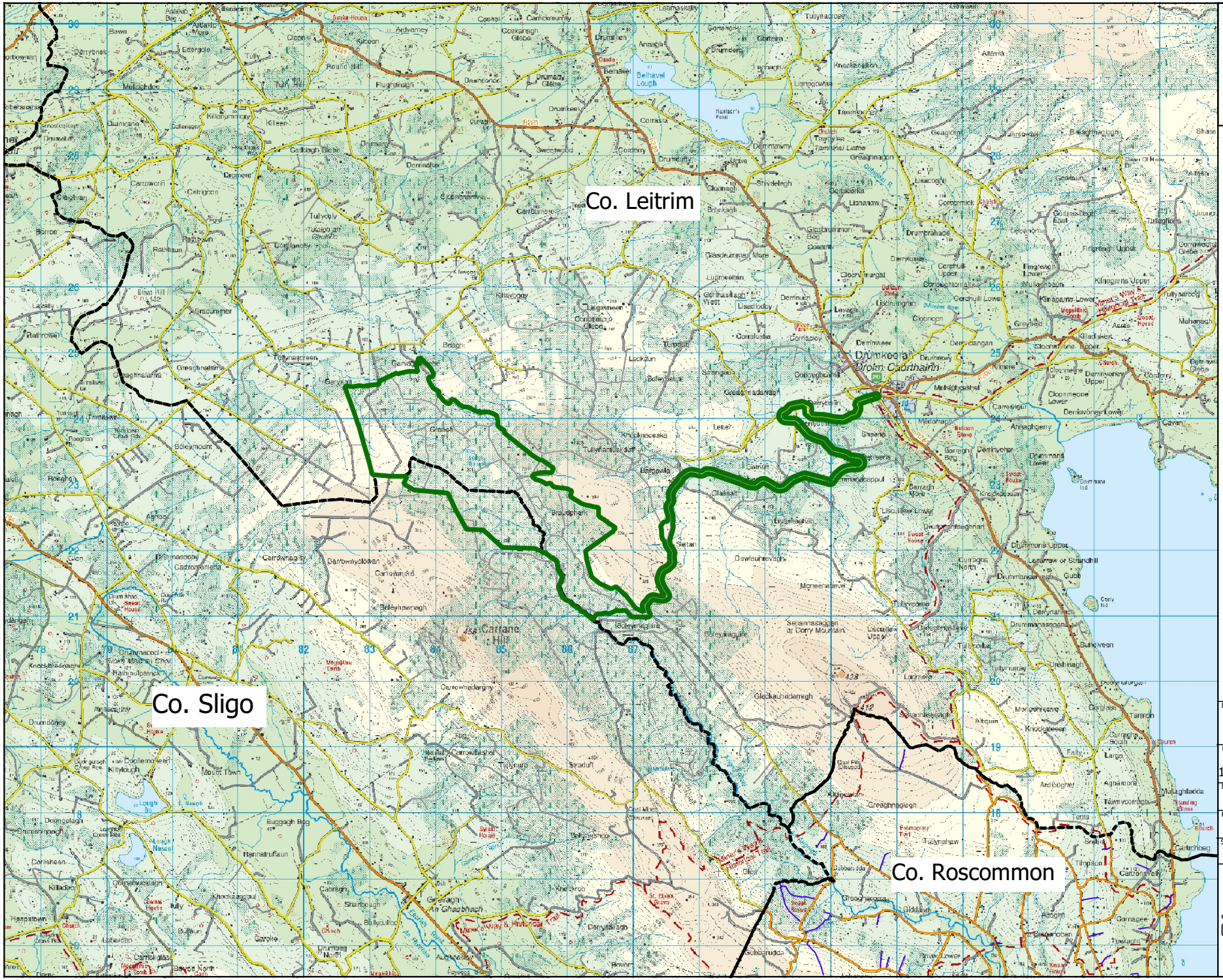
2. PROJECT DESCRIPTION

The proposed development site is located on the boundary of Counties Leitrim and Sligo, approximately 5 kilometres west of the village of Drumkeeran and 7 kilometres southeast of Dromahair. The Grid Reference coordinates for the approximate centre of the site are E 584730 N 823130 (Figure 2.1).

The site is accessed via a series of small unnamed local roads that can be accessed by traveling north on the R280. The land-use/activities within the proposed site comprise of commercial forestry. The surrounding landscape is also dominated by commercial forestry, wind energy and, agriculture. A number of wind energy developments are in operation including Geevagh and Carranne Hill to the west and Black Banks and Garvagh to the East.

The Proposed Development comprises:

1. *Construction of 10 No. wind turbines with a maximum overall blade tip height of up to 170 metres, and associated hardstand areas;*
2. *1 no. 38kV permanent electrical substation including a control building with welfare facilities, all associated electrical plant and equipment, security fencing, all associated underground cabling, waste water holding tank and all ancillary works;*
3. *1 no. permanent Meteorological Mast with a maximum height of up to 100 metres;*
4. *All associated underground electrical and communications cabling connecting the turbines to the proposed wind farm substation;*
5. *All works associated with the connection of the proposed wind farm to the national electricity grid, via underground cabling to the existing Garvagh substation;*
6. *Upgrade of existing tracks and roads, provision of new site access roads and hardstand areas;*
7. *The partial demolition and alteration of two agricultural buildings in the townlands of Sheena and associated junction access and road works to the existing yard, agricultural buildings and agricultural lands in the townlands of Sheena and Derrybofin to provide a link road primarily for construction traffic off the R280. This link road will be used for the delivery of abnormal loads to the site during the construction period and may be used during the operational period if necessary or to facilitate the decommissioning of the wind farm. Following construction, access to the link road will be closed off and the yard/agricultural building will revert to its use for agricultural purposes except if and when required for delivery of abnormal loads during the operational period of the windfarm or to facilitate the decommissioning of the wind farm;*
8. *1 no. borrow pit;*
9. *2 no. peat and spoil repository areas*
10. *2 no. temporary construction compounds;*
11. *Recreation and amenity works, including marked trails, boardwalk and viewing area provision of a permanent amenity car park, and associated recreation and amenity signage*
12. *Site Drainage;*
13. *Permanent Signage;*
14. *Ancillary Forestry Felling to facilitate construction and operation of the proposed development; and*
15. *All associated site development works*



Map Legend

- EIAR Site Boundary
- County Boundary

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Drawing Title

Site Location Context

Project Title	180511 - Croagh Wind Farm EIAR
Drawn By: Daire O'Shaughnessy	Checked By: Eoin McCarthy
Project No.: 180511	Drawing No.: Fig 2.1
Scale: 1:75,000	Date: 12.06.2020

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3. METHODS

3.1 Consultation

A scoping exercise was undertaken as part of the EIAR for the proposed development. A Scoping Document, providing details of the application site and the proposed development, was prepared by MKO and circulated to consultees in December 2018. As part of this exercise, prominent Irish conservation groups were contacted, the National Parks and Wildlife Service (NPWS) and Bat Conservation Ireland (BCI) were specifically invited to comment on the potential of the proposed development to affect bats.

Details of consultation responses are provided in Section 4.1 below.

3.2 Desk Study

A desk study of published and unpublished material was undertaken prior to conducting field surveys. The aim was to provide context to the site in order to assist bat survey planning and assessment. This included the identification of designated sites, species of interest or any other potential risk factors within the Study Area and the surrounding region.

3.2.1 Bat Records

The National Bat Database of Ireland holds records of bat observations received and maintained by BCI. These records include results of national monitoring schemes, roost records as well as ad-hoc observations. A search of the National Bat Database of Ireland was last carried out on the 8th October 2019 and examined bat presence and roost records within a 10 km radius of a central point in the Study Area (IG E184554 N323115) (BCI 2012, Hundt 2012, SNH 2019).

3.2.2 Bat Species' Range

EU member states are obliged to monitor the conservation status of natural habitats and species listed in the Annexes of the Habitats Directive. Under Article 17, they are required to report to the European Commission every six years. In April 2019, Ireland submitted the third assessment of conservation status for Annex-listed habitats and species, including all species of bats (NPWS, 2019).

The 2019 Article 17 Reports were reviewed for information on bat species' range and distribution in relation to the location of the proposed development. The aim was to identify any high-risk species at the edge of their range (SNH, 2019).

3.2.3 Designated Sites

The National Parks and Wildlife Service (NPWS) map viewer and website provides information on rare and protected species, sites designated for nature conservation and their conservation objectives. A search was undertaken of sites designated for the conservation of bats within a 10 km radius of the Study Area (BCI 2012, Hundt, 2012, SNH 2019). This included European designated sites, i.e. SACs, and nationally designated sites, i.e. NHAs and pNHAs.

3.2.4 Landscape Features

Ordnance survey maps (OSI 1:5,000 and 1:50,000) and aerial photographs were reviewed to identify any habitats and features likely to be used by bats. Maps and images of the Study Area and general landscape were examined for suitable foraging or commuting habitats including woodlands and forestry, hedgerows, treelines and watercourses. In addition, any potential roost sites, such as buildings and bridges, were noted for further investigation.

The Geological Survey Ireland (GSI) online mapping tool and UBSS Cave Database for the Republic of Ireland were consulted for any indication of natural subterranean bat sites, such as caves, within 10 km of the proposed site (BCI, 2012) (last searched on the 22nd May 2020). Furthermore, the archaeological database of national monuments was reviewed for any evidence of manmade underground structures, e.g. souterrains, that may be used by bats (last searched on the 22nd May 2020).

3.2.5 Habitat Suitability

The National Biodiversity Data Centre (NBDC) map viewer presents "Bat Landscape" maps for individual species and for all species combined. Lundy et al. (2011) used Maximum Entropy Models to examine the relative importance of bat landscape and habitat associations in Ireland. The resulting map provides a 5-point scale, ranging from highest habitat suitability index (presented in red) to lowest suitability index (presented in green). However, squares highlighted as less favourable may still have local areas of abundance.

The location of the proposed wind farm was reviewed in relation to bat habitat suitability indices. The aim of this was to assess habitat suitability for all bat species within the Study Area. It is worth noting that these results are based on a modelling exercise and not confirmed bat species records. Regardless, they may provide a useful indication of potential favourable bat associations within the proposed site.

3.2.6 Other Wind Energy Developments

A search for existing and permitted wind energy developments within 10km of the proposed site was undertaken (SNH, 2019). The IWEA interactive wind map (iwea.com) was reviewed in conjunction with wind farm planning applications from Sligo and Leitrim County Councils.

3.2.7 Multidisciplinary Surveys

The grid connection route was visited as part of the multidisciplinary surveys undertaken on the 14th August 2019 and the 31st January 2020, outlined in the main EIAR. The habitats (including any culverts/bridges) were assessed for bat commuting, foraging and roosting suitability (see sections 4.10 and 4.11).

3.3 Ecological Appraisal

Bat walkover surveys were carried out throughout 2019. During these surveys, habitats were assessed for their suitability for bats to roost, forage and commute. Connectivity with the wider landscape was also considered. Suitability categories, as described by Collins (2016) are divided into *High*, *Moderate*, *Low* and *Negligible*, and are described fully in **Appendix 1.**

3.3.1 Roost Surveys

A search for roosts was undertaken within 200m plus the rotor radius of the boundary of the proposed development (SNH, 2019).

One structure was identified (IG Ref: 186351 321105) and was subject to a roost assessment (See Figure 3.1). This comprised a detailed inspection of the exterior to look for evidence of bat use, including live and dead specimens, droppings, feeding remains, urine splashes, fur oil staining and noises. The interior of the building was inaccessible. A dusk emergence survey was undertaken on the evening of the 7th May 2019. Two surveyors, equipped with Bat Logger M bat detectors (Elekon AG, Lucerne, Switzerland). Conditions were suitable for bat survey; dry, warm (10˚C) with light air (Beaufort Force 1). The emergence survey commenced 30 minutes before sunset and concluded 1.5 hours after sunset. No other structures within the site were identified as being, within 200m of a turbine location, or as providing roosting bat features and thus further surveys were not deemed necessary.

Any potential tree roosts were examined for the presence of rot holes, hazard beams, cracks and splits, partially detached bark, knot holes, gaps between overlapping branches and any other potential roost features (i.e. PRFs) identified by Andrews (2018).

3.3.2 Walked & Driven Transects

Manual activity surveys comprised walked and driven transects at dusk. The aim of these surveys was to identify bat species using the site and gather any information on bat behaviour and important features used by bats.

A series of representative transect routes were selected throughout the proposed wind farm site. Transect routes were prepared with reference to the proposed layout, desktop and walkover survey results as well as any health and safety considerations and access limitations. As such, transect routes generally followed existing roads and tracks. Transect routes are presented in Figures 4.1- 4.3.

Transects were walked or driven by two surveyors, recording bats in real time. Driven transects followed the methodology described by Roche et al. (2012). Surveys commenced within 30 mins before sunset and were completed within 3 hours after sunset. Surveyors were equipped with active full spectrum bat detectors, the Batlogger M bat detector (Elekon AG, Lucerne, Switzerland) and all bat activity was recorded for subsequent analysis to confirm species identifications. Transects surveys were undertaken in spring, summer and autumn 2019. Table 3.1 summarises survey effort in relation to walked and driven transects.

Table 3.1 2019 Survey Effort – Walked & Driven Transects

Date	Surveyors	Sunset	Start-End	Weather	Walked and driven transects (km)
7th May 2019	Claire Stephens & Daire O'Shaughnessy	21:15	20:45 - 00:10	8˚; very light rain; gentle breeze.	12.27
11th June 2019	Claire Stephens & Daire O'Shaughnessy	22:05	21:26 - 00:13	9-13˚; dry; light breeze.	7.48
21st August 2019	Luke Dodebier & Sara Fissolo	21:51	20:18 - 23:30	13˚; dry; light breeze.	11.61
Total Survey Effort					**31.36**

3.3.3 Ground-level Static Surveys

SNH required 1 detector per turbine up to 10 and then 1/3 after. Given that 10 turbines are proposed 10 detectors were deployed to ensure compliance with SNH guidance

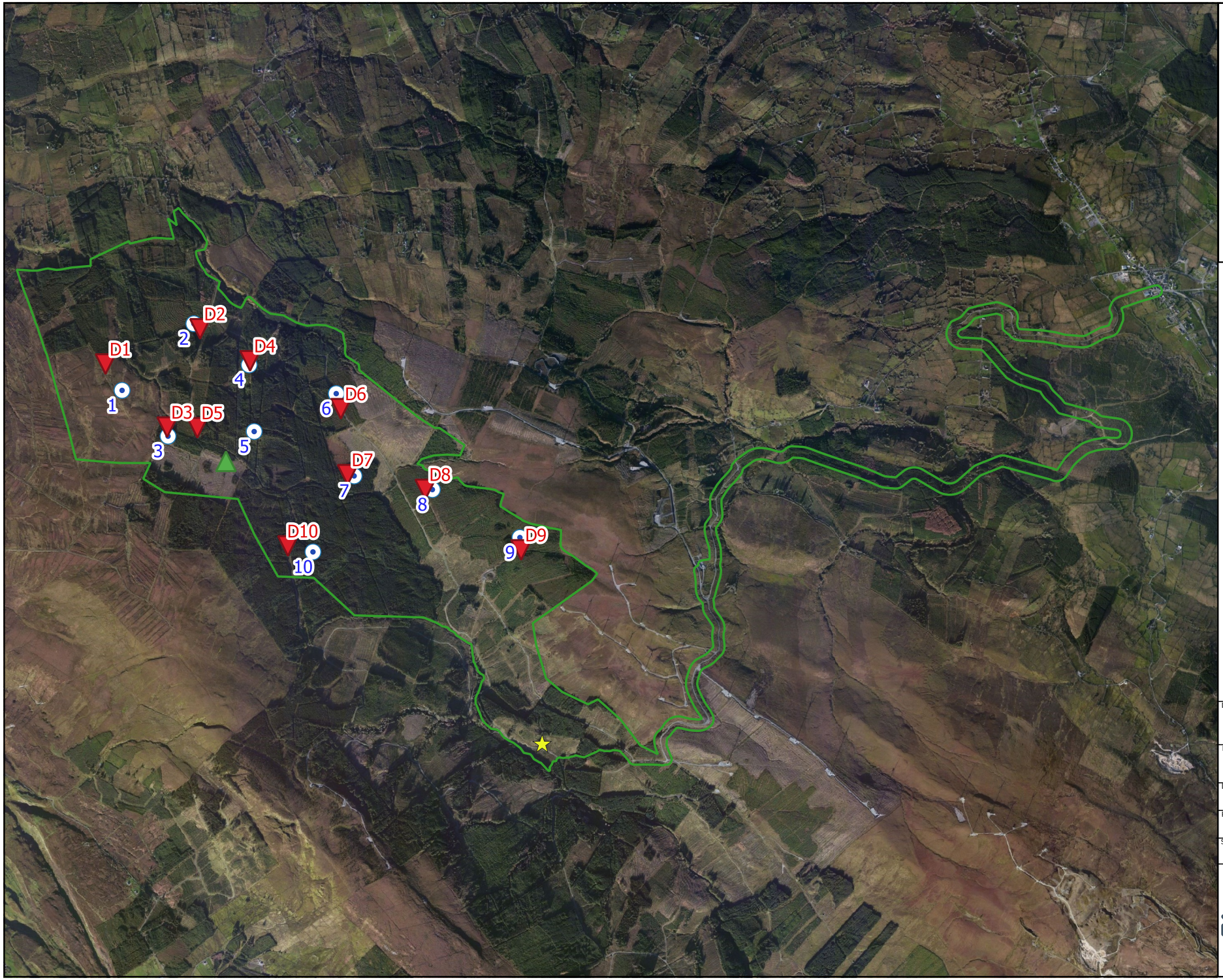
Automated bat detectors were deployed at 10 no. locations for at least 10 nights in each of spring (April-May), summer (June-mid August) and autumn (mid-August-October) (SNH, 2019). Detector locations were based on indicative turbine locations and differ slightly to the final proposed layout. As proposed turbine locations are often subject to change, static bat detectors are deployed in locations that provide a representative sample of bat activity On review of the final turbine layout static detector locations provide an accurate representation of the habitats and associated turbine locations on site. Where keyholing [1] is proposed, detectors were located along nearby forestry edge in order to more closely reflect the likely post-construction habitat. Static detector locations are described in Table 3.2 and presented in Figure 3.1.

Table 3.2 Ground-level Static Detector Locations.

ID	Location	Habitat	Presence/Absence of linear feature within 50m
D01	E183252 N323818	Conifer edge, open bog/wet grassland	Present
D02	E184947 N323039	Conifer ride	Present
D03	E183687 N323374	Conifer edge, open bog	Present
D04	E184297 N323846	Conifer edge, road verge	Present
D05	E183899 N323363	Conifer edge, road verge	Present
D06	E184918 N323500	Conifer edge, road verge	Present
D07	E184947 N323039	Clearfell	Present
D08	E185516 N322930	Conifer ride	Present
D09	E186194 N322495	Conifer edge, stream	Present
D10	E184542 N322527	Conifer ride	Present

Full spectrum bat detectors, Song Meter SM4BAT (Wildlife Acoustics, Maynard, MA, USA), were employed. Settings used were those recommended by the manufacturer for bats, with minor adjustments in gain settings and band pass filters to reduce background noise when recording. Detectors were set to record from 30 minutes before sunset until 30 minutes after sunrise. The Song Meter automatically adjusts sunset and sunrise times using the Solar Calculation Method when provided with GPS coordinates.

[1] *Keyholing involves creating open areas in commercial forestry plots as a buffer around proposed wind turbine locations. This is typically a 50m buffer from the turbine blade tip to the forestry edge. These keyholes remain open for the duration of the windfarm lifetime*



Map Legend

- Site Boundary
- Static Detector Locations
- Met Mast
- Proposed Turbine Locations
- Potential Roost

Microsoft product screen shots reprinted with permission from Microsoft Corporation

N

Drawing Title: Static Detector Locations

Project Title: Croagh Windfarm

Drawn By	Checked By
LD	JH
Project No.	Drawing No.
180511	Figure 3.1
Scale	Date
1:35000	08.07.2020

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Onsite weather monitoring was undertaken concurrently with static detector deployments. One Vantage Pro 2 (Davis Instruments, CA, UCS) was deployed each season and night-time hourly data was tracked remotely to ensure a sufficient number of nights (i.e. minimum 10 no.) with appropriate weather conditions were captured (i.e. dusk temperatures above 8˚, wind speeds less than 5m/s and no or only very light rainfall). Table 3.3 summarises survey effort achieved for each of the 10 no. detector locations.

Table 3.3 2019 Survey Effort – Ground-level Static Surveys.

Season	Survey Period	Total Survey Nights per detector location	Nights with Appropriate Weather
Spring	24th April – 7th May 2019	13*	10
Summer	11th June – 25th June 2019	14	12
Autumn	21st August – 5th September 2019	15	11
Total Survey Effort		**42**	**33**

*Detector D06 (Figure 3.1) was stolen from the site during the spring deployment. A report was made to the Gardaí and additional site-wide security measures were employed during subsequent deployments to avoid any further incidents.

3.3.4 Static Surveys at Height

Monitoring at height can provide useful information on bat activity within the rotor sweep area and is particularly relevant at proposed key-holed sites (SNH, 2019). One Song Meter SM3BAT (Wildlife Acoustics, Maynard, MA, USA) was installed on a meteorological mast within the proposed site (IG Ref E184319 N323560) (Figure 3.1). The detector was equipped with two microphones; one at ground level and one at height (approx. 75 m above ground level). Table 3.4 describes survey effort in relation to surveys at height.

Table 3.4 2019 Survey Effort – Static Surveys at Height

ID	Survey Period	Total Survey Nights
Mast - 1	29th May – 11th June 2019	13
Mast - 2	11th June – 25th June 2019	14
Mast - 3	25th June – 13th July 2019	18
Mast - 4	21st August – 2nd September 2019	12
Mast - 5	5th September – 17th September 2019	12
Total Survey Effort		**69**

3.4 Bat Call Analysis

All recordings were later analysed using bat call analysis software Kaleidoscope Pro v.5.1.9 (Wildlife Acoustics, MA, USA). Bat species were identified using established call parameters, to create site-specific custom classifiers. All identified calls were also manually verified.

Echolocation signal characteristics (including signal shape, peak frequency of maximum energy, signal slope, pulse duration, start frequency, end frequency, pulse bandwidth, inter-pulse interval and power spectra) were compared to published signal characteristics for local bat species (Russ, 1999). Myotis species (potentially *M. daubentonii, M. mystacinus, M. nattereri*,) were considered as a single group, due to the difficulty in distinguishing them based on echolocation parameters alone (Russ, 1999). The echolocation of *P. pygmaeus* and *P. pipistrellus* are distinguished by having distinct (peak frequency of maximum energy in search flight) of ~55 kHz and ~ 46 kHz respectively (Jones & van Parijs, 1993).

Plate 3.1 below shows a typical sonogram of echolocation pulses for Common Pipistrelle recorded with a SM4BAT bioacoustic static bat recording device. The recorded file is illustrated using Wildlife Acoustics Kaleidoscope software.

Individual bats of the same species cannot be distinguished by their echolocation alone. Thus, 'bat passes' was used as a measure of activity (Collins, 2016). For the purposes of this survey, a bat pass was defined as a recording of an individual species/species group's echolocation containing at least two echolocation pulses and of maximum 15 seconds length.

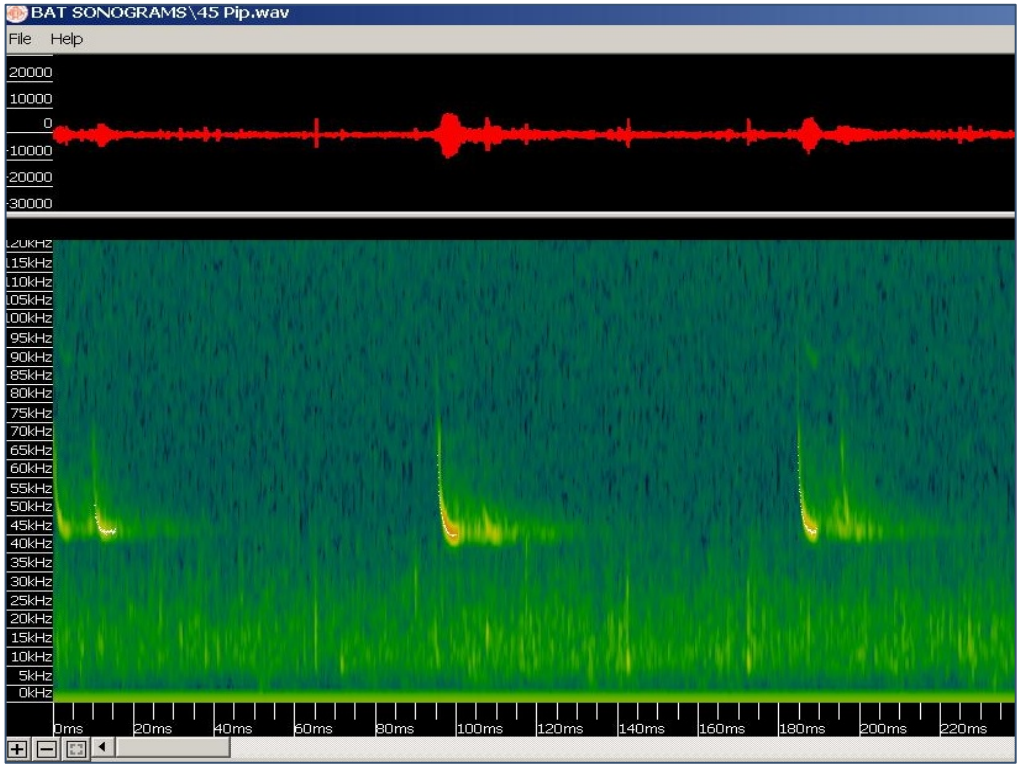


Plate 3.1 Sonogram of echolocation pulses of Common Pipistrelle (Peak Frequency 45kHz).

3.5 Assessment of Bat Activity Levels

Static detector monitoring results were uploaded to the online database tool Eco bat (ecobat.org.uk). This web-based interface, launched in August 2016, allows users to upload activity data and to contrast results with a comparable reference range, allowing objective interpretation. Uploaded data then contributes to the overall dataset to provide increasingly robust outputs.

Static detector at ground level results for the proposed wind farm were uploaded on the 14th October 2019. Database records used in analyses were limited to those within a similar time of year (within 30 days) and a within a similar geographic region (within 200 km).

Ecobat generates a percentile rank for each night of activity and provides a numerical way of interpreting levels of bat activity in order to provide objective and consistent assessments. Table 3.5 defines bat activity levels as they relate to Ecobat percentile values (SNH, 2019).

Although records of bat activity uploaded in Ireland have been increasing each year since the launch of Ecobat in 2016, there are still a limited number of datasets for objective interpretation. Guidelines in the use of Ecobat recommend a Reference Range of 2000+ to be confident in the relative activity level. Although there is an increased uptake in the use of Ecobat in Ireland, some of the reference ranges remain below 2000. The accuracy of data outputs and results will improve over time.

Table 3.5 Ecobat percentile score & categorised level of activity (SNH, 2019).

Ecobat Percentile	Bat Activity Level
81 to 100	High
61 to 80	Moderate to High
41 to 60	Moderate
21 to 40	Low to Moderate
0 to 20	Low

Results for static detector surveys at ground level and at height were uploaded in October 2019. Database records used in analyses were limited to those within a similar time of year (i.e. within 30 days) and within a similar geographic region (i.e. within 200 km).

3.6 Assessment of Collision Risk

3.6.1 Population Risk

SNH (2019) provides a generic assessment of bat collision risk for UK species, based on species behaviour and flight characteristics. In the guidelines, this measure of collision risk is used, in combination with relative abundance, to indicate the potential vulnerability of British bat populations.

In Plate 3.2, an adapted assessment of vulnerability for Irish bat populations is provided. Species' collision risk follows those described in SNH (2019). Relative abundance for Irish species was determined in accordance with Wray et al. (2010) using population data available in the 2019 Article 17 reports (NPWS, 2019).

Relative Abundance	Low Collision Risk	Medium Collision Risk	High Collision Risk
Common species			Common pipistrelle Soprano pipistrelle
Rarer species	Daubenton's bat Brown long-eared bat Lesser horseshoe bat		Leisler's bat
Rarest species	Natterer's bat Whiskered bat		Nathusius' pipistrelle
	Low Population Vulnerability	Medium Population Vulnerability	High Population Vulnerability

Plate 3.2 Population vulnerability of Irish bat species (adapted from SNH, 2019)

3.6.2 Site Risk

The likely impact of a proposed development on bats is related to site-based risk factors, including habitat and development features. Plate 3.3 describes the criteria and site-specific characteristics used to determine an indicative risk level for the proposed site. All site assessment levels, as per SNH (2019) are presented in **Appendix 2**.

		Project Size		
		Small	Medium	Large
Habitat Risk	Low	1	2	3
	Moderate	2	3	4
	High	3	4	5
		Low/Lowest Site Risk (1-2)	Medium Site Risk (3)	High/Highest Site Risk (4-5)

Plate 3.3 Site risk level assessment matrix (SNH, 2019)

3.6.3 Overall Risk Assessment

An overall assessment of risk was made by combining the site risk level (i.e. Medium) and Ecobat bat activity outputs, as shown in the overall risk assessment matrix table (Plate 3.4). The assessment was carried out for both median and maximum Ecobat activity categories in order to provide insight into typical bat activity (i.e. median values) and activity peaks (i.e. maximum values).

	Ecobat Activity Category					
Site Risk Level	Nil (0)	Low (1)	Low-Moderate (2)	Moderate (3)	Moderate-High (4)	High (5)
Lowest (1)	0	1	2	3	4	5
Low (2)	0	2	4	6	8	10
Medium (3)	0	3	6	9	12	15
High (4)	0	4	8	12	15	18
Highest (5)	0	5	10	15	20	25

Low Overall Risk (0-4)	Medium Overall Risk (5-12)	High Overall Risk (15-25)

Plate 3.4 Overall risk assessment matrix (SNH, 2019)

This exercise was carried out for each high collision risk species, i.e. Common, soprano and Nathusius' pipistrelles, and Leisler's bat. Overall risk assessments were also considered in the context of any potential impacts at the population level, particularly for species identified as having high population vulnerability (Table 4.5 – 4.7).

3.7 Limitations

A comprehensive suite of bat survey have been undertaken at the Proposed Development site in 2019. The surveys undertaken, in accordance with SNH Guidance, provide the information necessary to allow a complete, comprehensive and robust assessment of the potential impacts of the Proposed Development on bats receptors.

One static detector (D06) was stolen from the site during the spring deployment. A report was made to the Gardaí and additional site-wide security measures were employed during subsequent deployments to avoid any further incidents.

The information provided in this report accurately and comprehensively describes the baseline environment; provides an accurate prediction of the likely effects of the Proposed Development; prescribes mitigation as necessary; and describes the predicted residual impacts. The specialist studies, analysis and reporting have been undertaken in accordance with the appropriate guidelines.

No significant limitations in the scope, scale or context of the assessment have been identified.

4. RESULTS

4.1 Consultation

4.1.1 Bat Conservation Ireland

No response received from Bat Conservation Ireland as of the 22.0.2020.

4.1.2 Development Applications Unit - NPWS

A detailed scoping exercise was undertaken for the proposed wind farm. A response from the Department of Culture, Heritage and the Gaeltacht provided recommendations regarding nature conservation, including bats. The relevant excerpts, specifically relating to bats, are summarised below and the full results of the scoping and consultation exercise are described in the main EIAR. The response was received on the 30/01/2019 and the letter is provided in Appendix 4 of the EIAR.

1. **Bat roosts**
   Bat roosts may be present in trees, buildings and bridges. Bat roosts can only be destroyed under licence and such a licence would only be given if suitable mitigation measures were implemented. Any proposed migratory bat friendly lighting should be proven to be effective.

2. **Post-construction monitoring**
   The applicant should not use any proposed post construction monitoring as mitigation to supplement inadequate information in the assessment. The EIAR process should identify any pre and post construction monitoring which should be carried out. The post construction monitoring should include bird and bat strikes/fatalities including the impact on any such results of the removal of carcasses by scavengers. Monitoring results should be made available to the competent Authority and copied to this Department. A plan of action needs to be agreed at planning stage with the Planning Authority if the results in future show a significant mortality of birds and/or bat species. It is important to note again that unless post decision consultation with this Department is specifically stated as a condition of planning, this Department has no post consent role. However, regional staff are available for liaison regarding any associated licencing requirements and/or new information arising for specific species of concern.

3. **Licences**
   Where there are impacts on protected species and their habitats, resting or breeding places, licences may be required under the Wildlife Acts or derogations under the Habitats Regulations. In particular bats and otters are strictly protected under annex IV of the Habitats Directive.

   In order to apply for any such licences or derogations, the results of a survey should be submitted to the National Parks and Wildlife Service section of this Department. Such surveys are to be carried out by appropriately qualified person/s at an appropriate time of the year. Details of survey methodology should also be provided. Should this survey work take place well before construction commences, this Department recommends that an additional ecological survey of the development site should take place immediately prior to construction to ensure no significant change in the findings of the baseline ecological survey has occurred. If there has been any significant change mitigation may require amendment and where a licence has expired, there will be a need for new licence applications for protected species.

All recommendations made by the Department were fully considered in the design of bat surveys and the preparation of this report.

4.2 Desk Study

4.2.1 Bat Records

The National Bat Database of Ireland was searched for records of bat activity and roosts within a 10 km radius of the proposed site (IG Ref: G 84319 23560; last search 22/05/2020). A number of observations have been recorded including roosts (n=10), transects (n=3) and ad-hoc observations (n=7). At least six of Ireland's nine resident bat species were recorded within 10 km of the proposed works including common and soprano pipistrelle, Leisler's bat, Daubenton's bat, Natterer's bat and brown long-eared bat, as well as several records of unidentified bats. The results of the database search are provided in Table 4.1.

Table 4.1 National Bat Database of Ireland records within 10km

Type	Location	Results	Survey	Designation
Roost	Douglas River, Sligo	Type: Bridge Species: Natterer's bat	Unknown	Annex IV
	Douglas River, Sligo	Type: Bridge Species: Daubenton's bat	Unknown	Annex IV
	Dromahir, Leitrim	Type: Building Species: Pipistrelle sp. Unidentified bat	Unknown	Annex IV
	Ballintogher, Sligo	Type: Bridge Species: Natterer's bat	Unknown	Annex IV
	Ballynakill, Sligo	Type: Bridge Species: Natterer's bat	Unknown	Annex IV
	Bellarush, Sligo	Type: Bridge Species: Daubenton's bat	Unknown	Annex IV
	Camogue, Leitrim	Type: Bridge Species: Natterer's bat	Unknown	Annex IV
	Cloonemeone, Leitrim	Type: Bridge Species: Daubenton's bat	Unknown	Annex IV
	Geevagh, Sligo	Type: Bridge Species: Unidentified bat	Unknown	Annex IV
	Castlebaldwin, Sligo	Type: Building Species: Soprano pipistrelle, Brown long-eared bat	Unknown	Annex IV
Transect	Cloonemeone, Leitrim	Daubenton's bat, Unidentified bat	Waterways Survey	Annex IV
	Drumlease, Leitrim	Daubenton's bat, Unidentified bat	Waterways Survey	Annex IV
	Drumlease, Leitrim	Leisler's bat, Soprano pipistrelle, Pipistrelle sp., Unidentified bat	Car-Based Monitoring	Annex IV
Ad-Hoc	Tullycoly, Leitrim	Daubenton's bat, Soprano pipistrelle	BATLAS 2010	Annex IV

Type	Location	Results	Survey	Designation
	Drumkeeran, Leitrim	Leisler's bat, Soprano pipistrelle	BATLAS 2010	Annex IV
	Drumkeeran, Leitrim	Soprano pipistrelle	BATLAS 2010	Annex IV
	Castlebaldwin, Sligo	Leisler's bat, Soprano pipistrelle	BATLAS 2010	Annex IV
	Geevagh, Sligo	Myotis sp., Leisler's bat, Common pipistrelle, Soprano pipistrelle, Brown long-eared bat	BATLAS 2010	Annex IV
	Behavel Lough, Leitrim	Daubenton's bat, Myotis sp., Leisler's bat, Common pipistrelle, Soprano pipistrelle	BATLAS 2010	Annex IV
	Geevagh, Sligo	Daubenton's bat	EIS Surveys	Annex IV

4.2.2 Bat Species Range

The potential for negative impacts is likely to increase where there are high risk species at the edge of their range (SNH, 2019). Therefore, range maps presented in the 2019 Article 17 Reports (NWPS, 2019) were reviewed in relation to the location of the proposed development.

The main part of the proposed site is located at the edge of the current range for one species, whiskered bat. The proposed site is located outside the current range for Nathusius' pipistrelle and lesser horseshoe bat, and within range but not at the edge for all other species.

4.2.3 Designated Sites

Within Ireland, the lesser horseshoe bat is the only bat species requiring the designation of Special Areas of Conservation (SACs) and the proposed site is situated outside the known range of this species. Natural Heritage Areas (NHAs) and proposed Natural Heritage Areas (pNHAs) may be designated for any bat species. A search of NHAs and pNHAs within a 10 km radius of the Study Area found no sites designated for the conservation of bats.

4.2.4 Landscape Features

A review of mapping and photographs provided insight into the habitats and landscape features present at the proposed development site. In summary, the primary land use within the proposed site is plantation forestry, while the remainder of the wind farm infrastructure site is dominated by upland peatland habitats.

A review of the GSI online mapper did not indicate the possible presence of any subterranean sites within the study area and a search of the National Monuments Database did not reveal the presence of any manmade subterranean sites within the study area.

A search of the UBSS Cave Database for the Republic of Ireland found no caves within the proposed site. However, numerous caves occur within 10km of the site boundary, with the nearest located 2 km away (Table 4.2). No maternity, hibernation or swarming sites, or other bat presence records, were available for any caves within 10km.

A review of the NBDC bat landscape map provided a habitat suitability index of 11.11 (Green). This indicates that the proposed development area has low habitat suitability for bat species.

Table 4.2 UBSS Cave Database records within 10km

Cave Name	Description	Distance (km)
Carrowmore Caverns	540m long, 142m deep system	2.0
Polliska	None available	2.1
Brock's Cave	50m long to small streamway	2.2
Polldonon	30m long, 8m drop	2.4
Dragonfly Pot	90m deep pothole with 250m of passage	2.4
Carrownadargny-Pollnagollum	Large passage 50m to boulder choke	2.4
Carrownadargny Swallet	Pothole 50m deep, 130m long	2.6
Jumar Pot	45m deep pothole	2.7
Tap Cave – Natural Bridge	114m long streamway	3.0
Bone Hole Cave	210m long passage, 25m deep	3.0
Ailtnaseabhach Cave (4)	5m narrow rift cave	3.2
Ailtnaseabhach Cave (1)	None available	3.2
Churdhe Mhor	Large entrance to choke, 10m long	3.2
Ailtnaseabhach (2)	5m rift cave	3.7
Ailtnaseabhach (3)	5m rift cave	4.3
Foyoge's Bridge Cave	25m crawl in the stream	5.6
Whistling Eel Cave	30m through trip	7.9
Skeanada Sink	12m tight streamway	8.3
Treanmore Cave	30m rift	8.4
The Cove (Dromahair)	20m long, large stream passage	8.5
Carrickard Cave	2m crawl	8.7
Patricia's Rift	Large 7m long passage	8.7
Ballinlig Cave (1)	50m long rift	8.8
Ballinlig Cave (2)	8 m rift	8.8

Ballinlig Cave (3)	10m rift	8.8
Angela's Doubt	12m tunnel	8.8
Singing Blackbird Cave	9m long through trip	8.9
Croghmine Cave	5m pot	9.1
Ballinlig Cave (4)	3m long	9.4

4.2.5 Other Wind Energy Developments

Table 4.3 provides an overview of other wind farms in the vicinity of the proposed wind farm.

Table 4.3 Wind farm developments within 10km of the proposed site.

Wind Farm Name & Location	No. Turbines	Status
Within 5 km of proposed Croagh Wind Farm		
Geevagh, Co. Sligo	6	Existing
Carrane Hill, Co. Sligo	4	Existing
Garvagh Tullyhaw, Co. Leitrim	11	Existing
Garvagh Glebe, Co. Leitrim	13	Existing
Corry Mountain, Co. Leitrim	8	Existing
Spion Kop, Co. Leitrim	2	Existing
Moneenatieve, Co. Leitrim (Existing)	6	Existing
Black Banks I & II, Co. Leitrim	12	Existing
Derrysallagh, Co. Sligo	12	Permitted
Altagowlan, Co. Leitrim	9	Existing
Within 5-10 km of proposed Croagh Wind Farm		
Kilronan, Co. Roscommon	10	Existing
Tullynamoyle + Extensions, Co. Leitrim	15	Existing
Seltannaveeny, Co. Roscommon	2	Existing

4.3 Overview of study area & Ecological Appraisal

The majority of the study area (86.3%) is dominated by plantation forestry, comprising mainly of Sitka spruce (Picea sitchenis) and Lodgepole pine (Pinus contorta). The site is accessible via a network of existing forestry access tracks and forestry rides. The remainder of the wind farm infrastructure site is dominated by degraded Upland Blanket Bog (PB2). The haulage route to the east of the site primarily traverses areas of Wet grassland (GS4), Scrub (WS1), Conifer plantation (WD4) and existing roads. Results from the desktop review and walkover surveys were used to assess habitats for their suitability to support foraging and commuting bats, and roosting bats, according to Collins (2016). Suitability categories, divided into *High*, *Moderate, Low* and *Negligible*, are described fully in **Appendix 1.**

With regard to foraging and commuting bats, areas of closed canopy forestry as well as exposed areas of grassland and peatland habitats were considered *Negligible* suitability, i.e. negligible habitat features on site likely to be used by commuting or foraging bats (Collins, 2016). Forestry edge and scrub habitats may provide greater foraging and commuting opportunities. These habitats within the study area are connected to the wider landscape by further adjacent forestry. As such, these habitats were classified as *Moderate* suitability, i.e. habitat connected to the wider landscape that could be used by bats for foraging and commuting (Collins, 2016).

One structure, a derelict dwelling, was identified as having bat roosting potential within the site. Due to the structure's poor condition and the low suitability of the surrounding habitat, the building was assessed as *Low* suitability for roosting bats. The building was subject to a preliminary roost assessment and a dusk emergence survey. Trees present within the proposed site are commercial coniferous species with *Negligible – Low* roosting potential.

4.4 Roost Surveys

One structure was identified within the proposed site (IG Ref E186351 N321105). The derelict dwelling had a slate roof and was in a state of disrepair (Plate 4.1). Numerous potential access points were identified in broken windows and gaps in slates. The surrounding habitats were assessed as low as the building had suitable roosting features however, there was no evidence of bat use recorded during the roost assessment (Collins, 2016). In addition, no bats were recorded during a dedicated roost survey undertaken by two surveyors on the 7th May 2019. No other structures within the site were identified as being, within 200m of a turbine location, or as providing roosting bat features and thus further surveys

were not deemed necessary.

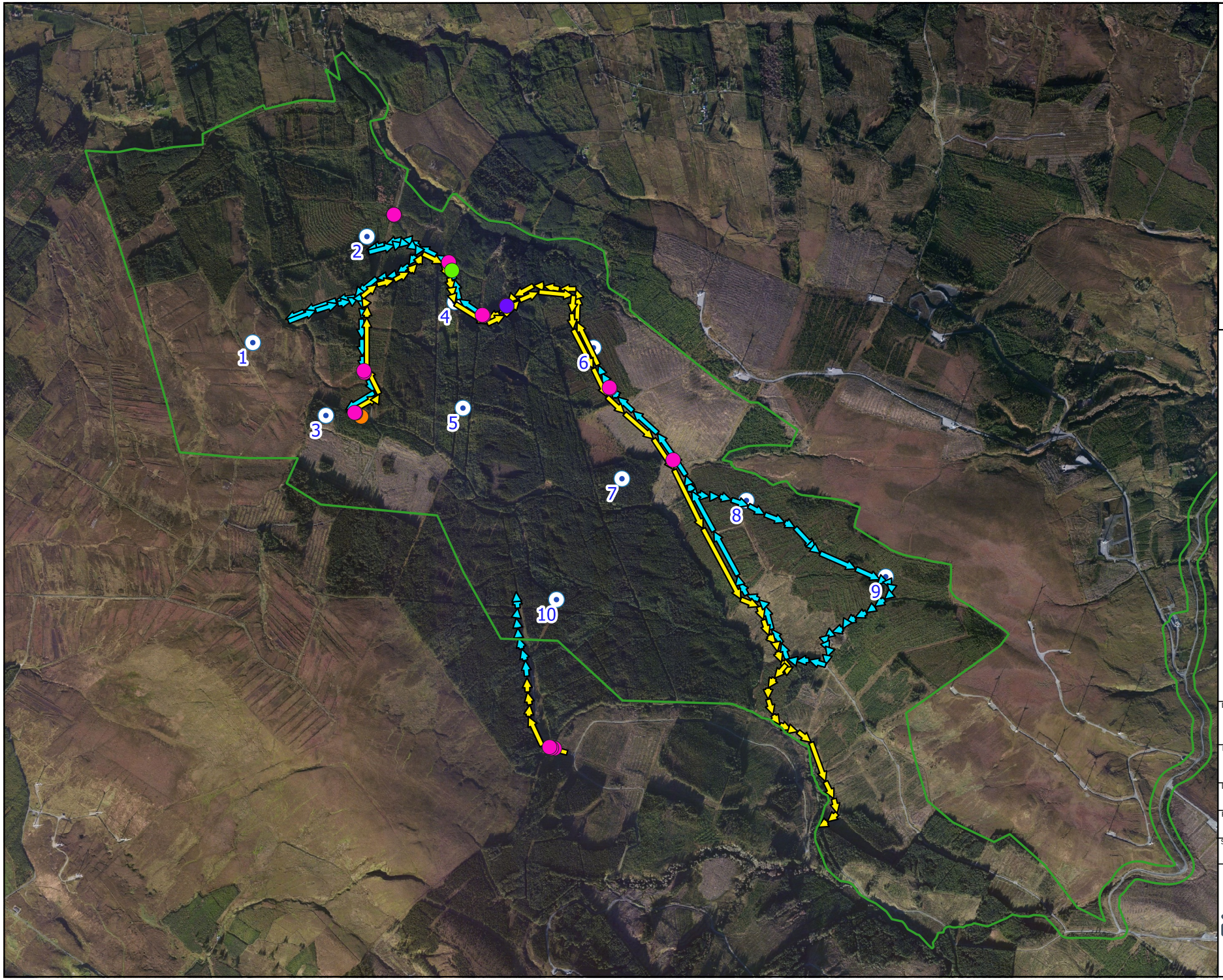


Plate 4.1 Derelict dwelling located on site.

The site was checked for potential tree roosts but no trees with significant roosting features were identified within the site. Trees may have increased or decreased probability of hosting roosting bats in certain circumstances i.e. Having large broadleaf trees with cavities or other damage such as rot or loose bark increased probability whereas, Conifer plantations and young trees with little – no damage have a decreased probability of hosting bats (Kelleher and Marnell, 2006).

4.5 Manual Transects

Manual transects were undertaken in spring, summer and autumn 2019 (Fig 4.1 – 4.3). Bat activity was recorded on all surveys. Bat activity was low with just 68 bat passes in total recorded across all survey nights. Activity was particularly low during the summer transect where only 2 bat passes were recorded in total. In general, Leisler's bat was recorded most frequently. This activity was largely concentrated in the spring season. Common and soprano pipistrelle were also frequently recorded, particularly in autumn. *Myotis* sp. and brown long-eared bat were less frequently encountered. Species composition and activity levels varied significantly between surveys. Transect survey results were calculated as bat passes per km surveyed (to account for differences in survey effort). Figure 4.4 presents results for individual species per survey period.



Map Legend

- Site Boundary
- Proposed Turbine Locations
- Spring Driven Transect
- Spring Walked Transect
- Myotis species
- Leislers
- Soprano pipistrelle
- Brown long-eared

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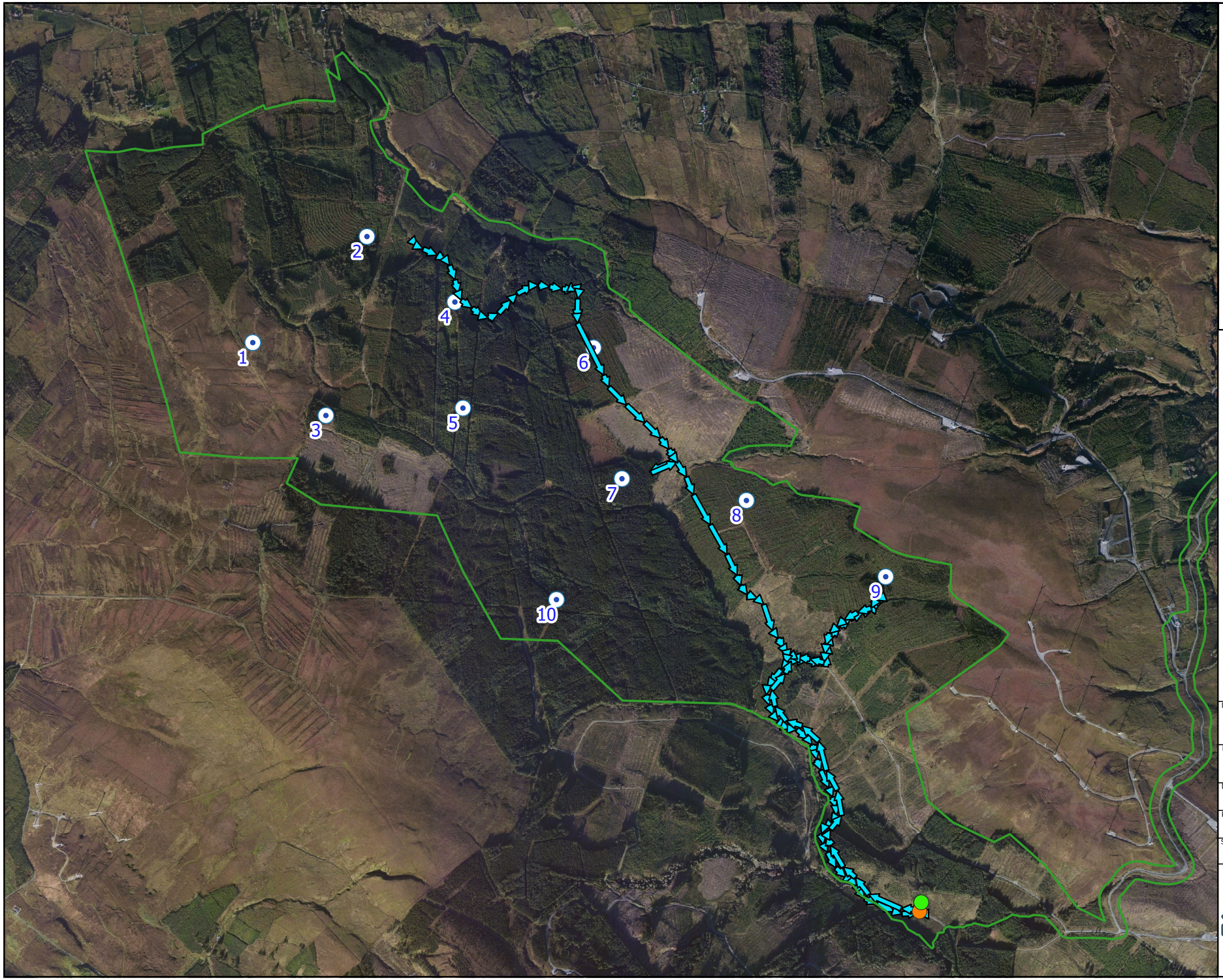
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Drawing Title: Spring Manual Transect Results

Project Title: Croagh Windfarm

Drawn By	Checked By
LD	JH
Project No.	Drawing No.
180511	Figure 4.1
Scale	Date
1:22000	08.07.2020

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Map Legend

- Site Boundary
- Proposed Turbine Locations
- Summer Walked Transect
- Myotis species
- Soprano Pipistrelle

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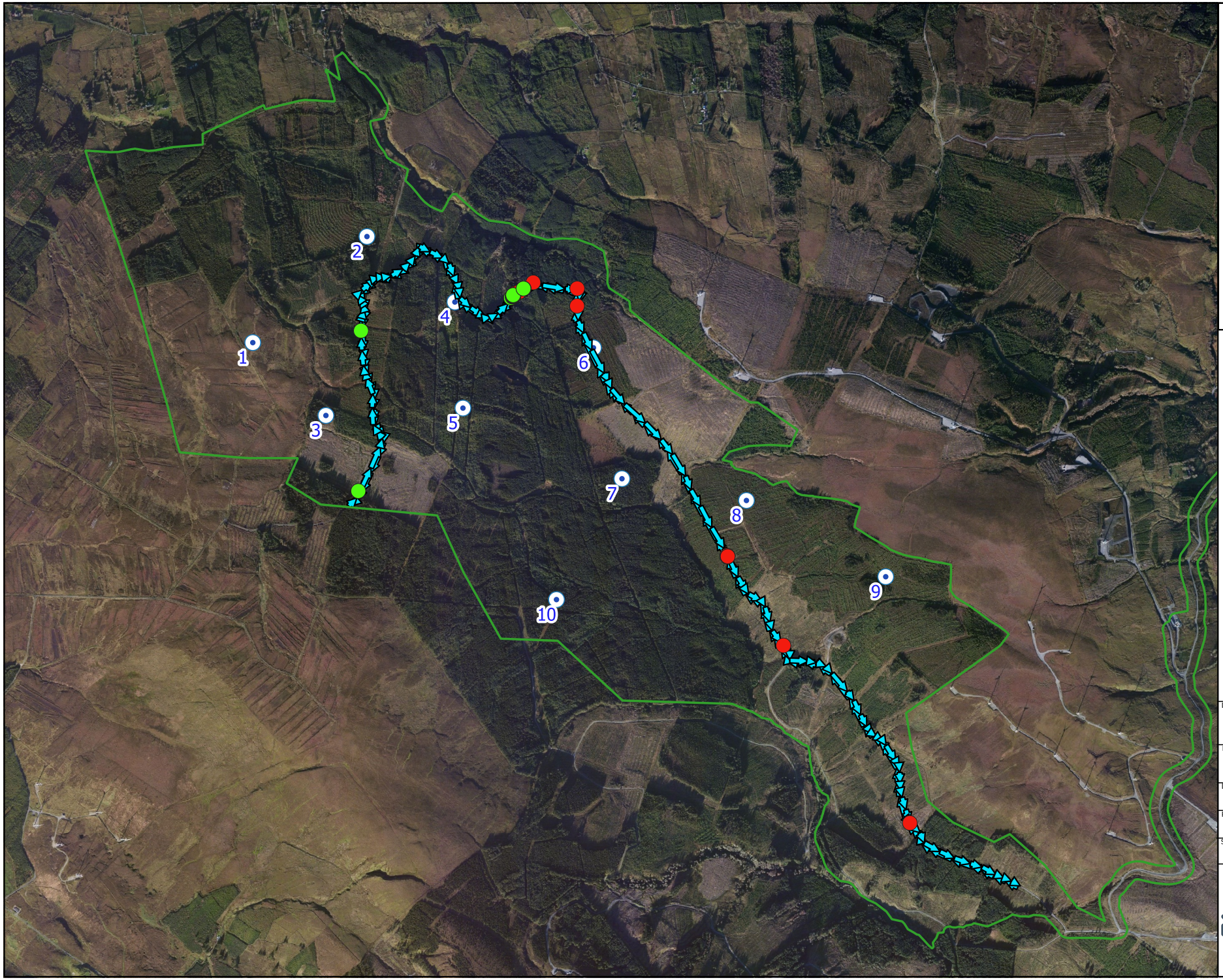
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Drawing Title: Summer Manual Transect Results

Project Title: Croagh Windfarm

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Project No.	Drawing No.
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Map Legend

- Site Boundary
- Proposed Turbine Locations
- Autumn Walked Transects
- Common pipistrelle
- Soprano pipistrelle

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Drawing Title
Autumn Manual Transect Results

Project Title
Croagh Windfarm

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LD	JH
Project No.	Drawing No.
180511	Figure 4.3
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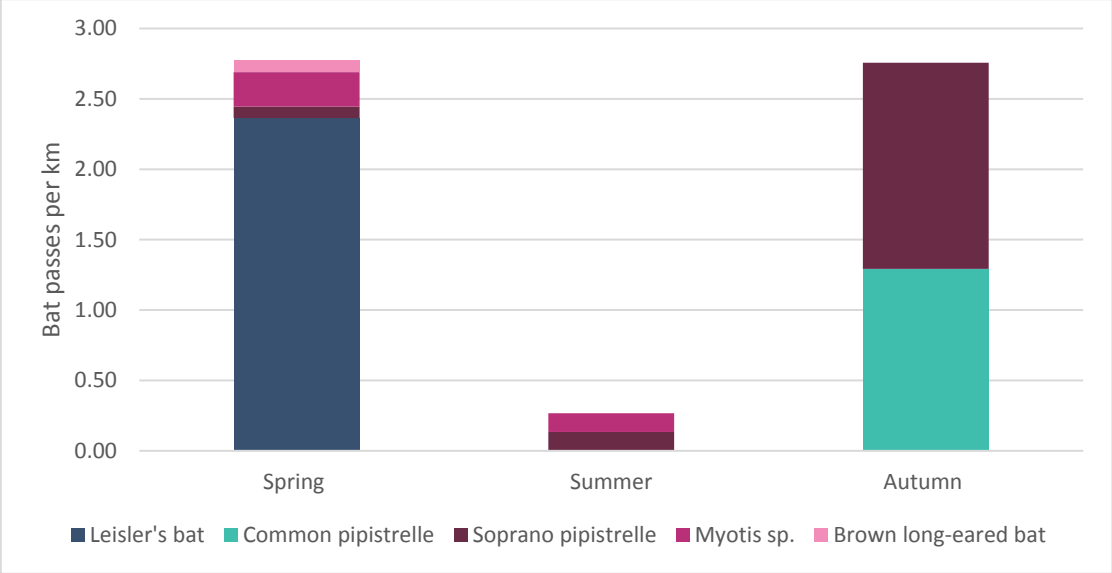


Figure 4.4 Walked & driven transects 2019 – Species composition per survey period.

4.6 Ground-level Static Surveys

In total, 21,214 bat passes were recorded across all deployments. In general, Leisler's bat (n= 7,699), common pipistrelle (n=6,384) and soprano pipistrelle (n=6,628) occurred most frequently, while instances of *Myotis* sp. (n=456) and brown long-eared bat (n=47) were significantly less. Figure 4.5 presents relative species composition across all ground-level static detector surveys.

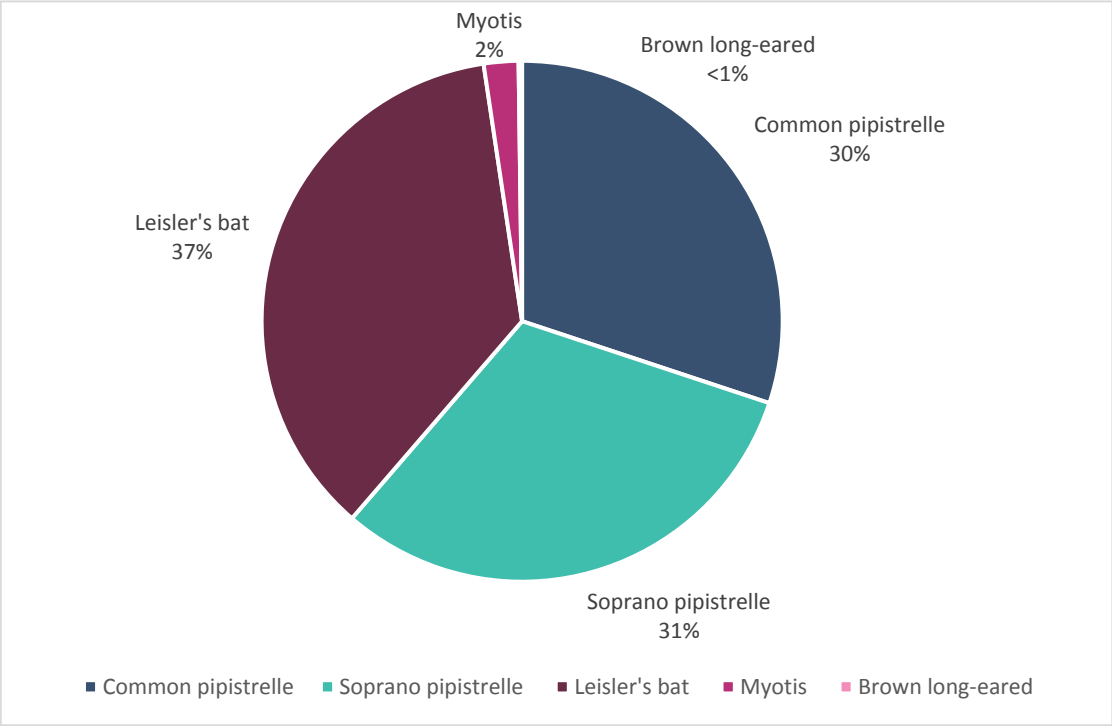


Figure 4.5 Static detector surveys: Species composition across all deployments (total bat passes)

Bat activity was calculated as total bat passes per hour (bpph) per season to account for any bias in survey effort, resulting from varying night lengths between seasons. Figure 4.6 and Table 4.4 presents these results for each species. Bat activity was dominated by Leisler's bat in spring. Common and

soprano pipistrelle were more frequently occurring in summer and autumn. Instances of *Myotis* sp. and brown long-eared bat were relatively rare.

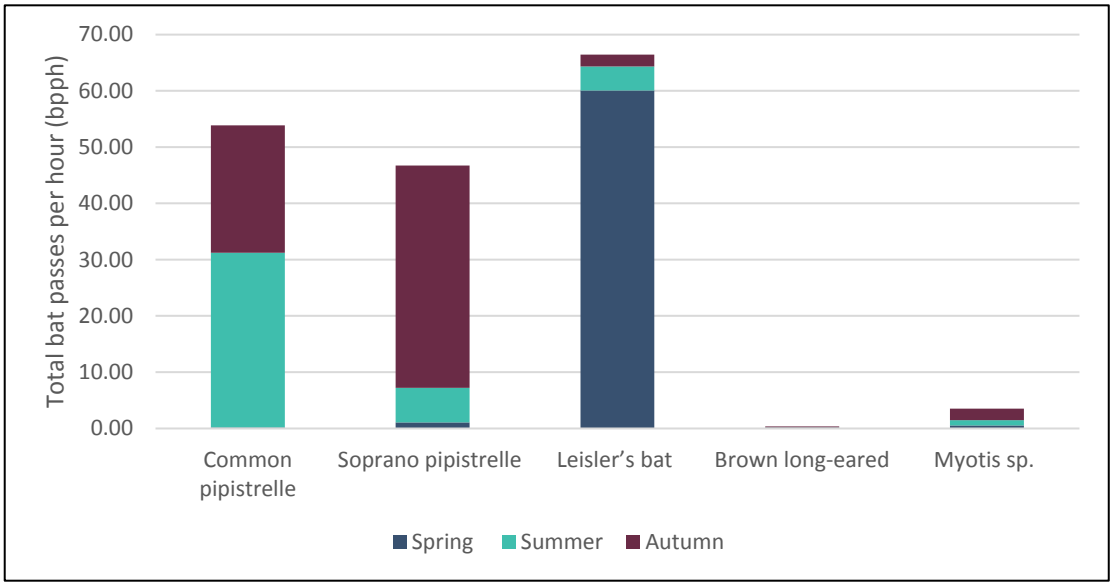


Figure 4.6 Static detector surveys: Species composition across all deployments (total bat passes per hour, all nights)

Table 4.4 Static detector surveys: Species composition across all deployments (total bat passes per hour, all nights).

	Spring	Summer	Autumn
Total survey hours	*116.1*	*95.7*	*149.8*
Common pipistrelle	0.16	31.04	22.66
Soprano pipistrelle	1.06	6.15	39.49
Leisler's bat	60.05	4.27	2.12
Brown long-eared	0.09	0.05	0.21
Myotis sp.	0.52	0.95	2.04

The Nightly Pass Rate (i.e. total bat passes per hour, per night) was used to determine typical bat activity at the proposed site. Activity was variable between survey nights. Therefore, the median Nightly Pass Rate was used as the most appropriate measure of bat activity (Linott & Mathews, 2018). Figure 4.7 illustrates the median Nightly Pass Rate per species per deployment. Zero data, when a species was not detected on a night, was also included.

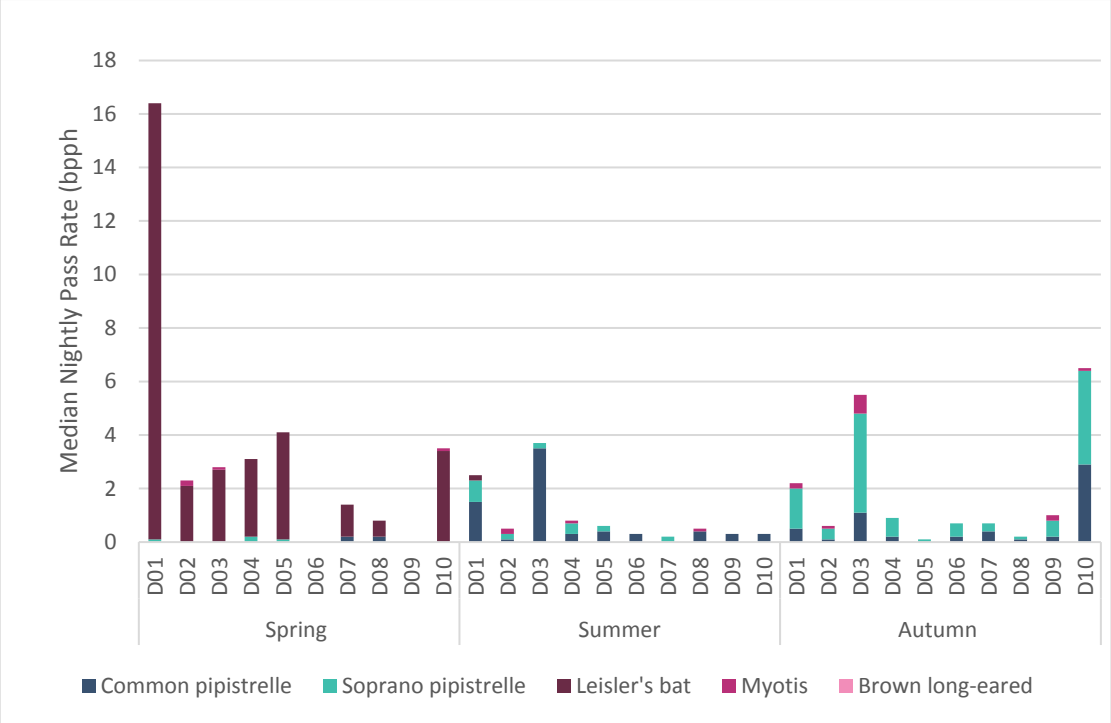


Figure 4.7 Static detector surveys: Median Nightly Pass Rate (bat passes per hour) including absences, per location per survey period.

Leisler's bat was predominant at all other detectors during the spring particularly at detector 1 where Leislers activity was significantly higher than all other species (Figure 4.7). During the summer and autumn seasons, Leisler's activity dropped off and common and soprano pipistrelles were more prevalent during the summer and autumn seasons.

Bat activity levels were objectively assessed against a reference dataset using Ecobat. Table 4.5 presents the results of Ecobat analysis for each species per season on a site-level. **Appendix 3** provides these results per detector. All species showed at least *Moderate* median bat activity during at least one season. Activity peaked with *Moderate* activity for brown long-eared bat and *High* activity for all other species.

Table 4.5 Static detector surveys: Site-level Ecobat Analysis

Survey Period	Median Percentile	Median Bat Activity	Max Percentile	Max Bat Activity	Nights Recorded	Ref Range
Common pipistrelle						
Spring	6	Low	45	Moderate	11	1087
Summer	47	Moderate	100	High	81	2203
Autumn	58	Moderate	99	High	96	1996
Soprano pipistrelle						
Spring	23	Low-Moderate	85	High	26	1104
Summer	24	Low-Moderate	96	High	63	2074
Autumn	64	Moderate-High	100	High	100	1923
Leisler's bat						
Spring	76	Moderate-High	100	High	98	954
Summer	47	Moderate	89	High	35	1698

Survey Period	Median Percentile	Median Bat Activity	Max Percentile	Max Bat Activity	Nights Recorded	Ref Range
Autumn	54	Moderate	86	High	37	1217
***Myotis* sp.**						
Spring	6	Low	57	Moderate	28	762
Summer	5	Low	68	Moderate-High	46	1217
Autumn	41	Moderate	81	High	72	1365
Brown long-eared bat						
Spring	6	Low	40	Moderate	5	305
Summer	5	Low	5	Low	5	481
Autumn	31	Low-Moderate	54	Moderate	13	831

4.7 Surveys at Height

Two microphones, one at the top of the met mast (High) and one at the bottom (Low) attached to a Static detector recorded simultaneously. Bat activity was extremely low with just 38 bat passes recorded over 69 nights of monitoring. Overall, bat activity was higher at height than at ground level (Figure 4.8). However, the majority of this activity (n = 20 bat passes) was attributed to Leisler's bat on a single night in June (Mast-2). The bat species recorded at the met mast were also recorded during the ground level static detector surveys else where on site. The bat activity levels recorded at height are extremely low when compared ground level static bat detector levels i.e.Leisler's bat (n= 7,699) were recorded across all ground level static detectors across all seasons.

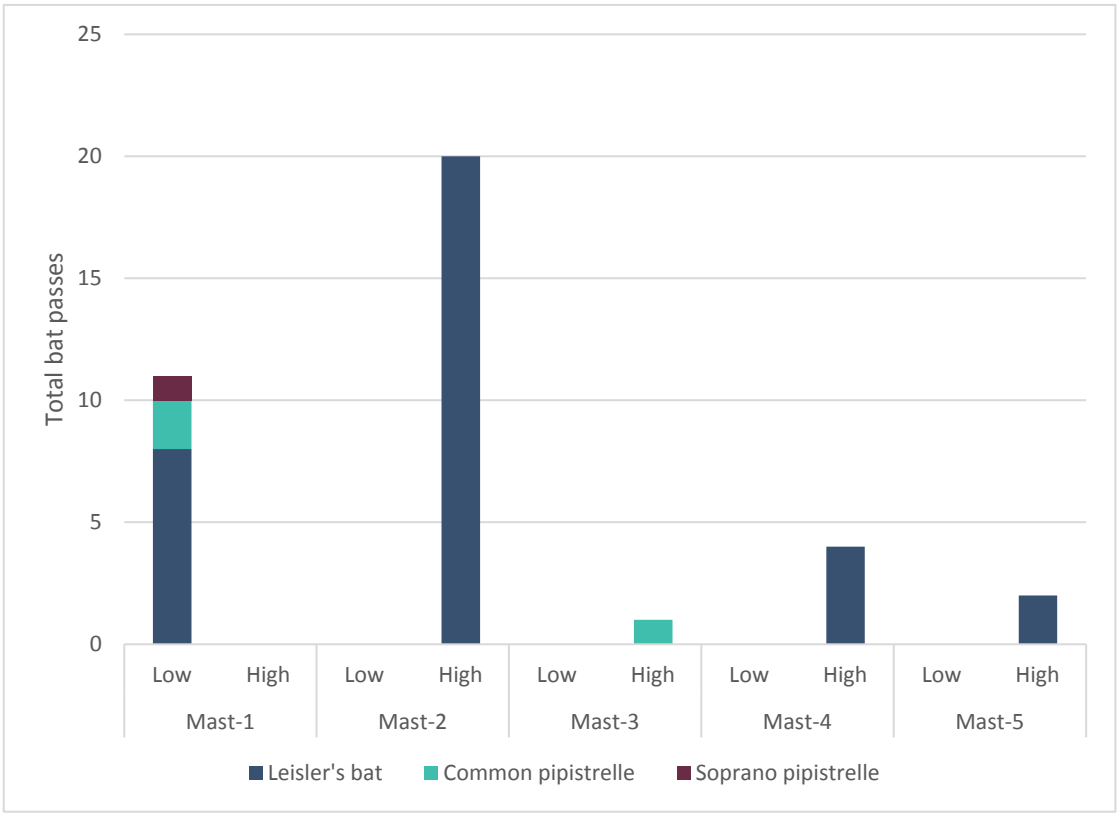


Figure 4.8 Surveys at height - species composition per microphone per deployment.

4.8 Significance of Bat population recorded at the site

Ecological evaluation and within this Section follows a methodology that is set out in Chapter three of the '*Guidelines for Assessment of Ecological Impacts of National Roads Schemes'* (NRA, 2009).

All bat species in Ireland are protected under the Bonn Convention (1992), Bern Convention (1982) and the EU Habitats Directive (92/43/EEC). Additionally, in Ireland bat species are afforded further protection under the Birds and Natural Habitats Regulations (2011) and the Wildlife Acts 1976-2019. No bat roosts were identified within the footprint of the proposed development. Bats as an Ecological Receptor have been assigned ***Local Importance (Higher value***) on the basis that the habitats within the study area are utilised by a regularly occurring bat population of Local Importance.

The development site does not support a roosting site of ecological significance. Risk & Impact Assessment

As per SNH Guidance, wind farms present four potential risks to bats:

- Collision mortality, barotrauma and other injuries
- Loss or damage to commuting and foraging habitat
- Loss of, or damage to, roosts
- Displacement of individuals or populations

For each of these four risks, the detailed knowledge of bat distribution and activity within the study area has been utilised to predict the potential effects of the wind farm on bats.

4.9 Collision Mortality

4.9.1 Assessment of Site-Risk

The likely impact of a proposed development on bats is related to site-based risk factors, including habitat and development features. The site risk assessment, as per Table 3a of the SNH guidance, is provided in Table 4.6 below.

Table 4.6 Site Risk Assessment

Criteria	Site-specific Evaluation	Individual Risk	Site Assessment
Habitat Risk	No potential roost features identified within the site.	Low	Low
	Upland peatland & conifer forestry habitats within the site (Low foraging/commuting suitability)	Low	
	Connected to wider landscape by forestry habitats.	Moderate	
Project Size	Small scale development (10 no. turbines)	Small	Large
	Other wind energy developments within 5km (see Table 4.3)	Large	
	Comprising turbines>100 m in height	Large	
Site Risk Assessment (from criteria in plate 3.3)			**Medium Site Risk (3)**

The site of the proposed development is located in conifer plantation with small areas of upland peatland. As per table 3a of the SNH Guidance (2019), it has a low habitat risk score. The proposed development includes 10 turbines of over 100m in height. As per Table 3a, it is a small project (10 turbines) but the turbines are greater than 100m in height and thus for the purposes of the assessment, it is considered to be a large project. It is also noted that it is in close proximity to other wind farm developments.

The cross tabulation of a large project on a low risk site results in an overall risk score of **Medium** (SNH Table 3a)(Appendix 1).

4.9.2 Assessment of Collision Risk

The following high-risk species were recorded during the dedicated surveys:

- Leisler's Bat,
- Common Pipistrelle
- Soprano pipistrelle

The Overall Risk Assessment for high collision risk species is provided in the sections below. Overall Risk was determined, in accordance with Table 3b of SNH guidance (**Appendix 4**), by a cross-tablature of the site risk level (i.e. Medium) and Ecobat bat activity outputs for each species. The assessment was carried out for both median and maximum Ecobat activity categories in order to provide insight into typical bat activity (i.e. median values) and activity peaks (i.e. maximum values). SNH recommends that that most appropriate activity level (i.e. median or maximum) be utilised to determine the overall risk assessment for a species.

As per SNH guidance there is no requirement to complete an Overall Risk Assessment for low risk species. During the extensive suite of surveys undertaken that following low risk species were recorded:

- Myotis spp.
- Brown Long-eared Bat

Overall activity levels were low for the above species no significant collision related effects are anticipated.

4.9.2.1 Leisler's bat

This site is within the current range of the Leisler's bat (NPWS, 2019). Leisler's bats are classed as a rarer species of a high population risk which have a high collision risk (Plate 3.2). Leisler's bats were recorded during activity surveys across the proposed site. When assessed in the context of the identified site risk and in line with Table 3b (SNH 2019) overall activity risk for Leisler's bat was found to be ***Medium*** at typical activity levels and ***High*** at peak activity levels across all three seasons (See Table 4.7).

Based on site visit and survey data, including walked and driven transects, it is determined that the Typical Activity (i.e. Median) is reflective of the nature of the site, which is an upland conifer plantation with low levels of bat activity recorded during the walked and driven transects undertaken

Thus, there is **Medium** collision risk level assigned to the local population of Leisler's Bat.

Table 4.7 Leisler's bat - Overall risk assessment

Survey Period	Site Risk	Typical Activity (Median)	Typical Risk Assessment (as per Table 3b SNH 2019)	Activity Peaks (Maximum)	Peak Risk Assessment (as per Table 3b SNH 2019)
Spring	Medium (3)	Moderate to High (4)	Typical Risk is Medium (12)	High (5)	Peak Risk is High (15)

Survey Period	Site Risk	Typical Activity (Median)	Typical Risk Assessment (as per Table 3b SNH 2019)	Activity Peaks (Maximum)	Peak Risk Assessment (as per Table 3b SNH 2019)
Summer		Moderate (3)	Typical Risk is Medium (9)	High (5)	Peak Risk is High (15)
Autumn		Moderate (3)	Typical Risk is Medium (9)	High (5)	Peak Risk is High (15)

4.9.2.2 Soprano pipistrelle

This site is within the current range of the Soprano pipistrelle bat (NPWS, 2019). Soprano pipistrelle are classed as a common species of a medium population risk which have a high potential collision risk (Plate 3.2). Soprano pipistrelle were recorded during activity surveys across the proposed site. When assessed in the context of the identified site risk and in line with Table 3b (SNH 2019) overall activity risk for Soprano pipistrelle was found to be ***Medium*** at typical activity levels and ***High*** at peak activity levels across all three seasons (See Table 4.8 below).

Based on site visit and survey data, including walked and driven transects, it is determined that the Typical Activity (i.e. Median) is reflective of the nature of the site, which is an upland conifer plantation with low levels of bat activity recorded during the walked and driven transects undertaken

Thus, there is **Medium** collision risk level assigned to the local population of Soprano Pipistrelle.

Table 4.8 Soprano pipistrelle – Overall risk assessment

Survey Period	Site Risk	Typical Activity (Median)	Typical Risk Assessment (as per Table 3b SNH 2019)	Activity Peaks (Maximum)	Peak Risk Assessment (as per Table 3b SNH 2019)
Spring	Medium (3)	Low to Moderate (2)	Typical Risk is Medium (6)	High (5)	Peak Risk is High (15)
Summer		Low to Moderate (2)	Typical Risk is Medium (6)	High (5)	Peak Risk is High (15)
Autumn		Moderate to High (4)	Typical Risk is Medium (12)	High (5)	Peak Risk is High (15)

4.9.2.3 Common pipistrelle

This site is within the current range of the Common pipistrelle bat (NPWS, 2019). Common pipistrelle are classed as a common species of a medium population risk which have a high collision risk (Plate 3.2). Common pipistrelle were recorded during activity surveys across the proposed site. When assessed in the context of the identified site risk and in line with Table 3b (SNH 2019); overall activity risk for Common pipistrelle at typical activity levels was found to be ***Low*** in Spring and ***Medium*** in Summer & Autumn. Peak risk levels for Common pipistrelle were ***Medium*** in Spring and ***High*** in Summer & Autumn.(See Table 4.9)

Based on site visit and survey data, including walked and driven transects, it is determined that the Typical Activity (i.e. Median) is reflective of the nature of the site, which is a upland conifer plantation with low levels of bat activity recorded during the walked and driven transects undertaken

Thus, there is **Moderate** collision risk level assigned to the local population of Common Pipistrelle.

Table 4.9 Common pipistrelle – Overall risk assessment

Survey Period	Site Risk	Typical Activity (Median)	Typical Risk Assessment (as per Table 3b SNH 2019)	Activity Peaks (Maximum)	Peak Risk Assessment (as per Table 3b SNH 2019)
Spring	Medium (3)	Low (1)	Typical Risk is Low (3)	Moderate (3)	Peak Risk is Medium (9)
Summer		Moderate (3)	Typical Risk is Medium (9)	High (5)	Peak Risk is High (15)
Autumn		Moderate (3)	Typical Risk is Medium (9)	High (5)	Peak Risk is High (15)

4.10 Loss or damage to commuting and foraging habitat

In absence of appropriate design, the loss or degradation of commuting/foraging habitat has potential to reduce feeding opportunities and/or displace bat populations. However, the development is predominantly located within an existing commercial forestry plantation and there will be no net loss of bat foraging/commuting habitat associated with the proposed wind farm development.

The development, including the creation of new road infrastructure and grid connection route, has the potential to open up the commercial forestry and thereby increase the amount and availability of linear landscape features that may be utilised by bats for commuting or foraging.

No significant effects with regard to loss of commuting and foraging habitat are anticipated.

4.11 Loss of, or damage to, roosts

The development is predominantly located within a commercial forestry plantation. The trees in the plantation do not provide potential roosting habitat of significance for bats. One derelict structure was identified within the proposed site. Although the structure will be retained it was subject a roost inspection and emergence survey, but no evidence of bats was recorded.

Overall no roosting sites suitable for maternity colonies, swarming or hibernation were identified and none will be impacted by the proposed development.

There will be no loss of tree roosting habitat of linear landscape connectivity associated with these works.

Any culverts located along the grid connectiuon route were assessmend as having neglidable roosting potential for bats.

The habitats present along the grid connection route consist mostly of coniferous plantation, previously exiting forestry tracks and regional roads. The coniferous plantations along the grid connection route were assessed as low suitability for roosting bats, and there will be no loss of any roosting site of ecological significance.

No significant effects with regard to loss of, or damage to, roosts anticipated.

4.12 Displacement of individuals or populations

The development is predominantly located within a commercial forestry plantation. There will be no net loss of linear landscape features for commuting and foraging bats and there will be no loss of any roosting site of ecological significance. The habitats on the site will remain suitable for bats and no significant displacement of individuals or populations is anticipated.

5. BEST PRACTICE & MITIGATION MEASURES

This section describes the best practice and site-specific mitigation measures that are in place to avoid and reduce the potential for significant effects on local bat populations.

5.1 Standard Best Practice Measures

5.1.1 Noise Restrictions

During the construction phase, 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).

5.1.2 Lighting Restrictions

Where lighting is required, directional lighting will be used to prevent overspill on to woodland/forestry edges. This will be achieved using lighting accessories, such as hoods, cowls, louvers and shields, to direct the light to the intended area only.

5.1.3 Buffering

A 50m buffer from the blade tip to the nearest woodland, as recommended by the Natural England (2014) and SNH (2019) guidelines, shall be implemented. These vegetation-free areas will be maintained during the operational life of the development.

The correct buffer distance must be measured from the blade tip sweep to the canopy of the nearest habitat feature. Measuring 50m for the base of the turbine to the habitat feature is inadequate as tall tree canopies may put bat populations at risk. It is necessary to calculate the distance between the edge of the habitat feature and the centre of the tower (b). Using the formula:

$$b = \sqrt{(50 + bl)^2 - (hh - fh)^2}$$

Where, bl =Blade length, hh = hub height, fh = feature height all in metres. i.e (above) b = 69.3m (Plate 5.1)

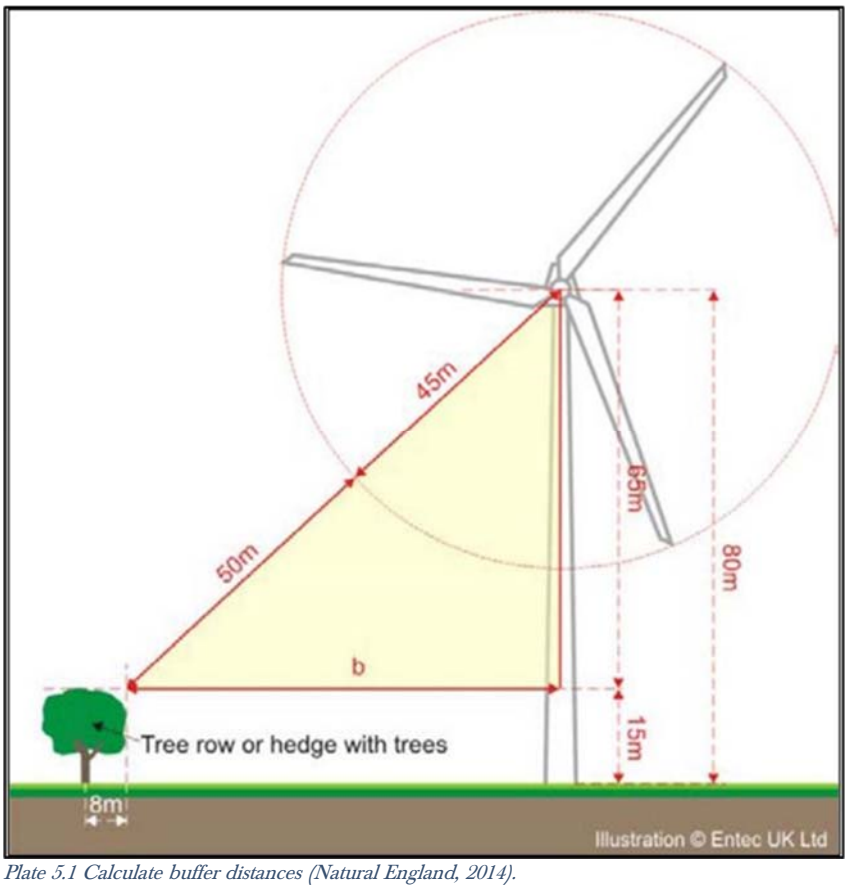


Plate 5.1 Calculate buffer distances (Natural England, 2014).

5.2 Site Specific Mitigation and Monitoring Programme

Overall risk levels for high collision risk bat species was typically ***Medium***. This risk level is reflective of the nature of the site, which is an upland conifer plantation with low levels of bat activity recorded during the walked and driven transects undertaken.

However, taking precautionary approach and given that high collision risk was recorded at peak activity levels, an adaptive monitoring and mitigation strategy has been devised for the proposed development in line with the case study example provided in Appendix 5 of the SNH Guidance.

5.2.1 Post Construction Monitoring & Assessment of Adaptive Mitigation Requirement

As per SNH Guidance at least 3 years of post-construction monitoring is required to assess the effects of construction related habitat modification on bat activity. For example, it may be that the construction of wind turbines significantly reduces bat activity at the site relative to that recorded pre-construction and to a level at which there is no longer potential for significant effects on bats (SNH 2019). Therefore, the results of post construction monitoring shall be utilised to assess changes in bat activity patterns and to inform the design of any advanced site specified mitigation requirements, including curtailment, to ensure that there are no significant residual effects on bat species.

5.2.1.1 Operational Year 1

Static monitoring at turbine bases and nacelle level shall take place at each turbine during the bat activity season (between April and October). Full spectrum recording detectors shall be utilised for the same duration as during pre-application surveys and at the same density (SNH, 2019).

Key weather parameters and other factors that are known to influence collision risk will be monitored and shall include:

- Windspeed in m/s (measured at nacelle height)
- Temperature (ºC)
- Precipitation (mm/hr)

Carcass searches, to monitor and record bat fatalities, shall be conducted at each turbine in accordance with SNH Guidance. This shall include searcher efficiency trials and an assessment of scavenger removal rates to determine the appropriate correction factor to be applied in relation to determining an accurate estimate of collision mortality. Calculating casualty rates across the site shall be done in accordance with the methods and formulas provided in Appendix 4 of the SNH Guidance.

At the end of Year 1, and if a curtailment requirement is identified (i.e. significant bat fatalities encountered), a curtailment programme shall be devised around key activity periods and weather parameters.

Curtailment involves raising the cut-in speed with associated loss of power generation in combination with reducing the blade rotation (blade feathering) below the cut-in speed. The most basic and least sophisticated form of curtailment "blanket" curtailment -involves feathering the blades between dusk and dawn over the entire bat active period (April to October). A more sophisticated and efficient solution is to focus on certain times and dates, corresponding with those periods when the highest level of bat activity is expected to occur. Further savings can be achieved by programming the SCADA operating system to only pause/feather the blades below a specified wind speed and above a specified temperature within specified time periods.

In order to minimise down time, the threshold values at which turbines are feathered should be site specific and informed by bat activity peaks at that location, but as an indication, they are likely to be in the range of wind speeds between 5.0 and 6.5m/s and at temperatures above approximately 10 or 11ºC measured at the nacelle. Significant savings can be achieved by so-called "smart "curtailment over the other less sophisticated alternatives.

The effectiveness of curtailment needs to be monitored in order to determine (a) whether it is working effectively (i.e. the level of bat mortality is incidental), and (b) whether the curtailment regime can be refined such that turbine down-time can be minimised whilst ensuring that it remains effective at preventing casualties.

5.2.1.2 Operational Years 2 & 3

Where a curtailment requirement is identified, monitoring surveys shall continue in Year 2 and 3 and the success of the curtailment strategy shall be assessed in line with the baseline data collected in the subsequent year/years.

The performance of the curtailment programme in terms of its ability to respond to the changes in bat abundance based on temperature and wind speed shall be analysed to confirm it is neither significantly over- nor under- curtailing during different periods of bat activity.

At the end of each year, the efficacy of the curtailment programme shall be reviewed, and any identified efficiencies incorporated into the curtailment programme.

5.3 Residual Impacts

Taking into consideration the proposed best practice and adaptive mitigation measures; significant residual effects on bats with regard to 1) Collision mortality, barotrauma and other injuries, 2) Loss or damage to commuting and foraging habitat, 3) Loss of, or damage to, roosts and 4) Displacement of individuals or populations are not anticipated.

6. CONCLUSION

This report provides a full and comprehensive assessment of the potential for impact on bat populations at the proposed development site. The surveys and assessment provided in this report are in accordance with SNH guidance. Following consideration of the residual effects (post mitigation) it is noted that the proposed development will not result in any significant effects on bats

Provided that the proposed wind farm development is constructed and operated in accordance with the design, best practice and mitigation that is described within this report, significant effects on bats are not anticipated at any geographic scale.

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APPENDIX 1

HABITAT SUITABILITY ASSESSMENT

Guidelines for assessing the potential suitability of a site for bats, based on the presence of habitat features (taken from Collins, 2016).

Suitability	Roosting Habitats	Commuting and Foraging Habitats
Negligible	Negligible habitat features on site likely to be used by roosting bats.	Negligible habitat features on site likely to be used by commuting or foraging bats.
Low	A structure with one or more potential roost sites that could be used by individual bats opportunistically. However, these potential roost sites do not provide enough space, shelter, protection, appropriate conditions[1] and/or suitable surrounding habitat to be used on a regular basis or by larger numbers of bats, i.e. unlikely to be suitable for maternity or hibernation[2]. A tree of sufficient size and age to contain potential roost features but with none seen from the ground or features seen with only very limited roosting potential[3].	Habitat that could be used by small numbers of commuting bats such as a gappy hedgerow or unvegetated stream, but isolated, i.e. not very well connected to the surrounding landscape by other habitat. Suitable, but isolated habitat that could be used by small numbers of foraging bats such as a lone tree (not in a parkland situation) or a patch of scrub.
Moderate	A structure or tree with one or more potential roost sites that could be used by bats due to their size, shelter, protection, conditions and surrounding habitat but unlikely to support a roost of high conservation status (with respect to roost type only - the assessments in this table are made irrespective of species conservation status, which is established after presence is confirmed).	Continuous habitat connected to the wider landscape that could be used by bats for commuting such as lines of trees and scrub or linked back gardens. Habitat that is connected to the wider landscape that could be used by bats for foraging such as trees, scrub, grassland or water.
High	A structure or tree with one or potential roost sites that are obviously suitable for use by larger numbers of bats on a more regular basis and potentially for longer periods of time due to their size, shelter, protection, conditions and surrounding habitat.	Continuous, high-quality habitat that is well connected to the wider landscape that is likely to be used regularly by commuting bats such as river valleys, streams, hedgerows, lines of trees and woodland edge. High-quality habitat that is well connected to the wider landscape that is likely to be used regularly by foraging bats such as broadleaved woodland, tree-lined watercourses and grazed parkland. Site is close to and connected to known roosts.

1 For example, in terms of temperature, humidity, height above ground, light levels or levels of disturbance.
2 Larger numbers of Common pipistrelle may be present during autumn and winter in large buildings in highly urbanised areas, based on evidence from the Netherlands (Korsten et al. 2015).

3 Categorisation aligns with BS 8596:2015 Surveying for bats in trees and woodland (BSI, 2015).

APPENDIX 2

SITE RISK ASSESSMENT

Table 3a: *Stage 1 - Initial site risk assessment*

Site Risk Level (1-5)*	**Project Size**			
		Small	**Medium**	**Large**
Habitat Risk	**Low**	1	2	3
	Moderate	2	3	4
	High	3	4	5

Key: Green (1-2) - low/lowest site risk; Amber (3) - medium site risk; Red (4-5) - high/highest site risk.

* Some sites could conceivably be assessed as being of no (0) risk to bats. This assessment is only likely to be valid in more extreme environments, such as above the known altitudinal range of bats, or outside the known geographical distribution of any resident British species.

Habitat Risk	**Description**
Low	Small number of potential roost features, of low quality. Low quality foraging habitat that could be used by small numbers of foraging bats. Isolated site not connected to the wider landscape by prominent linear features.
Moderate	Buildings, trees or other structures with moderate-high potential as roost sites on or near the site. Habitat could be used extensively by foraging bats. Site is connected to the wider landscape by linear features such as scrub, tree lines and streams.
High	Numerous suitable buildings, trees (particularly mature ancient woodland) or other structures with moderate-high potential as roost sites on or near the site, and/or confirmed roosts present close to or on the site. Extensive and diverse habitat mosaic of high quality for foraging bats. Site is connected to the wider landscape by a network of strong linear features such as rivers, blocks of woodland and mature hedgerows. At/near edge of range and/or on an important flyway. Close to key roost and/or swarming site.

Project Size	**Description**
Small	Small scale development (≤10 turbines). No other wind energy developments within 10km. Comprising turbines <50m in height.
Medium	Larger developments (between 10 and 40 turbines). May have some other wind developments within 5km. Comprising turbines 50-100m in height.
Large	Largest developments (>40 turbines) with other wind energy developments within 5km. Comprising turbines >100m in height.

APPENDIX 3

ECOBAT PER DETECTOR ANALYSIS

ECOBAT ANALYSIS – PER DETECTOR RESULTS

Summary tables are provided for each species recorded showing key metrics per detector per survey period.

LEISLER'S BAT

Survey Period	Nights Recorded	Ref Range	Detector ID	Median Bat Activity Level	Median Bat Activity	Max Bat Activity Level	Max Bat Activity Level
Spring	11	449	D01	94	High	100	High
Spring	8	449	D02	72	Moderate/High	86	High
Spring	8	449	D03	78	Moderate/High	94	High
Spring	12	449	D04	76	Moderate/High	96	High
Spring	10	449	D05	80	High	94	High
Spring	-	-	D06	-	-	-	-
Spring	12	449	D07	64	Moderate/High	82	High
Spring	10	449	D08	48	Moderate	84	High
Spring	0	449	D09	0	Nil	0	Nil
Spring	9	449	D10	78	Moderate/High	97	High
Summer	5	616	D01	51	Moderate	78	Moderate/High
Summer	3	616	D02	43	Moderate	43	Moderate
Summer	4	616	D03	58	Moderate	81	High
Summer	4	616	D04	54	Moderate	78	Moderate/High
Summer	3	616	D05	41	Moderate	71	Moderate/High
Summer	5	616	D06	51	Moderate	85	High
Summer	0	616	D07	0	Nil	0	Nil
Summer	2	616	D08	28	Low/Moderate	38	Low/Moderate
Summer	2	616	D09	74	Moderate/High	83	High
Summer	3	616	D10	43	Moderate	72	Moderate/High
Autumn	4	840	D01	71	Moderate/High	77	Moderate/High
Autumn	4	840	D02	53	Moderate	84	Moderate/High
Autumn	7	840	D03	48	Moderate	79	Moderate/High
Autumn	4	840	D04	32	Low/Moderate	53	Moderate
Autumn	0	840	D05	0	Nil	0	Nil
Autumn	3	840	D06	57	Moderate	78	Moderate/High
Autumn	4	840	D07	77	Moderate/High	86	High
Autumn	2	840	D08	48	Moderate	53	Moderate
Autumn	3	840	D09	74	Moderate/High	78	Moderate/High
Autumn	3	840	D10	70	Moderate/High	72	Moderate/High

SOPRANO PIPISTRELLE

Survey Period	Nights Recorded	Ref Range	Detector ID	Median Bat Activity Level	Median Bat Activity	Max Bat Activity Level	Max Bat Activity Level
Spring	4	370	D01	30	Low/Moderate	85	High
Spring	2	370	D02	37	Low/Moderate	43	Moderate
Spring	3	370	D03	30	Low/Moderate	43	Moderate
Spring	4	370	D04	30	Low/Moderate	53	Moderate
Spring	13	370	D05	30	Low/Moderate	30	Low/Moderate
Spring	-	-	D06	-	-	-	-
Spring	0	370	D07	0	Nil	0	Nil
Spring	0	370	D08	0	Nil	0	Nil
Spring	0	0	D09	0	Nil	0	Nil
Spring	1	370	D10	19	Low	19	Low
Summer	9	614	D01	54	Moderate	94	High
Summer	6	614	D02	18	Low	61	Moderate/High
Summer	8	614	D03	54	Moderate	82	High
Summer	10	614	D04	38	Low/Moderate	57	Moderate
Summer	6	614	D05	18	Low	60	Moderate
Summer	4	614	D06	31	Low/Moderate	43	Moderate
Summer	1	0	D07	18	Low	18	Low
Summer	0	614	D08	0	Nil	0	Nil
Summer	2	614	D09	18	Low	31	Low/Moderate
Summer	3	614	D10	25	Low/Moderate	63	Moderate/High
Autumn	14	961	D01	76	Moderate/High	100	High
Autumn	11	961	D02	53	Moderate	84	High
Autumn	13	961	D03	86	High	97	High
Autumn	10	961	D04	66	Moderate/High	87	High
Autumn	4	961	D05	24	Low/Moderate	92	High
Autumn	12	961	D06	63	Moderate/High	87	High
Autumn	9	961	D07	53	Moderate	84	High
Autumn	7	961	D08	24	Low/Moderate	66	Moderate/High
Autumn	6	961	D09	76	Moderate/High	81	High
Autumn	11	961	D10	86	High	99	High

COMMON PIPISTRELLE

Survey Period	Nights Recorded	Ref Range	Detector ID	Median Bat Activity Level	Median Bat Activity	Max Bat Activity Level	Max Bat Activity Level
Spring	2	358	D01	19	Low	19	Low
Spring	1	358	D02	19	Low	19	Low
Spring	0	358	D03	0	Nil	0	Nil
Spring	4	358	D04	25	Low/Moderate	48	Moderate
Spring	0	358	D05	0	Nil	0	Nil
Spring	-	-	D06	-	-	-	-
Spring	2	358	D07	25	Low/Moderate	30	Low/Moderate
Spring	1	358	D08	30	Low/Moderate	30	Low/Moderate
Spring	0	358	D09	0	Nil	0	Nil
Spring	1	358	D10	30	Low/Moderate	30	Low/Moderate
Summer	11	666	D01	61	Moderate/High	96	High
Summer	5	666	D02	31	Low/Moderate	61	Moderate/High
Summer	10	666	D03	74	Moderate/High	100	High
Summer	6	666	D04	41	Moderate	65	Moderate/High
Summer	6	666	D05	18	Moderate	60	Moderate/High
Summer	7	666	D06	46	Moderate	74	Moderate/High
Summer	0	666	D07	0	Nil	0	Nil
Summer	3	666	D08	43	Moderate	71	Moderate/High
Summer	7	666	D09	35	Low/Moderate	75	Moderate/High
Summer	6	666	D10	38	Low/Moderate	60	Moderate
Autumn	11	1119	D01	87	High	99	High
Autumn	6	1119	D02	41	Moderate	72	Moderate/High
Autumn	12	1119	D03	72	Moderate/High	100	High
Autumn	9	1119	D04	48	Moderate	77	Moderate/High
Autumn	1	1119	D05	48	Moderate	48	Moderate
Autumn	13	1119	D06	40	Low/Moderate	76	Moderate/High
Autumn	8	1119	D07	63	Moderate/High	92	High
Autumn	5	1119	D08	24	Low/Moderate	63	Moderate/High
Autumn	7	1119	D09	52	Moderate	78	Moderate/High
Autumn	9	1119	D10	84	High	93	High

MYOTIS SP.

Survey Period	Nights Recorded	Ref Range	Detector ID	Median Bat Activity Level	Median Bat Activity	Max Bat Activity Level	Max Bat Activity Level
Spring	3	256	D01	19	Low	60	Moderate
Spring	4	256	D02	35	Low/ Moderate	53	Moderate
Spring	4	256	D03	19	Low	30	Low/Moderate
Spring	4	256	D04	29	Low/ Moderate	57	Moderate
Spring	13	256	D05	19	Low	30	Low/ Moderate
Spring	-	-	D06	-	-	-	-
Spring	0	256	D07	0	Nil	0	Nil
Spring	3	256	D08	19	Low	19	Low
Spring	0	256	D09	0	Nil	0	Nil
Spring	5	256	D10	19	Low	19	Low
Summer	5	367	D01	38	Low/ Moderate	67	Moderate/High
Summer	5	367	D02	18	Low	18	Low
Summer	6	367	D03	25	Low/ Moderate	38	Low/ Moderate
Summer	7	367	D04	38	Low/ Moderate	51	Moderate
Summer	2	367	D05	18	Low	18	Low
Summer	5	367	D06	18	Low	31	Low/ Moderate
Summer	0	367	D07	0	Nil	0	Nil
Summer	3	367	D08	18	Low	31	Low/ Moderate
Summer	4	367	D09	18	Low	31	Low/ Moderate
Summer	5	367	D10	18	Low	31	Low/ Moderate
Autumn	6	796	D01	51	Moderate	76	Moderate/High
Autumn	6	796	D02	24	Low/ Moderate	70	Moderate/High
Autumn	12	796	D03	63	Moderate/High	81	High
Autumn	6	796	D04	24	Low/ Moderate	53	Moderate
Autumn	1	796	D05	24	Low/ Moderate	24	Low/ Moderate
Autumn	6	796	D06	48	Moderate	57	Moderate
Autumn	4	796	D07	40	Low/ Moderate	40	Low/ Moderate
Autumn	2	796	D08	24	Low/ Moderate	24	Low/ Moderate
Autumn	8	796	D09	53	Moderate	66	Moderate/High
Autumn	7	796	D10	48	Moderate	66	Moderate/High

BROWN LONG-EARED BAT

Survey Period	Nights Recorded	Ref Range	Detector ID	Median Bat Activity level	Median Bat Activity	Max Bat Activity Level	Max Bat Activity Level
Spring	3	174	D01	31	Low/Moderate	43	Moderate
Spring	1	174	D02	19	Low	19	Low
Spring	0	174	D03	0	Nil	0	Nil
Spring	0	174	D04	0	Nil	0	Nil
Spring	0	174	D05	0	Nil	0	Nil
Spring	-	-	D06	-	-	-	-
Spring	0	174	D07	0	Nil	0	Nil
Spring	0	174	D08	0	Nil	0	Nil
Spring	0	174	D09	0	Nil	0	Nil
Spring	0	174	D10	0	Nil	0	Nil
Summer	2	186	D01	18	Low	18	Low
Summer	0	186	D02	0	Nil	0	Nil
Summer	0	186	D03	0	Nil	0	Nil
Summer	1	186	D04	18	Low	18	Low
Summer	0	186	D05	0	Nil	0	Nil
Summer	0	186	D06	0	Nil	0	Nil
Summer	0	186	D07	0	Nil	0	Nil
Summer	0	186	D08	0	Nil	0	Nil
Summer	2	186	D09	18	Low	18	Low
Summer	0	186	D10	0	Nil	0	Nil
Autumn	3	517	D01	40	Low/Moderate	40	Moderate
Autumn	1	517	D02	53	Moderate	53	Moderate
Autumn	1	517	D03	57	Moderate	57	Moderate
Autumn	4	517	D04	40	Low/Moderate	53	Moderate
Autumn	0	517	D05	0	Nil	0	Nil
Autumn	0	517	D06	0	Nil	0	Nil
Autumn	0	517	D07	0	Nil	0	Nil
Autumn	0	517	D08	0	Nil	0	Nil
Autumn	2	517	D09	40	Low/Moderate	48	Moderate
Autumn	0	517	D10	0	Nil	0	Nil

APPENDIX 4

OVERALL RISK ASSESSMENT

Table 3b: *Stage 2 - Overall risk assessment*

Site risk level (from Table 3a)	Ecobat activity category (or equivalent justified categorisation)					
	Nil (0)	Low (1)	Low-moderate (2)	Moderate (3)	Moderate-high (4)	High (5)
Lowest (1)	0	1	2	3	4	5
Low (2)	0	2	4	6	8	10
Med (3)	0	3	6	9	12	15
High (4)	0	4	8	12	15	18
Highest (5)	0	5	10	15	20	25

The scores in the table are a product of multiplying site risk level and the Ecobat activity category (or equivalent). The activity categories equate to those given in Table 1 for high collision risk species. Nil (0) means no bat activity was recorded across the whole site, but caution is needed here, because although the values given in this column are "0", at sites where pre-construction surveys found no bat activity, there remains the possibility that new turbines could attract some bat species, thereby altering the level of risk that applies in reality.

Overall assessment:

Low (green)	0-4
Medium (amber)	5-12
High (red)	15-25

It is important to have an understanding of both "typical" and unusually high levels of bat activity at a site so that potentially important peaks in activity are not overlooked. It is therefore recommended that both the highest Ecobat activity category and the most frequent activity category (i.e. the median) are assessed separately in Table 3b and presented in the overall risk assessment. A judgement can then be made on which is the most relevant. It should be noted that presenting mean activity levels can be highly misleading where the data are highly skewed, as is frequently the case with bat activity at wind turbines (Lintott & Mathews, 2018).

Aquatic and fisheries assessment of Croagh wind farm, Drumkeeran, Co. Leitrim

Triturus

Prepared by Triturus Environmental Ltd. for McCarthy Keville O' Sullivan

October 2019

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Non-technical summary

- In order to collate baseline fisheries information, Triturus Environmental Ltd. were contracted by McCarthy Keville O' Sullivan to undertake both a catchment-wide electro-fishing, white-clawed crayfish and Q-sampling survey of watercourses within the footprint of the proposed Croagh wind farm development near Drumkeeran, Co. Leitrim. A total of *n*=21 sites were electro-fished across the Killanummery, Argina, Tullynascreena and Owengar rivers as well as numerous unnamed tributaries over the course of Monday 19th – Wednesday 21st August 2019. Biological water quality was analysed (via Q-sampling) at *n*=13 sites.

- A total of *n*=112 fish across five species were recorded via electro-fishing. Brown trout were the dominant species overall accounting for 92% of the total catch, followed by small numbers of Atlantic salmon, stone loach and minnow. Only one site (A7, Killanummery Stream) produced species other than brown trout and this was the only site to support Atlantic salmon at the time of survey. European eel was not recorded from any site.

- Lamprey (*Lampetra* spp.) were not recorded during the survey, with all bar one site (A7) considered generally unsuitable for the species in terms of both nursery and spawning habitat. Typically, survey sites were too high-energy to support lamprey larvae or adult spawning.

- A total of *n*=12 (57%) electro-fishing sites did not support resident fish (any species) at the time of survey. These sites were located in more upland areas and invariably featured high-energy flows exposed to regular spate conditions, often flowing over moderate to steep gradients. Upstream fish access for salmonids was difficult or blocked entirely due to such physical characteristics in several cases e.g. sites A1, A2, A3, C1, C2 etc. Some did offer some low suitability for European eel, however, despite their absence at the time of survey.

- No white-clawed crayfish were recorded via trapping or sweep netting surveys across a total of *n*=24 sites in the footprint of Croagh wind farm. However, crayfish remains were recorded in otter spraint under bridges at sites A7 on the Killanummery Stream and site D3 on the Rathgeean River. The majority of sites were considered unstainable for the species.

- The biological water quality (Q-sampling) of the majority of *n*=13 sampled sites was Q3 (poor status, moderately polluted). Only a single site (A7, Killanummery Stream) achieved good status Q4 water quality as required under the Water Framework Directive (2000/60/EC). Site C1 on the upper Owengar River achieved a water quality of Q3-4 (slightly polluted).

- Overall, the watercourses with the highest value for fish species were the lower survey reaches of the Killanummery, Argina, Tullynascreena and Owengar rivers. Over half of the survey sites were on upland, eroding watercourses and featured higher gradients and higher flows not conducive to supporting resident salmonids, European eel, lamprey or white-clawed crayfish. Peat-escapement and afforestation pressures from the upland Croagh catchment may be impacting the overall fisheries value of channels downstream.

1. Introduction

1.1 Project background

Triturus Environmental Ltd. were contracted by McCarthy Keville O' Sullivan (MKO) to conduct a fisheries assessment along numerous watercourses in the footprint of the proposed Croagh wind farm near Drumkeeran, Co. Leitrim. The watercourses in question included the Killanummery, Argina, Tullynascreen and Owengar rivers as well as several unnamed channels.

In order to gain an accurate overview of the existing and potential fisheries value of the riverine watercourses within the footprint of the proposed wind farm, a catchment-wide electro-fishing survey across *n*=21 sites was undertaken (see Figure 1.1, Table 1.1 below). Electro-fishing helped to identify the importance of the watercourses as nurseries and habitats for salmonids, lamprey and European eel (*Anguilla anguilla*), as well as other species, and helped to further inform mitigation for the wind farm development.

In addition to fish stock assessments, surveys were also carried out for white-clawed crayfish (*Austropotamobius pallipes*) across all sites (under licence). Macro-invertebrate Q-sampling was undertaken at *n*=13 sites across the wider catchment to infer water quality.

Triturus Environmental Ltd. made an application under Section 14 of the Fisheries (Consolidation) Act, 1959 as substituted by Section 4 of the Fisheries (Amendment) Act, 1962, to undertake a catchment-wide electro-fishing survey in the footprint of the proposed Croagh wind farm located near Drumkeeran, north Co. Leitrim. Permission was granted on Tuesday 17th August 2019 and the survey was undertaken over Monday 19th – Wednesday 21st August 2019. Triturus also hold a national open license to survey for white-clawed crayfish (license no. C180/2019).

1.2 Croagh catchment and fisheries asset

The Croagh wind farm development encompasses numerous small streams and rivers in north Leitrim, primarily on the Killanummery, Argina, Tullynascreen and Owengar river sub-catchments. Many of these watercourses drained upland areas. Primarily, watercourses within the wider catchment flowed over dark grey shale and minor sandstones in upland areas, with carboniferous shale and occasional limestone in more lowland areas according to Geological Survey of Ireland online data (GSI, 2019).

The Tullynascreen Stream, a tributary of the Killanummery Stream was assessed as an "*intermediate stream, may be at risk*" based on Small Streams Risk Score (SSRS) conducted by Inland Fisheries Ireland in 2016 (IFI, 2016). The Tullynascreen was also identified as having unsatisfactory (Q3, moderate status) water quality by the EPA in 2015 (EPA, 2019). The Killanummery Stream, however, achieved a high status water quality (Q4-5) in 2018 (EPA, 2019). The Owengar River achieved a Q4 good status rating in 2017 according to EPA data.

Fisheries data for the Killanummery, Argina, Tullynascreen and Owengar river sub-catchments was largely lacking. A range of fish species including Atlantic salmon (*Salmo salar*), brown trout (*Salmo trutta*), European eel, stone loach (*Barbatula barbatula*), minnow (*Phoxinus phoxinus*), *Lampetra* spp., perch (*Perca fluviatilis*), gudgeon (*Gobio gobio*), three-spined stickleback (*Gasterosteus aculeatus*), roach (*Rutilus rutilus*) and pike (*Esox lucius*) are known from the wider Bonet catchment, to which the Killanummery adjoins (IFI, 2016; Kelly et al., 2011). White-clawed crayfish (*Austropotamobius pallipes*) are also know from the lower reaches of the Killanummery Stream (IFI, 2016). Natural barriers likely preclude many non-salmonid species from the upper Killanummery. The Owengar River is known locally to support a stock of brown trout. Fisheries data was not available for the Argina and Tullynascreen channels.

Table 1.1 Location of *n*=21 electro-fishing survey sites and *n*=3 fisheries appraisal sites within the footprint of the proposed Croagh wind farm, Drumkeeran, Co. Leitrim. (*sites D1, D2 & D3 are Q-sampling sites only)

Site no.	Watercourse & location	X (ITM)	Y (ITM)
Electro-fishing Sites			
A1	Killanummery Stream, Corratimore Glebe	586302	824682
A2	Unnamed stream, Garvagh Glebe	584829	823916
A3	Unnamed stream, Garvagh Glebe	584180	824297
A4	Killanummery Stream, Garvagh Glebe	583719	825138
A5	Killanummery Stream, Corglancey	582125	825961
A6	Killanummery Stream, Carrigeen	580246	827162
A7	Killanummery Stream, Killanummery	580137	828203
A8	Tullynascreen Stream, Garvagh Glebe	583602	823481
A9	Tullynascreen Stream, Garvagh Glebe	583315	823880
A10	Tullynascreen Stream, Tullynascreen	582071	824790
B1	Argina River, Garvagh Glebe	585122	822889
B2	Unnamed stream, Carrowmore	584586	822633
B3	Unnamed stream, Carrowmore	585047	822443

Site no.	Watercourse & location	X (ITM)	Y (ITM)
Electro-fishing Sites			
B4	Argina River, Carrowmore	585546	821996
B5	Argina River, Carrownadargny	585949	821229
B6	Unnamed stream, Boleymaguire	586634	821263
B7	Unnamed stream, Boleymaguire	586884	821086
B8	Argina River, Boleymaguire	586350	820949
C1	Owengar River, Knocknacosta	587611	823438
C2	Unnamed stream, Knocknacosta	587599	823415
C3	Owengar River, Camalt	589159	823317
Fisheries Appraisal Sites			
D1	Greaghnafarna River, Greaghnafarna	579776	825143
D2	Unnamed stream, Rathrower	578416	825170
D3	Rathgeean River, Drumee	576787	825036

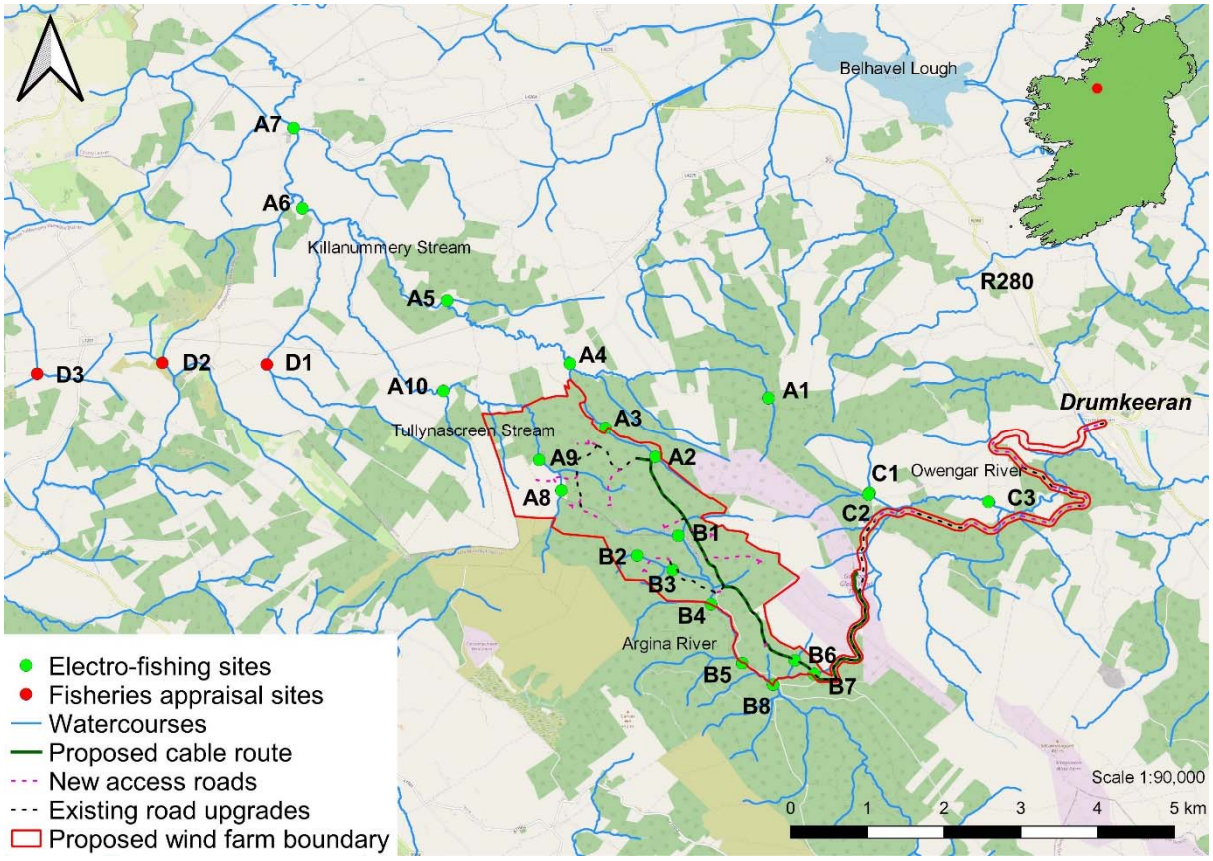


Figure 1.1 Location of the *n*=21 electro-fishing survey sites & *n*=3 fisheries appraisal sites surveyed in August 2019 in the footprint of the proposed Croagh wind farm, Drumkeeran, Co. Leitrim

Table 1.2 Location of *n*=13 Q-sampling sites within the footprint of the proposed Croagh wind farm, Drumkeeran, Co. Leitrim.

Site no.	Watercourse & location	X (ITM)	Y (ITM)
A1	Killanummery Stream, Corratimore Glebe	586302	824682
A2	Unnamed stream, Garvagh Glebe	584829	823916
A4	Killanummery Stream, Garvagh Glebe	583719	825138
A7	Killanummery Stream, Killanummery	580137	828203
A8	Tullynascreen Stream, Garvagh Glebe	583602	823481
B1	Argina River, Garvagh Glebe	585122	822889
B3	Unnamed stream, Carrowmore	585047	822443

Site no.	Watercourse & location	X (ITM)	Y (ITM)
B8	Argina River, Boleymaguire	586350	820949
C1	Owengar River, Knocknacosta	587611	823438
C3	Owengar River, Camalt	589159	823317
D1	Greaghnafarna River, Greaghnafarna	579776	825143
D2	Unnamed stream, Rathrower	578416	825170
D3	Rathgeean River, Drumee	576787	825036

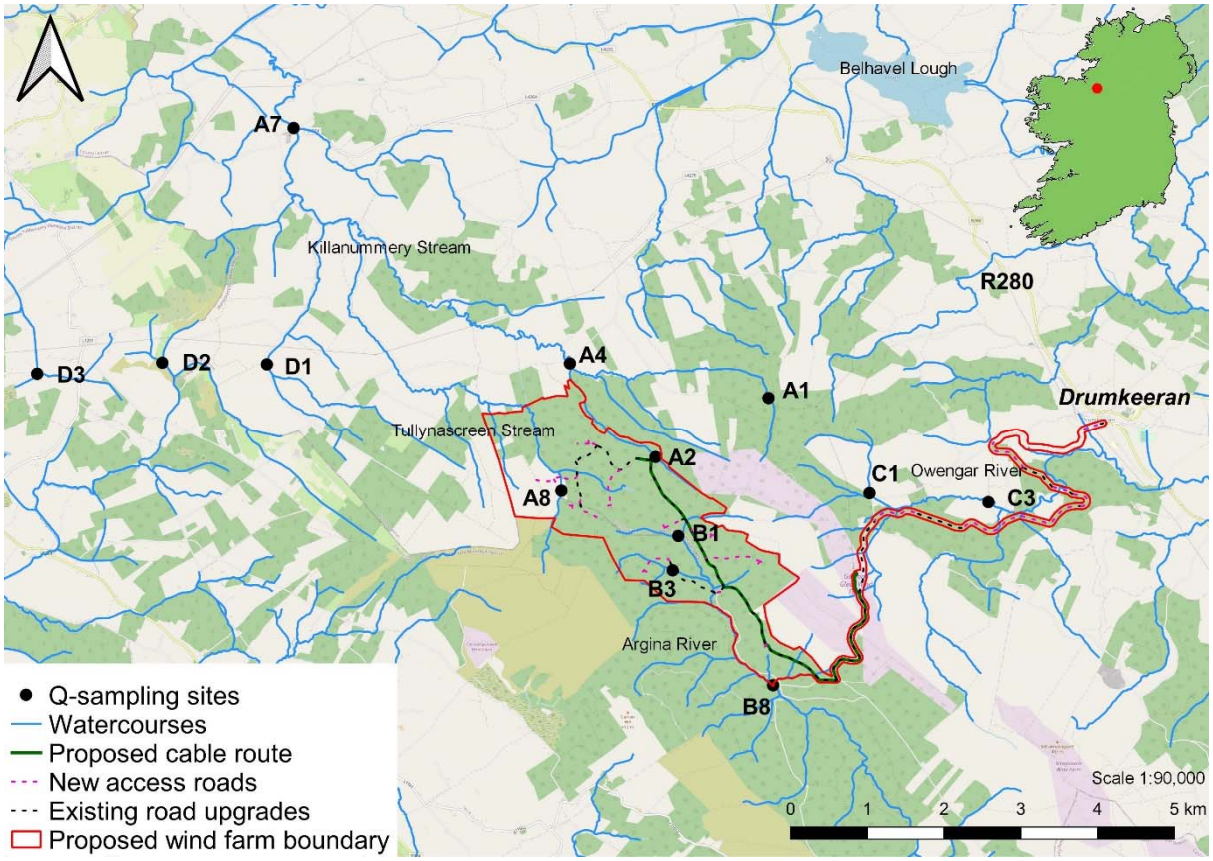


Figure 1.2 Location of the *n*=13 Q-sampling sites surveyed in August 2019 in the footprint of the proposed Croagh wind farm, Drumkeeran, Co. Leitrim

2. Methodology

2.1 Desktop review

A desktop review of the available fisheries-related data for the Killanummery, Argina and Owengar river sub-catchments was undertaken. These included consultations with Inland Fisheries Ireland, local landowners and anglers. Data records held by the National Biodiversity data Centre (NBDC) and National Parks & Wildlife Service (NPWS) were also reviewed.

2.2 Fish stock assessment (electro-fishing)

A-state-of-the-art single anode Smith-Root LR24 backpack (12V DC input; 300V, 100W DC output) was used to electro-fish sites along the Killanummery, Argina, Tullynascreen and Owengar rivers as well as several unnamed tributaries over the course of Monday 19th – Thursday 22nd August 2019, under the conditions of a Department of Communications, Climate Action & Environment (DCCAE) license. Both river and holding tank water temperature was monitored continually throughout the survey to ensure temperatures of 20°C were not exceeded, thus minimising stress to the captured fish due to low dissolved oxygen levels. A portable battery-powered aerator was also used to further reduce stress to any captured fish contained in the holding tank.

Salmonids, European eel and other captured fish species were transferred to a holding container with oxygenated fresh river water following capture. All captured fish were anaesthetised using 0.5ml/l clove oil solution (emulsified in ethanol at a ratio of 1:9), measured to the nearest millimetre and released in-situ following a suitable recovery period.

As three primary species groups were targeted during the survey, i.e. salmonids, lamprey, and eel/cyprinids, the electro-fishing settings were tailored for each species. By undertaking electro-fishing using the rapid electro-fishing technique (see methodology below), the broad characterisation of the fish community at each sampling reach could be determined as a longer representative length of channel can be surveyed. Electro-fishing methodology followed accepted European standards (CEN, 2003) and is outlined below.

The catchment-wide electro-fishing (CWEF) survey was undertaken across *n*=21 sites (see Table 1.1, Figure 1.1). Length frequency graphs and species composition graphs for all species with numbers captured are illustrated in the Results section.

Salmonids, European eel & cyprinids

For salmonid species and European eel, as well as other incidental cyprinid species such as three-spined stickleback (*Gasterosteus aculeatus*) and minnow (*Phoxinus phoxinus*), electro-fishing was carried out in an upstream direction for a 10-minute CPUE, an increasingly common standard approach for wadable streams (Matson et al., 2018). A total of approx. 100-150m channel length was surveyed at each site, where feasible, in order to gain a better representation of fish stock assemblages.

Relative conductivity of the water at each site was checked in-situ with a conductivity meter and the electro-fishing backpack was energised with the appropriate voltage and frequency to provide enough draw to attract salmonids and European eel to the anode without harm. For the low to moderate conductivity waters of the Croagh upland sites (most draining uplands and blanket bog) a voltage of 250-300V, frequency of 40-45Hz and pulse duration of 3.5ms was utilised to draw fish to the anode without causing physical damage.

Lamprey species

Electro-fishing for lamprey ammocoetes was conducted using targeted box quadrat-based electro-fishing (as per Harvey & Cowx, 2003) in objectively suitable areas of sand/silt, where encountered. As lamprey take longer to emerge from silts and require a more persistent approach, they were targeted at a lower frequency (30Hz) setting which also allowed detection of European eel, if present. Settings for lamprey followed those recommended and used by Harvey & Cowx (2003), APEM (2004) and Niven & McAuley (2013). Using this approach, the anode was placed under the water's surface, approx. 10–15 cm above the sediment, to prevent immobilising lamprey ammocoetes within the sediment. The anode was energised with 100V of pulsed DC for 15-20 seconds and then turned off for approximately five seconds to allow ammocoetes to emerge from their burrows. The anode was switched on and off in this way for approximately two minutes. Immobilised ammocoetes were collected by a second operator using a fine-mesh hand net as they emerged.

Lamprey species would be identified to species level where possible if captured, with the assistance of a hand lens, through external pigmentation patterns and trunk myomere counts as described by Potter & Osborne (1975) and Gardiner (2003).

2.3 Fisheries habitat assessment

Salmonids

Fisheries habitat quality for salmonids was assessed using the Life Cycle Unit method (Kennedy, 1984; O'Connor & Kennedy, 2002) to map the *n*=24 riverine sites (*n*=21 electro-fishing sites plus *n*=3 fisheries appraisal sites) as nursery, spawning and holding water, by assigning quality scores to each type of habitat. 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.

Table 2.1 Life Cycle Unit scoring system for salmonid nursery, spawning and holding habitat value (as per Kennedy, 1984 & O'Connor & Kennedy, 2002)

Habitat quality	Habitat score	Overall score
Poor	4	12
Moderate	3	9-11
Good	2	6-8
Excellent	1	3-5

Lamprey species

An outline of the evaluation of the lamprey importance of the *n*=24[1] sites surveyed in the footprint of Croagh wind farm is provided below, and follows the novel Lamprey Habitat Quality Index (LHQI) scoring system as devised by the authors of this report (manuscript in preparation).

In the absence of a universally accepted lamprey-specific scoring system for overall habitat quality, the LHQI loosely follows the same rationale as the Life Cycle Unit score for salmonids above (Kennedy, 1984; O'Connor & Kennedy, 2002). 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 our improvised method of lamprey fisheries quantification are thus of poorer value (in a similar fashion to the salmonid Life Cycle Unit Index), with lower scores being more optimal despite this appearing counter intuitive. 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. 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.

Incidentally, 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

[1] Note that while electro-fishing was conducted at *n*=21 sites, a fisheries appraisal was conducted for three additional sites (D1, D2 & D3) and thus the LHQI was applied here making up *n*=24 sites.

including bedrock and overly-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), adapted from Kennedy (1984)

Habitat quality	Habitat score	Overall score
Poor	4	8
Moderate	3	6 - 7
Good	2	3 - 5
Excellent	1	2

General fisheries habitat

A broad appraisal / overview of the upstream and downstream habitat at each site was also undertaken to evaluate the wider contribution to salmonid and lamprey spawning and general fisheries habitat. River habitat surveys and fisheries assessments were also carried out utilising elements of the approaches in the River Habitat Survey Methodology (Environment Agency, 2003) and Fishery Assessment Methodology (O'Grady, 2006) to broadly characterise the river sites (i.e. channel profiles, substrata etc.).

2.4 White-clawed crayfish survey

An appraisal of white-clawed crayfish (*Austropotamobius pallipes*) habitat across the *n*=24 riverine sites was undertaken based on trapping, sweep netting and walkover surveys in addition to physical channel attributes. Furthermore, a desktop review of known distributions of crayfish within the wider Croagh catchment was also undertaken.

Crayfish survey (trapping)

The crayfish survey was undertaken under the National Parks and Wildlife (NPWS) under license no. C133/2019, as prescribed by Sections 9, 23 and 34 of the Wildlife Act (1976-2012) to capture and release them to their site of capture under condition no. 7 of the license (see Appendix II). As per Inland Fisheries Ireland recommendations (and as with other surveys conducted e.g. electro-fishing), the crayfish license sampling started at the uppermost site on each river sub-catchment in the study area to minimise the risk of transfer of crayfish plague or invasive species in an upstream direction.

A team of six no. 51 x 20cm, 19mm mesh polypropylene "Trappy" crayfish traps, ballasted with extra rock to prevent excessive movement, were used at each site. Traps were fished in two trains of three

and positioned in suitable marginal areas overnight before being retrieved the following morning. Traps were wetted for approx. 12 hours at each site.

Since trapping has been shown to select for larger individuals and possibly introduce a sex-bias (Gallagher, 2006), a subset of the traps (50%) were wrapped with 10mm green garden mesh. Mesh-modified traps have been found to be far more effective at retaining juveniles and therefore result in a higher CPUE (O'Connor et al., 2008). Traps were inspected using the check-clean-dry approach between sites in addition to disinfection with Virkon. New traps were used during the survey that had not been used in other catchments. All traps were baited with 100g of tuna-flavoured cat food placed in fixed proprietary bait cages within each trap. Oily food such as tuna-based products offer greater attractant properties to crayfish because of the oil-scent dispersion (pers. obs.).

Crayfish survey (sweep netting)

Sweep netting (following Reynolds et al., 2010) was utilised at each canal site to detect both adult and juvenile crayfish and assess habitat quality. Biosecurity pond nets were used for all sweep netting and invertebrate sampling. Sweep netting involves sampling of both in-channel macrophytes, in addition to checking typical boulder and cobble refugia. This process involves the lifting of littoral boulders (single boulder considered a single refuge) while the net is swept underneath to trap any crayfish positioned underneath.

Crayfish survey (riparian walkover survey)

Further to physical survey methods, riparian walkover surveys were undertaken to examine any spraint from mustelids (i.e. otters & mink) feeding along riparian corridors, when other sampling techniques (i.e. trapping, sweep netting) returned a zero result. 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. Whilst not quantitative, riparian walkover/spraint surveys are useful for clarifying the presence of absence of crayfish at a particular site (notably in the wider catchment given the large known territories of male otter in particular ~ 20km).

2.5 Q-sampling (macro-invertebrates)

In order to determine biological water quality across the wider Croagh catchment, the aquatic baseline survey included Q-sampling at *n*=13 sites (see Table 1.2, Figure 1.2). Macro-invertebrate samples were converted to Q-ratings as per Toner et al. (2005) and assigned to WFD status classes (see Table 2.1 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 Environmental Protection Authority (EPA) methodology. 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, stoneflies, mayflies and other relevant taxa.

Table 2.1 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 Biosecurity protocol

A strict biosecurity protocol was employed during the survey including the Check-Clean-Dry approach as well as the thorough drying (UV exposure) and disinfection of all equipment before and after use with Virkon®, to prevent the transfer of pathogens and/ or invasive species between survey areas. Electro-fishing surveys were undertaken across watercourses in a downstream order to minimise the mobilisation of pathogens and invasive propagules up river catchments. Any aquatic invasive species or pathogens recorded within or adjoining the survey area were geo-referenced and records forwarded to IFI (as part of their typical license conditions).

3. Site descriptions

A brief site summary outlining both instream and adjoining habitats as well as physical characteristics is provided below. Scientific names are provided at first mention only. Habitat codes are given according to Fossitt (2000).

3.1 Site A1 – Killanummery Stream, Corratimore Glebe

Site A1 on the Killanummery Stream represented an upland eroding watercourse (FW1; Fossit, 2000) flowing through an extensive area of upland blanket bog (PB2). The stream was situated in a small valley and was deeply cut into a peat-based U-shaped channel. Averaging 0.2-0.3m deep and just 0.5m wide, the site featured 40% boulder, 20% cobble, 10% coarse gravel with 30% silt substrata. Harder substrata were heavily bedded in peat. The stream had a sinuous natural form with relatively high shading due to its deeply cut profile. Glide habitat predominated (60%) with 30% riffle and localised pools. Instream macrophyte and bryophyte growth was limited to occasional water earwort (*Scapania undulata*) on instream boulders.

The site was bordered by immature lodgepole pine (*Pinus contorta*) plantation (WS2) on north bank with an upland blanket bog riparian buffer of 30-50m grading into mixed age sitka spruce WD4 plantation. Species such as ling (*Calluna vulgaris*) and bilberry (*Vaccinium myrtillus*) were common with a dense moss layer dominated by *Polytrichum* spp. and *Sphagnum* spp. Soft rush (*Juncus effusus*), common polypody (*Polypodium vulgare*) and bramble (*Rubus fructicosus* agg.) were also common.



Plate 3.1 Representative image of site A1, a small upland, high-energy stream situated in upland blanket bog

3.2 Site A2 – Unnamed stream, Garvagh Glebe

Located along a forestry access, site A2 was a small upland eroding watercourse (FW1) flowing in an upland afforested area which supported mature Sitka spruce (*Picea sitchensis*) (WD4) on both banks, with frequent willow (*Salix* spp.) borders. The channel was U-shaped and 0.5-1m wide with a 1m bank height. It was fast flowing and of high energy, flowing over a relatively steep gradient. The stream depth averaged 0.2-0.4m. The channel cascaded over bedrock (10%) with 30% boulder, 20% cobble and 30% coarse gravels. The substrata were compacted and bedded given the high flows. The stream profile was dominated by glide habitat (50%) with 20% riffle and localised pool. The stream changed into a V-shaped valley downstream of the road crossing. Peat deposits were also present.

In addition to sitka spruce, the site was bordered by scrub composed of bracken (*Pteridium aquilinum*) buttercups (*Ranunculus* spp.), bent grasses (*Agrostis* spp.), willow, bramble and rushes (*Juncus* spp.). Instream growth was limited to water earwort on top of instream boulders. The high shading from steep vegetated banks (many undercut) reduced the capacity of the stream to support macrophytes, in addition to its high energy nature.



Plate 3.2 Representative image of site A2, a small, heavily shaded upland, high-energy stream situated in sitka spruce plantations

3.3 Site A3 – Unnamed stream, Garvagh Glebe

Located some 350m downstream from site A2, site A3 was a small upland eroding watercourse (FW1) flowing in an upland afforested area. Peat dominated the substrata (60%) although some limited boulder (10%), cobble (20%) and coarse gravels (10%) were also present in faster flowing areas downstream of the road crossing culvert. Given the high gradient, riffle habitat dominated (40%), with

equal proportions of pool and glide. Situated in a natural V-shaped valley, the channel was cut into peat soils forming a sinuous pattern through upland blanket bog. This habitat supported common species such as bilberry, tormentil (*Potentilla erecta*), heath bedstraw (*Galium saxatile*), devil's bit scabious (*Succisa pratensis*), common bent (*Agrostis capillaris*), purple moor grass (*Molinia caerulea*), common knapweed (*Centaurea nigra*) and wild angelica (*Angelica sylvestris*). Mosses such as *Sphagnum* spp., *Polytrichum* spp. and big shaggy-moss (*Rhytidiadelphus triquetrus*) were common on the wet sloping banks adjoining the stream.

There were no instream macrophytes due to the high peat staining and high energy nature of the site although water earwort was present locally on boulders. Some limited marsh horsetail (*Equisetum palustre*) grew on the channel margins. The liverwort overleaf pellia (*Pellia epiphylla*) grew on muddy areas of bank and mossy hummocks supported common liverwort (*Marchantia polymorpha*). A small concrete weir (0.5m fall) with no fish pass was located immediately downstream of the road crossing which hindered fish access upstream.



Plate 3.3 Representative image of site A3 (facing downstream) a small, upland, high-energy stream flowing through upland blanket bog

3.4 Site A4 – Killanummery Stream, Garvagh Glebe

The Killanummery Stream at site A4 was located approx. 1km downstream from site A3. The stream was a small upland eroding watercourse (FW1). The channel was cascading in nature, 2.5-3m wide, 0.2m deep on average and dominated by equal proportions of riffle and glide habitat with localised deeper pool near the bridge (>1.5m deep). The stream flowed over a moderate gradient through a semi-natural V-shaped valley populated by mature treelines of ash, willow, hawthorn (*Crataegus monogyna*) and sycamore (*Acer psuedoplatanus*) adjoined by poor-quality wet grassland (GS4) and

semi-improved pasture (GA1) dominated by *Juncus* spp. rushes. The invasive shrub snowberry (*Symphoricarpos albus*) was abundant along riparian corridors. Given the high energy, the substrata were composed primarily of boulder (50%) with cobble (30%) and low fractions of coarse gravels and sand. There was no soft sediment present and the localised sand deposits were bound in peat.

Instream macrophyte and bryophyte growth was sparse given the high energy of the channel and high riparian shading, although some yellow fringe moss (*Racomitrium aciculare*) grew on top of instream boulders alongside water earwort.



Plate 3.4 Representative image of site A4 (facing upstream to road bridge), a medium, cascading high-energy stream

3.5 Site A5 – Killanummery Stream, Corglancey

The Killanummery River at site A5 was an upland eroding channel (FW1) with peat-stained water. The channel width and water width were both 4-5m, with average depths ranging from 0.2m to 0.6m. The channel retained a semi-natural profile with 40% riffle, 40% glide and 20% pool habitats flowing through boulder cascade reaches. The bank height was variable between 1.0m and 2.0m but graded into a V-shaped valley downstream. The substrata were dominated by boulder (20%) and cobble (40%) with smaller quantities of coarse, medium and fine gravel (40% combined). Small areas of sand were present covering 5% by surface area of the substrata between larger substrata.

The riparian habitat comprised semi-mature alder (*Alnus glutinosa*) and ash with bramble, bracken and gorse (*Ulex europaeus*) in the understory. These buffered a of sitka spruce (WD4) plantation for 30m on the south bank. No macrophytes were present given the heavily peat-stained water and high shading (50%) with evident riparian tunnelling. Fountain feather-moss (*Hygroamblystegium tenax*)

was locally frequent on submerged boulders with yellow fringed moss on the topsides of boulders. Common water moss (*Fontanalis antipyretica*) was present very locally on large boulders instream. The liverwort water earwort was also present occasionally on the top sides of boulders.



Plate 3.5 Representative image of site A5, a medium, cascading high-energy stream

3.6 Site A6 – Killanummery Stream, Carrigeen

The Killanummery River at site A6 was a lowland spate river (FW2) with heavily peat-stained water at the time of survey. The channel width and water width were both 7-8m wide and the depth ranging between 0.2-1.2m. Bank height was variable between 1.5 and 2m and the channel was broadly U-shaped. The stream retained a semi-natural profile flowing through agricultural grassland (GA1) and the survey section featured a mix of with 30% riffle, 50% deep glide and 20% deeper pool habitats. The substrata were dominated by coarse gravel (40%) and small cobble (50%) with smaller quantities of boulder (5%). Small areas of peat and sand were present in marginal slacks covering 5% by surface area of the substrata. The gravels were, however, bedded in peat with evident heavy siltation and also moderate compaction. Softer sediment areas were also heavily compacted given the relatively high flows.

The riparian habitat comprised herbaceous scrubby margins of nettle (*Urtica dioica*), bramble, creeping thistle (*Cirsium arvense*), hedge woundwort (*Stachys sylvatica*), meadow buttercup (*Ranunculus acris*) with scattered treelines of alder, ash, willow and osier (*Salix viminalis*). Very small patches of brooklime (*Veronica beccabunga*) and water pepper (*Persicaria hydropiper*) grew on gravel shoals in the river margins. A small area of water starwort (*Callitriche* sp.) was also present in a pool slack. No moss species were recorded, likely because of the absence of more stable large cobble and boulder.



Plate 3.6 Representative image of site A6 (facing downstream) on the Killanummery Stream, an upland eroding watercourse flowing through agricultural lands

3.7 Site A7 – Killanummery Stream, Killanummery

Site A7 on the Killanummery Stream was a lowland spate river (FW2) with heavily peat-stained water at the time of survey. It was the furthest site downstream from the proposed wind farm site boundary (approx. 6.5km by water). The channel and water width were both 8-10m wide, with depths ranging from 0.2m to 0.8m. Flow rates were high. The stream channel retained a semi-natural profile with 30% riffle, 50% glide and 20% pool habitats. The bank height was variable between 1.5m and 2.5m. The substrata were dominated by bedrock (40%) and boulder (20%) with smaller quantities of cobble (20%) and coarse gravel (10%). Very small pockets of sand were present representing no more than 1% by area of the substrata. Soft sediment was absent given the spate nature of the channel and typically high flow rates.

The riparian habitat comprised herbaceous scrubby margins, mature hedgerows and treelines. The scrub (WS1) areas comprised great willowherb (*Epilobium hirstutum*), hogweed (*Heracleum sphondylium*), grey willow (*Salix cinerea*), meadow buttercup, creeping buttercup (*Ranunculus repens*), tufted vetch (*Vicia cracca*), bramble, hemp agrimony (*Eupatorium cannabinum*) with bent and cock's foot (*Dactylis glomerata*) grasses. Riparian treelines and hedgerows comprised sycamore, ash, hawthorn and blackthorn (*Prunus spinosa*). Shading was high upstream and downstream of the bridge, with a more open section adjacent to the bridge. No macrophytes were recorded present given the spate nature of the channel and peat-stained water. The moss species *Fontanalis squamosa* was present very locally on submerged boulders, with fountain feather moss characteristically present on

the downstream side of boulders. *Pellia* spp. liverworts were present on the muddy margins of the channel.



Plate 3.7 Representative image of site A7 (facing downstream) on the Killanummery Stream, a high-energy spate channel with good suitability for salmonids

3.8 Site A8 – Tullynascreen Stream, Garvagh Glebe

Located on the upper Tullynascreen Stream, a Killanummery Stream tributary, site A8 was a small upland eroding, spate watercourse (FW1) flowing over a moderate to steep gradient through a steep V-shaped valley in upland blanket bog (PB2) habitat. The channel was 1.5-2m wide in a shallow U-shaped channel. Owing to high flow rates, the substrata were heavily bedded, with heavy sedimentation from peat escapement. The stream bed was dominated by cobble (60%) with 20% boulder, 10% gravels and 10% peat. The average depth was 0.2-0.3m with localised deeper plunge pools, especially on meanders. Riffles dominated (80%) with some fast glide and limited pool (20% by surface area for both).

The banks on the Tullynascreen Stream were steep and often undercut through natural erosion. Water was heavily peat-stained given the surrounding habitats. The stream was bordered by scattered sitka spruce and lodgepole pine (WD4) on the east bank with extensive sloping blanket bog with mosaics of wet heath (HH3) on the west. Afforestation was present upstream also. The riparian zone was colonised by abundant bilberry, *Polytrichum* spp. mosses, purple moor grass, tormentil, devil's bit scabious, soft rush, marsh horsetail, *Agrostis* spp. grasses and abundant ling. The channel was largely open as it flowed through the valley, with 30% shading.

Instream macrophyte and bryophyte growth was sparse given the high energy, spate nature of the channel, in addition to shading. Yellow fringe moss along with water earwort was present on top of boulders.



Plate 3.8 Representative image of site A8, a small, narrow, shallow high-energy upland watercourse flowing through upland blanket bog

3.9 Site A9 – Tullynascreen Stream, Garvagh Glebe

Located approx. 0.6km downstream from site A8, site A9 was again represented by a small upland eroding, spate watercourse (FW1) flowing over a moderate to steep gradient through a steep V-shaped valley in upland blanket bog (PB2) habitat. The channel was 1-1.8m wide in a deep U-shaped channel which retained a natural, sinuous profile. Owing to high flow rates, the substrata were heavily bedded, with heavy sedimentation from peat escapement. The stream bed was dominated by cobble (60%) with 20% boulder, 10% gravels and 10% peat. The average depth 0.2-0.3m with localised deeper plunge pools, especially on meanders. Riffles dominated (70%) with some fast glide and pools. Fisheries value was considered better compared to upstream with a greater proportion of pools.

Banks were steep and often undercut through natural erosion. Water was heavily peat-stained given the surrounding peat dominated habitats supporting coniferous plantations. The stream was bordered by scattered sitka spruce and lodgepole pine (WD4) on the east bank with extensive sloping blanket bog with mosaics of wet heath (HH3) on the west. Afforestation was present but not as extensive as upstream. The riparian zone was colonised by abundant bilberry, *Polytrichum* spp. mosses, purple moor grass, tormentil, devil's bit scabious, soft rush, marsh horsetail, *Agrostis* spp. grasses and abundant ling. The channel was largely open as it flowed through the valley, with 20-30% shading.

Instream macrophyte and bryophyte growth was sparse given the high energy, spate nature of the channel, in addition to shading. Yellow fringe moss along with water earwort was present on top of boulders.



Plate 3.9 Representative image of site A9, a small, narrow, shallow high-energy upland watercourse flowing through upland blanket bog

3.10 Site A10 – Tullynascreen Stream, Tullynascreen

Site A10 was located on the Tullynascreen Stream near the Tullynascreen Mass Rock. Here the stream was an upland eroding watercourse (FW1) flowing through a large open natural valley. The channel was U-shaped with often steep, naturally cut banks in peaty soils. The stream was high-energy both upstream and downstream of an adjoining WD4 unnamed stream confluence and dominated by fast riffle and glide with limited pool in a semi-cascading channel. The substrata were dominated by boulder and large cobble (40% overall) with lesser amounts of coarse gravels and some limited peat. The substrata were relatively mobile but their larger sizes reduced value for spawning salmonids.

Poor-quality, wet GA1 agricultural grassland (semi-improved) bordered the channel and was dominated by soft rush and thistles. Intermittent alder treelines grew along the banks with occasional hawthorn but was largely open. Some marsh thistle (*Cirsium palustre*), devil's bit scabious and bramble was also present. Less than 0.5km upstream of the site was a mature sitka spruce plantation (WD4). Macrophyte and bryophyte growth was limited to yellow fringe-moss and water earwort present on boulders. *Pellia* spp. liverworts grew on muddy, peaty banks.



Plate 3.10 Representative image of site A10 on the Tullynascreen Stream, a small, shallow high-energy upland watercourse

3.11 Site B1 – Argina River, Garvagh Glebe

Site B1 on the upper Argina River was situated in an upland eroding peat-base channel adjoining a mature sitka spruce plantation (WD4). The narrow channel retained a semi-natural, meandering profile with 10% riffle, 70% glide and 20% pool habitats. The bank height was 1.5m and water width and channel width of between 1m and 1.5m. Banks were often undercut and featured numerous plunge pools. The substrata were dominated by peat (40%) with frequent bedded cobble (20%) and also small quantities of gravel (20%). Boulders were localised (10%). Siltation levels were high given the erosion of peat in the catchment, with large areas of historical clear-fell (WS5) upstream.

The riparian habitat comprised small strips of species poor wet grassland (*Juncus* spp. dominated) with patches of willow grading into sitka spruce plantation. No macrophytes were recorded given the heavily-peat stained water and high degree of shading (60%) resulting from the deeply-cut U-shaped channel and afforestation cover. No aquatic mosses or liverworts were recorded instream.



Plate 3.11 Representative image of site B1 on the upper reaches of the Argina River, a small, very narrow, high-energy upland watercourse largely unsuitable for fish

3.12 Site B2 – Unnamed stream, Carrowmore

Site B2 was an unnamed upland eroding stream flowing through an extensive area of sitka spruce (WD4) over upland peaty soils. The channel featured steep V-shaped banks, heavily shaded by afforestation, and retained some semi-natural sinuous profile. The stream was narrow, often <1.5m in width and was invariably shallow (<0.2m). Riffle and glide dominated with localised shallow pools only in cascading areas. Large woody debris was frequent instream. The stream flowed over a moderate gradient through the plantation and featured a peat-dominated base (50%) with some localised (bedded and silted) cobble and coarse gravels in higher-energy areas.

Given the high shading from mature sitka spruce, the riparian vegetation was limited to mosses such as *Sphagnum* spp. with broad buckler fern (*Dryopteris dilatata*), hay-scented buckler-fern (*Dryopteris aemula)* common polypody (*Polypodium vulgare*) and tormentil occasional. Growth of *Russulla* spp. fungi was frequent. No macrophytes or bryophytes were recorded instream.



Plate 3.12 Representative image of site B2, a small, shallow, high-energy upland watercourse dominated by peat substrata flowing through dense sitka spruce plantations

3.13 Site B3 – Unnamed stream, Carrowmore

Located at a forestry access road crossing, site B3 was a small, narrow deeply cut V-shaped channel, <2m wide and <0.5m deep flowing through an area of mature sitka spruce and lodgepole pine (WD4). The site featured a series of cascading riffles, glides and pools with 30% riffle, 60% glide and 10% pool. Bankful height was up to 2.5m upstream of the culvert but >4m downstream, where the channel entered a steep V-shaped valley. Downstream of the pipe culvert, the channel was bordered by an extensive area of recently cleared clear-fell (WS5), which extended to the channel edge.

The stream flowed over a moderate gradient with the substrata composed mostly of bedrock (30%) with boulder (10%), cobble (20%) and coarse gravels (20%). The remainder was bare peat, especially upstream of the culvert where there was also lots of slate-like cobble. The riparian zone supported a low diversity of grass species only, with little herbaceous vegetation. Common liverwort grew on the muddy banks upstream of the culvert.



Plate 3.13 Representative image of site B3, a small, shallow, high-energy upland watercourse adjoining extensive areas of recent clear-fell.

3.14 Site B4 – Argina River, Carrowmore

The Argina River at site B4 was an upland eroding river 4-5m wide, in a moderate to high gradient channel with heavily peat-stained water at the time of survey. The channel retained a semi-natural profile in a shallow U-shaped channel set in a wider valley. The site comprised 30% riffle, 50% glide and 20% pool habitat. The bank height was 0.8m with a water width averaging 4-5m, equalling the channel width. The substrata were dominated by bedrock (30%) and boulder (30%) with smaller quantities of gravel (20%). The substrata were, however, bedded in peat that comprised 20% by surface area of the channel bed. Siltation levels were high given the erosion of peat in the catchment, with large areas of coniferous clear-fell (WS5) upstream.

The riparian habitat was dominated by upland blanket bog (PB2) with frequent willow and ling with characteristic blanket bog species such as tormentil, purple moor grass, bilberry and common haircap moss (*Polytrichum commune*) moss also present. However, this graded into semi-mature sitka plantation (WD4) to the west of the site (downstream). No macrophytes were recorded present given the higher energy of the site and heavily peat-stained water. The moss species *Fontanalis squamosa* was present very locally on boulders. As with many of the other sites in the catchment, the yellow fringe-moss was locally common on instream boulders above the waterline alongside water earwort.



Plate 3.14 Representative image of site B4 on the upper Argina River flowing through areas of afforestation and upland blanket bog

3.15 Site B5 – Argina River, Carrownadargny

Located approx. 0.8km downstream from site A4, site A5 was an upland eroding river (FW1) with a 6-7m wide channel over a moderate to high gradient with peat-stained water. The Argina River retained a semi-natural profile with 20% riffle, 50% glide and 30% pool habitats. Deeper pool habitat (>2m) was present downstream of the site. The bank height was 0.6m with a water width averaging 6-7m, equalling the channel width. The substrata were dominated by bedrock (30%) and boulder (30%) with smaller quantities of cobble (20%) and gravel 10%. Some peat substrata existed but it was not as extensive as other sites on the river (typically 10% only). Siltation levels were moderate given the erosion of peat in the catchment but, again, lower than areas upstream and downstream given the absence of adjoining clear-fell.

The riparian habitat was dominated by mature sitka spruce on both banks which were situated on a very steep V-shaped valley. Mosses such as *Sphagnum* spp. moss, *Polytrichum* spp. and big shaggy moss dominated much of the banks with broad buckler fern, hay-scented buckler-fern, common polypody, hard fern (*Blechnum spicant*), hart's tongue (*Asplenium scolopendrium*), great wood rush (*Luzula sylvatica*) and wood sorrel (*Oxalis acetosella*) common. The river was heavily shaded by forestry (50%). No macrophytes were recorded present given the very high energy of the site, heavy shading and peat-stained water. As with many of the other sites in the catchment yellow fringe-moss and water earwort were frequent on instream boulders above the water line with small areas of *Fontanalis squamosa* on submerged boulders.



Plate 3.15 Representative image of site B5 on the upper Argina River flowing through a natural, very steep V-shaped valley colonised by mature sitka spruce

3.16 Site B6 – unnamed stream, Boleymaguire

Site B6 was a small, unnamed upland eroding stream (FW1) in a high-gradient area that was situated in a narrow 0.5m wide V-shaped channel in an area of upland peat. Located at a forestry access road crossing, the bank height was 1m with a water width <0.5m in cascading riffle-pool sequences. The profile was of 30% riffle, 50% glide and 20% pool. The substrata comprised medium gravels (20%) but with frequent boulder and cobble (30% combined). However, peat made up 50% by area of the bed. Much of the substrata were bedded in a peaty base.

The riparian habitat was species poor wet grassland (GS4) dominated by soft rush and willow with foxglove (*Digitalis purpurea*), broad buckler-fern and great willowherb. These areas graded into young growth sitka spruce (several years old), some 20-30m from the stream. These stands appeared to have been replanted on historical clear-fell. More recent clear-fell was also noted upstream and downstream of the site.



Plate 3.16 Representative image of site B6, a very narrow, steep gradient, cascading upland eroding watercourse largely unsuitable for fish

3.17 Site B7 – unnamed stream, Boleymaguire

Site B7 was a small, unnamed upland eroding stream (FW1) in a high-gradient area that was situated in a narrow 2-2.5m wide V-shaped channel in an area of upland peat. Located at a forestry access road crossing, the bank height was 1m with a water width averaging 1-2m in cascading riffle-pool sequences. Deeper plunge pools associated with the road culvert and steeper gradient areas were present, sometimes >1m deep. The profile was of 50% riffle, 20% glide and 30% pool. The substrata comprised medium gravels (20%) but with frequent boulder and cobble (70% combined) and some exposed bedrock in higher energy areas. Siltation levels moderate given natural erosion of peat banks but moderate at worst. Most of the substrata were clean but nonetheless bedded given high flow rates and the spate nature of channel. The water was heavily peat-stained.

The riparian habitat was dominated by species poor wet grassland (GS4), supporting soft rush, purple moor grass, willow and tormentil with mature sitka spruce and lodgepole pine plantations mature adjoining downstream. Some natural growth of sitka spruce was present upstream. An evident area of clear-fell was located upstream on north bank. Common haircap moss grew on the banks with some bilberry and broad buckler-fern. Water earwort was limited but present on instream boulders.



Plate 3.17 Representative image of site B7, a small, steep gradient, cascading upland eroding watercourse largely unsuitable for fish

3.18 Site B8 – Argina River, Boleymaguire

Represented by an upland eroding river (FW1), site B8 on the Argina River was 6-8m wide in a moderate to high gradient channel with peat-stained water. The Argina retained a semi-natural profile with 40% riffle, 40% glide and 20% pool habitats. The bank height was 1m with a water width averaging 6-8m, equalling the channel width. The substrata comprised medium gravels (30%) but with frequent boulder and cobble (40% combined). The substrata were, however, bedded in peat that comprised 30% by area of the channel bed. Siltation levels were high given the erosion of peat in the catchment, with large areas of clear-fell located adjacent to the site (north bank) as well as upstream.

The riparian habitat was dominated by mature sitka spruce plantation (WD4, south bank) but also recent clear-fell (WS5). No macrophytes were recorded present given the high energy of the site and peat-stained water, although some marsh horsetail existed marginally near the confluence of a small unnamed stream. The moss species *Fontanalis squamosa* was present very locally on boulders common liverwort present on muddy margins. As with many of the other sites in the catchment, yellow fringe-moss was common on in-stream boulders. The liverwort water earwort was also locally frequent on exposed boulders.



Plate 3.18 Representative image of site B8 on the upper Argina River, flowing through extensive areas of afforestation and recent clear-fell

3.19 Site C1 – Owengar River, Knocknacosta

Located at a road crossing, site C1 was a high-energy upland eroding small stream (FW1) with cascading sequences flowing over siliceous rock. The meandering semi-natural channel was dominated by small boulder substrata (40%) with large cobble co-dominating (30%) substrata. The cobble was also represented by a more slate-like form which was largely unstable. Smaller amounts of bedrock (10%) with greater quantities of angular coarse and medium gravel (20%) was locally present in pockets. The channel was 0.75m wide with a water and channel width of 1.0m. Overall, the channel was shallow at 0.2m deep with the deepest areas 0.3m. The stream flowed through a steep V-shaped valley with a bankful height of 2.5-3m. The river profile was predominantly fast riffle (80%) with 10% glide and 10% pool. Above the road crossing the channel flowed over a moderate gradient before steepening considerably downstream and flowing predominantly over bedrock.

Riparian areas were composed of scattered gorse, grey willow, bramble scrub and patches of hazel (*Corylus avellana*) woodland. The channel was heavily shaded (40%) due to overhanging trees and scrub. No macrophytes were present instream given the high energy but yellow fringe-moss and water earwort were present locally attached to instream boulders. Big shaggy-moss and common liverwort grew on muddy banks.



Plate 3.19 Representative image of site C1, a small, narrow, steep gradient, cascading upland eroding watercourse largely unsuitable for fish

3.20 Site C2 – Unnamed stream, Knocknacosta

Located adjacent to site C1, site C2 on a separate unnamed stream was a high-energy upland eroding small stream (FW1) featuring cascading sequences over siliceous rock. The meandering semi-natural channel was again dominated by small boulder and unstable slate-like cobble substrata (50% overall). Site C2 supported more gravels than neighbouring site although these were typically angular and coarse. Bedrock was also present, particularly downstream of the road crossing where the gradient steepened in a scrubbed-over valley. The gravels were situated in pockets between slate cobble and localised boulder areas.

The channel was 1.75m wide with 2m-wide channel (larger than site C1). Overall, the channel was shallow with a maximum depth of 0.2m. It was situated in a steep V-shaped valley with a bankful height of 2.0m and the river profile was predominantly riffle (80%) with smaller proportions of glide and pool (10% by area of each). Riparian areas were of scattered gorse, sally willow, bracken, wild angelica and bramble scrub. Scrubby willow woodland was abundant upstream of the box culvert. Mature sitka plantations adjoined upstream but were buffered somewhat by several metres of willow-dominated habitat. This also accounted for the heavy shading of the channel due to overhanging tree limbs and scrub (>60%). No macrophytes were present instream given the high energy nature but the epiphytic yellow fringe-moss was present locally attached to instream boulders. The liverworts *Marchantia polymorpha* and great scented liverwort (*Conocephalum conicum*) were present on the culvert wall near the waterline.



Plate 3.20 Representative image of site C2, a small, shallow, steep gradient, cascading upland eroding watercourse largely unsuitable for fish

3.21 Site C3 – Owengar River, Camalt

Located upstream of a bridge featuring two 1.5m pipe culverts, the Owengar River at site C3 was a high-energy upland eroding small river (FW1) with boulder cascade sequences over siliceous rock. Instream works including bridge repair and boulder revetments had evidently been previously completed at the site. However, a meandering semi-natural channel remained and was dominated by boulder substrata (70%) with large frequent cobble (30%). Smaller amounts of coarse and medium gravel were present in pockets under boulder and cobble.

The channel was 2m wide with a 3m channel with. The depth varied between 0.2m in riffles to 0.5m in pools. Historical boulder revetment works that were very well constructed maintained sinuosity and channel form, which was broadly V-shaped with a bankful height of 2.5m with occasional littoral exposed cobble bars on meanders (2 stage channel). The river profile was predominantly riffle (70%) with 20% glide and 10% pool.

Riparian areas were of scattered gorse, sally willow, bramble scrub with species poor wet grassland (GS4; rough pasture). The channel was quite open with limited overhanging trees. No macrophytes were present instream given the high energy nature of the site but epiphytic moss species such as yellow fringe-moss, along with the water earwort liverwort, were present locally attached to instream boulders. Localised rusty feather moss (*Brachythecium plumosum*) grew above the waterline on the bridge structure. The former species prefers rocky outcrops in fast flowing water in base poor habitats of the west. Big shaggy-moss was common higher up on the river banks.



Plate 3.21 Representative image of site C3, a medium-sized upland eroding watercourse with some good salmonid habitat. Historical bank works (boulder revetments) are evident in the background

3.22 Site D1 – Greaghnafarna River, Greaghnafarna

Site D1 was a semi-natural stream (FW1) located below the confluence of two small rivers (one unnamed). The Greaghnafarna River had been historically straightened but not deepened for a short distance (50m) downstream of the confluence. Averaging 3m wide and 0.2-0.3m deep with some localised deeper slacks, the stream at site D1 was high-energy and dominated by riffles (60%) with fast glide and limited pool. The substrata were dominated by cobble (60%) with 30% boulder and the remainder coarse gravels. No soft sediment was present given the high-energy nature of the site.

The river flowed through areas of dry meadow and grassy verge habitat (GS2) which supported common species such as spear thistle (*Cirsium vulgare*), marsh thistle, cocksfoot, common bent, tufted vetch, oxeye daisy (*Leucanthemum vulgare*), hogweed and wild angelica. Upstream and downstream the site was bordered by mature treelines (WL2) composed mostly of alder, sycamore and willow with bramble scrub common. A 10m^2 stand of invasive Himalayan knotweed (*Persicaria wallichii*) existed on exposed gravel shoal at the confluence of the two channels (ITM 579776, 825143). Although riparian shading was high upstream and downstream, the channel was open at the site but macrophyte and bryophyte growth was sparse due to high flows. Rusty feather moss grew on top of exposed boulders with yellow fringe-moss and water earwort on submerged boulders.



Plate 3.22 Representative image of site D1 below the confluence of two smaller high-energy channels. A Himalayan knotweed stand is evident in the centre of the image.

3.23 Site D2 – unnamed channel, Rathrower

Site D2 was situated at the confluence of two small unnamed channels, an upland eroding watercourse (FW1) from the north and an adjoining drainage channel (FW4) from the west. Downstream of the confluence the channel had been historically straightened and deepened, with a bankful height of 1-1.2m and sheer sides. The channel was 1m wide and <0.15m deep and heavily silted by peat. The gravel substrata (50% overall) were bedded and compacted. The site comprised 100% slow flowing glide, with the adjoining FW1 dominated by shallow riffles.

North of site was poor quality wet (drained) agricultural grassland (soft rush dominated) with degraded cutover bog habitat (PB4) on the south bank. There was some better-quality pockets of lowland blanket bog habitat (PB3) near the channel supporting ling, purple moor grass and tormentil. The banks were lined on both sides by a narrow strip of scrub (WS1) supporting bramble with devil's bit scabious, common catsear (*Hypochaeris radicata*), common sorrel (*Rumex acetosa*), broad-leaved dock (*Rumex obtusifolius*), soft rush, meadowsweet (*Filipendula ulmaria*), marsh thistle and rank grasses. Few trees were present in the vicinity due to previous land clearance and channel straightening. Riparian shading and encroachment by terrestrial plant species was high in the channel. In terms of bryophytes, some *Pellia* spp. on more exposed muddy banks but generally there was little macrophyte or bryophyte growth due to shading.



Plate 3.23 Representative image of site D2, a narrow, heavily shaded, silted and historically straightened drainage channel largely unsuitable for fish

3.24 Site D3 – Rathgeean River, Drumee

Site D3 was a small stream (FW1) situated at a road crossing in *Juncus* spp. dominated wet grassland (GS4, upstream) and agricultural grassland (GA1, downstream). The channel had been straightened and deepened historically and was box-culverted underneath the road. Gabion mattressing was present near the road bridge. The substrata comprised of 40% boulder, 20% cobble and 10% medium with the rest silt/peat. The substrata were heavily bedded and heavily silted. A concrete apron existed under the small masonry arch bridge, evidence of historical works to the channel. A regular otter spraint site, containing white-clawed crayfish remains, was recorded under the bridge.

The site was shallow with an average depth of 0.1-0.2m and drained upland areas but not bog as per other sites in the survey. Peat staining was low at this site compared to most others in the wider Croagh catchment (i.e. did not drain upland peat areas). The bankful height was 1-1.5m in a steep U-shaped channel, which was 1.5m in width. The site was dominated by glide habitat (60%) with limited pool and occasional riffles. Downstream of the bridge, the channel became more overgrown and less natural (straightened) and retained little natural profile. Upstream, the stream was heavily tunnelled by bramble-bracken scrub and hawthorn hedgerows. Species such as water figwort (*Scrophularia auriculata*), field horsetail (*Equisetum arvense*), reed canary grass (*Phalaris arundinacea*) and nettle all indicated enrichment of the surrounding lands. Downstream of the road bridge the channel became more open as it flowed through a GA1 landscape. Occasional osier and willow existed but channel was largely open with steep vegetated banks supporting a herbaceous riparian zone with great willowherb, meadowsweet and rank grasses.

Given the high degree of shading and terrestrial encroachment, macrophyte and bryophyte growth instream was sparse but rusty feather moss was present on top of boulders with yellow fringe-moss submerged on the downstream sides.



Plate 3.24 Representative image of site C3 (facing downstream of bridge), a small, shallow stream flowing through an agricultural landscape

4. Results

A catchment-wide electro-fishing survey of *n*=21 sites in the footprint of the proposed Croagh wind farm was conducted over Monday 19th – Wednesday 21st August 2019 following notification to Inland Fisheries Ireland (Ballina). The results of the survey are discussed below in terms of fish population structure, population size and the suitability and value of the surveyed areas as nursery and spawning habitat for salmonids, European eel and lamprey species. White-clawed crayfish habitat value was also assessed for each site. Scientific names are provided at first mention only.

4.1 Fish stock assessment (electro-fishing)

Site A1 – Killanummery Stream, Corratimore Glebe

No fish were recorded during electro-fishing at site A1 on the upper Killanummery Stream. The site had little value as salmonid habitat due to its upland, high-energy nature. Lamprey spawning and nursery habitat was absent. The substrata were largely bedded in peat and, as such, there was little spawning value for salmonids. Fish access was poor given the high-elevation, upland location. While trout can sometimes occur at steep gradients, the smaller size of the cascading boulder-pool profile of the Killanummery Stream was not considered suitable for resident fish.

Site A2 – Unnamed stream, Garvagh Glebe

No fish were recorded during electro-fishing at site A2. The site had low fisheries value due to the upland and small nature of the channel which flowed over a relatively steep gradient. Spawning and nursery habitat was impacted by siltation and bedded gravels due to adjacent peat and forestry influences. There was limited holding habitat given the high-energy flows. Lamprey habitat was absent. Access for salmonids from downstream was difficult given naturally high gradients. Overall, the site was not considered suitable for resident fish.

Site A3 – Unnamed stream, Garvagh Glebe

No fish were recorded during electro-fishing at site A3. The site had low fisheries value due to upland and small nature of the channel. As with site A2 upstream (connecting watercourse), spawning and nursery habitat was impacted by siltation and bedded gravels due to adjacent peat and forestry influences. There was limited holding habitat given the high-energy flows. Lamprey habitat was absent. Access for salmonids from downstream was difficult given naturally high gradients and there was no upstream fish passage provided at the small but vertical 0.5m-fall weir at the site. Overall, the site was not considered suitable for resident fish but may support migratory European eel at low densities, albeit none were recorded during the current survey.



Plate 4.1 Electro-fishing at site A3, which did not produce fish. The site was largely unsuitable for fish given its upland nature and access issues from the lower catchment

Site A4 – Killanummery Stream, Garvagh Glebe

Brown trout (*Salmo trutta*) was the only species recorded at site A4 on the upper Killanummery Stream. Low numbers of adult fish (*n*=3) were captured. No juveniles were recorded. Fish density was low at this upper catchment site.

The site had a moderate fisheries value due to its upland nature and small nature of the channel. There was some moderate quality nursery habitat, at best, with spawning substrata very limited due to the site's high energy nature. Some good holding habitat was present, especially in vicinity of bridge where a deep 1.5m pool existed, as well as in undercut banks. Some localised pools were also present upstream and downstream of site. There was no lamprey value due to the cascading, moderate gradient and bedded substrata. The site provided some low value European eel potential, despite their absence from the survey.

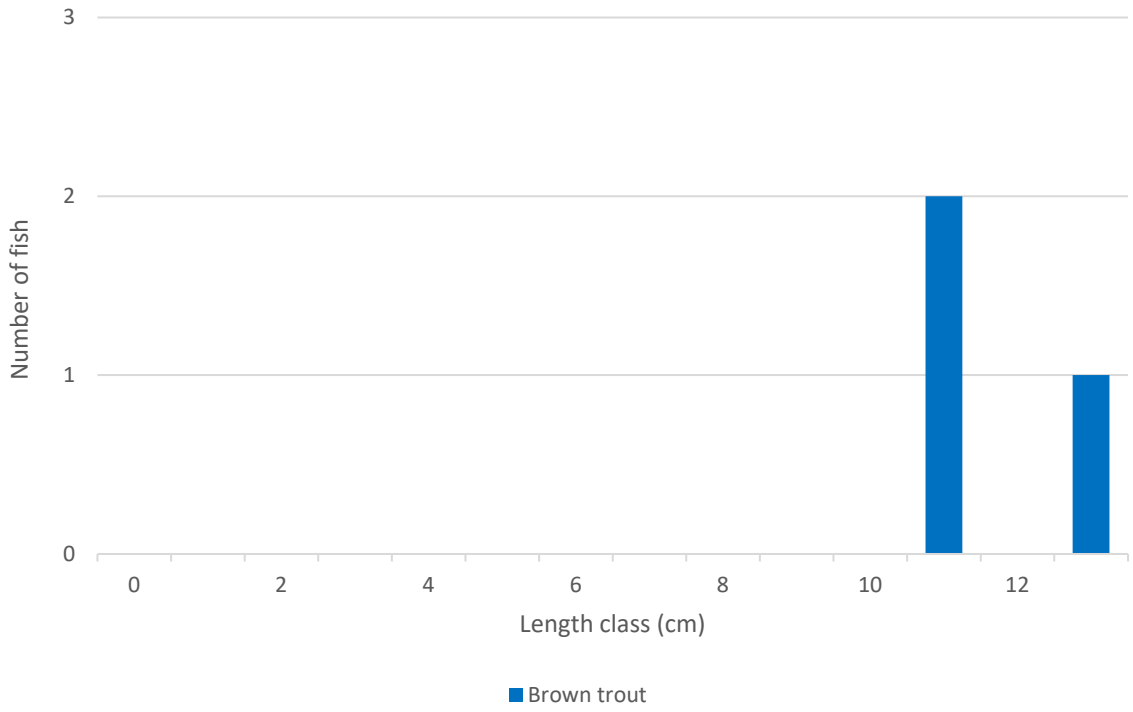


Figure 4.1 Fish stock length distribution recorded via electro-fishing at site A4 on the Killanummery Stream, Garvagh Glebe, Co. Leitrim in August 2019

Site A5 – Killanummery Stream, Corglancey

Brown trout was the only species recorded at site A5 on the Killanummery Stream at Corglancey. A range of adult size classes were captured, with low numbers of juveniles recorded (Figure 4.2).

The site was a moderate quality trout nursery given its semi-natural profile and well oxygenated broken flow patterns with cobble and gravel substrata. Overall the nursery habitat was only diminished by the fact that it was situated in an upland eroding channel with high-energy flows. The spawning value was also moderate, given that only smaller lenses of gravel were present between large substrata types. They were, however, as with all the substrata in the Killanummery at site A5, unbedded with low levels of siltation. Adult holding habitat was very good with abundant glide and pool habitat between boulder cascade areas and meanders. While some patches of sand were present the river was too high energy to support lamprey ammocoetes and none were recorded. The site provided some moderate value European eel potential, despite their absence from the survey.

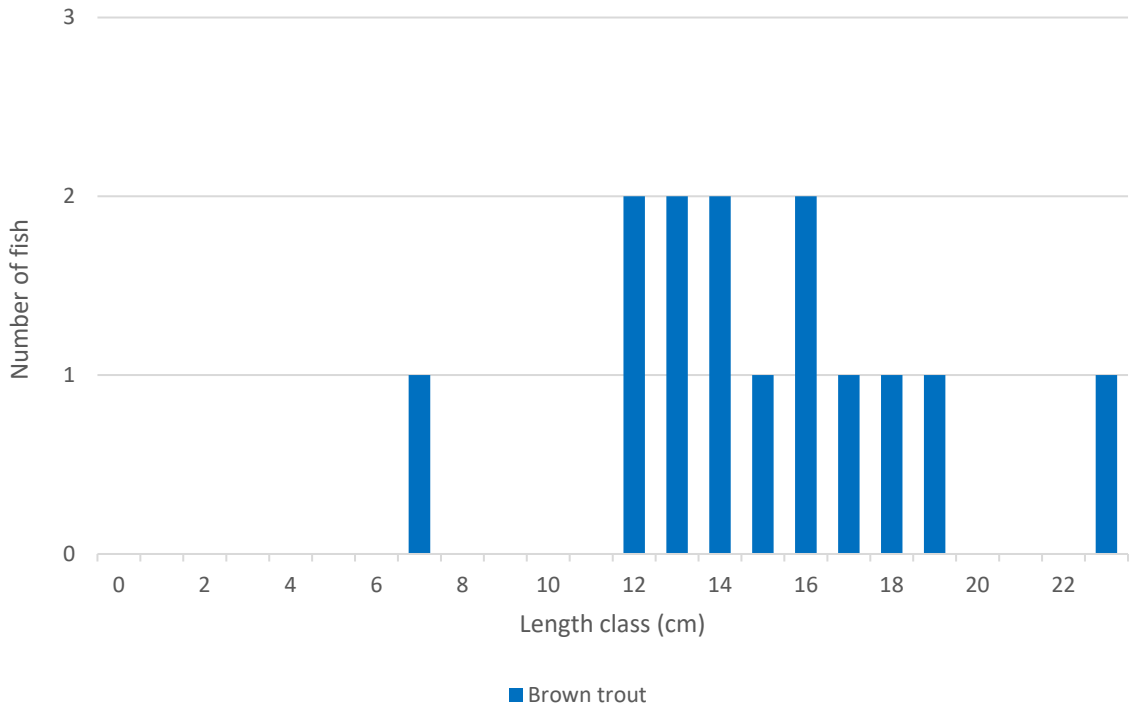


Figure 4.2 Fish stock length distribution recorded via electro-fishing at site A5 on the Killanummery Stream, Corglancey, Co. Leitrim in August 2019

Site A6 – Killanummery Stream, Carrigeen

Brown trout was the only species recorded at site A6 on the Killanummery Stream at Carrigeeen. A range of adult size classes were captured, with no juveniles recorded (Figure 4.3).

As with upstream sites on the stream, site A6 was a moderate quality trout nursery habitat given the semi-natural profile and well oxygenated broken flow patterns over cobble and gravel. Nursery value would have improved significantly had the gravels been less bedded and sedimentation by peat was reduced. These characteristics also reduced the spawning quality to moderate. Evidently the absence of 0+ fish would suggest issues with successful spawning in the Killanummery Stream at site A6. Holding habitat for adult salmonids was, however, good throughout the survey area with both deep glide and pool areas undercut into the banksides. Fair numbers of brown trout in cohorts of 1+, 2+ and 3+ year classes were present, exemplifying the better-quality holding habitat. While some sandy areas existed, they were very compacted underfoot with peat-clay fractions making them poorer quality for lamprey. Despite good fishing effort no ammocoetes emerged after targeted electro-fishing of these very localised patches located on meanders. The site provided some moderate value European eel potential, despite their absence from the survey.

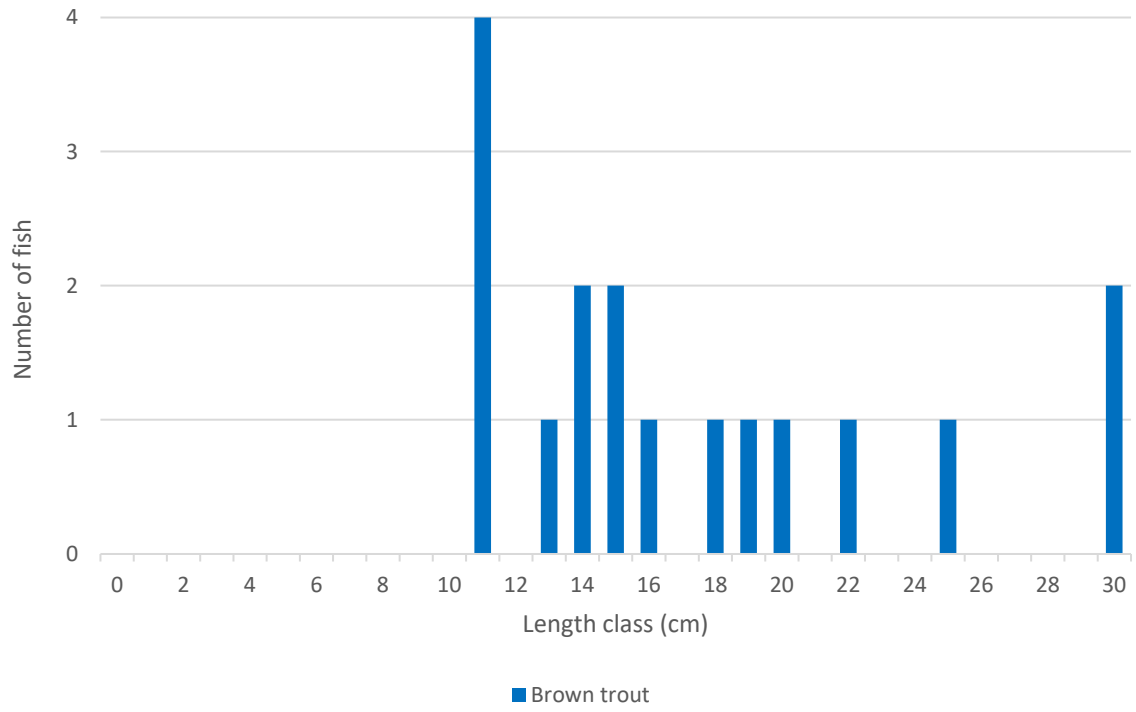


Figure 4.3 Fish stock length distribution recorded via electro-fishing at site A6 on the Killanummery Stream, Corglancey, Co. Leitrim in August 2019



Plate 4.2 A particularly large brown trout recorded at site A6 on the Killanummery Stream. Despite good nursery habitat, juveniles were scarce at this site indicating poor recruitment

Site A7 – Killanummery Stream, Killanummery

A total of four fish species were recorded at site A7 on the Killanummery Stream (Figure 4.4). Brown trout were the most abundant (*n*=23) followed by low numbers of Atlantic salmon (*Salmo salar*) parr and stone loach (*Barbatula barbatu*la). A single example of minnow (*Phoxinus phoxinus*) was also captured.

The site was evidently a very good salmonid nursery, with ample boulder and cobble refugia. Evidently the presence of both 0+ Atlantic salmon and brown trout in fair numbers exemplified the stream's value as a nursery. However, the absence of significant areas of well-sorted gravels within the survey area reduced the channel's value as a spawning site but the localised pockets of gravel within the high-energy spate channel evidently supported recruitment. The extensive bedrock and predominance of large substrata indicated that downstream, shallower-gradient areas may produce improved spawning as the energy of the river lessens. Holding habitat was good throughout the river with both deep glide and pool undercut into bedrock. The high energy of the channel resulted in very limited fines (1% by area) which were composed of shallow sand. These areas were not considered deep enough or extensive enough to support lamprey ammocoetes and none were recorded. The site provided some good potential for European eel, despite their absence from the survey.

White-clawed crayfish remains (Plate 4.4) were recorded in otter spraint under the bridge.

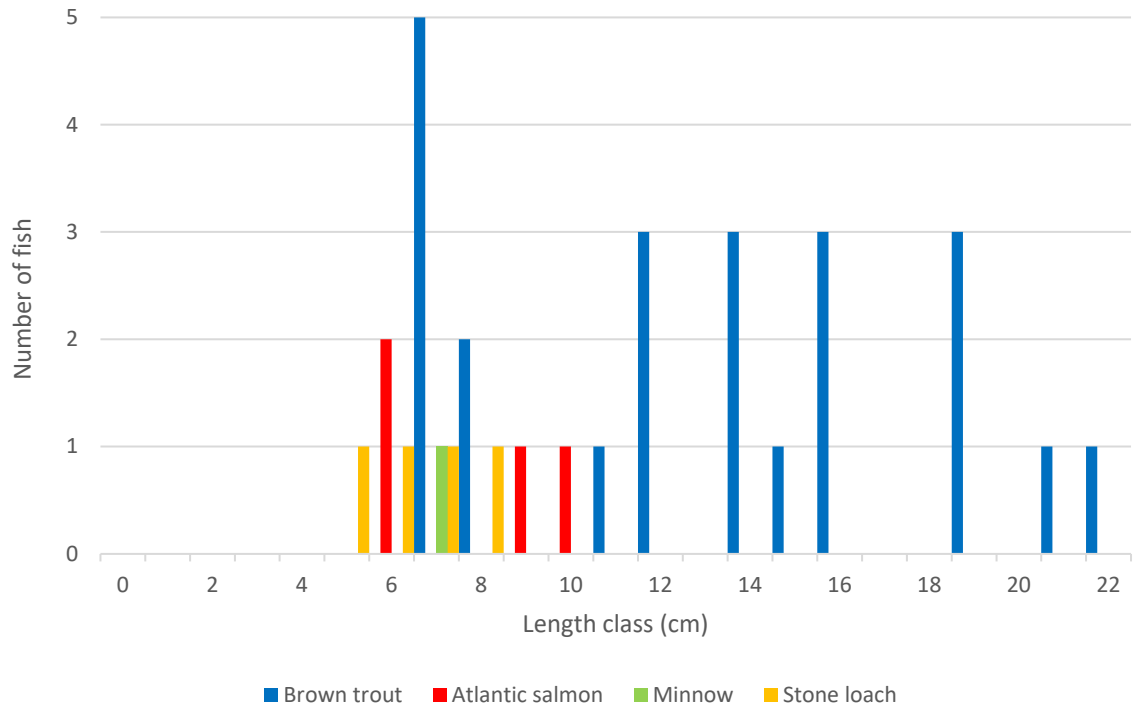


Figure 4.4 Fish stock length distribution recorded via electro-fishing at site A7 on the Killanummery Stream, Killanummery, Co. Leitrim in August 2019



Plate 4.3 A range of species were recorded at site A7 on the Killanummery River. Top to bottom: adult brown trout, juvenile brown trout, Atlantic salmon parr, minnow & stone loach



Plate 4.4 White-clawed crayfish remains were recorded in otter spraint underneath the bridge at site A7 on the Killanummery Stream

Site A8 – Tullynascreen Stream, Garvagh Glebe

No fish were recorded during electro-fishing at site A8 on the upper Tullynascreen Stream. The site had little fisheries value due to its upland elevation and high-energy nature. Fish access from the lower catchment was difficult due to naturally high gradients and fish were seemingly absent from the site. Spawning and nursery habitat were both poor due to high spate flows and likely low flows during

drought periods. The absence of finer gravels for spawning and fines for larval settlement resulted in there being no lamprey potential and none were recorded. The site provided some low value European eel migratory potential, despite their absence from the survey.

Site A9 – Tullynascreen Stream, Garvagh Glebe

As with site A8 downstream, no fish were recorded during electro-fishing at site A9 on the upper Tullynascreen Stream. The site had little fisheries value due to its upland elevation and high-energy nature. Fish access from the lower catchment was difficult due to naturally high gradients and fish were seemingly absent from the site. Spawning and nursery habitat were both poor due to high spate flows and likely low flows during drought periods. The absence of finer gravels for spawning and fines for larval settlement resulted in there being no lamprey potential and none were recorded. The site provided some low value European eel migratory potential, despite their absence from the survey.

Site A10 – Tullynascreen Stream, Tullynascreen

Brown trout was the only fish species recorded at site A10 on the Tullynascreen Stream, with a low number of small adults (*n*=6) recorded (Figure 4.5).

The site had a moderate value as a salmonid nursery with a low density of salmonids present. No juveniles were recorded which likely reflects the high-energy nature of the stream at this site. The overall densities observed may also be related to upland afforestation influences plus peat escapement in the wider catchment. Some good adult holding habitat was present locally. Spawning habitat was very limited and localised, with the site dominated by boulder and cobble. Finer gravels and sediment accumulations were absent and, as such, no lamprey habitat was present. Access to the adjoining confluence stream was poor due to a naturally steep gradient. Overall, the Tullynascreen was likely to support trout further upstream. The site provided some low to moderate value European eel migratory potential, despite their absence from the survey.

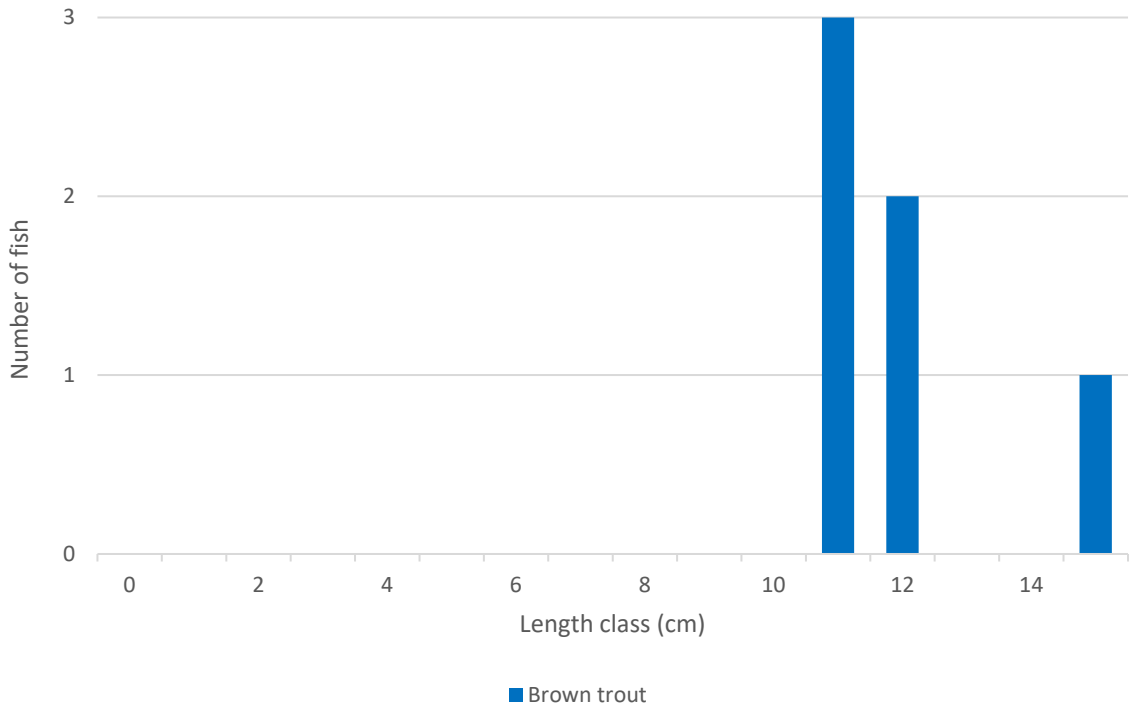


Figure 4.5 Fish stock length distribution recorded via electro-fishing at site A10 on the Tullynascreen Stream, Tullynascreen, Co. Leitrim in August 2019



Plate 4.5 A sample of adult brown trout recorded from site A10 on the Tullynascreen Stream. Juveniles were absent from this high-energy, upland site

Site B1 – Argina River, Garvagh Glebe

No fish were recorded during electro-fishing at site B1 on the upper Argina River. The site had little fisheries value due to its upland elevation and high-energy nature. Overall, the site offered very poor salmonid habitat given the small size of the channel (often <0.5m in width), heavy shading from afforestation and peat-stained water. The bedded substrata in peat reduced the spawning value of the stream and the deeply-cut shaded peat channel with more limited broken water was considered a poor nursery habitat. While some pool holding habitat existed, no salmonids were recorded present. As with other sites in the Argina River, the quality of the river as a spawning habitat would have improved significantly had the erosion of peat in the catchment not impacted the river gravels (i.e. sedimentation & compaction). The channel was of no importance to lamprey given the upland high energy nature of the site and lack of suitable soft sediment. The site provided some low value European eel migratory potential, despite their absence from the survey.



Plate 4.6 Electro-fishing site B1 on the upper extremities of the Argina River. The site was found to contain no fish at the time of survey

Site B2 – Unnamed stream, Carrowmore

No fish were recorded during electro-fishing at site B2 in the upper Argina River catchment. The site had little fisheries value due to its upland elevation and high-energy nature. Overall, the site offered very poor salmonid habitat given the small size of the channel, heavy shading from afforestation and peat-stained water. The bedded substrata in peat reduced the spawning value of the stream and the deeply-cut, shaded peat channel was considered a poor nursery habitat. While some pool holding habitat existed, no salmonids were recorded present. As with other sites in the Argina River catchment, the quality of the river as a spawning habitat would have improved significantly had the erosion of peat in the catchment not resulted in impacts to the instream gravels (i.e. sedimentation & compaction). The channel was of no importance to lamprey given the upland high energy nature of

the site and lack of suitable soft sediment. The site provided some low value European eel migratory potential, despite their absence from the survey.

Site B3 – Unnamed stream, Carrowmore

As with site B2 upstream, no fish were recorded during electro-fishing at site B3 in the upper Argina River catchment. The site had little fisheries value due to its upland elevation and cascading, high-energy nature. Overall, the site offered very poor salmonid habitat given the small size of the channel in addition to the bedded substrata (peat laden), that reduced the spawning value of the stream. Furthermore, the deeply-cut, shaded peat channel was considered a poor nursery habitat. While some pool holding habitat existed, no salmonids were recorded present at this moderate gradient site. As with other sites in the Argina River catchment, the quality of the river as a spawning habitat would have improved significantly had the erosion of peat in the catchment not impacted the instream gravels (i.e. sedimentation & compaction). The channel was of no importance to lamprey given the upland high energy nature of the site and lack of suitable soft sediment. The site provided some low value European eel migratory potential, despite their absence from the survey.

Site B4 – Argina River, Carrowmore

Brown trout was the only fish species recorded from site B4 on the upper Argina River (Figure 4.6). A range of both juvenile and adult year classes were recorded, with a moderate density of fish present (*n*=11).

The site was a moderate to good trout nursery habitat given the semi-natural profile and well oxygenated broken flow patterns with boulder and cobble refugia. The bedded substrata in peat reduced the spawning value of the stream somewhat but the presence of localised unbedded gravel areas indicated it had localised spawning areas. The quality of the river as a spawning habitat would have improved significantly had the erosion of peat in the upper catchment had not impacted the river gravels (i.e. sedimentation & compaction), as with sites B5 and B8 downstream. However, the very localised pockets of coarse gravel did facilitate spawning, a indicated by the presence of a low-density of young-of-the-year 0+ trout. Holding value for adults was moderate given the presence of deep pools between boulder pockets, in addition to good areas of deeper glide habitat. The channel was of no importance to lamprey given the upland high-energy nature of the site. The site provided some moderate value European eel potential, despite their absence from the survey.

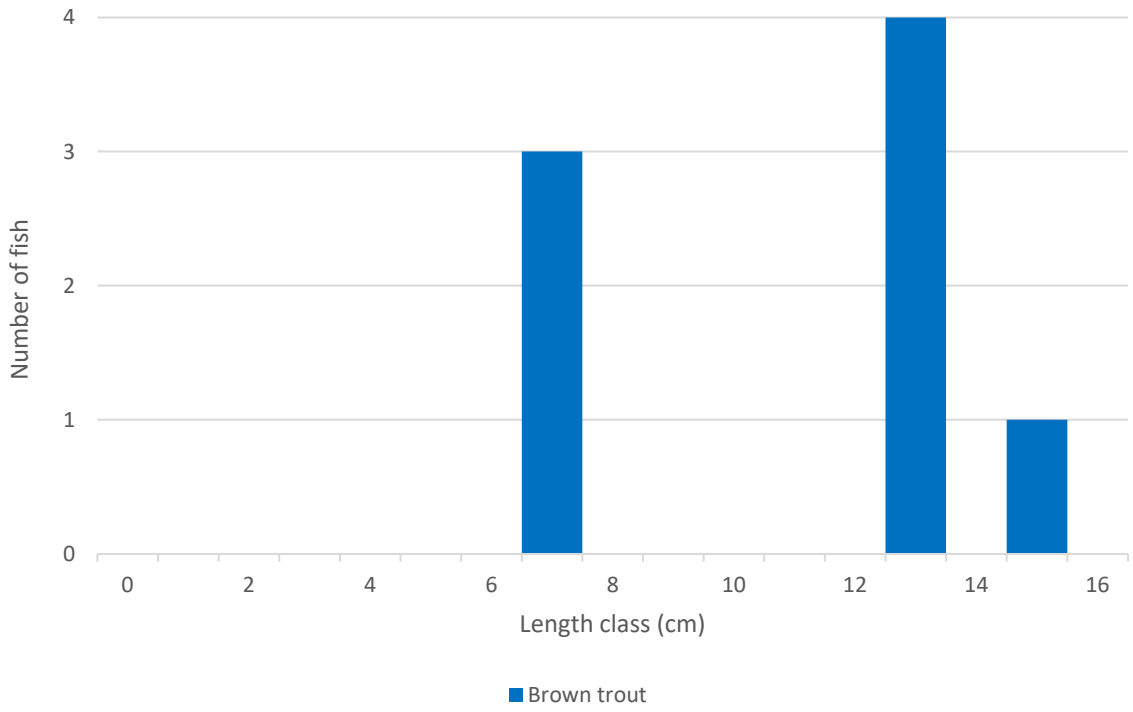


Figure 4.6 Fish stock length distribution recorded via electro-fishing at site B4 on the Argina River, Stream, Carrowmore, Co. Leitrim in August 2019



Plate 4.7 Low densities of adult and juvenile brown trout were recorded at site B4 on the upper Argina River. Fish were considered to be in excellent condition

Site B5 – Argina River, Carrownadargny

As with upstream site B4, brown trout was the only fish species recorded from site B5 on the upper Argina River (Figure 4.7). A range of both juvenile and adult year classes were recorded, with a low density of fish present (*n*=17).

The site was evidently a moderate to good trout nursery habitat given semi-natural profile and well oxygenated broken flow patterns with boulder and cobble refugia. The bedrock dominated substrata with very localised angular gravel patches reduced the spawning value of the river at this site, but evidently supported small numbers of 0+ trout. Holding value for larger fish was moderate given the presence of deep pools and glide runs between boulder pockets and bedrock. The channel was of no importance to lamprey given the upland, high-energy nature of the site and absence of soft burial ammocoete habitat. The site provided some moderate European eel potential, despite their absence from the survey.

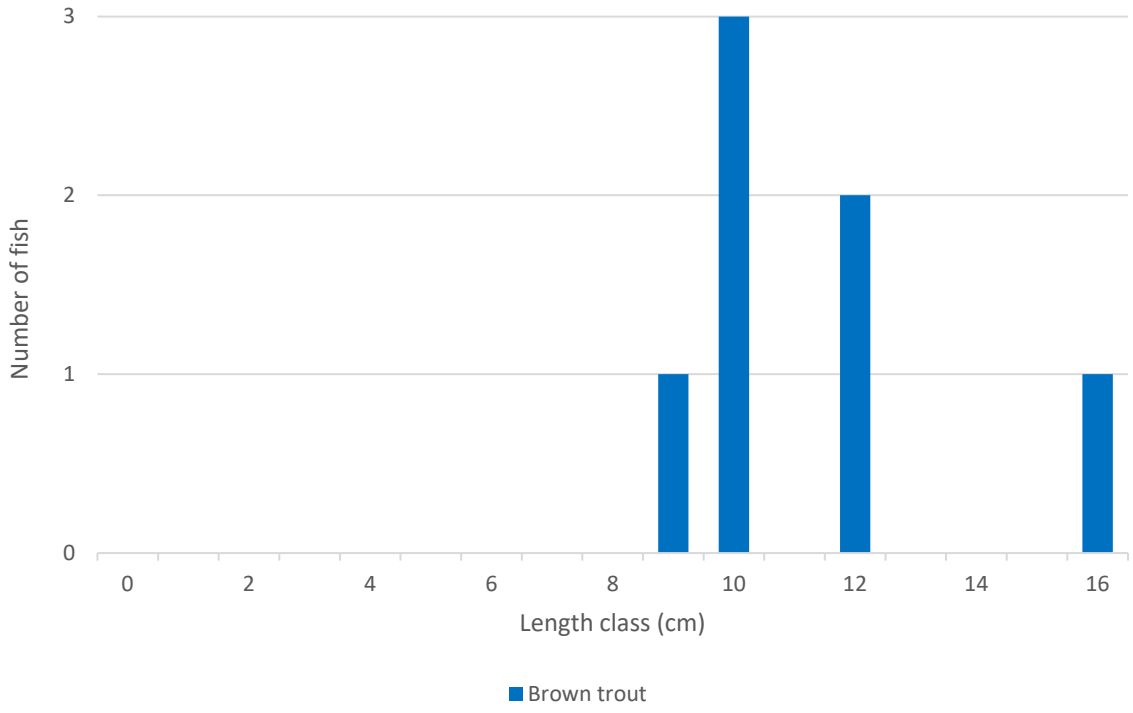


Figure 4.7 Fish stock length distribution recorded via electro-fishing at site B5 on the Argina River, Stream, Carrownadargny, Co. Leitrim in August 2019

Site B6 – unnamed stream, Boleymaguire

No fish were recorded during electro-fishing at site B6 in the upper Argina River catchment. The site had little fisheries value due to its upland elevation, very steep gradient and cascading, high-energy nature. There was very poor salmonid nursery, spawning and holding habitat given the shallow, small and upland nature of the channel in an afforested area. The bedded substrata and limited glide and pool areas for fish to rest would further diminish the fisheries value. Channels such as site B6 in high-energy, upland environments with poor fish access to the upper reaches on peaty bases are typically

of low fisheries value. The absence of fish recorded during electro-fishing was most likely a consequence of the small size and upland nature of the channel in addition to adjoining land use impactors. The site was of no importance to lamprey given the upland, high-energy nature of the site. The site provided little to no European eel potential and none were recorded.

Site B7 – unnamed stream, Boleymaguire

No fish were recorded during electro-fishing at site B7 in the upper Argina River catchment. Very similar to site B6, the site had little fisheries value due to its upland elevation, very steep gradient and cascading, high-energy nature. There was very poor salmonid nursery, spawning and holding habitat given the shallow, small and upland nature of the channel in an afforested area. The bedded substrata and limited glide and pool areas for fish to rest would further diminish the fisheries value. Channels such as site B6 in high-energy, upland environments with poor fish access to the upper reaches on peaty bases are typically of low fisheries value. . The absence of fish recorded during electro-fishing was most likely a consequence of the small size and upland nature of the channel in addition to adjoining land use impactors. The site was of no importance to lamprey given the upland, high-energy nature of the site. The site provided little to no European eel potential and none were recorded.



Plate 4.8 RM electro-fishing site A7 downstream of the culvert. No fish were recorded and the stream was considered unsuitable for resident fish given its high-energy, high-gradient and upland nature

Site B8 – Argina River, Boleymaguire

Brown trout was the only fish species recorded at site B8 on the Argina River (Figure 4.7). A moderate density of both juvenile and adult fish were present (total *n*=12).

The site was evidently a good trout nursery habitat given semi-natural profile and well oxygenated broken flow patterns with boulder and cobble refugia. The bedded substrata in peat reduced the spawning value of the stream but the presence of localised unbedded gravel areas indicated it was a moderate trout nursery and spawning area. However, the very localised pockets of coarse gravel did facilitate spawning, with low numbers of 0+ trout captured. Holding value for larger fish was moderate given the presence of deeper pools between boulder pockets but no extensive areas of pool or deep glide were present. The site was of no importance to lamprey given the upland, high-energy nature of the site. Localised softer peat and clay beds were highly compacted and did not contain any lamprey ammocoetes during the electro-fishing. Small numbers of 1+ and 2+ adult trout were also recorded in the lower reaches of the adjoining unnamed stream (same channel as site B7). The site provided some moderate European eel potential, despite their absence from the survey.

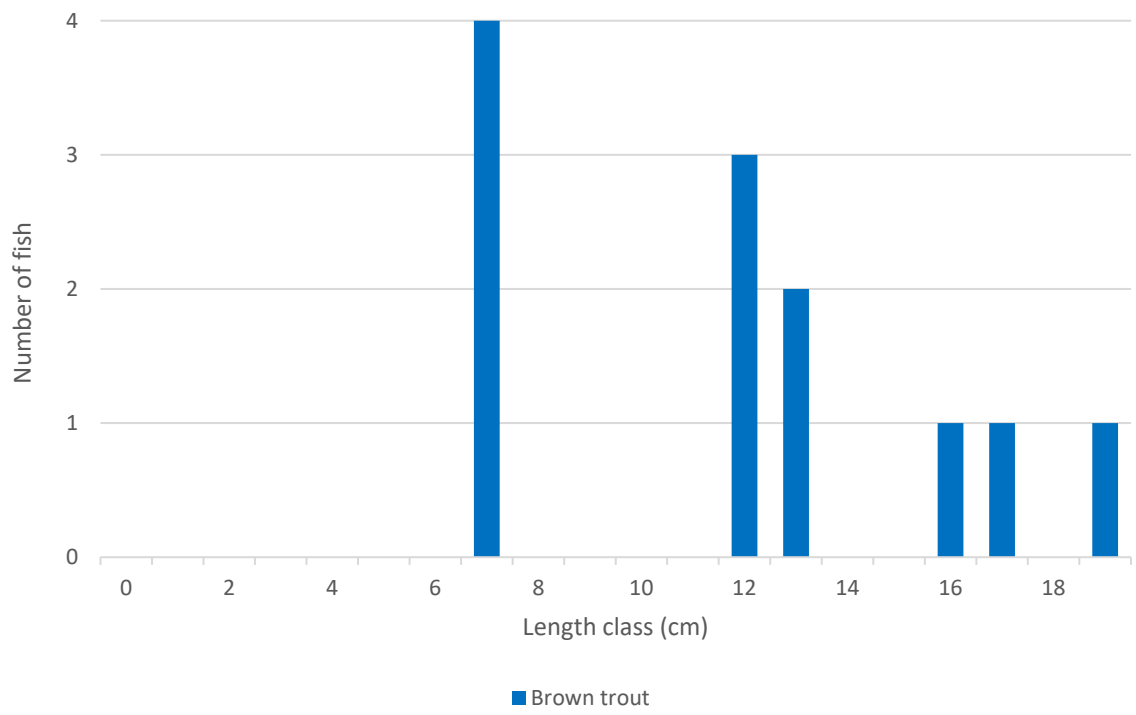


Figure 4.8 Fish stock length distribution recorded via electro-fishing at site B8 on the Argina River, Stream, Boleymaguire, Co. Leitrim in August 2019



Plate 4.9 A range of brown trout age classes were recorded from site B8 on the upper Argina River although juveniles were present in low densities

Site C1 – Owengar River, Knocknacosta

No fish were recorded during electro-fishing at site C1 in the upper Owengar River catchment. Overall, the site had little fisheries value due to its upland elevation, relatively steep gradient (especially immediately downstream) and cascading, high-energy nature

Site C1 offered poor trout nursery habitat given the shallow, small nature of the channel. The high-energy upland environment and dominance of large substrata (i.e. boulder & unstable cobble) reduced the spawning value to poor. However, the very localised pockets of coarse gravel may have facilitated some spawning by trout present downstream, despite none being recorded during the current survey. Holding value for larger fish was poor given the absence of any significant pools between boulder pocket or extensive areas of deep glide. This, however, was considered normal for an upland eroding channel of this size (i.e. smaller and shallower in nature). Salmonid remains (scales and bones likely from brown trout) were present in otter spraint sites (3 number) indicating brown trout presence in the wider channel. The site was of no importance to lamprey given the upland, high-energy nature of the site and lack of suitable soft sediment areas for larval settlement. The site provided only low value European eel potential and were not recorded during the survey.



Plate 4.10 RM electro-fishing site C1 on the upper Owengar River. No fish were captured and the river was considered largely unsuitable for resident fish at the time of survey

Site C2 – Unnamed stream, Knocknacosta

No fish were recorded during electro-fishing at site C2 in the upper Owengar River catchment. Similar to the adjacent but unconnected site C1, the site had little fisheries value due to its upland elevation, relatively steep gradient (especially immediately downstream) and cascading, high-energy nature.

The site offered poor trout nursery habitat given the shallow, small and upland nature of the channel. The high-energy upland environment and dominance of large substrata (i.e. boulder & cobble) reduced the spawning value to moderate, at best. However, the very localised pockets of coarse gravel may facilitate some spawning by upland trout that exist downstream, despite none being recorded during the current survey. Site C2 did have more gravel fractions than the nearby site C1 but the absence of juvenile trout at the site exemplified its poor nursery value. Holding value was also poor given the absence of any significant pools between boulder pockets and or extensive areas of deep glide. However, this would be considered normal for an upland eroding stream channel of this size (i.e. smaller and shallower in nature). The adjoining mature sitka spruce plantation likely reduced the viability of the spawning value for fish given a higher likelihood of acidification, despite some buffering by native scrub and willow vegetation (Triturus pers. obs.). The site was of no importance to lamprey given the upland, high- energy nature of the site and lack of suitable soft sediment areas for larval settlement. The site provided only low value European eel potential and were not recorded during the survey.

Site C3 – Owengar River, Camalt

Brown trout was the only fish species recorded at site C3 on the Owengar River (Figure 4.9). A moderate density of both juvenile and adult fish were present (total *n*=10).

Evidently, the site provided some good brown trout nursery habitat given the semi-natural profile and well-oxygenated broken flow patterns with boulder and cobble refugia. The high energy upland environment and dominance of large substrata (i.e. boulder & cobble) reduced the spawning value to moderate, at best. However, the very localised pockets of coarse gravel likely facilitated spawning by the upland, low-density trout population. Despite recent instream works related to bridge repairs (boulder revetments, two-stage channel construction etc.), holding value for larger fish was moderate given presence of some localised pools between installed boulder pockets but no extensive areas of pool or deep glide were present. This, however, would be considered normal for an upland eroding channel. The site was of little importance to lamprey given the high-energy, upland nature of the site and lack of suitable spawning and or ammocoete burial habitat. The site provided some moderate European eel potential, despite their absence from the survey.

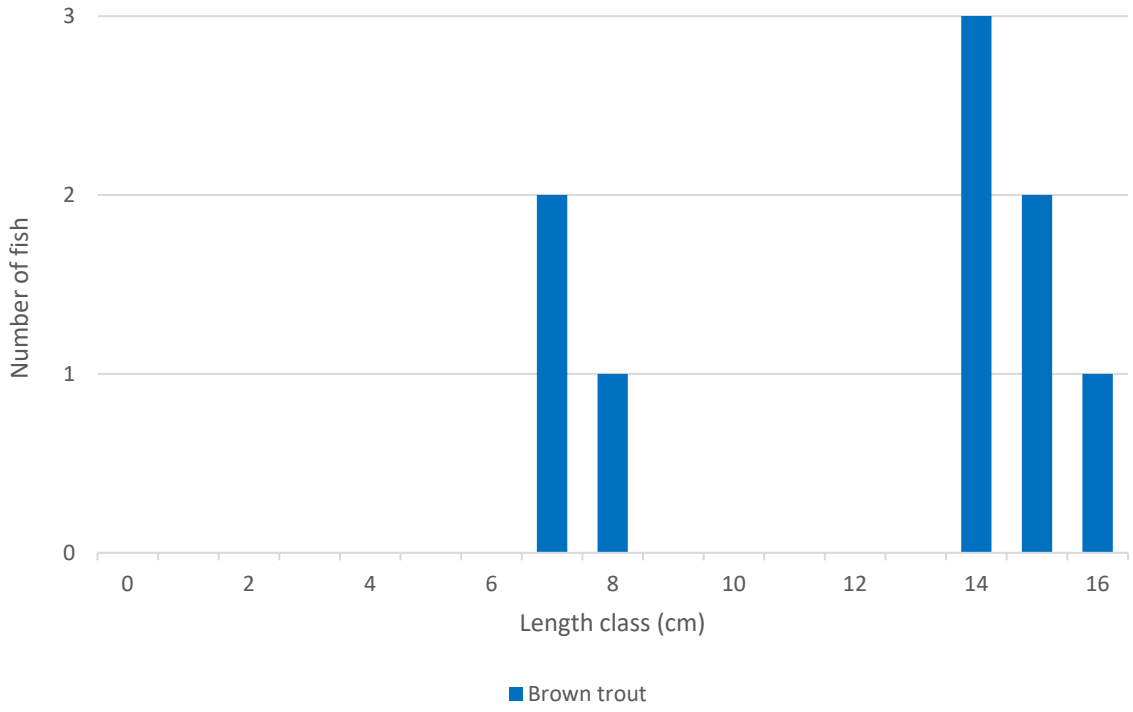


Figure 4.9 Fish stock length distribution recorded via electro-fishing at site C3 on the Owengar River, Camalt, Co. Leitrim in August 2019



Plate 4.11 A moderate density of juvenile and adult brown trout were recorded from site C3

Site D1 – Greaghnafarna River, Greaghnafarna

Whilst no electro-fishing was undertaken at site D1, a broad fisheries appraisal was made. The Greaghnafarna River at site D1, downstream of the confluence, offered good nursery habitat for salmonids. However, spawning was moderate (at best) given the compacted/bedded and larger size of harder substrata as result of high-energy flows. Deeper pools for holding were also limited in their distribution, although this improved downstream of the site in a more tunnelled section. Upstream of the confluence, the eastern channel (unnamed) had been dammed historically at a farm access track and upstream fish passage was not provided (>1m high barrier). Lamprey habitat in terms of finer spawning substrata was scarce to absent with the only soft sediment present being sand-dominated, compacted, localised and not considered suitable for ammocoete burial. European eel habitat was considered moderate given the general lack of deeper pools and accessible instream refugia.

Site D2 – unnamed channel, Rathrower

Whilst no electro-fishing was undertaken at site D2, a broad fisheries appraisal was made. Site D2 offered little if any fisheries value for salmonids. The drainage channel was heavily silted with any harder substrata present bedded in peat, resulting in a lack of spawning habitat for both salmonids and lamprey. Flow rates and water levels were low (even after heavy rainfall) and this likely precluded lamprey. The site had some moderate potential for three-spined stickleback. European eel may have used the channel for migratory purposes, in season. Despite higher flow rates, the small unnamed stream adjoining the site from the north also offered poor overall fisheries value given the very shallow depth and silted/bedded nature of the channel.

Site D3 – Rathgeean River, Drumee

Whilst no electro-fishing was undertaken at site D3, a broad fisheries appraisal was made. The site featured a lack of deeper pooling areas which reduced the value for supporting resident salmonids in such a small, shallow watercourse. Spawning habitat was also poor given the silted, bedded (peat) nature of the substrata. Nursery habitat was also poor overall although the stream did offer some low suitability for brown trout. The generally high-energy, non-depositing characteristics of the site (except for localised bedded peat) greatly reduced the value for larval lamprey, which were considered unlikely to be present. White-clawed crayfish remains were recorded in otter spraint underneath the bridge structure which indicated some suitability and presence locally. Sweep netting of limited boulder refugia failed to reveal any live crayfish at the site. The Rathgeean Stream offered some moderate potential for European eel, especially as a migratory route.

4.2 Fisheries habitat

Salmonids

Given the range of physical differences between sites, the quality of salmonid habitat varied across the *n*=24 locations assessed (Table 4.1). Whilst *n*=9 sites achieved 'good' Life Cycle Unit score, *n*=5 were moderate and *n*=10 graded as 'poor' based on combinations of spawning, nursery and holding habitat. No sites achieved 'excellent' Life Cycle Unit scores, i.e. optimal spawning, nursery and holding. In general, smaller more upland watercourses received higher (worse) scores given their lack or even absence of suitable spawning substrata and nursery habitat resulting from higher gradients, higher-energy flows and spate nature.

Table 4.1 Summary of the salmonid Life Cycle Unit scores for the sites surveyed in the footprint of Croagh wind farm, August 2019 (after Kennedy, 1984; O Connor & Kennedy, 2002). *sites D1, D2 & D3 were Q-sampling sites only

Site	Salmonid habitat value	Spawning	Nursery	Holding	Total Score	Salmonids recorded
A1	Poor	4	4	4	**12**	No
A2	Poor	4	4	4	**12**	No
A3	Poor	4	4	4	**12**	No
A4	Moderate	4	3	2	**9**	Yes
A5	Good	3	3	2	**8**	Yes
A6	Good	3	3	2	**8**	Yes

Site	Salmonid habitat value	Spawning	Nursery	Holding	Total Score	Salmonids recorded
A7	Good	3	2	2	**7**	Yes
A8	Moderate	4	3	3	**10**	No
A9	Moderate	4	3	3	**10**	No
A10	Good	3	3	2	**8**	Yes
B1	Poor	4	4	4	**12**	No
B2	Poor	4	4	4	**12**	No
B3	Moderate	4	3	3	**10**	No
B4	Good	3	2	2	**7**	Yes
B5	Good	4	2	1	**7**	Yes
B6	Poor	4	4	4	**12**	No
B7	Poor	4	4	4	**12**	No
B8	Good	3	2	2	**7**	Yes
C1	Poor	4	4	4	**12**	No
C2	Poor	3	4	4	**12**	No
C3	Good	3	2	3	**8**	Yes
D1*	Good	3	2	3	**8**	n/a
D2*	Poor	4	4	4	**12**	n/a
D3*	Moderate	3	3	3	**9**	n/a

Lower scores indicate superior habitat. n/a = site not electro-fished

Lamprey species

Lamprey habitat was almost universally poor across all survey sites in the footprint of Croagh wind farm and cable route (Table 4.2). Suitable spawning habitat by way of finer, unbedded gravels were absent from almost all sites, with the only exception being site A6 (Killanummery Stream, moderate quality habitat present). Finer sediment (silt) accumulations suitable for larval (ammocoete) settlement were absent from all sites surveyed. No lamprey were recorded during electro-fishing across *n*=21 sites and no records were available for any lamprey species in the watercourses surveyed.

Table 4.2 Lamprey Habitat Quality Index (LHQI) scoring system for lamprey habitat value for the sites surveyed in the footprint of Croagh wind farm and cable route, Co. Leitrim (Macklin et al., 2018), adapted from Kennedy (1984). Habitat type for ammocoetes is assessed according to Applegate (1950) and Slade et al. (2003).

Site	Lamprey habitat value	Spawning	Nursery	Total Score	Lamprey recorded	Habitat type present
A1	Poor	4	4	**8**	No	Type 3
A2	Poor	4	4	**8**	No	Type 3
A3	Poor	4	4	**8**	No	Type 3
A4	Poor	4	4	**8**	No	Type 3
A5	Poor	4	4	**8**	No	Type 3
A6	Moderate	3	4	**7**	No	Type 3
A7	Poor	4	4	**8**	No	Type 3
A8	Poor	4	4	**8**	No	Type 3
A9	Poor	4	4	**8**	No	Type 3
A10	Poor	4	4	**8**	No	Type 3
B1	Poor	4	4	**8**	No	Type 3
B2	Poor	4	4	**8**	No	Type 3

Site	Lamprey habitat value	Spawning	Nursery	Total Score	Lamprey recorded	Habitat type present
B3	Poor	4	4	**8**	No	Type 3
B4	Poor	4	4	**8**	No	Type 3
B5	Poor	4	4	**8**	No	Type 3
B6	Poor	4	4	**8**	No	Type 3
B7	Poor	4	4	**8**	No	Type 3
B8	Poor	4	4	**8**	No	Type 3
C1	Poor	4	4	**8**	No	Type 3
C2	Poor	4	4	**8**	No	Type 3
C3	Poor	4	4	**8**	No	Type 3
D1	Poor	4	4	**8**	No	Type 3
D2	Poor	4	4	**8**	No	Type 3
D3	Poor	4	4	**8**	No	Type 3

*lower scores indicate superior habitat. n/a = site not electro-fished

European eel

European eel habitat quality was typically poor across the survey sites and no eels were recorded at any site via electro-fishing. Many sites were considered sub-optimal (or in some cases even unsuitable) for the species given the often-high gradients, high-energy profiles and typically upland nature of the channels. However, some moderate to good suitability was present across the larger watercourses (Killanummery Stream, Owengar River), especially in terms of seasonal migratory value (despite their absence from electro-fishing efforts).

4.3 White-clawed crayfish

No white-clawed crayfish were recorded via trapping or sweep netting surveys across the *n*=21 sites in the footprint of Croagh and cable route wind farm. However, crayfish remains were recorded in otter spraint under bridges at sites A7 on the Killanummery Stream (Plate 4.4) and site D3 on the Rathgeean River. These were recorded in otter spraint and thus likely originated from a downstream population given that ranges of male otter can extend up to 20km.

There were no existing records for white-clawed crayfish in the watercourses within the footprint of the proposed Croagh wind farm development. The nearest records were available for the Douglas and Feorish Rivers approx. 4km south/southwest of the catchment and the Bonnet River near Dromahair (approx. 6km north), as well as the River Shannon catchment upstream of Lough Allen (NBDC, 2019).



Plate 4.12 Crayfish traps at site A7 on the Killanummery River before overnight deployment. Trapping returned zero crayfish at all sites in the study area although remains were recorded in otter spraint at two sites (A7 and D3), indicating cryptically-low presence locally

4.4 Q-sampling (macro-invertebrates)

Q-samples were collected and analysed from *n*=13 sites on the Killanummery, Argina, Owengar and Tullynascreen Rivers as well as several unnamed watercourses in the wider Croagh wind farm catchment. A total of *n*=32 species across *n*=21 families were recorded in the *n*=13 kick samples collected from the Croagh catchment (see Table 4.3 & Figure 4.10 below for site locations).

Samples were collected from riffle-glide areas of channel as per standard practice (i.e. Toner et al., 2005) although sample D2 (unnamed stream, Rathrower) was considered a **tentative** Q-sample given that it was collected from semi-stagnant drainage channel habitat.

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.

Only a single sampling site (A7, Killanummery River) achieved **Q4** good status water quality, with fair numbers numbers of class A Heptageniidae stoneflies present in addition to class B Leuctridae stoneflies (*Leuctra hippopus*). The site also had EPA Class B pollution intolerant cased caddis species *Apatania muliebris* and *Drusus annulatus*. Moderate numbers of class C, pollution tolerant species such as *Gammarus duebenii* and *Potamopyrgus antipodarum* were present. As such site A7 achieved 'good status' water quality (i.e. Q-rating of 4).

Site C1 on the Owengar River had the EPA class A and B stonefly families Heptageniidae and Leuctridae present but in low numbers. This, coupled with a dominance of moderate water quality indicators (i.e. EPA class C *Gammarus dubenii*) indicated slightly polluted **Q3-4** water quality.

All of the remaining sampling sites (i.e. sites A1, A2, A4, A8, B1, B3, B8, C3, D1, D2 & D3) had an absence of EPA class A clean-water mayfly and stonefly species. Their invertebrate composition was composed of low numbers (or even absent) EPA class B invertebrate taxa such as Luectridae stonefly and Limnephilidae caddis families. Typically, they were dominated by EPA class C invertebrates such as the freshwater shrimp *Gammarus dubenii* and the widespread mayfly species, *Baetis rhodani*. As such, the biological water quality at these sites was recorded as **Q3** moderately polluted water.

No rare macroinvertebrate species were recorded from the *n*=13 samples across the Croagh wind farm catchment (summarised below). The invertebrate Q-sampling was summarised as follows at the *n*=13 sites, with only site A7 on the Killanummery Stream achieving good status **Q4** water quality as required under the Water Framework Directive (2000/60/EC) as implemented by the recently amended European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (S.I. No. 77 of 2019). These regulations specify a minimum target EQR of 0.75 or equivalent **Q4** for all rivers.

- Site A1 (Killanummery Stream) **Q3** Moderately polluted (WFD Moderate status)
- Site A2 (unnamed stream) **Q3** Moderately polluted (WFD Poor Status)
- Site A4 (Killanummery Stream) **Q3** Moderately polluted (WFD Moderate status)
- Site A7 (Killanummery Stream) **Q4** Unpolluted (WFD Good status)
- Site A8 (Tullynascreen Stream) **Q3** Moderately polluted (WFD Poor Status)

- Site B1 (Argina River) **Q3** Moderately polluted (WFD Poor Status)
- Site B3 (unnamed stream) **Q3** Moderately polluted (WFD Poor Status)
- Site B8 (Argina River) **Q3** Moderately polluted (WFD Poor Status)
- Site C1 (Owengar River) **Q3-4** Slightly polluted (WFD Moderate Status)
- Site C3 (Owengar River) **Q3** Moderately polluted (WFD Poor Status)
- Site D1 (Greaghnafarna River) **Q3** Moderately polluted (WFD Poor Status)
- Site D2 (unnamed stream) **Q3** Moderately polluted (WFD Poor Status)
- Site D3 (Rathgeean River) **Q3** Moderately polluted (WFD Poor Status)

Table 4.3 Macro-invertebrate composition & associated Q-ratings for *n*=13 sites in the footprint of Croagh wind farm near Drumkeeran, Co. Leitrim (August 2019)

Group	Species	Common name	Site A1	Site A2	Site A4	Site A7	Site A8	Site B1	Site B3	EPA Class
Heptageniidae	*Heptagenia sulphurea*	Stonefly				7				A
Leuctridae	*Leuctra hippopus*	Stonefly		2		4				B
Leuctridae	*Leuctra moselyi*	Stonefly								B
Ephemerellidae	*Seratella ignita*	Blue winged olive								C
Baetidae	*Baetis rhodani*	Dark olive			3	1	12	3	9	C
Ephemerellidae	*Seratella ignita*	Blue winged olive								C
Goeridae	*Goera pilosa*	Cased caddis						1		B
Limnephilidae	*Apatania muliebris*	Cased caddis	2			1				B
Limnephilidae	*Drusus annulatus*	Cased caddis				2				B
Limnephilidae	*Micropterna sequax*	Cased caddis								C
Limnephilidae	*N/D early instar*	Cased caddis							1	B
Ryacophilidae	*Ryacophila dorsalis*	Caseless caddis			1					C
Polycentropodidae	*Polycentropus flavomaculatus*	Caseless caddis				3				C
Polycentropodidae	*Plectronemia geniculata*	Caseless caddis					2	6		C
Gammaridae	*Gammarus duebenii*	Freshwater shrimp	27	9	6	8				C
Elmidae	*Elmis aenea*	Riffle beetle	3	1						C
Elmidae	*Limnius volckmari*	Riffle beetle				4		1		C
Elmidae	*Oulimnius parallelepidus*	Riffle beetle								C
Dytiscidae	*Agabus bipustulatus*	Water beetle						1		C
Dytiscidae	*Oreodytes sanmarkii*	Water beetle								C
Dytiscidae	*Dytiscid larvae early instar*	Water beetle							1	C

Group	Species	Common name	Site A1	Site A2	Site A4	Site A7	Site A8	Site B1	Site B3	EPA Class
Ancylidae	*Ancylus fluviatilis*	River limpet				2				None
Sphaeriidae	*Sphaerium corneum*	Horny orb mussel						1		D
Hydrobiidae	*Potamopyrgus antipodarum*	Jenkin's spire snail				13				C
Erpobdellidae	*Erpobdella octoculata*	Leech								D
Simuliidae	*Simulium sp.*	Blackfly		1	4		6			C
Chironomidae	n/d (Tanypodinae subfamily)	Non-biting midge				2				C
Chironomidae	n/d (Chironominae subfamily)	Non-biting midge							1	C
Pediciidae	*Dicranota sp.*	Cranefly larvae			1		2			C
Tubificidae	*Limnodrilus sp.*	Worm		2	1			1		D
Lumbricidae	*Eiseniella tetraedra*	Worm					1		2	n/a
Veliidae	*Velia sp.*	Small water slider					1	1		C
Taxon richness (*n*)			**3**	**5**	**6**	**11**	**6**	**8**	**5**	
Q-rating			**Q3**	**Q3**	**Q3**	**Q4**	**Q3**	**Q3**	**Q3**	
WFD status			**Poor**	**Poor**	**Poor**	**Good**	**Poor**	**Poor**	**Poor**	

Table 4.3 (continued) Macro-invertebrate composition & associated Q-ratings for *n*=13 sites in the footprint of Croagh wind farm near Drumkeeran, Co. Leitrim (August 2019)

Group	Species	Common name	Site B8	Site C1	Site C3	Site D1	Site D2	Site D3	EPA Class
Hetageniidae	*Heptagenia sulphurea*	Stonefly		1					A
Leuctridae	*Leuctra hippopus*	Stonefly							B
Leuctridae	*Leuctra moselyi*	Stonefly	3	4	3			3	B
Ephemerellidae	*Seratella ignita*	Blue winged olive			5				C
Baetidae	*Baetis rhodani*	Dark olive	2		8	8			C
Ephemerellidae	*Seratella ignita*	Blue winged olive							C
Goeridae	*Goera pilosa*	Cased caddis				1			B
Limnephilidae	*Apatania muliebris*	Cased caddis							B
Limnephilidae	*Drusus annulatus*	Cased caddis							B
Limnephilidae	*Micropterna sequax*	Cased caddis				2			C
Limnephilidae	*N/D early instar*	Cased caddis			1				B
Ryacophilidae	*Ryacophila dorsalis*	Caseless caddis		2	2				C
Polycentropodidae	*Polycentropus flavomaculatus*	Caseless caddis			1				C
Polycentropodidae	*Plectronemia geniculata*	Caseless caddis		1		1			C
Gammaridae	*Gammarus duebenii*	Freshwater shrimp	5	12	3	22	103	16	C
Elmidae	*Elmis aenea*	Riffle beetle						2	C
Elmidae	*Limnius volckmari*	Riffle beetle					2	7	C
Elmidae	*Oulimnius parallelepidus*	Riffle beetle						3	C
Dytiscidae	*Agabus bipustulatus*	Water beetle							C

Group	Species	Common name	Site B8	Site C1	Site C3	Site D1	Site D2	Site D3	EPA Class
Dytiscidae	*Oreodytes sanmarkii*	Water beetle	1						C
Dytiscidae	*Dytiscid larvae early instar*	Water beetle							C
Ancylidae	*Ancylus fluviatilis*	River limpet		2	5	2		3	None
Sphaeriidae	*Sphaerium corneum*	Horny orb mussel							D
Hydrobiidae	*Potamopyrgus antipodarum*	Jenkin's spire snail						31	C
Erpobdellidae	*Erpobdella octoculata*	Leech			1				D
Simuliidae	*Simulium sp.*	Blackfly							C
Chironomidae	n/d (Tanypodinae subfamily)	Non-biting midge							C
Chironomidae	n/d (Chironominae subfamily)	Non-biting midge							C
Pediciidae	*Dicranota sp.*	Cranefly larvae			2				C
Tubificidae	*Limnodrilus sp.*	Worm	3						D
Lumbricidae	*Eiseniella tetraedra*	Worm	1	1					n/a
Veliidae	*Velia sp.*	Small water slider							C
Taxon richness (*n*)			**6**	**7**	**10**	**6**	**2**	**7**	
Q-rating			**Q3**	**Q3-4**	**Q3**	**Q3**	**Q3[2]**	**Q3**	
WFD status			**Poor**	**Moderate**	**Poor**	**Poor**	**Poor**	**Poor**	

[2] Site D2 was a **tentative** Q-sample, taken from semi-stagnant glide habitat, and, as such, should be interpreted with caution

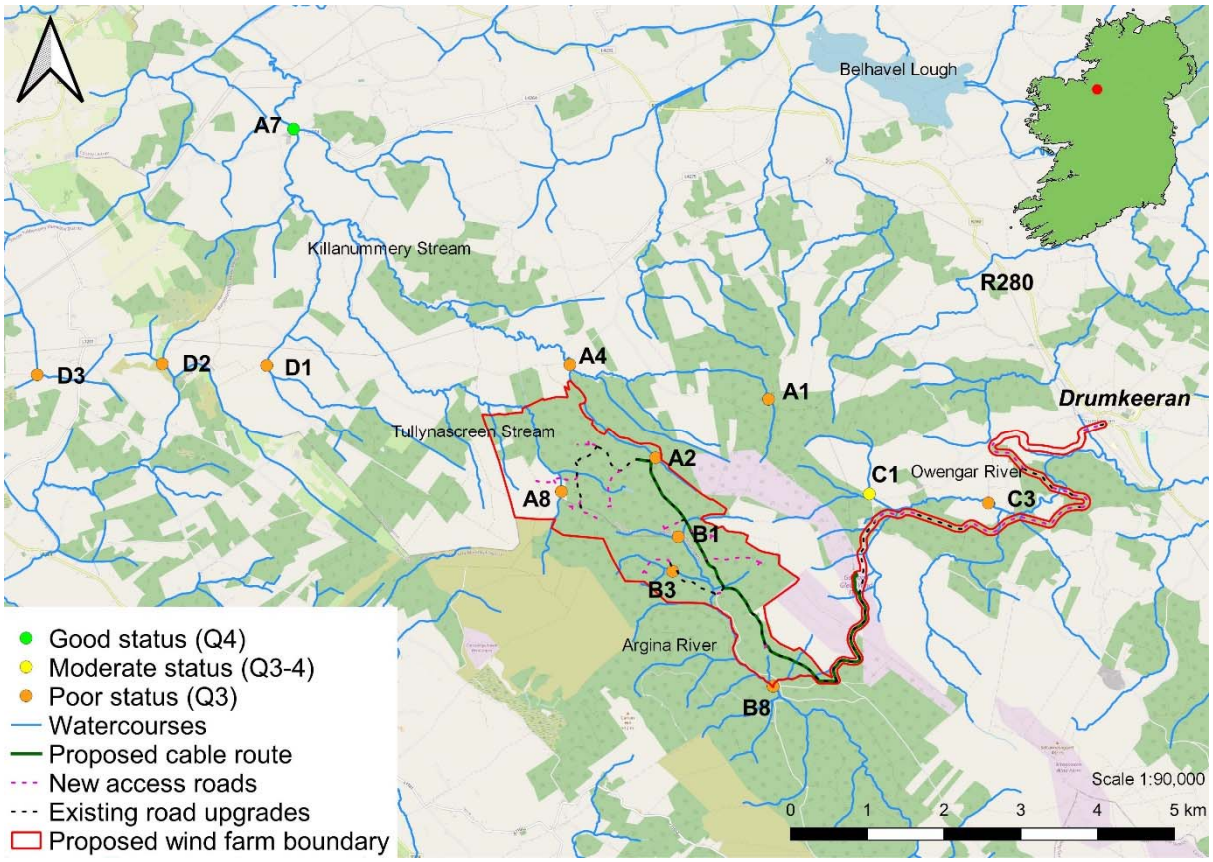


Figure 4.10 Water quality (WFD) status of the *n*=13 Q-sampling sites sampled in the footprint of the proposed Croagh wind farm, Co. Leitrim (August 2019)

5. Discussion

5.1 Most and least valuable sites

Salmonids

Atlantic salmon were only recorded from one site (A6, Killanummery Stream), with brown trout composing over 90% of all fish captured across all sites. Salmonid habitat across the *n*=24 survey sites ranged from poor to good according to Life Cycle Unit scores (Table 4.1) with their potential determined by a number of factors, mostly relating to physical site characteristics. Whilst *n*=9 sites achieved 'good' Life Cycle Unit scores, *n*=5 were moderate and *n*=10 graded as 'poor' based on combinations of spawning, nursery and holding habitat. No sites achieved 'excellent' Life Cycle Unit scores, i.e. optimal spawning, nursery and holding.

In general, smaller more upland watercourses received higher (worse) scores given their lack or even absence of suitable spawning substrata and nursery habitat resulting from higher gradients, higher-energy flows and spate natures. Some sites which offered good or excellent adult holding habitat (e.g. A4-A7, B4, B5, B8 etc.) would have received better overall scores had spawning, and to a lesser extent, nursery habitat been superior. Stream gradient is known to be one of the principal determinants of juvenile salmonid production, with medium gradients most optimal in terms of successful recruitment and population persistence (Wood & Budy, 2009; O'Grady, 2006; Amiro, 1993; Kennedy & Strange, 1982). As would be expected in upland catchments exposed to pressures from afforestation and peat escapement (see below), the lower reaches of the Killanummery Stream, Argina River and Owengar River sub-catchments typically offered better quality salmonid habitat and supported higher densities of salmonids.

A total of 57% of *n*=21 electro-fishing sites did not support resident fish (any species) at the time of survey. These sites were located in upland areas and invariably featured high-energy flows exposed to regular spate conditions, often flowing over moderate to steep gradients. Upstream fish access for salmonids was difficult or blocked entirely due to such physical characteristics in several cases e.g. sites A1, A2, A3, C1, C2 etc.

Many of the watercourses surveyed were small, shallow, high-energy, upland eroding streams draining afforested and or blanket bog areas. These featured cobble/boulder-dominated substrata which were often bedded in peat and had a lack (not absence) of finer gravels for spawning. Smaller gravel fractions are vital in structuring salmonid populations (Meredith et al., 2017; Hudy et al., 2010), being necessary for successful spawning and egg development, and there is generally a strong correlation between the availability of spawning substrata and the size of populations (Montgomery et al., 1999). Additionally, peat-based catchments such as that in the vicinity of Croagh wind farm are less productive than those flowing over other geologies (O'Grady, 2006), with reduced primary productivity, reduced macro-invertebrate communities, and, generally speaking, lower fish biomass (Richardson, 1993). This can also be validated from the invertebrate samples collected in the current study that typically had lower overall diversity of species and also densities (pers. obs.). Channels with higher proportions of peat substrata can also suffer from increased siltation and bedding (compaction) of instream gravels and cobbles necessary for salmonid spawning, further limiting local populations.

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). Peat escapement would appear to be impacting salmonid recruitment in numerous channels across the Croagh catchment, given lower-than-expected densities of trout parr at several sites on the Killanummery Stream, Tullynascreen River and Argina River.

The loss of dissolved organic carbon (DOC) is a phenomenon also associated with peat catchments and can result in changes (reductions) in pH and general ecosystem processes (Feeley et al., 2016), leading to reduced fish biomass and recruitment. Furthermore, clear-felling (as recorded in the upper Argina River catchment) is known to contribute greatly to DOC loss in peat catchments, impacting Atlantic salmon in particular (Harrison et al., 2014). Coniferous afforestation can also have various impacts on water quality and salmonid populations, namely through a reduction in water pH (increased acidity), increases in heavy metal concentrations and eutrophication (Giller & O'Halloran, 2004; Lehane et al., 2004; Graham et al., 2010). The impacts from afforestation can influence fish survival and growth and are typically most marked in winter and spring, when salmonids are at their most vulnerable life stages (Giller & O'Halloran, 2004). This may be a factor impacting salmonid populations of several watercourses throughout the wider Croagh catchment.

Biological water quality was typically of Q3 (poor status) across the survey sites, with only sites A6 on the Killanummery Stream and C3 on the Owengar River offering improved water quality (Q4 and Q3-4, respectively). Site A6 on the Killanummery Stream was the only river site meeting the Water Framework Directive (i.e. ≥Q4) and Surface Water Regulations (S.I. No. 77/2019)(ammended) standards (i.e. EQR good ≥0.75). The abundance of salmonids (especially Atlantic salmon as opposed to brown trout) is more stable at better quality sites (≥Q4), with salmon populations tending to oscillate due to fry abundance 'pulses' at moderate quality sites (i.e. Q3-4) (Kelly et al., 2007; Champ et al., 2009). As such, the paucity of Atlantic salmon in all but one survey site, as well as the predominance of Q2-3 tolerant brown trout, is perhaps unsurprising given the observed biological water quality results.

Lamprey species

Lamprey habitat was assessed as poor across almost all *n*=24 survey sites in the footprint of Croagh wind farm (Table 4.2), with the only exception being site A6 on the Killanummery Stream. Generally, survey sites were located on upland watercourses not considered suitable for lamprey species. Suitable spawning habitat by way of finer, unbedded gravels were absent from all sites apart from site A6. Additionally, finer sediment accumulations suitable for larval (ammocoete) settlement were absent given the high-energy nature of the sites. The majority of sites represented upland eroding watercourses and naturally such sites do not encourage the deposition of fine, organic rich sediment required by larval lamprey (Goodwin et al., 2008; Aronsuu & Virkkala, 2014). Invariably, any finer sediment present was typically sand-dominated and or compacted/bound in peat. Typically, *Lampetra* spp. are not present in sites with average water velocities of >0.5m/s (Taverney et al., 2012) – many of the Croagh survey sites were considered to exceed this (no flow rate data available). No lamprey were recorded during electro-fishing across *n*=21 sites and no records existed for any lamprey species in the watercourses surveyed.

European eel

No European eels were recorded across the *n*=21 electro-fishing sites and overall habitat quality was typically poor. On both a global and Irish scale the species is listed as 'critically endangered' (Jacoby & Gollock, 2014; King et al., 2011).

While eels are known for their remarkable ability to often climb and navigate even near-vertical structures as juveniles (glass eels, Watz et al., 2019; Tamario et al., 2019; Podgorniak et al., 2015), many sites were considered sub-optimal or even unsuitable for the species given the often high gradients, high-energy profiles and typically upland nature of the channels. The lower reaches of the Killanummery Stream, Argina River and, to a lesser extent the Owengar River, provided the best potential eel habitat overall, despite their apparent absence at the time of survey. However, given the life history of European eels, even sub-optimal (e.g. drainage channel or high-energy sites) may be utilised by the species as seasonal migration routes (i.e. adult migration seawards, usually from September/October onwards).

White-clawed crayfish

No white-clawed crayfish were recorded via trapping or sweep netting surveys across *n*=21 sites assessed in the footprint of Croagh wind farm. However, crayfish remains were recorded in otter spraint under bridges at sites A7 on the Killanummery Stream and site D3 on the Rathgeean River. Mustelid spraint surveys can help identify crayfish when present at cryptically low densities (Triturus pers. obs.). Previous studies in the wider catchment (IFI, 2016) noted that crayfish were absent from the upper reaches of the Killanummery although our record from the underneath the bridge at Killanummery suggests the species may be present further upstream than previously thought. It appears that crayfish are absent from the study area given conditions inimical to their survival (i.e. unsuitable geology, peatland afforested catchments & high energy channels). As stated however, the species may occur at locations further downstream where conditions improve (i.e. lower gradient channels with influences from geological changes with higher pH and alkalinity).

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Peatland Enhancement and Biodiversity Management Plan

Croagh Wind Farm, Co. Leitrim & Co. Sligo



DOCUMENT DETAILS

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1. INTRODUCTION

1.1 Background

The proposed Croagh windfarm will result in the loss of approximately 0.38 hectares of peatland habitat that has been classified as conforming to the EU Habitats Directive Annex I habitat; Blanket Bog [7130]. However, this habitat does not form part of any Special Area of Conservation (SAC). The habitat loss is associated with a single turbine, Turbine no. 1. The drainage plan for the site has been specifically designed to limit the extent of impacts outside the immediate footprint of this turbine as much as possible. The proposed development layout is provided in Figure 1.1.

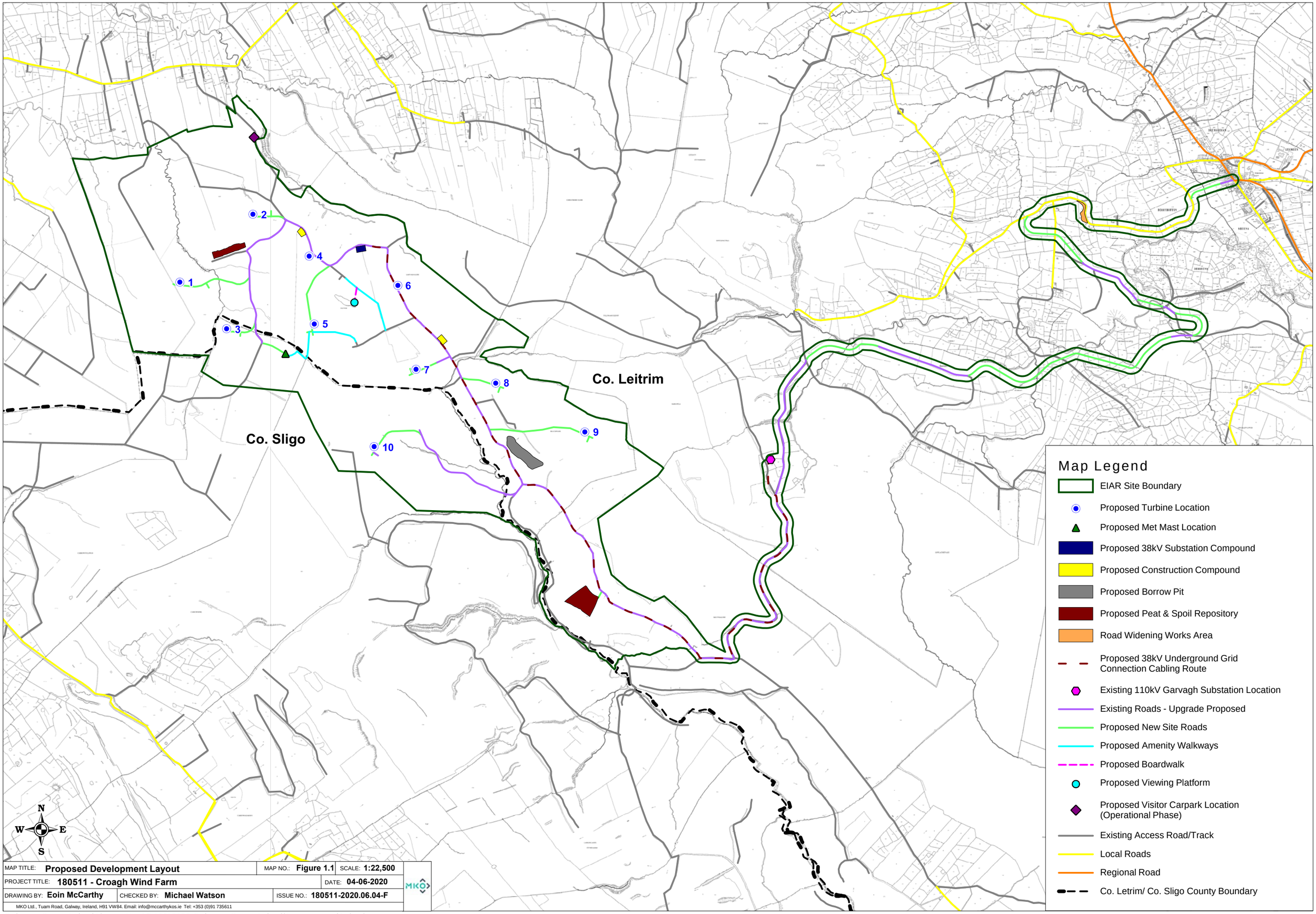
The area that will be lost, or degraded through drainage, to facilitate Turbine no. 1 will be compensated for in full by felling an equivalent area of land where conifers have been planted on blanket bog habitat. In addition, an area of blanket bog adjoining the proposed restoration area will also be enhanced through the implementation of drain blocking and encroaching conifers. This blanket bog covers an area of 3.74 hectares within the Coillte landholding. The establishing conifers on this area of bog have spread as a result of natural seed dispersal from the nearby plantation forestry, see Plate 1.1. Both the replacement area and enhancement area are provided in Figure 1.2. The combination of enhancing 3.74 hectares of degraded blanket bog (due to drainage and establishing conifers, growing as a result of natural seed dispersal) and locating the proposed compensation area of 0.38 hectares adjacent to this aims, to maximise the potential overall biodiversity benefits associated with the restoration plan.



Plate 1.1 Area of blanket bog identified for enhancement, drain blocking and coniferous tree removal, located to the north of T7.

The bog restoration programme will be implemented in accordance with the published guidelines and best practice such as the guidelines arising from the EU–LIFE/Coillte '*Irish Blanket Bog Restoration Project*" (2002-2007)', Scottish Natural Heritage (SNH)'s guidance note Planning for development: *What to consider and include in Habitat Management Plans* (Version 2, January 2014).

The areas to be restored will be located where forestry is to be felled to facilitate Turbine no. 7 and will be equal to or greater than the area lost to facilitate the Turbine no. 1.



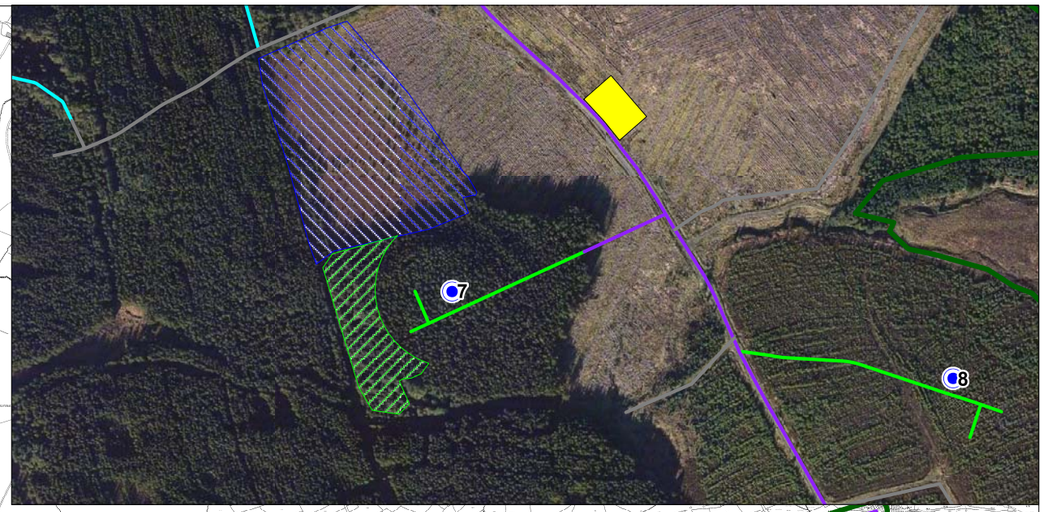
Map Legend

- EIAR Site Boundary
- Proposed Turbine Location
- Proposed Met Mast Location
- Proposed 38kV Substation Compound
- Proposed Construction Compound
- Proposed Borrow Pit
- Proposed Peat & Spoil Repository
- Road Widening Works Area
- Proposed 38kV Underground Grid Connection Cabling Route
- Existing 110kV Garvagh Substation Location
- Existing Roads - Upgrade Proposed
- Proposed New Site Roads
- Proposed Amenity Walkways
- Proposed Boardwalk
- Proposed Viewing Platform
- Proposed Visitor Carpark Location (Operational Phase)
- Existing Access Road/Track
- Local Roads
- Regional Road
- Co. Letrim/ Co. Sligo County Boundary

MAP TITLE: **Proposed Development Layout**		MAP NO.: **Figure 1.1**	SCALE: **1:22,500**
PROJECT TITLE: **180511 - Croagh Wind Farm**			DATE: **04-06-2020**
DRAWING BY: **Eoin McCarthy**	CHECKED BY: **Michael Watson**	ISSUE NO.: **180511-2020.06.04-F**	

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Map Legend

- Peatland Restoration Area
- Peatland Rehabilitation Area
- Proposed Turbine Location
- Proposed Met Mast Location
- Existing 110kV Garvagh Substation Location
- Existing Roads - Upgrade Proposed
- Proposed New Site Roads
- Line
- Proposed Amenity Walkway
- Proposed Boardwalk
- Proposed 38kV Substation Compound
- Proposed Visitor Carpark Location (Operational Phase)
- Road Widening Works Area
- Proposed Peat & Spoil Repository
- Proposed Construction Compound
- Proposed Borrow Pit
- Existing Access Road/Track
- Proposed Viewing Platform
- EIAR Site Boundary

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MAP TITLE: **Location of replacement and enhancement areas**	MAP NO.: **Figure 1.2**	SCALE: **23,500**
PROJECT TITLE: **180511 - Croagh Wind Farm**		DATE: **30-06-2020**
DRAWING BY: **DMN**	CHECKED BY: **PR**	ISSUE NO.: **180511-2020.06.30-D1**

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1.1.1 Statement of Authority

This report has been prepared by David McNicholas and Pat Roberts (B.Sc. Environmental Science, MCIEEM). David McNicholas has over 9 years' professional ecological consultancy experience and is a full member of the Chartered Institute of Ecology and Environmental Management. Pat has over 14 years' experience in ecological management and assessment. The baseline ecological surveys were undertaken by David McNicholas (BSc., MSc., MCIEEM) and James Owens (BSc., MSc). James has over 4 years' consultancy experience and is a competent expert in undertaking ecological surveys.

2. MANAGEMENT PRESCRIPTIONS

2.1 Management techniques

2.1.1 Measures to be implemented within the peatland replacement area

The management techniques to be undertaken within the replacement area located around Turbine no. 7 are as follows:

- All coniferous forestry will be felled.
- Drains will be blocked, where appropriate, using peat dams or plastic dams, see Plate 2.1 & 2.2.
- The planting of forestry will not be permitted in this area.
- No vehicular access will be permitted to or within the dedicated peatland reinstatement area once all initial works are completed.
- Self-seeded conifers from adjacent conifer plantation areas will be cleared and removed (by hand or brushcutter) from the newly created peatland reinstatement areas on an ongoing basis, following the felling of the existing forestry.
- Peat extraction within the proposed peatland reinstatement area will not be permitted.
- Burning and dumping will not be permitted.



Plate 2.1 Example of peat dams to be used for on-site drain blocking.



Plate 2.2 Example of plastic dams to be used for on-site drain blocking.

2.1.2 Management measures to be implemented within the peatland enhancement area

The management techniques to be undertaken within the peatland enhancement area will include:

- Drains within and adjacent to the enhancement area will be blocked using peat dams or plastic dams.
- Self-seeded conifers that have established within this area of peatland from the adjacent conifer plantation will be cleared and removed (by hand or brushcutter). This will continue on an ongoing basis, following the implementation of the plan and any subsequent new growth.
- No vehicular access will be permitted to or within the peatland enhancement area once all initial works are completed.
- The planting of forestry will not be permitted in this area.
- Peat extraction within the proposed enhancement area will not be permitted.
- Burning and dumping will not be permitted.

2.2 Timing of Works

Replacement works will be conducted in line with the provisions of the Wildlife Acts 1979-2012 as amended.

2.3 Monitoring

The plan will be the subject of ongoing monitoring to assess the effectiveness of the measures proposed and employed and to contribute to advances in habitat management methods, which can be applied to future similar projects. The monitoring measures will include:

- Vegetation sampling: A number of fixed relevé sites (i.e. permanent quadrats) will be set up in areas where active management is proposed of previously forested areas. Baseline data will be recorded prior to the commencement of habitat management activities set out in this outline plan. The character of each relevé will be recorded (e.g. species proportions present, vegetation

structure and height) and photographs will be taken of each relevé from a fixed point. These relevés will then be re-examined during years 1, 2, 3, 5, 10, 15 and 25 following commencement of the plan in place in order to establish the extent of habitat improvement resulting from management practices.

- Hydrological monitoring: Water levels within areas where drains are blocked will be recorded quarterly for two years. A number of phreatic stand pipes will be installed (prior to restoration) to allow monitoring of water levels within both the restoration and enhancement areas. In this way, any positive impacts on the local hydrology can be verified and quantified.

The efficacy of the habitat rehabilitation and enhancement measures employed will be reviewed in years 1, 2, 3, 5, 10, 15 and 25 following commencement of the plan on the basis of the results of vegetation sampling and water level readings from the managed areas. Analysis of the data collected will be the basis for a review of the measures and techniques employed.

2.4 Reporting

Reports detailing the monitoring works carried out, the results obtained and a review of their success, along with any suggestions for amendments to the plan will be prepared and submitted to the planning authority in years 1, 2, 3, 5, 10, 15 and 25 following commencement of the plan's implementation.

3. BIODIVERSITY ENHANCEMENT MEASURES

3.1 Native Tree Planting

As part of the proposed amenity walkway infrastructure incorporated into the proposed project, as fully described in Chapter 4 of the EIAR, it is proposed to include native tree planting along this linear infrastructure. It is proposed to plant a 5-meter-wide strip on either side of the infrastructure. This will result in the creation of approximately 3 kilometers of native tree planting along the proposed amenity walkway'. An example of where native broadleaf tree species occur as a corridor along a forestry access track is provided in Plate 3.1.



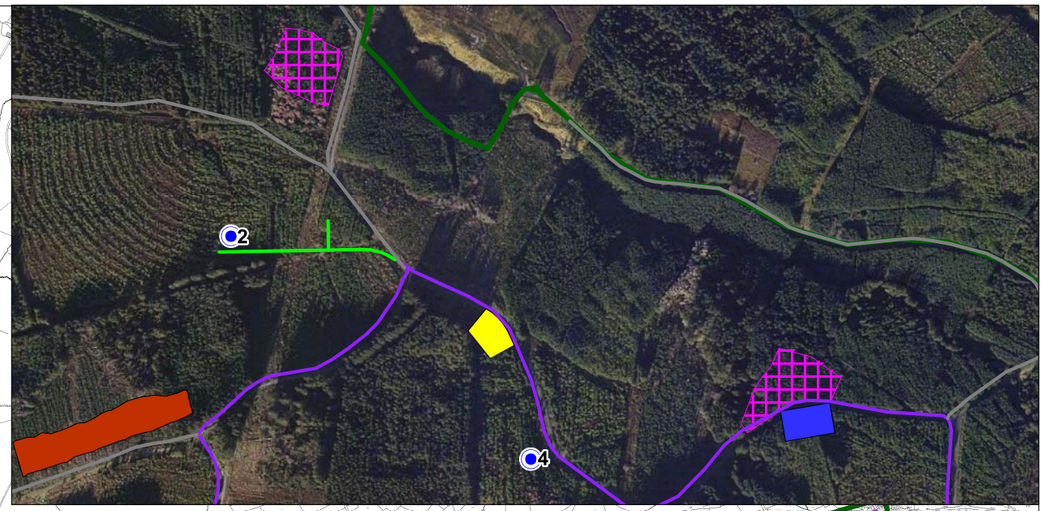
Plate 3.1 Example of native willow's (Salix sp.) growing along a forestry access track. The proposed planting will be broader and more continuous, providing a commuting corridor for local faunal species.

The native tree species chosen for planting along the amenity infrastructure will include species already occurring in the wider area, as well as species adapted to establishing in upland acidic soils. For this reason, it is proposed to plant a mix of roan (*Sorbus aucuparia*), willow (*Salix* spp.), Scots pine (*Pinus sylvestris*), birch (*Betula pendula*) and hawthorn (*Crataegus monogyna*).

The planting of native woodland as part of the amenity aspect of the proposed development will enhance biodiversity locally as the species proposed are native, provide flowering plants for pollinators and seed for a wide variety of wintering bird and other faunal species.

In addition to planting along the amenity access tracks, it is also proposed to plant an additional two areas of broadleaf woodland comprising of 6,598.3 m^2 & 6,914.3 m^2. The location of these are shown in Figure 3.1. This equates to over 13,512.6 m^2 or 1.35 hectares of native broadleaf woodland planting

within the site. This will provide a greater cover of native broadleaf woodland in the area. Such additional broadleaf woodland will contribute to a biodiversity net gain associated with the proposed development as well as the enhancement of the recreation and amenity walks proposed.



Map legend

- Proposed broadleaf woodland planting
- Peatland Rehabilitation Area
- Peatland Restoration Area
- Proposed Met Mast Location
- Existing 110kV Garvagh Substation Location
- Existing Roads - Upgrade Proposed
- Proposed New Site Roads
- Line
- Proposed Amenity Walkway
- Proposed Boardwalk
- Proposed 38kV Substation Compound
- Proposed Visitor Carpark Location (Operational Phase)
- Road Widening Works Area
- Proposed Peat & Spoil Repository
- Proposed Construction Compound
- Proposed Borrow Pit
- Existing Access Road/Track
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MAP TITLE: **Location of proposed broadleaf tree planting**	MAP NO.: **Figure 3.1**	SCALE: **23,500**
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